LETTER TO THE EDITOR

Car Seat Heaters as a Potential Burn Hazard: A Clarification

To the Editor:

This letter is submitted to address an error in an article previously published in this journal that has led to confusion concerning the thermal conditions that cause skin burns. The thermal comfort of vehicle occupants has been an issue of concern from the earliest days of automobile design. Many embodiments of vehicular climate control systems have evolved over the years, including the introduction of integral car seat heaters as early as the 1930s. Given their long history and broad application, it is beyond question that heated seats are considered to provide a positive feature benefiting the comfort of automotive passengers. Nonetheless, since the operation of seat heaters must inherently raise the temperature of the surface on which occupants are seated, there is a chance that seat heaters might cause a thermal injury if the temperature exceeds the safe range. Various manufacturers have used a spectrum of surface temperatures for an occupied seat, with the heater on its highest setting. In general, these temperatures have a typical upper limit of 43°C (109.4°F), with an anticipated deviation of ±2°C (3.8°F).

In modern seat heater technology, there are multiple mechanisms by which the surface temperature of a seat is raised. An integral power source is built into the structure of the seat with a control system to regulate the temperature that is produced on the surface when an occupant is sitting on the seat. The most common heater mechanism is via conduction from an electric resistance heater installed beneath the seat cover material. Alternately, warm air may be circulated through channels beneath the cover. It is anticipated that vehicle occupants will be wearing clothing over their skin that is exposed to the heated surface, thereby providing thermal insulation that will result in a temperature drop of 2 or 3°C or greater between the seat and the skin. However, the most conservative evaluation of the potential for causing a thermal injury should assume that the skin is in direct contact with the seat surface.

It has been known for many decades that thermal burns may result from exposure of the skin surface to an elevated temperature for an extended period of time. The seminal data that describe first- and second-degree thermal injury in humans were published in 1947 in an extended series of articles by Moritz and Henriques. Their data are widely considered to be the gold standard for definition of the thermal insult conditions that cause burn injury. These data are derived from experiments in which skin was exposed to flowing water at a constant temperature for a controlled period of time. The conditions were identified for the minimum exposure times at a specified temperature that resulted in “Reversible Epidermal Injury” and “Complete Transepidermal Necrosis.” These conditions correspond to causation of threshold first- and second-degree burn wounds.

Over the subsequent decades, these causation conditions for threshold thermal injuries have been verified in other experimental models in human and animal subjects. For example, the data of Lawrence and Bull for causation of a threshold second-degree burn in humans match very closely with the data of Moritz and Henriques. The data have been interpreted to explain the causation of thermal injury for many different types of high-temperature environments, sometimes with a questionable heat transfer justification, and the data are widely cited, frequently in the popular press, in defining safety standards for avoiding burn injury.

Unfortunately, the Moritz and Henriques data have also been frequently cited in error, including by burn professionals. As a consequence, burn safety standards are promulgated that are not based accurately on foundational experimental data. A common error is to misstate that the minimum exposure time and temperature causative of complete epidermal necrosis represent a third-degree injury, a full-thickness

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burn. Of course, complete epidermal necrosis is representative of a second-degree injury, not a third-degree injury. An example of this citation error relevant to defining standards for avoiding car seat heater burns is found in the article by Maguïña et al. In this article, the authors state that at 120°F, “third-degree burns can occur within 10 minutes,” citing the Mortiz and Henriques data. The relevant Mortiz and Henriques data are excerpted in Table 1, with the temperature conversion in °F added.

As can be seen from the Moritz and Henriques data, thermal stress defined by a combination of 120°F and 600 seconds matches the criteria for producing a threshold second-degree burn. Thus, the statement that these conditions will produce a third-degree burn is incorrect.

The author has had multiple interactions with colleagues who have responsibility for defining safe and efficacious conditions for the operation of vehicle seat heaters who have been confused and misled by the Maguïña et al article. Furthermore, the erroneous statement in this article has been cited in other subsequent medical literature as being authoritative.

Although this article has now been in the literature for many years, it is not too late to set the record straight regarding the scientific basis of the recommendations therein. Hopefully, professionals working in the field of seat heater design will have a more accurate guide to consider in determining the criteria for the regime of safe operation.

Table 1. Data adapted from Henriques for experimentally observed minimum exposure times at the defined cutaneous surface temperatures that result in “Complete Transepidermal Necrosis”

<table>
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<th>Exposure Time (sec)</th>
<th>Surface Temperature (°C)</th>
<th>Surface Temperature (°F)</th>
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<tbody>
<tr>
<td>25,000</td>
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<td>111.2</td>
</tr>
<tr>
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<td>300</td>
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REFERENCES


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