



Before the Burn

Mitigating the Risk of Burn Injuries in Consumer Electronics and Wearable Devices

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Burn injuries from consumer electronics and wearable devices are growing more common as we maintain increasingly constant contact with these technologies. From laptops and tablets to smart watches, fitness trackers, and virtual reality goggles, we are using our devices for longer and closer to our skin than ever before. Many consumer electronics can overheat when malfunctioning, but they can also generate significant heat under normal operating conditions. While consumer electronics manufacturers seek to mitigate all safety risks during the product design process, understanding and addressing the specific risk of skin burns can be difficult.

A skin burn hazard depends on more than just a device's temperature. Hazard assessments can benefit from considering both the user and the device concurrently, a practice that requires knowledge of both human physiology and the science of heat transfer. Electronics that pose a risk for non-contact or prolonged-contact burns in particular can benefit from burn hazard assessment frameworks that evaluate burn risks beyond what is prescribed by current consensus standards and guidelines. By proactively integrating comprehensive burn risk assessments into the product design process, consumer electronics and wearable device manufacturers can enhance user safety while minimizing the risk of product redesign, recall, or litigation.

Primary Drivers of Burn Risk

Because burn injuries are driven by heat transfer, burn risk assessments should consider where heat energy is generated and where that energy wants to go. If there is a likelihood that heat energy will travel into a user's skin, human thermoregulatory response and physiological aspects may come into play. How will the body respond when exposed to the device for long durations? Will blood flow increase in response to the contact? What

amount of heat can the body take without experiencing cell damage? All of these questions are becoming increasingly relevant as we become more intimate with our electronics. If a wearable device is designed to be worn outside, the extent of a burn hazard may be influenced by varying and possibly extreme environmental conditions.

It is important to note that long-duration exposures are not limited to wearable devices. Any consumer electronic device can pose a burn risk if it remains in contact with skin for a long enough period.

A Burn Risk Methodology That Goes Beyond Consensus Standards

ASTM 1055, ISO 13732-1, and IEC 62368 are three consensus standards related to burn injuries. However, these standards do not directly address certain thermal exposure scenarios involving non-contact burns and non-skin tissues, and they are frequently misinterpreted or misapplied. This is particularly challenging for manufacturers of virtual reality goggles and head-mounted display devices where the user's eyes may be exposed to elevated temperatures in certain scenarios.

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Our team at Exponent has developed a robust methodology to assess burn risk for a wide variety of consumer electronics and wearable devices. Through a mixture of experiments and computational modeling of heat transfer phenomena, we can provide manufacturers the data needed to comprehensively assess burn risk for a range of human tissues. We encourage product developers to consider burn hazards and assess these early in the product development process. This proactive approach to user safety can help manufacturers avoid costly product redesigns and delays to product launch. If need be, this framework can also be applied after production to assess concerns of burn injuries that may arise.

How Exponent Can Help

Exponent's multi-disciplinary team of mechanical engineers, regulatory experts, and thermal and materials scientists can help manufacturers of consumer electronics and wearable devices integrate burn risk assessment into the product design process and assess claims of burn injuries throughout a product's life cycle.



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