# Concept 300

## White Paper

# Introduction

Q Acoustics' reputation for designing and marketing world-beating yet affordable loudspeakers has been enhanced in recent years by the success of our first ever high-end floorstander, the Concept 500. The Concept range was developed in collaboration with Europe's leading acoustics experts whose objective was to strike a perfect balance between art and science and produce loudspeakers that would be stylish, contemporary, fine-sounding and accurate but with less priority on price.

This holistic approach has proved so successful that the Concept 500 has become universally acclaimed by the high-end hi-fi community and was also awarded Product of the Year by the European Imaging and Sound Association. Now, in a logical extension to the range and employing the same high-end design concepts, the Q Acoustics design team are pleased to present the Concept 300 high-end stand-mount loudspeaker.

Designed for the hi-fi connoisseur with a preference for a more compact speaker, the Concept 300 incorporates the same key features as the 500, together with several unique innovations that ensure that the smaller design is able to match the lofty sonic standards set by its larger sibling.

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# The Loudspeaker Cabinet and Stand

## Perfecting the Stereo Image

The purpose of a good hi-fi system is quite simply to enhance the musical experience of playback at home. To get something that even resembles the real thing, a stereo image that gives as good an impression of width, depth and height as would be found at a concert is needed. Good quality drive units, a well designed cross-over and a properly constructed cabinet can achieve this, but of these, the cabinet itself is absolutely essential. The unwanted noise that can be created by sympathetic vibrations in a loudspeaker cabinet tends to be exaggerated only at certain frequencies and is not coherent in its phase relationship with the program material. Some frequencies will be reinforced, some will cancel and it is important to realise that all this happens at very low levels, where important ambient clues which help to create the stereo image exist. The random noise created by poorer, noisier enclosures dramatically reduces image stability and consequently the illusion of reality. In addition to this, for smaller speakers, the stand becomes an important part of the equation too. If care is not taken to optimise its construction and most importantly the interface between it and the speaker cabinet, it can end up contributing its own resonant peaks and troughs which further diminish the illusion of reality which the speakers would otherwise be capable of creating.

Unfortunately, most manufacturers overlook this very important area, concentrating only on how loud a speaker will play with respect to the effects of dynamic compression and neglecting the equally important area of how softly it can play and how silent the cabinet can be made.



## Q Acoustics Isolation Base Suspension System

Conventional wisdom has it that loudspeakers should be rigidly coupled to their stands and thence to the floor. A speaker cabinet that is free to rock back-and-forth will tend to recoil in response to movement of the speaker cone because it has to obey Newton's Third Law of motion. This will have an effect on its sound, especially at low frequencies where speaker cone excursion is at its greatest.

At the same time it is undesirable for cabinet resonances to be transmitted into the speaker stand as these can in turn radiate into the room, causing cancellations and other unwanted distortion of the signal. Traditionally, these two seemingly opposing requirements have been met by using spikes, which at once provide stability to the loudspeaker cabinet and (theoretically at least) minimise the contact area between the speaker and the stand across which vibrations are unlikely to find it easy to traverse. Unfortunately, although the former is undoubtedly true, the latter - no matter how logical it may seem - has in practice been found to be wholly without foundation.

In fact, far from decreasing it, rigidly coupling a loudspeaker cabinet to the stand using spikes actually increases the intensity of transmitted vibrational energy many times over[1]. Of course the reverse is also true and any vibrations that are present in the floor (and it may be a surprise to learn that the ground beneath our feet is subject to constant small-scale seismic activity) are equally as easily transmitted back into the speaker cabinet, where they again constructively and destructively interfere with the musical information[2].

Q Acoustics' answer to this conundrum is the Isolation Base Suspension System. It consists of a specially constructed integral base plate which forms the bottom of the speaker cabinet and suspends the entire mass of the speaker above it on four springs. The compliance of the springs is specified so that during transients where cabinet recoil would normally be a problem they act as a completely rigid coupling system, whereas for cabinet vibrations which would ordinarily be transmitted into the stand they act to isolate the cabinet and the energy is effectively absorbed. This isolation principle works so effectively because the cabinet has such a large mass and therefore high cabinet-inertia. This acts as a mechanical "ground" giving the drivers an extremely stable platform from which to accelerate correctly. Lightweight cabinets would not provide sufficient grounding and so the Isolation Base system would not be so effective. At higher frequencies where wavelengths are comparable to the dimensions of the cabinet, so called "bending (or flexural) waves" are propagated transversely across its surface and it is these that are effectively isolated from the stand by the Isolation Base suspension system.

In order to prevent sympathetic vibration of this sprung-mass system, the springs are critically damped using a special material called Sylodamp™. This is a proprietary polyurethane elastomer which is precisely tailored to the mass of the speaker which rests upon it and effectively converts all the vibrational energy contained in the springs directly into heat. In this way the Isolation Base system ensures that the Concept 300 exhibits negligible levels of colouration caused by kinetic energy escaping into the speaker stands. The bass response of the speakers is extended and becomes immediately tighter; meanwhile stereo imaging ability is improved, bringing greater depth and focus to the performance.

*[1] Articles on vibration by Keith Howard in the July and August 2002 issues of Hi Fi News*
*[2] Textbook: Structure-borne sound, by Cremer, Heckl, and Ungar, published by Springer-Verlag.*

## Q Acoustics Tensegrity Stands

As was noted earlier, the loudspeaker and its stand must not be allowed to recoil in response to loudspeaker transients as this can have an adverse effect on the low-frequency response characteristics of the system. Commonly this is prevented by using a rigid stand, fabricated from solid MDF or tubular steel, which is firmly fixed to the floor using spiked feet to penetrate unstable coverings such as carpets. The first problem with this type of stand is that, because they usually have four feet, they are notoriously difficult to make perfectly level and upright. The second and more pernicious problem with conventional stands is that their relatively large surface area acts as a re-radiating surface for the sound waves created by the drivers above them. A well-designed loudspeaker system will be as omni-directional as possible using multiple drivers which cross-over as each one reaches a frequency where it becomes too directional. This means that sound leaving the drive units will radiate uniformly in all directions and will reflect from any nearby surfaces - such as the speaker stand - with an accompanying phase shift causing constructive and destructive interference with the direct sound.

Q Acoustics Tensegrity stands solve both these problems in a completely innovative and elegant way. This entirely new loudspeaker support concept (Fig 1) draws on the work done by Buckminster Fuller in the early 1960's. His invention - itself an extension of the Skylon concept first demonstrated at the 1951 Festival of Britain - describes a self-supporting structure that is made up of elements that are either in compression or tension but never subjected to a bending force (or moment). The load bearing struts, which never touch each other, are in compression (shown in red) and those in tension (shown in blue) are cables which merely define and maintain the spatial orientation of the struts.

The structural embodiment of the Tensegrity stand relies on components operating in pure compression and tension in the same way as the original Skylon concept; the stand utilises this principle by means of solid stainless-steel rods in compression and steel cables in tension to form a statically stable tri-pod support. Thanks to its high strength to volume ratio, the stand offers a negligible acoustic footprint therefore minimising re-radiation of sound through sympathetic vibration.

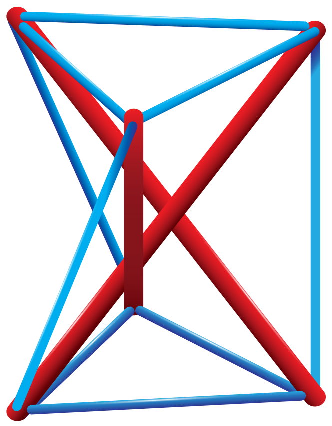

*Figure 1. Tensegrity stand concept showing tension and compression elements*

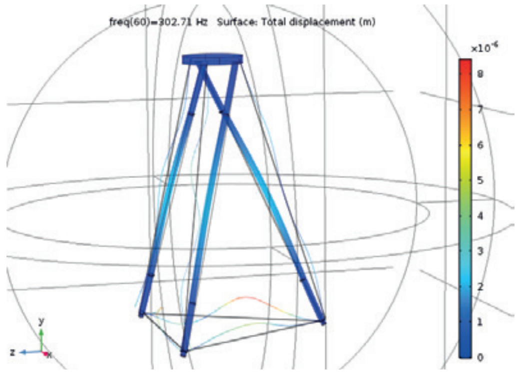

*Figure 2. Total displacement Tensegrity Stand*

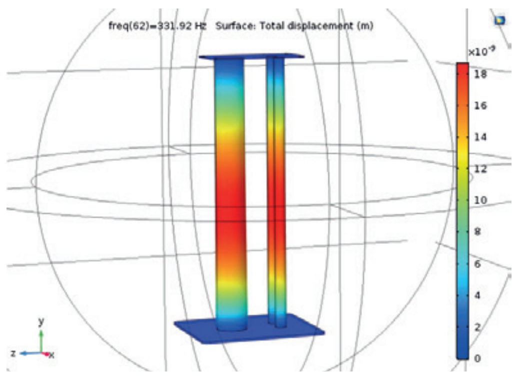

*Figure 3. Total displacement Tube Stand*

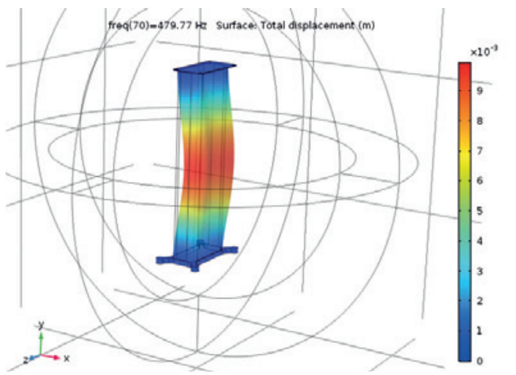

*Figure 4. Total displacement Solid Stand*



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As usual we did not leave the sonic benefits of the new design to chance or the vague unsubstantiated claims of a good theory. In order to model the in-room resonant response profile of the new stand, the top plate was artificially excited in planes x, y and z (Fig 2) using a constant velocity (1 m/s) sweep from 20 Hz to 1 kHz. Using finite element analysis the actual displacement of the different areas of the stand could be mapped so that we could understand how the structure would behave when stimulated by a loudspeaker placed on the top plate. At the same time the resultant acoustic sound power radiated into the room by the stand was measured and plotted against frequency. The experiment was then repeated using the two most common types of stand on the market; the first, an up-market all-steel tubular column construction (Fig 3) and the second, a less expensive solid MDF model (Fig 4). As can be seen, the Tensegrity tripod exhibits only a small displacement of about 3 microns as it begins to resonate at frequencies above 300 Hz whereas the other two designs show significant displacements of up to 10 microns.

The normalised acoustic sound power measurement for the Tensegrity stand is shown in the graph of figure 5 below (blue trace) and can be compared with that for the Tubular columns (red) and Solid stands (green). This is a measure of the actual acoustic energy which is radiated into the room by the displacement of the stands under the same conditions as before. It can clearly be seen that the Tensegrity stand deviates from a linear response due to the artificial excitation of the top plate far less markedly than the other two designs. Although all three designs behave in a broadly similar way up to about 300 Hz (the beginning of the lower mid-band), the Tensegrity stand shows only a very low-level wide-bandwidth rise in its resonant output above 300 Hz - which is modest when compared to either of the other two.

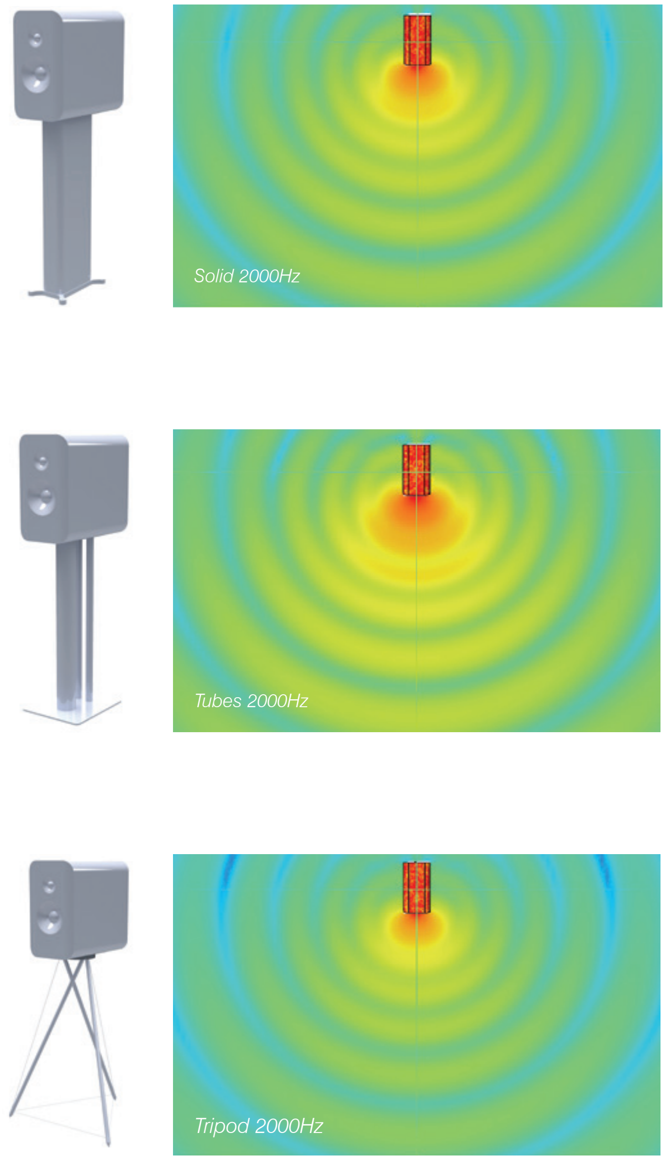



*Figure 6 Acoustic Interface Comparison*

The solid stand performs the worst, exhibiting much larger wide bandwidth resonant peaks with some very pronounced low-bandwidth peaks which are absent in the Tensegrity and tubular designs. The higher level of wide bandwidth resonance exhibited by the tubular columns and solid-type stands would prove much more intrusive on the loudspeaker performance when listening to a real world music source than that produced by the Tensegrity stand.

Outside of an artificially modelled environment, finite element analysis can also show how a real-world radiated sound field is affected by reflections from the surface of the different types of stand.

This analysis was taken with a Concept 300 speaker sitting on each stand and playing a pure tone audio signal. In the diagrams of Fig 6 the same solid and tubular steel stands are compared to the Tensegrity design. The radiated sound field should look like the perfect ripples on a still pond after a stone is thrown into the water. As can be seen the solid MDF and tubular designs re-radiate far more of the original loudspeaker signal and therefore exhibit significant disturbance (red and yellow) of the ideal sound field when compared with the Tensegrity design. Interestingly, this time, it is the tubular design which performs less well.

The Tensegrity stand has been designed exclusively with the Concept 300 loudspeaker in mind. As such, the top-plate is designed to interface perfectly with the Isolation Base fitment on the speakers and is available as an option for those who wish to realise maximum performance from their purchase.

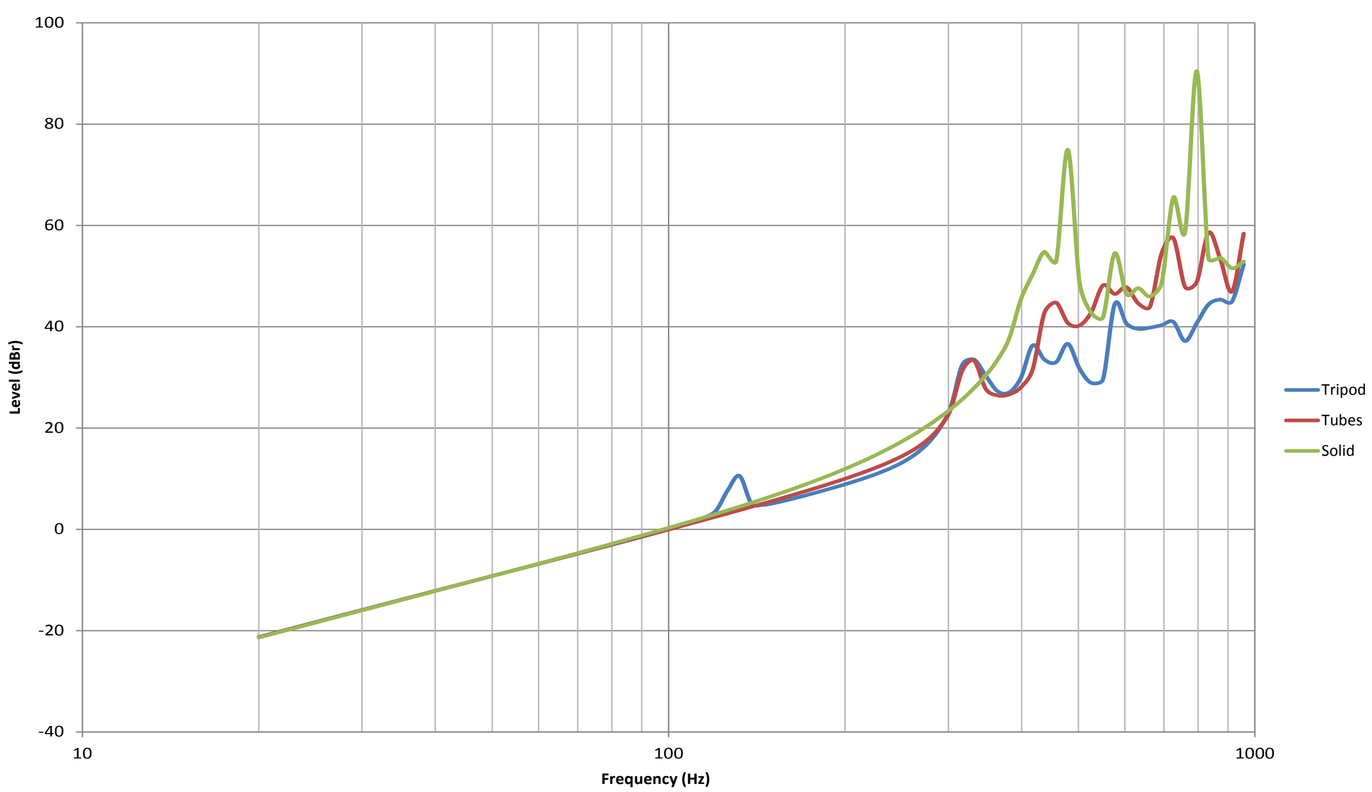



*Figure 5: Normalised in-room acoustic power measurement for loudspeaker stands*





## Choice of Materials

Some high-end speaker manufacturers espouse the use of natural-wood cabinets as a superior construction material and some reject this in favour of significantly more expensive and exotic alternatives. Wooden cabinets, it is true, can bring some benefits; wood is self-damped, easy to cut and shape and is reasonably inexpensive. However, Q Acoustics have found that fibreboards such as MDF have the advantage over wooden panels; they are even easier to cut, fit and finish but crucially, because they are not totally homogenous in their makeup, they are very well damped, avoiding high Q resonances. For these reasons Q Acoustics use these materials in preference to more esoteric alternatives which only really offer extra mass and expense for very little sonic benefit. The difference lies in how the cabinets are designed, measured and tested in order to maximise performance.

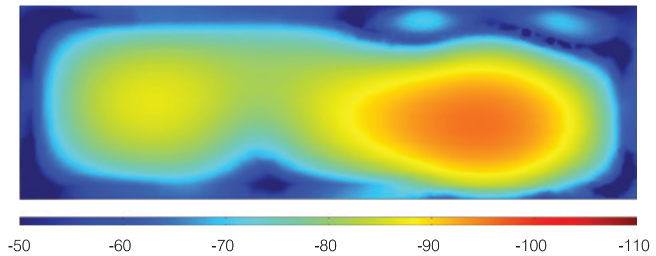



*Figure 7: Heat map showing unbraced wall velocity dispersion*

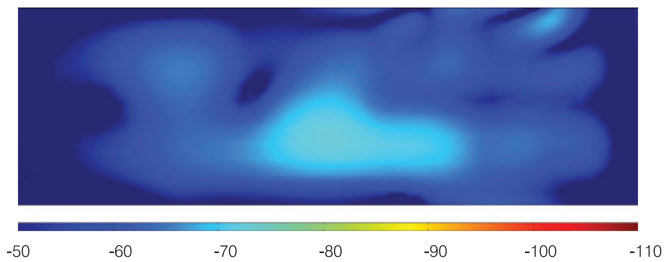



*Figure 8: Heat map showing cabinet wall velocity with P2P Bracing*

## Q Acoustics P2P™ Bracing

Often, much is made by other manufacturers of having cabinets heavily supported by solid shelf-type bracing to lend extra rigidity to the loudspeaker. Shelf-type bracing can be effective, but the disadvantage is that it can also transfer noise and vibration to all the other panels thus spreading the energy to a larger surface area. This design when used indiscriminately tends to be the reserve of manufacturers who only have access to rudimentary or outdated test and measurement techniques.

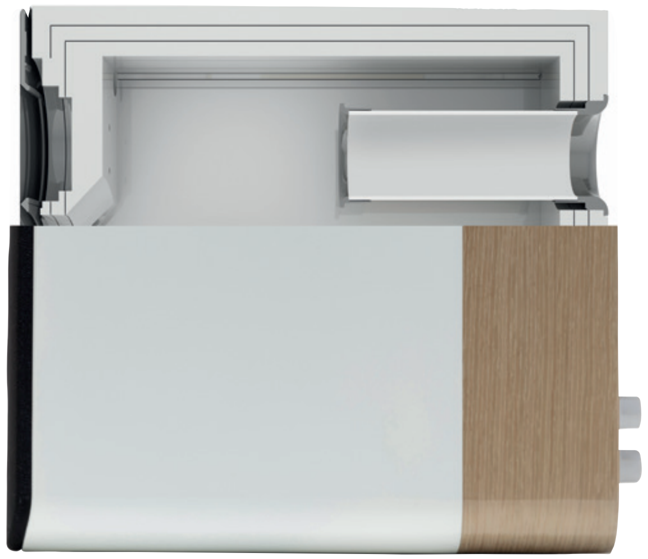
Through the use of Finite Element Analysis and Laser Interferometry the exact performance of the cabinet structure can be minutely and accurately analysed to reveal the exact positions which need support and those areas which do not. In place of the traditional indiscriminate bracing strategy used by other manufacturers, the resultant bracing method, known as Q Acoustics P2P™ (Point to Point) bracing, only supports the parts of the cabinet that need to be stiffened and does not spread unwanted energy randomly. The illustrations below show how effective this methodology can be.

A heat map of an unbraced cabinet wall with respect to its velocity of movement at a test frequency of 545 Hz is shown in Figure 7. Where velocity is greatest the area is coloured towards the red end of the spectrum and where it is least it is coloured towards the blue end. You can see where a hot spot of vibration has been created at the test frequency. Conventional bracing would allow this movement to be transferred to adjacent panels but Q Acoustics P2P™ allows the design team to apply bracing only in exactly the correct places. When the test is repeated on the treated enclosure the heat map (Figure 8) shows the measurement of much lower surface velocities, revealing how effectively cabinet resonances have been reduced.

## Dual Gelcore™

Whereas Q Acoustics P2P™ bracing deals with lower frequency panel vibrations, higher frequency cabinet noise is dealt with by the use of Dual Gelcore™ which is a development of the same Gelcore™ technology used to great success in the Q Acoustics Concept 20 & 40 loudspeakers. The speaker cabinet is constructed in three separate layers. The gaps between the layers are completely filled under pressure with a compliant form of non-setting gel. The two constrained layers effectively damp the walls of the speaker cabinet by converting higher frequency vibrations into heat, which is then dissipated harmlessly within the damping gel.

The graph of Figure 9 below shows how the cabinet performs in the mid-band frequency area from 500Hz to 2kHz. The blue line shows the amount of unwanted sound energy produced by the wall of a conventional loudspeaker cabinet. Any erroneous boost or cut in level at this frequency can affect the perception of musical timbre and contribute to listener fatigue. You can see from the trace of the red line how the addition of Dual Gelcore™ technology significantly reduces the ability of the speaker cabinet to interfere with the accurate reproduction of the source material.



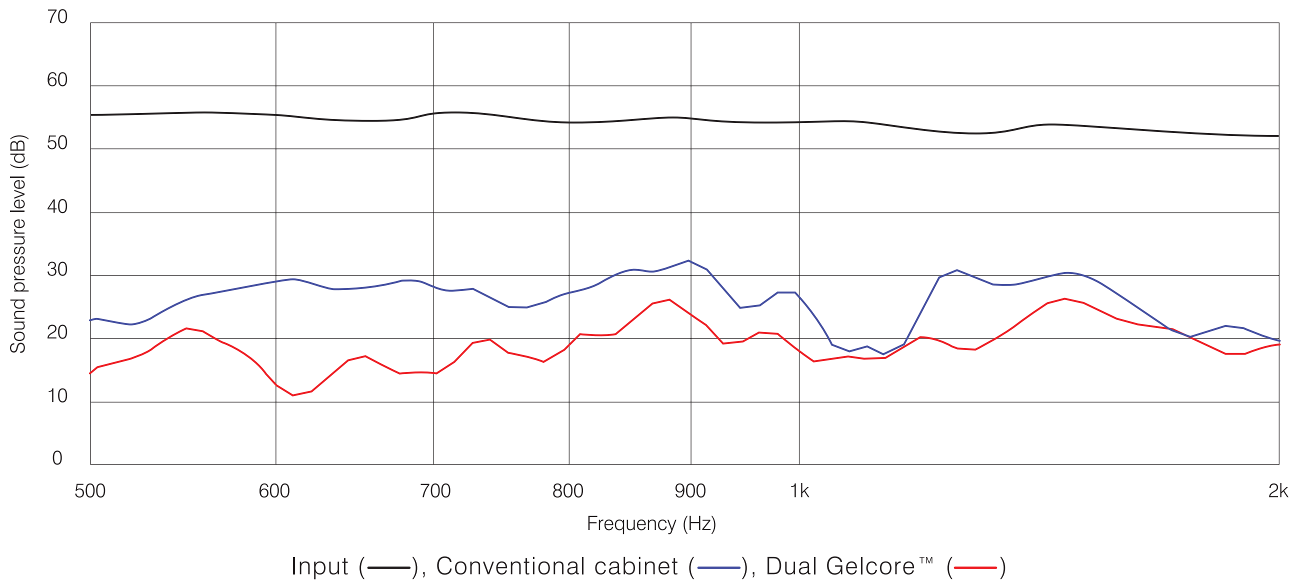



*Figure 9: Graph to show SPL v Frequency for a conventional & Dual Gelcore cabinet wall*



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## Drive Unit Mounting

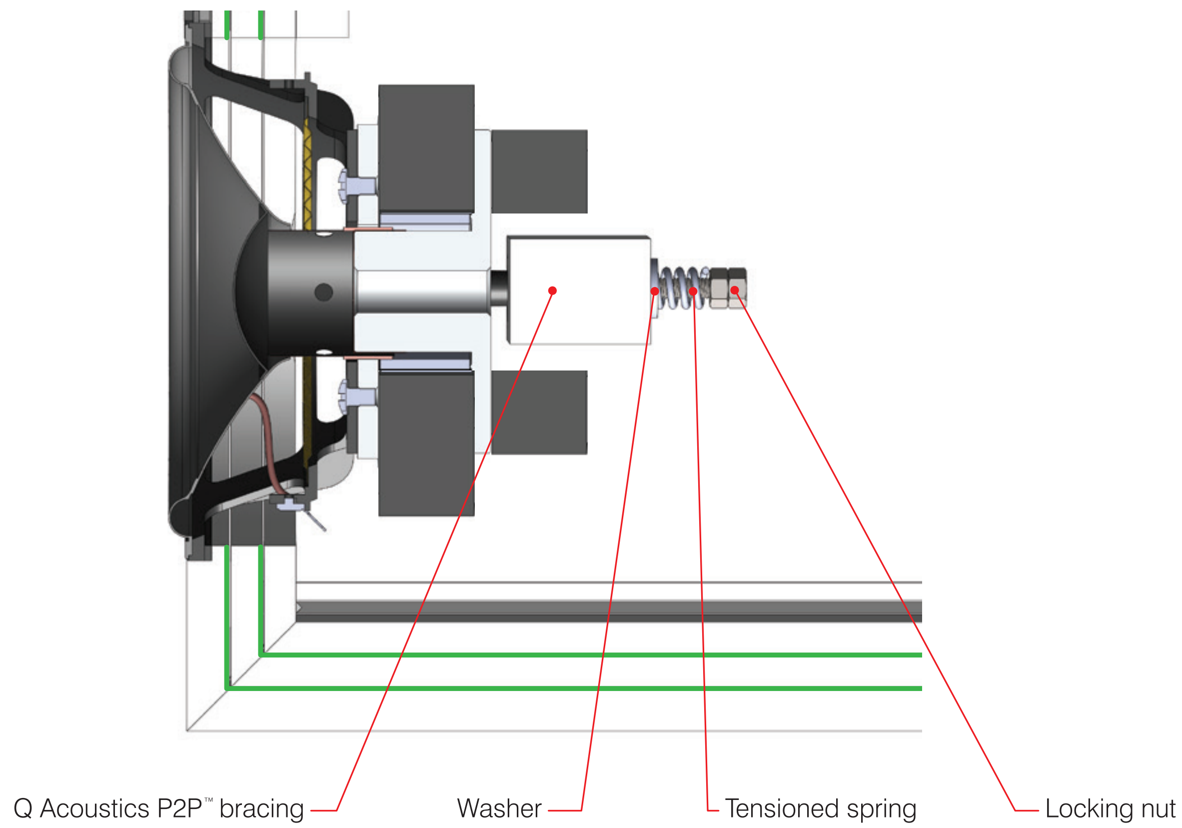
There are two additional aspects of loudspeaker cabinet design which are so obvious that they are often overlooked completely and they both revolve around drive unit fixing.

Firstly, unattractive screws or bolt heads need to be hidden and conventionally this requires solidly fixed decorative trims which at the same time need to be easily removable should servicing be required.

Secondly and more importantly is a problem most loudspeakers suffer from – that of drive unit mounting bolt torque stability. Over time most conventional screws or bolts can loosen due to vibration in the loudspeaker cabinet.

A performance improvement can usually be achieved by regularly tightening the drive unit screws (maybe every six months) to the designer prescribed torque. The problem is that most hi-fi owners don't have a torque adjustable driver and the degradation in sound quality is so slow and gradual that one barely notices.

The Concept 300 solves both the above problems in a simple and elegant way. The drive units are held in place from behind by strong spring tensioned retaining bolts, thus keeping the torque constant and obviating the need for decorative trims or regular tightening.



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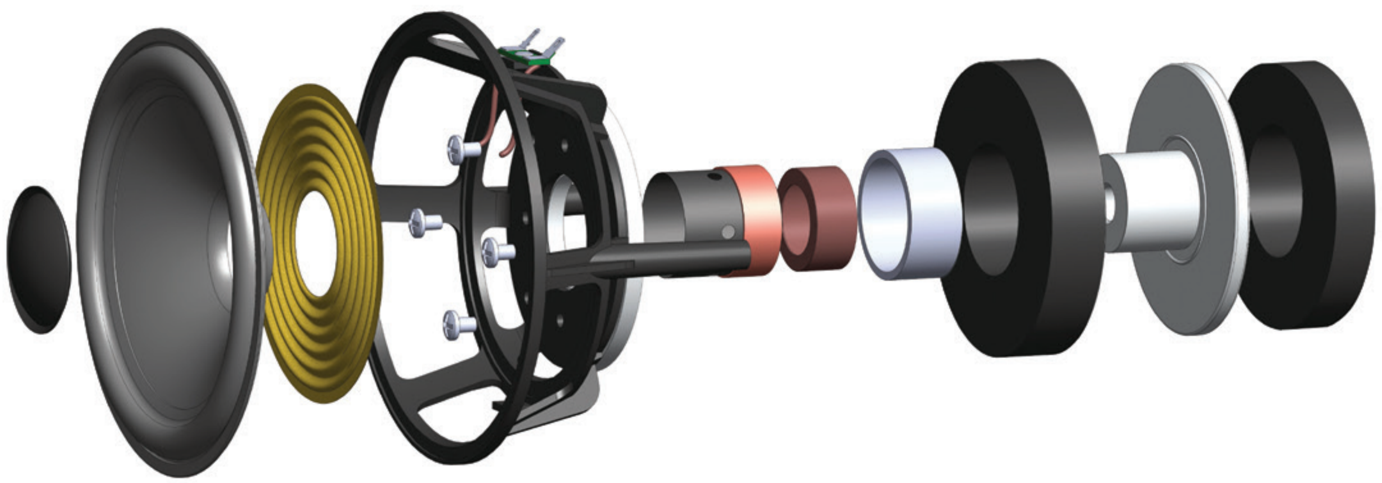
# Drive Units



## Drive Unit Design Overview

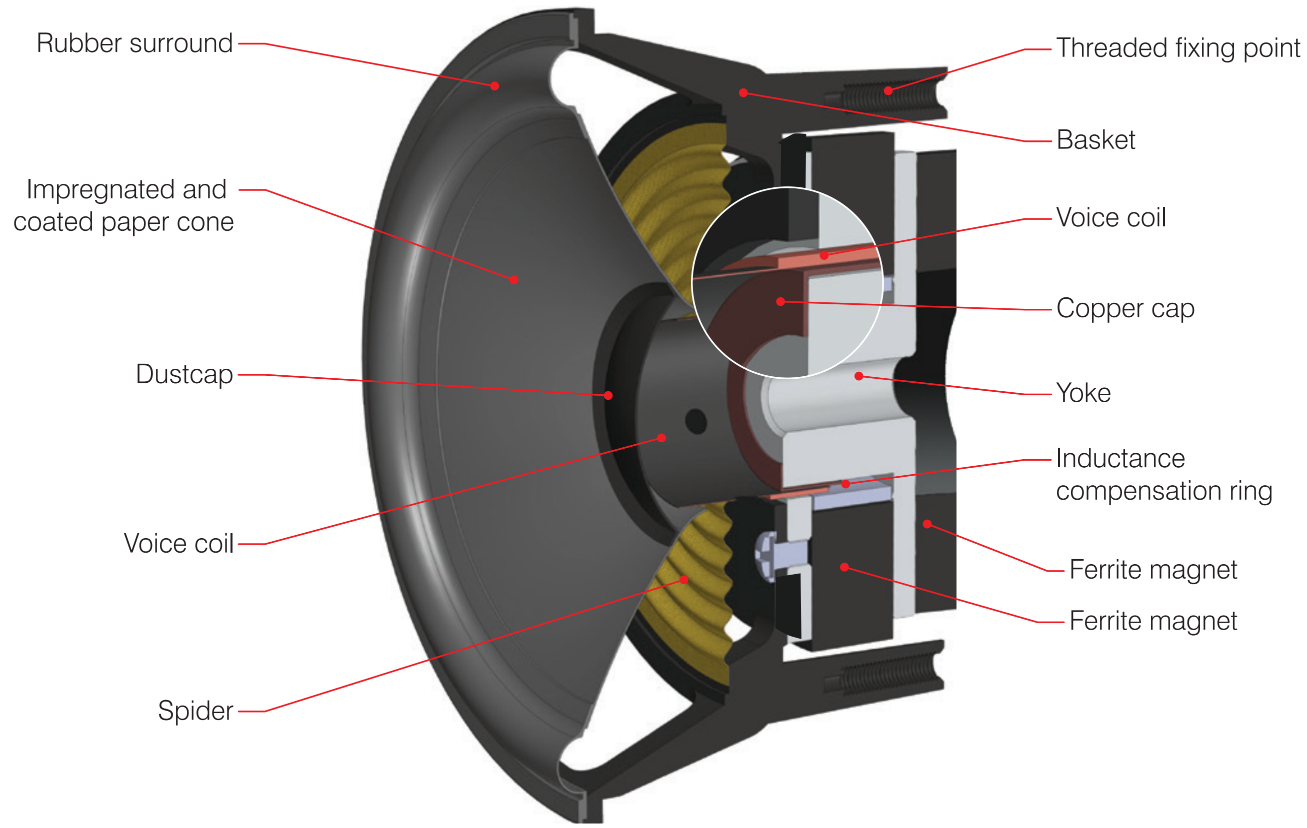
Our partnership with leading European acoustic design consultants has granted access to skills and techniques that alone would have taken years to develop. It has also brought unparalleled contact with the world's best loudspeaker manufacturers and suppliers of specialist components. Together this has led to the design and production of a proprietary range of drive units which are used to create loudspeakers that are far better than perhaps their price tag might indicate.

## Mid/Bass Driver

From the outset, in keeping with a policy of proprietary development, the 165mm mid/bass drive units were designed exclusively for the Concept 300 project so that each aspect of the design was tailored to exacting requirements.

The cone is precision formed from impregnated and coated paper and is teamed with a newly developed, low-hysteresis, rubber surround which helps to reduce unwanted cone resonance. The voice coil has an uncommonly large diameter of 35mm, but this allows increased 'shove' and higher power handling, as well as reduced dynamic compression. Instead of Kapton or aluminium, the voice coil former is made of glass fibre which delivers the required stiffness but without the unwanted effects of eddy currents within the former. The magnet too, when compared to those fitted to the twin drivers in the Concept 500 has been enlarged to help provide better control and efficiency for a single driver operating in a much smaller cabinet.

The voice coil uses an unusual 2+2 copper clad aluminium winding (CCAW) configuration. The two dual layers of CCAW conductors are wound in parallel, which gives the voice coil increased force for a given current input without adding extra mass. Higher distortion can sometimes be caused by this arrangement due to modulation of coil inductance as it moves but it can be effectively minimised by adding an aluminium compensation ring to the motor system and a copper cap to the top of the pole piece to preferentially draw in eddy currents that would normally circulate in the iron components of the magnet.



The key elements to look for in a drive unit from a measurement point of view are good Force Factor symmetry and a very low inductance variation, during both the full range of speaker excursion and varying coil current. Force Factor is a measure of the force exerted on the voice coil for a given current and should be exactly symmetrical in both directions of coil excursion as shown in Figure 10a. Similarly thanks to the compensation ring arrangement mentioned earlier Figures 10b and 10c show how the coil inductance remains essentially the same with varying coil excursion and coil current respectively. Having a driver with parameters which measure this well significantly reduces the mid-band distortion and intermodulation distortion and has an added benefit of attenuating the modulation effect on the crossover. The 'spider' features a symmetrical and progressive stiffness characteristic that has been optimised for use in medium-sized reflex enclosures like the Concept 300 as evidenced by the parabolic curve shown in Figure 10d.

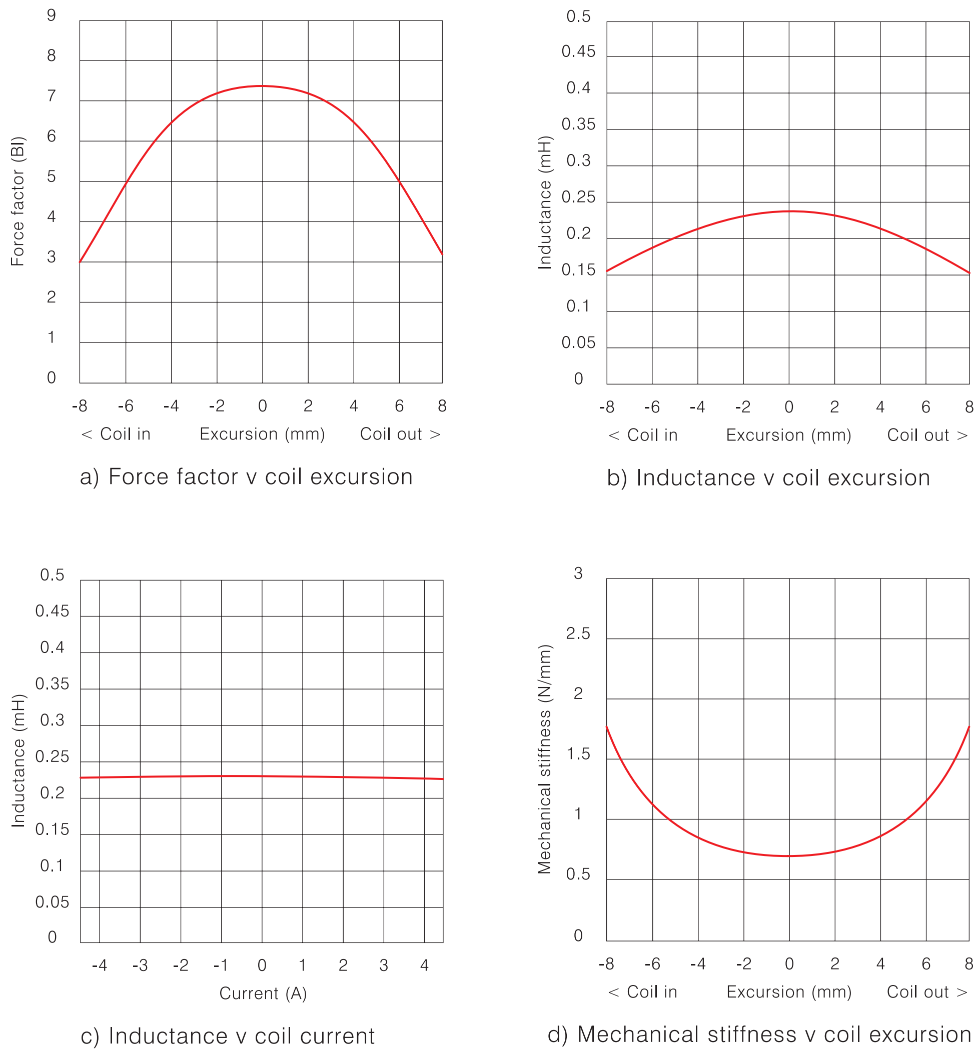



*Figure 10: Mid/Bass Driver voice coil parameters*





Optimisation of one parameter to the detriment of others is to be avoided because the essential element of any good drive unit design is achieving proper balance. As an example, optimising cone termination - dominated by the surround material and shape - can produce a very low colouration drive unit with perhaps an ideal looking response outside of the useable band, but this can make it sound dead and slow with little 'get up and go'. That is not to say that the opposite approach should be taken – resulting in something that is super excitable requiring an enormously complex crossover in order to tame it. It's all about balance, as the on-axis response curve of the mid/bass drive unit in Figure 11 shows. Here, the in-band response of the driver measured without a cross-over is extremely flat but the unit retains its lively character with a controlled rise in the response outside the useable band where the high frequency driver takes over.

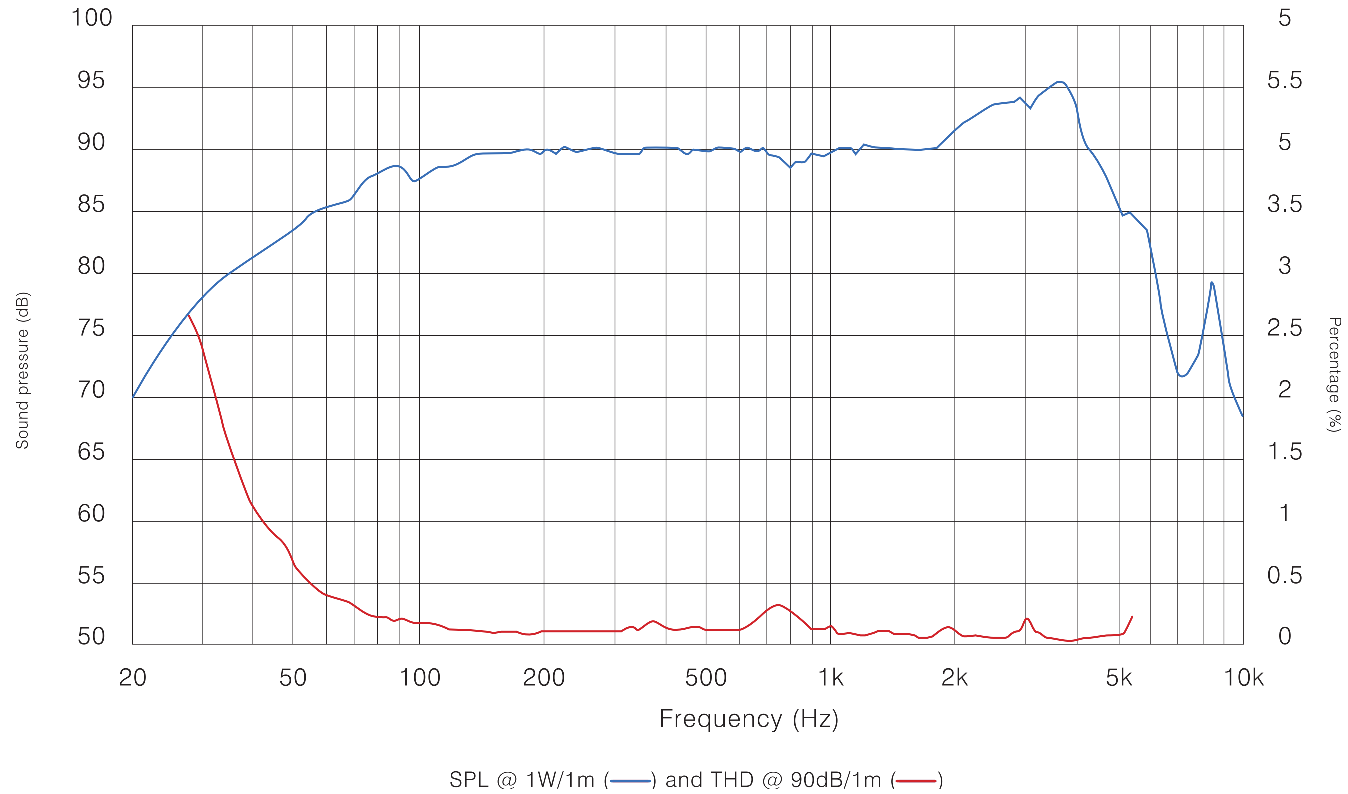
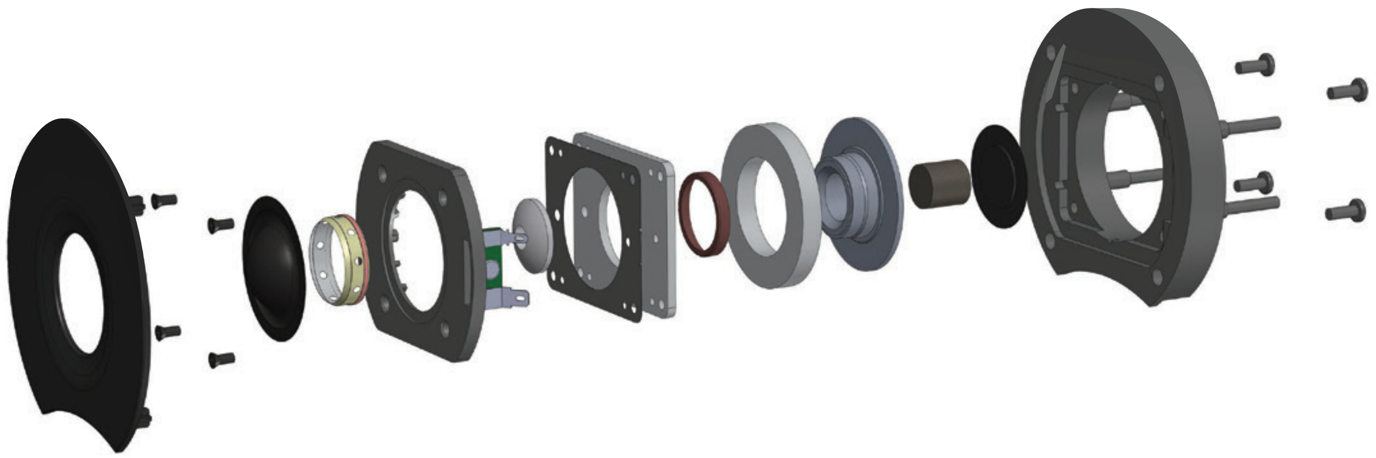



*Figure 11: On axis response curve Mid/Bass unit without crossover*



## High Frequency Drive Unit

To design and build a truly excellent high frequency drive unit is not an easy task. In comparison, the precision required in manufacturing a good mid/bass unit is much more straight-forward. The moving mass of a high frequency unit is so small that even the mass of the adhesive used becomes significant. The main task is to develop a design and implement a build process that is repeatable over thousands of units - not just a few specially selected samples.

Finite Element Analysis was used to model the acoustic performance of the soft dome and surround for optimal axial dispersion. Too narrow a high frequency dispersion characteristic means the speaker will not drive the room well, making it sound flat and uninteresting unless the listener is sitting in the exact 'sweet spot'. The extra wide high frequency drive unit surround contributes to the dispersion of upper frequencies, adding extra energy off axis. As can be seen by the axial response curves shown in Figure 12, the sound pressure level at 45 degrees off axis is only 6dB lower at 15 kHz, compared to the on-axis level.

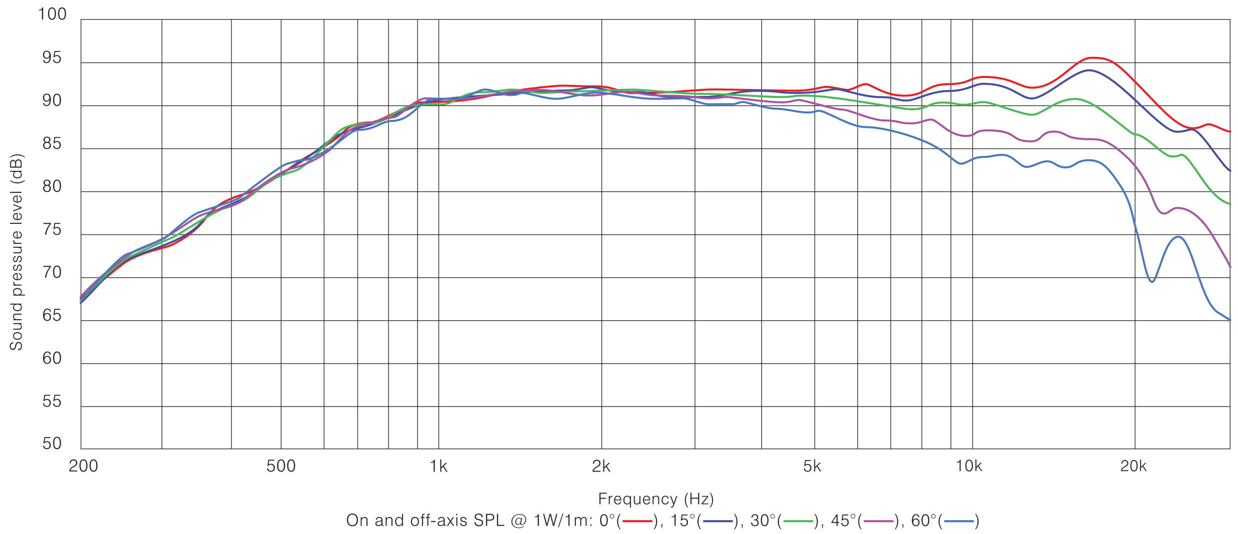
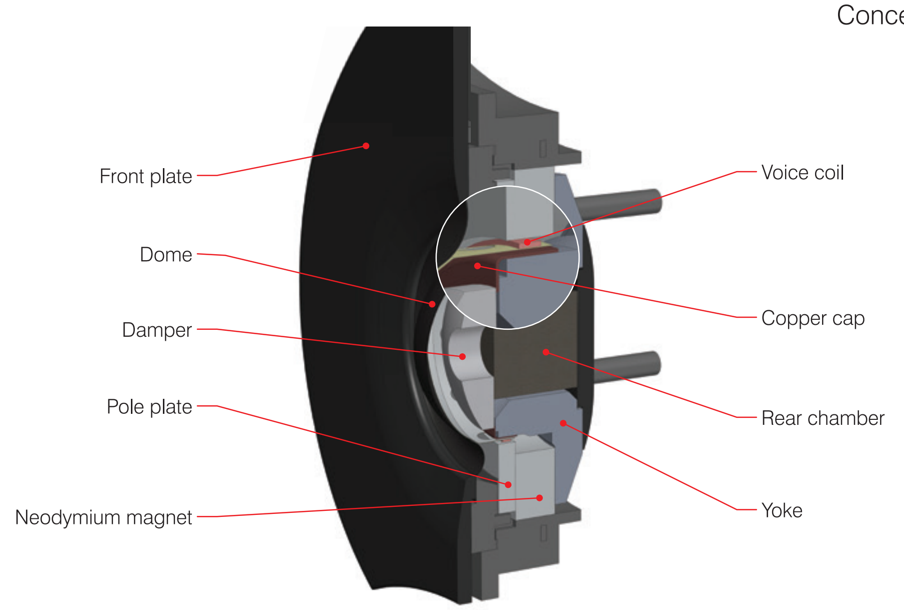



*Figure 12: Axial response curve*
*SPL v Frequency*





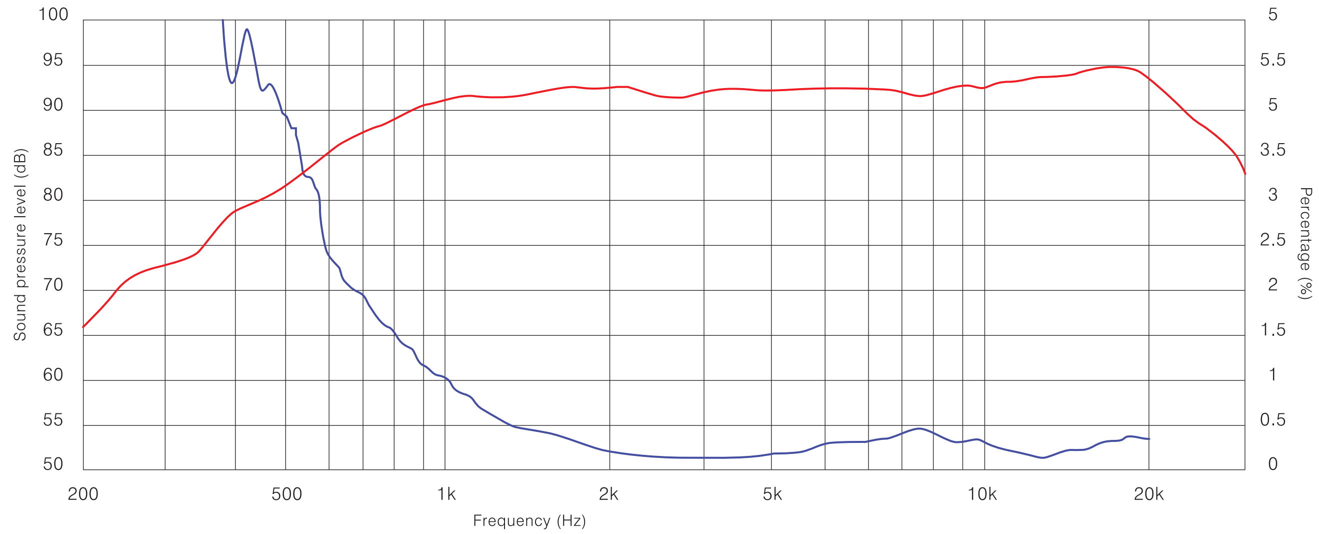



The high frequency unit is mechanically decoupled and mounted in a specially designed rubber gasket which is designed to effectively isolate the driver and speaker cabinet from reciprocal vibrations that otherwise would be transmitted between them.

The 28mm voice coil and larger than average one-piece coated-microfibre dome with its wide surround give excellent power handling capability, lower dynamic compression and hence, lower distortion - especially at the lower end of the frequency range. In addition, the pole piece includes a copper cap to further reduce distortion.

The front plate incorporates a very gentle horn shaped profile to facilitate acoustic impedance matching with the surrounding air without introducing horn resonance that would add unnatural character to the sound. To improve integration with the mid/bass driver at the cross-over frequency and to maximise the frequency response at this point both on and off-axis, the tweeter surround features a deep cut-out so that it can be mounted physically closer to the mid/bass unit than would otherwise be possible.

The internal volume of the dome has been carefully optimised using Thermo-Acoustic Finite Element Analysis to minimise the detrimental effects caused by coupled cavity resonances between the various sub-cavities.




On-axis SPL @ 1W/1m (—) and THD @ 90dB/1m (—)

*Figure 13: On-axis response curve*
*high frequency drive*

In common with all Q Acoustics drive units, the final design is the culmination of years of experience combined with precision modelling and measurement, confirmed of course, by critical listening. If proof were needed, the blue line in Figure 13 shows how distortion has been reduced to below 0.5% across the useable band.

# Crossover

Low distortion drive units and a very quiet cabinet can ruthlessly expose a poor crossover. This means that not only must the design of the crossover be exemplary but greater care must be taken when choosing components.

For this reason the crossover uses high grade polypropylene film capacitors and custom-made air-core and laminated steel-core inductors; even the resistors are custom made bifilar wire-wound types with astonishingly low inductance.

The 3rd-order based topology of the crossover in conjunction with the minimised driver separation-distance gives an excellent response on and off axis at the cross-over frequency, further strengthening the room friendly character of the Concept 300.

The nominal impedance (see Fig 14) is a deliberately sensible 6Ω with an absolute minimum of 4.7 Ω which makes the speakers relatively easy to drive.

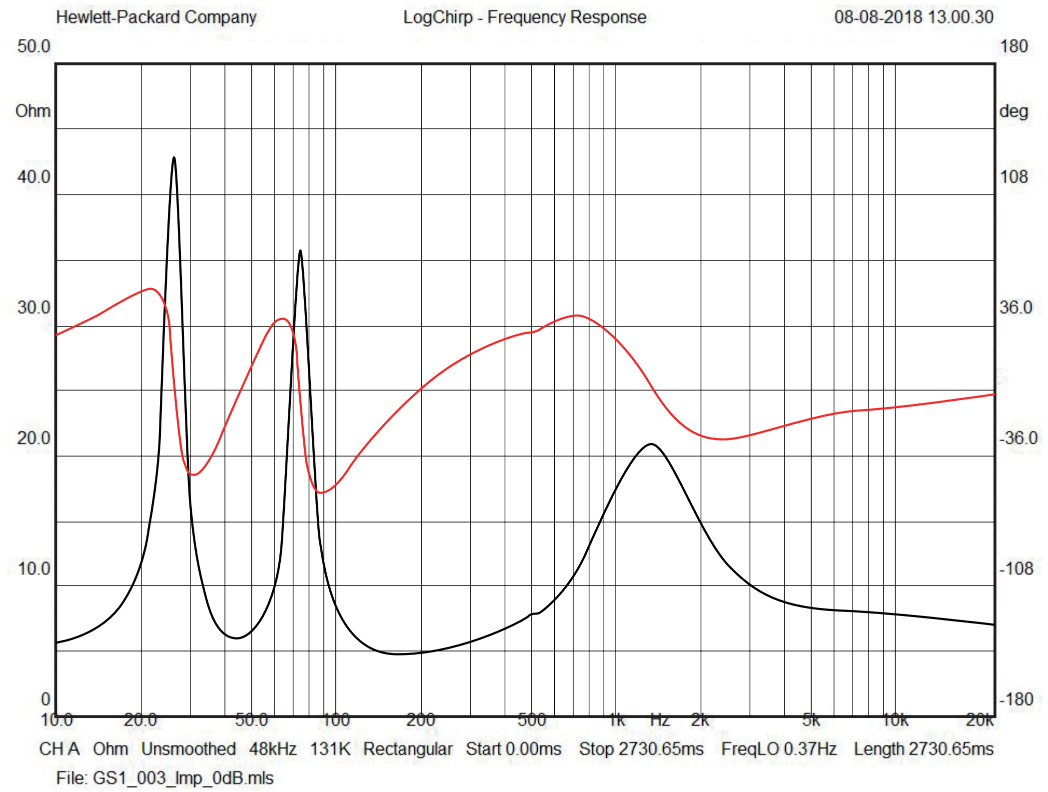



*Fig. 14. Concept 300 Impedance/ Phase Characteristic*

The crossover is hard wired and mounted well away from driver radiated fields which can introduce distortion.

By configuring different jumpers on the rear panel the Concept 300 allows the HF level to be adjusted by +/- 0.5dB to suit the room or individual taste.





# Terminal Panel

The terminal panel is designed in such a way that it is prevented from vibrating in sympathy with the music. It is surprising how often this can be a source of extraneous noise in many commercially available designs. The Concept 300 is equipped for bi-wiring or bi-amping with electrically isolated and oversized HF and LF terminals which can accept bare wires, spades or 4 mm banana plugs. If connected using a single run of cable the best performance will usually be obtained using bi-wire links made from the same cable as the speaker cable.

# Cabinet Aesthetics

Although this paper is principally concerned with the technology of the Concept 300, Q Acoustics believe that success has come through the integration of good engineering with good design and it would be inappropriate not to discuss the visual features of the product.

A major UK based Design Consultancy team worked on Concept 300. They wanted an elegant design, compatible with a contemporary living space and not specific to any particular interior style. In keeping with the design DNA of Q Acoustics, the concept was pared-back to be as clean looking as possible. The designers were able to exploit the rear-mounted mid/bass feature to keep the baffle uncluttered with trims and also specified embedded magnets to secure the grille so no fixings would be visible if it was removed.

The gloss finishes have been combined with real-wood veneers which are used sparingly in a subtle strip to create a cabinet that is at once visually light and clean, whilst still retaining the high perceived value of a heavier full-wood solution. The white gloss finish has been attractively paired with pale oak; the black gloss with deep rosewood; and the polished tourmaline with desert ironwood. Additional coats of lacquer have been used to give a deep piano gloss finish, appropriate to a premium product like the Concept 300.



# Conclusion

Concept 300 is a fine example of what can be achieved by a partnership of like-minded design engineers with access to world-class facilities. It can also be seen that the engineering practices employed in the project have left no stone unturned in a quest to improve upon universally accepted loudspeaker design philosophies.

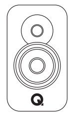
We focussed on the control and minimisation of resonances in both cabinet and stand because we recognise that these can have a profound effect on perceived sound quality. This led us to develop several new and proprietary technologies unique to the Q Acoustics brand. With a combination of P2P bracing and Gelcore construction, cabinet resonances have been reduced to negligible levels.

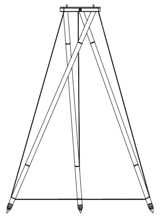
The introduction of the Isolation Base acoustic suspension system in combination with the new Tensegrity stand provides a very low resonance and reflection-free stand mount system for the first time ever.

This scientific engineering approach to compleatly control cabinet resonance has resulted in a real 30 dB improvement in signal-to-noise ratio across the board, or looking at it more simply, that's a lot more music and a lot less noise and distortion.

We recognise that the choice of a loudspeaker is always a personal one, with system matching, room acoustics and personal taste all playing an important role but we feel that the Concept 300 is easily good enough to be included in anyone's audition shortlist.

# Concept 300 Specifications



| | Concept 300 Speaker | Concept 300 Tensegrity Stand |
|---|---|---|
| **Enclosure type** | 2 way reflex | - |
| **Mid/Bass Driver** | 165mm | - |
| **High Frequency Unit** | 28mm | - |
| **Frequency Response (-6dB)** | 55 Hz - 30 kHz | - |
| **Nominal Impedance** | 6 Ω | - |
| **Minimum Impedance** | 4.7 Ω | - |
| **Sensitivity** | 84 dB/W/m | - |
| **Stereo Amplifier Power** | 25-200 W | - |
| **Crossover Frequency** | 2.5 kHz | - |
| **Effective Volume** | 11.4 L | - |
| **Dimensions W/H/D** | 220 x 355 x 400mm | 492 x 690 x 430mm |
| **Weight** | 14.5kg (per speaker) | 3.9 kg (per stand) |
| **Carton Dimensions W/H/D** | 320 x 500 x 520mm | 740 x 780 x 460mm |
| **Packaged Weight** | 16.6kg (per speaker) | 12.3 kg (pair) |

Our Policy is one of continuous product improvement.
We reserve the right to change the design and specification without notice.
This document contains information that is subject to change without notice.



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