wilson benesch

The Nanotube Tonearm

The latest development in Wilson Benesch's continued research and development into the application of advanced carbon composites in audio structures

Wilson Benesch has only ever released three tonearms in its 18-year history of analogue development, each iteration can be seen to build upon the last and push performance to new levels. Like each Wilson Benesch design before it, the Nanotube derives it's name from the materials technology employed or the geometrical forms upon which the design is based. In this case the employment of Carbon Nanotubes which enhance the high modulus aerospace quality pre-preg carbon fiber epoxy resin matrix and form the structure define the name.

Wilson Benesch Nanotube One Tonearm

An Engineering Solution:

Nanotube is a unique engineering solution to the challenges of building a tonearm. The structural performance of the A.C.T. Series have set the standard in terms of stiffness to weight ratio, as well as damping, since their introduction 17 years ago.

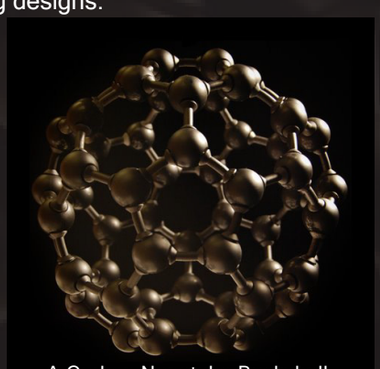
The Nanotube is much more complex. Like the A.C.T. Series, the tube is derived from the ideal natural form, a hyperbolic curve. This formation places the material in exactly the place where the beam requires it to be in order to achieve the stiffest structure, with the least amount of material.

Carbon fibers form the tube shape in a woven helix of fibres. This formation again optimises the materials, providing the stiffest torsional strength and the most damping from the billions of carbon fiber filaments.

Further localised stiffening has been determined by finite element analysis. Super high modulas uni-directional fibres, are deployed in these key regions, adding immense stiffness with virtually no additional mass. The key advance in this design over its predecessors is the use of Carbon Nanotubes to enhance the Epoxy resin matrix.

Finally, the structural integrity of the tubular form is improved further still by the addition of low mass, high compression internal bulkheads. These enhance tube stiffness and also provide high performance, cross axial damping.

The internal wire is isolated by these structures also, providing the ideal disposition for the low level signals. Beyond the logo, no additional finishing is added to the tube for aesthetic considerations as this would add mass that has no sonic benefit. The result is a structure that is more than an order of magnitude superior to its predecessors in terms of stiffness and damping and can be seen to lead the field in terms of competing designs.

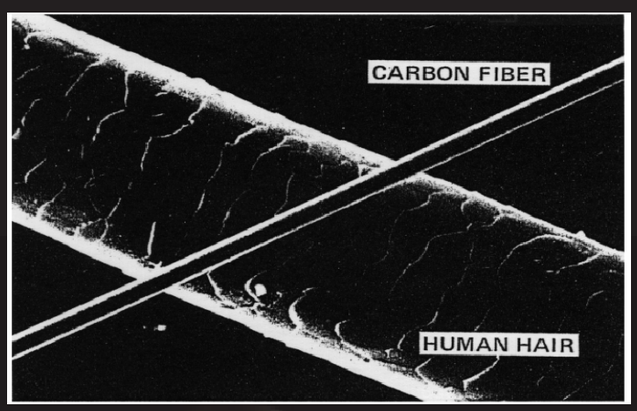

A Carbon Nanotube Buckyball

Carbon Fiber & Carbon Nanotubes

The graph below presents the specific modulus, or, stiffness to weight ratio of a group of different materials. Carbon Nanotubes are the strongest and stiffest materials yet discovered in terms of tensile strength and elastic modulus respectively. What is significant to the Nanotube tonearm design, is that these properties make the new Nanotube tonearm 30% stiffer than its predecessors.

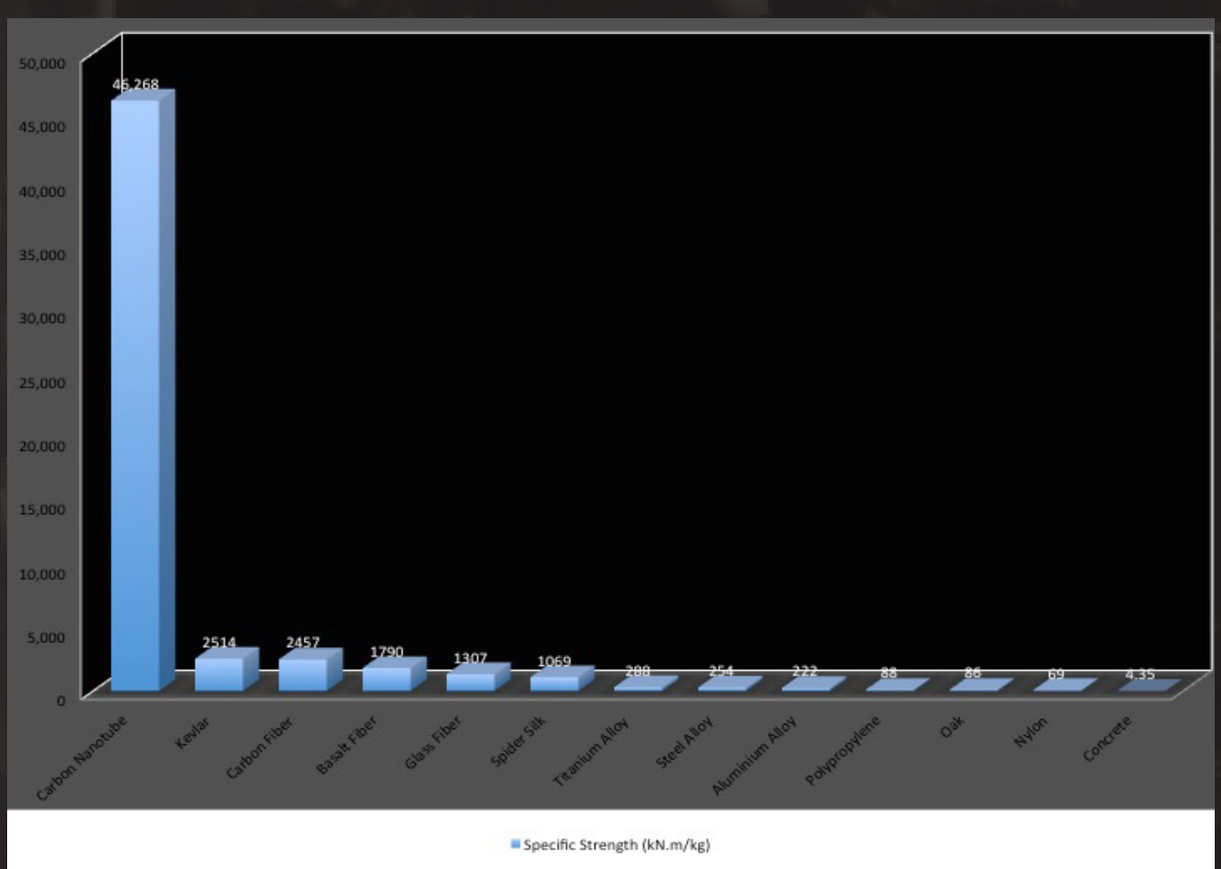
Nanotubes are structures that are measured at the molecular level. The “buckyball” shown at the foot of the previous page, is a graphical model of how the carbon molecules are organised into a geometrical form that was patented as an engineering structure by Buckminster Fuller.

On the almost visible scale, the image below this shows a human hair, and a carbon fibre filament. Typically, carbon is twenty five times smaller in diameter than a human hair. In each bundle that you see in a carbon fibre sheet, there are 25,000 fibres. In the A.C.T. Tonearm there are literally billions of energy consuming boundaries! In the Nanotube Tonearm these fibers are further damped and strengthened by cross linking at a molecular level.



Electron Microscope image of a single Carbon Fiber and a human hair

The Nanotube benefits from other research results, that make the whole system less audible as well as more user friendly. The counter balance looks similar to its predecessor but has been totally redeveloped. It now sees a two stage compliant mounting to thwart any potential resonance in the metal and carbon structures from which it is created. The mass of the counter balance has also been optimised so as to match exactly the requirements of the Wilson Benesch carbon fibre cartridges. A small collection of other metal structures have been replaced by carbon fibre also, including all the anti skate systems. V.T.A. is also now fully adjustable to 1/100th of a millimetre.



Graphical presentation of the strength to weight ratio of a variety of materials