QED

THE SUPREMUS REPORT

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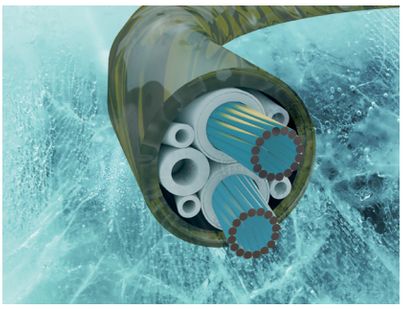
THE QED DESIGN PHILOSOPHY

At QED all our cable designs are informed by our exhaustive ongoing research into cable parameters which began in 1995 and is detailed variously in the Genesis Reports. These reports set out the design-principles to which we have since adhered and which have resulted most recently in the development of QED Supremus loudspeaker cable; the ultimate expression of sound through science without compromise.



CRYOGENIC TREATMENT

The improvement in physical properties of copper when cryogenically treated results from the elimination of dislocations in the material's microstructure. Trumpets and other brass instruments have been found to produce a better tone after Deep Cryogenic Treatment and it is also used to treat guitar and piano strings. Cryogenic treatment of welding electrodes, for example has been shown to improve their current capability and extend their working life. Our own subjective testing has shown that the cryogenically treated cable is preferred over the same cable without the treatment providing a more controlled and detailed sound and interestingly a better sound stage with wider instrument positioning.

SO WHAT ARE THE FEATURES WHICH MAKE THIS CABLE SO SPECIAL?

QED Supremus benefits from the appliance of Aircore™ Technology and therefore boasts very low impedance across the audio band.

Cable capacitance and inductance are controlled by the use of low loss dielectrics and the unique constraints of the Aircore™ geometry.

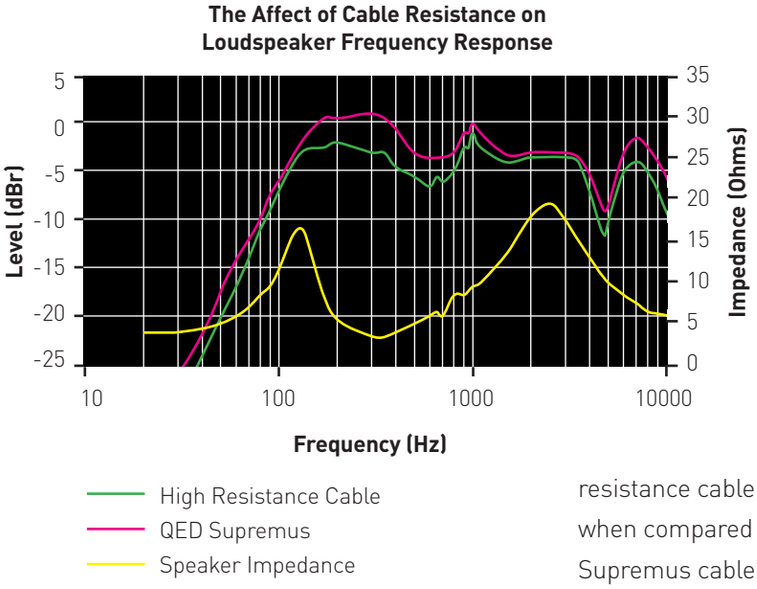
At just 5 mΩ/m QED Supremus has an extremely low DC loop resistance because it uses 6.16 mm² of cryogenically treated (see side panel) silver plated 99.999% oxygen free copper conductors - the largest cross-sectional area cable ever to be available from QED. This brings the amplifier electrically much closer to the loudspeakers enabling it to exercise better control over them, so that fidelity to the original music signal can be more accurately maintained.

BUT WHY IS LOW RESISTANCE IN A CABLE SO IMPORTANT?

Loudspeaker cables must deliver electrical power to the speakers and that means that they must have a large current carrying capacity. As current flows through the cable it encounters electrical resistance and therefore voltage is dropped across the cable. This means that the musical signal reaching the speakers has been altered by the resistance of the cable and so fidelity of the music has been lost. That's OK if the loss is linear (i.e. every frequency is affected equally) as the resulting drop in volume could be compensated for just by turning up the volume. Unfortunately the losses are not linear because the loudspeaker is a complex load involving two or more separate drivers. At different frequencies the speaker cable represents a different proportion of the total load seen by the amplifier and so becomes

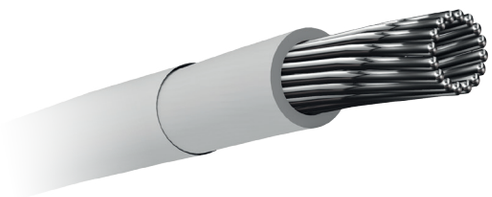
more or less significant depending on the part of the audio spectrum that is measured.

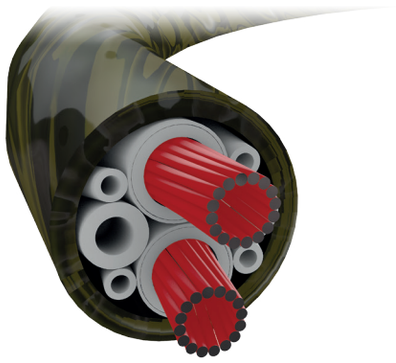
In the graph the impedance (yellow line) of a typical two way loudspeaker system shows two pronounced peaks at 135 Hz and 2.5 kHz corresponding to the resonant frequency of each driver. At resonance the loudspeaker demands the least current from the amplifier for a given power output and so only a relatively small voltage is dropped across the cable. Away from resonance, where the impedance is lowest, the speaker will demand the most current for the same power output and therefore a relatively high voltage will be dropped across the cable. This non-linearity leads to a measurable difference in loudspeaker frequency response when comparing a high resistance normal size speaker cable to QED Supremus. The sound level is altered markedly at some frequencies when using a thin high resistance cable (green line) and hardly changed at all at others when compared with the same speaker hooked up with QED Supremus cable (pink line). Therefore with the high resistance cable the fidelity of the system has been significantly changed whereas with QED Supremus, fidelity to the original signal has been maintained.



SO WHY NOT JUST USE A 'STANDARD' DESIGN LARGE CROSS-SECTION CABLE RATHER THAN SPENDING EXTRA MONEY ON AN ESOTERIC DESIGN SUCH AS QED SUPREMUS?

In traditional large cross-section cables, whether solid core or multi-stranded, high pitched sounds are forced to travel towards the outside of the conductor and so are able to use less and less of the available cross-sectional area as the pitch increases. This is called the "Skin Effect". It means that for high frequencies the resistance of the cable appears to be much higher than it does for lower pitched sounds. This has a detrimental effect on the fidelity of the sound you hear. QED AirCore™ Technology solves this problem by creating a hollow tubular conductor geometry through



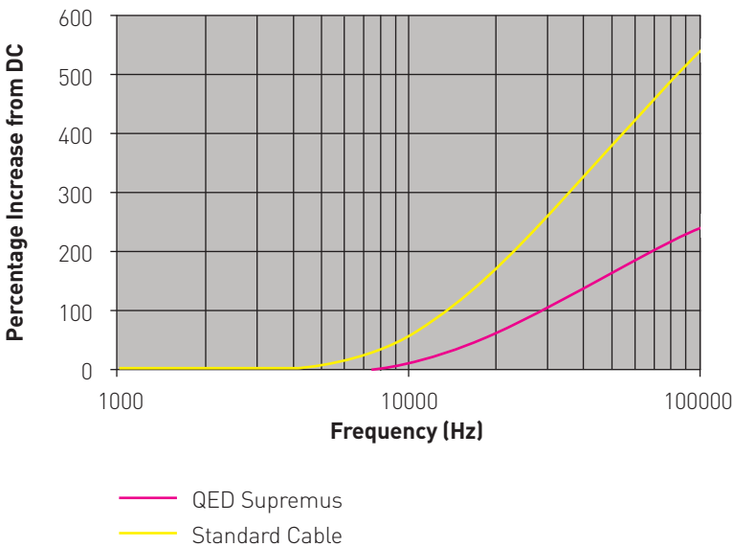


which each frequency can pass with equal ease when compared to traditional solid or stranded conductors.

AirCore™ Technology also features a special Litz-like cable geometry designed to obviate an equally damaging sonic problem known as the **"proximity effect"**. Where two conductors are laid side by side and carry current in opposite directions, the alternating magnetic fields built up around each conductor tend to reinforce current flow in the parts of the conductors which are nearest to each other and to cancel current carried in the side of the conductors furthest away.

Therefore in a normal "figure of eight" speaker cable - even one below the size where the skin effect becomes a problem - the proximity effect will still cause the resistance to rise by up to 25% within the audio band - affecting linearity and therefore fidelity of the music being conveyed. QED Supremus avoids this problem entirely by utilising AirCore™ Technology. Each of the sixteen silver plated 99.999% oxygen free solid copper cores which comprise the conductors within QED Supremus are individually insulated by a nearly invisible layer of enamel. This material was chosen because it has extremely good insulating properties for a given very thin layer and so can effectively separate each core within the conductor bundles while maximising the available cross-sectional area. Because they are twisted around a hollow central polyethylene core no single conductor remains at the outside or inside of the overall conductor along its entire length – thus evening out the current density and keeping the resistance uniform throughout the audio band.

Graph of Normallised Resistance against Frequency for QED Cables



GO ON THEN, PROVE IT!

The graph left shows how QED Supremus speaker cable (pink) compares with a standard cable (yellow) of the same cross-sectional area when measurements are taken of the resistance at different frequencies within the audio band and beyond.

From about 1kHz upwards the standard cable starts to exhibit a rising resistance due to the proximity effect whereas the QED Supremus cable does not exhibit any resistance increase until beyond 10 kHz at which point the resistance of the standard cable exhibits a runaway skin effect.

WHAT ABOUT INDUCTANCE AND CAPACITANCE? AREN'T THEY INCREASED WHEN YOU MAKE A LARGE CROSS- SECTIONAL AREA CABLE?

Speaker cables carry alternating current and therefore have a magnetic field constantly growing and collapsing around their conductors. This causes an electromotive force to be generated within the cable which opposes the flow of current. This effect is known as self inductance and will be greater the further apart the current carrying conductors are spaced in the speaker cable.

With a properly designed amplifier, adding large amounts of inductance in series can produce an audible high frequency loss and phase shift which both affects the fidelity of the sound you hear and the accuracy of the stereo soundstage; it is therefore vital to keep cable inductance as low as possible.

In addition the two current carrying conductors in a speaker cable act like the plates of a capacitor and the insulating material between them forms the dielectric. If the spacing of the conductors is very small then the capacitance will be high and if the conductors are spaced further apart then the capacitance will be lower. Given the same conductor spacing, a dielectric material with a high relative permittivity will create a higher capacitance than a low permittivity dielectric. Another issue is the dissipation factor of the dielectric material. Dissipation factor is an indicator of how much energy will be lost while charging and discharging the cable during each alternating cycle. Materials with low permittivity also tend to have low dissipation factor.

Large amounts of capacitance across an amplifier output can cause instability, especially at high frequencies, with many listeners describing high capacitance cables as harsh. It is therefore important to keep capacitance and dissipation factor of the cable as low as possible.

Unfortunately for the proponent of the 'standard cable' solution, there exists a "Catch 22" situation here. In order to make the capacitance lower, moving the conductors further apart increases the inductance and in order to make the inductance lower, moving the conductors closer together increases capacitance.

With QED Supremus speaker cable we have applied our research

techniques to escape this trap. By using low permittivity dielectric materials such as Low Density Foamed Polyethylene instead of the more usual PVC we get an immediate improvement in capacitance measurement for the same geometry. We then increase the conductor spacing to gain a further improvement.

BUT DOESN'T THAT JUST INCREASE INDUCTANCE OF THE CABLE?

AirCore™ Technology gives us an extremely useful side benefit. The electric fields that generate self inductance act towards the centre of each conductor, so by removing the conductor from the centre we reduce the self inductance of any cable given the AirCore™ treatment by up to half of that which would normally be expected.

This means that we can increase conductor spacing to reduce capacitance without increasing inductance; this is only possible through the use of Aircore™ technology, an option that is simply not available to our competitors.

OK, SO WHAT ARE THE FIGURES?

The table below shows the difference between QED Supremus cable and ordinary standard cable of the same cross-sectional area.

Cable	CSA mm²	Parallel Capacitance pF/m	Loop Inductance µH/m	Loop DC Resistance mΩ/m	Dissipation Factor @10kHz
QED Supremus	6.16	48	0.49	5.00	0.009
Standard Cable	6.00	80	0.70	6.10	0.070

The use of high quality dielectric materials and increased conductor spacing has enabled QED Supremus to have only 60% the capacitance of the standard cable. At the same time, through the use of Aircore™ Technology, inductance of the cable has been reduced by 30%. In addition due to the use of low permittivity dielectrics the dissipation factor has been reduced to 1/10th that of the PVC clad cable.

WHAT ABOUT THE ENAMEL? WON'T THE CABLES BE DIFFICULT TO TERMINATE?

QED Supremus cable is not available loose on the reel for self-termination. It can only be obtained from your dealer as a finished cable set which has been hand terminated by QED in a choice of standard or custom lengths with either rhodium plated high purity copper spade connectors or QED Airloc™ locking speaker plugs.

The Supremus Airloc™ is an all new locking banana plug designed specifically for QED Supremus cable. We developed a unique locking system which securely clamps the rhodium plated beryllium copper contact area of the plugs into the speaker binding posts simply by twisting the plug barrel.

The enamelled conductors are stripped using a special chemical process and both the plugs and the spades are attached using our exclusive Airloc™ cold weld system. This completely eliminates air from the cable/plug interface preventing oxidization of the silver conductor surface ensuring the connection remains low resistance for life.

Owners of high end hi-fi systems know that each sonic upgrade requires a greater and greater investment in audio hardware. It is imperative that these hard won tiny improvements are not swamped by inadequacies in the link between amplifier and speakers. Make sure that the fidelity of your system is maintained throughout. Use QED Supremus cable.

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SUPREMUS SPECIFICATIONS

CROSS-SECTIONAL AREA	WIRE GAUGE	JACKET OUTSIDE DIAMETER	JACKET INTERNAL DIAMETER
6.16 mm²	10 AWG	17 mm	8mm

LOOP RESISTANCE	CAPACITANCE	INDUCTANCE	DISSIPATION FACTOR
0.005 Ω/m	48 pF/m	0.49 µH/m	0.009

CONDUCTORS	INSULATION	PLUGS AND SPADES	OTHER
2 x 16 solid core silver plated 99.999% oxygen free copper conductors	Unique enamel with low loss surrounding foamed polyethylene dielectric insulation	Rhodium plated locking Airloc™ Plugs and Spades available	Aircore™ Technology Cryogenically treated

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