Managing the thermal impact on advanced medical cable assemblies through novel cable construction techniques and materials

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Thermal management inside medical cables and devices is becoming increasingly challenging for complex, next generation products. The trend for lighter, smaller and more flexible ultrasound probe solutions built with fine wire, ultra-high density coaxial cable is creating new and unique challenges. Many of the conventional approaches with regards to materials and construction are no longer adequate when reliability and usability are paramount.

Advanced surgical devices, imaging and implantable applications often push the limits of cable performance. Reduced device size in conjunction with ever-thinner plastic insulation layers on wire used for power delivery creates a real need for addressing the radiated heat. Proper heat dissipation methods are crucial. OEMs that do not take this into consideration may experience any number of issues affecting their products such as decreased life, signal degradation, increased opportunity for in-situ defects, general safety concerns due to burn exposure and other user discomfort. Trying to deal with these issues without the proper expertise could lead to cost increases. And avoiding this design element with the intent of saving costs generally has the reverse effect in the end. Fine wire should not run hot and cutting corners on the cable design and packaging may inevitably lead to higher overall program costs and a reduction in customer satisfaction.

Much like the filament of an incandescent light bulb, the impact of power on wire is critical. It is paramount to quickly and effectively remove the heat, while maintaining a healthy electrical steady state. To address this challenge, Hitachi and other cable and device manufacturers are looking into novel *passive* thermal control systems. Such systems offer significant design and manufacturing simplification over the highly complex *active* solutions, and they result in cable assemblies with improved reliability, greater user comfort and cost reductions when compared to an active control system or no solution at all. Such a passive thermal system is shown in *Figure 1.*

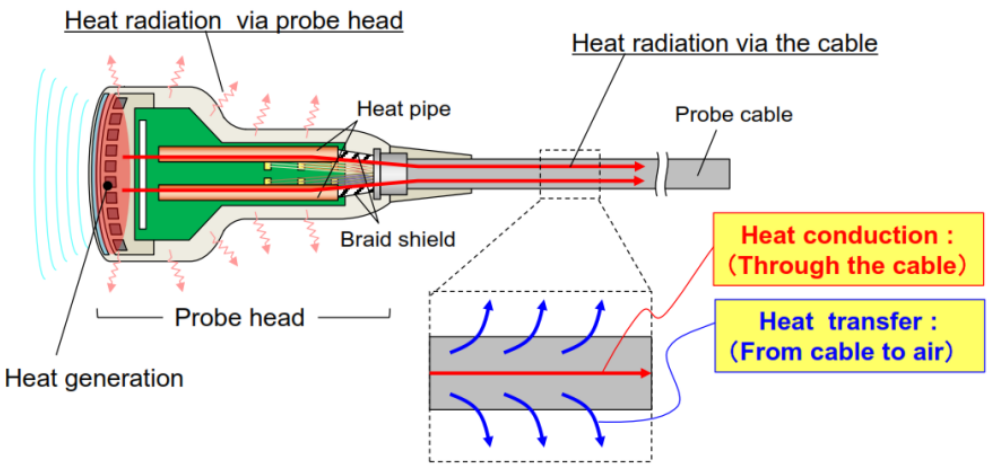

Figure 1 - Passive Thermal Heat Transfer

With this in mind, Hitachi Cable America in cooperation with Hitachi Metals has simulated and validated the ability to quickly remove heat. We studied the heat conductivity of a multi-core high count MCX probe cable with various shielding structures and configurations and we were able to demonstrate that a substantial improvement can be achieved passively via an optimized shield and assembly design. Using these special techniques and materials, we were able to reduce the overall heat resistance up to 40%. This is due in part to Hitachi Metals unique braid material with improved bend life and conductivity. These characteristic improvements coupled with improvements in shield termination made all the difference. Taken together, OEM designers can learn to better manage their probe head heat dissipation challenges while finding solutions that meet their budgets.

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