SURFACE VEHICLE RECOMMENDED PRACTICE	J3047™	JAN2016
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Recommendation for Acceptable Operating Parameters of Heated Automobile Seats in Order to Mitigate Occupant Injury

RATIONALE

This is to fix a typographical error in equation 1.

1. SCOPE

This recommended practice will promote a temperature and duration guideline that mitigates the risk of thermal injuries to the heated seat user. In addition, recommendations are established to indicate to the user when the heater is operating, and warnings that should be included in the vehicle literature.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this recommended practice to the extent specified herein. Unless otherwise indicated, the latest issue shall apply.

2.1.1 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org

ASTM C1055-03 American Society for Testing and Materials Standard Guide for Heated Surface Conditions that Produce Contact Burn Injuries

2.1.2 ISO Publications

Copies of these documents are available online at http://webstore.ansi.org/

ISO 13732-1 Ergonomics of the Thermal Environment - Methods for the Assessment of Human Responses to Contact with Surfaces - Part 1: Hot Surfaces (Sep 1, 2006)

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2.1.3 Other Publications

Henriques F.C. Jr., 1947, Studies of Thermal Injury. V. The Predictability and the Significance of Thermally Induced Rate Processes Leading to Irreversible Epidermal Injury, Archives of Pathology 43, 489-502.

Moritz, A.R, and Henriques, F.C, Jr., 1947: Studies of Thermal Injury II: The Relative Importance of Time and Surface Temperature in the Cutaneous Burns, American Journal of Pathology, Vol 23, 695-720.

Kokate, J.Y., Leland, K.J., Held, A.M., Hansen, G.L., Kvenn, G.L., Johnson, B.A., Wilke, M.S., Sparrow, E.M., and Iaizzo, P.A.: Temperature-Modulated Pressure Ulcers: A Porcine Model, Arch Phys Med Rehabil, Vol 76, July 1995, 666-673

3. DEFINITIONS

3.1 HEATED SEAT SYSTEM

A system consisting of a complete seat, heater source, heater controls, which may contain an electronic control unit (ECU), relay, etc., which provide a heated seat option to the vehicle occupants.

3.2 MAXIMUM OPERATING TEMPERATURE

The maximum temperature reached for either steady state operation or during heater ramp up, measured at the seat surface which is in full contact with an occupant or an equivalent test specimen.

4. ESTABLISHING MAXIMUM OPERATING TEMPERATURE AND DURATION

4.1 Maximum Operating Temperature Setting

The maximum operating temperature for a seat heater measured at the seat surface over a given time should be set to operate below the limit described in Equation 1:

$$T_B = 45.652 \times t^{-0.0222} \quad \text{(Eq. 1)}$$

Where:

t is time in hours

Equation 1: Threshold temperature (°C) for first degree burn

This is based on the experimental data for a first degree burn as described in Appendix A. This equation is graphically illustrated in Figure 1:

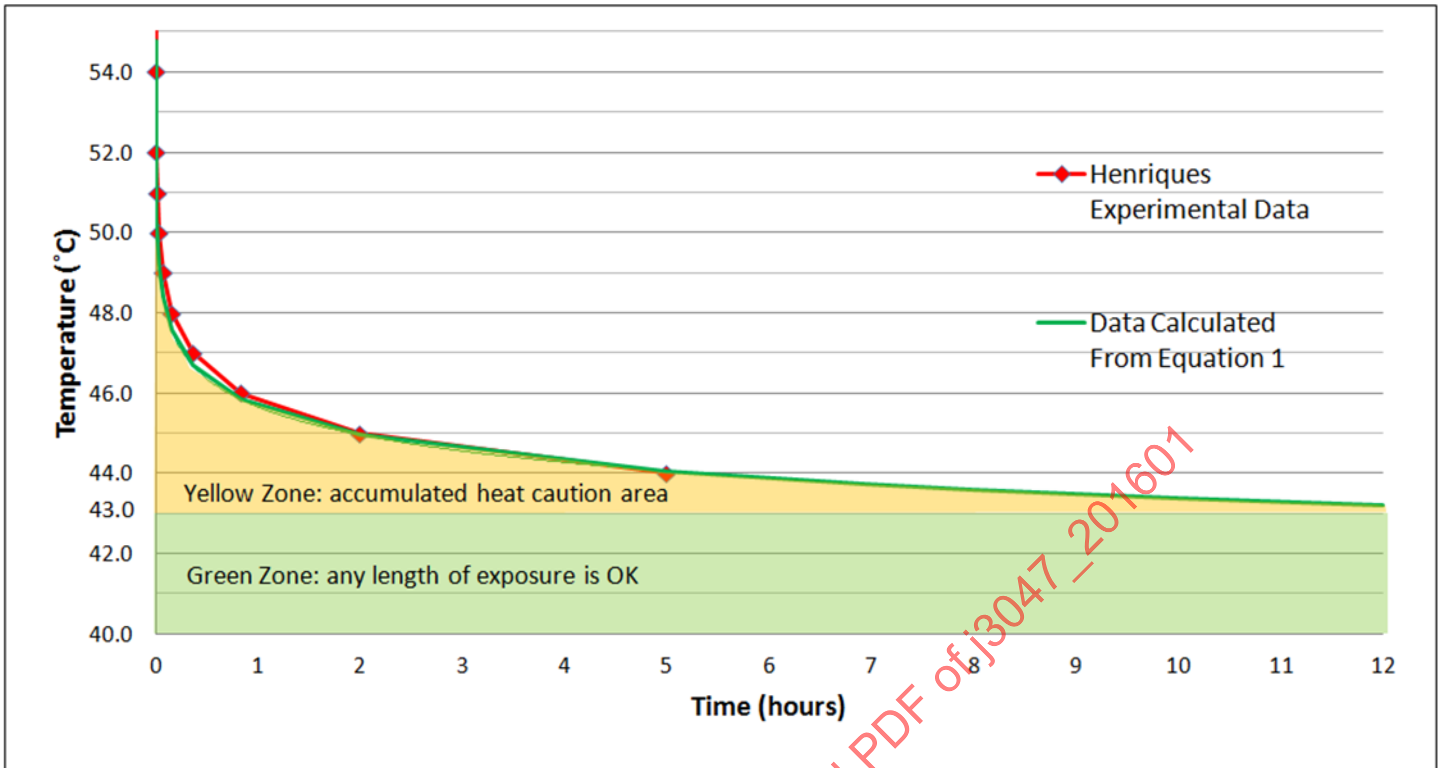

Figure 1 - Time/temperature limit for first degree burn threshold, extrapolated for longer durations

At long time exposures, this matches the ISO 13732-1 limit of setting 43 °C as a maximum operating temperature setting. At shorter time exposures, this temperature can be increased; for example, to improve customer comfort in a cold cabin at vehicle start up. This equation results in temperature limits that are slightly lower than the experimental data. This difference is larger in the first two minutes, leading to a conservative result compared to the experimental data. Refer to Appendix A for a full comparison.

Equation 1 defines a single maximum operating temperature exposure limit. If the limit as described by Equation 1 is reached, a heater should then reduce this temperature to 43 °C or lower. Alternatively, extra margin may be specified to the limit of Equation 1, which would allow the heater to step down over time while mitigating the risk of an accumulated heat low temperature burn. If one elects to pursue this type of design, it needs to be conducted with an understanding of how to adjust the temperature over time to address the effects of accumulated heat.

4.2 Temperature Setting Control

There are several possible methods to limit the heater performance into this area under the limit curve. For example, an ECU within the heater system could receive temperature feedback via a thermostat or temperature sensor and limit the heater power. A simpler method is to set the maximum operating temperature to 43 °C, controlled by a thermostat. Alternatively, the heater controller may have an auto adjustment feature that turns the heater down or off before it exceeds the limit curve threshold temperature.

The maximum operating temperature of the seat heater should account for variation within the performance of the heater.

5. INDICATION ALERT TO USER

Each seating position equipped with a seat heater shall have a clear indication of the operating status of the seat heater that is visible to that seat occupant when the occupant is in a normal seating position.

6. VEHICLE LITERATURE

The vehicle owner's manual or literature provided with the vehicle should describe heated seat operation and also include a warning for heated seat occupants with compromised senses, for example, paraplegics or diabetics.

7. TEST PROCEDURE

Each manufacturer should determine the best test method for evaluation of their heated seat system. The test procedure should include the measurement of variation to ensure that the maximum operating temperature of the seat heater falls within the recommended limits of section 4.1.

As the original experimental data was measured at the surface of the test subject's skin, manufacturers should take this into account when devising their test method (*Moritz and Henriques, Studies of Thermal Injury II, pages 696-698).*

8. NOTES

8.1 Revision Indicator

A change bar (l) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this document. An (R) symbol to the left of the document title indicates a complete revision of the document, including technical revisions. Change bars and (R) are not used in original publications, nor in documents that contain editorial changes only.

PREPARED BY THE SAE HEATED SEATS STANDARDS COMMITTEE

APPENDIX A - ESTABLISHING MAXIMUM OPERATING TEMPERATURE AND DURATION.

The medical definition of a burn is:

First degree burn – A superficial burn in which damage is limited to the outer layer of skin in the epidermis and is marked by redness, tenderness, and mild pain. Blisters do not form, and the burn heals spontaneously without scar formation.

Second degree burn – A burn that damages all of the epidermal and some superficial dermal tissues but does not damage the lower-lying hair follicles, sweat, or sebaceous glands. The burn is painful and red; local blood flow is maintained; blisters form; and wounds heal spontaneously but sometimes with a scar.

Third degree burn – A burn that extends through the full thickness of the skin and subcutaneous tissues beneath the dermis. The burn leaves skin with a pale, brown, gray, or blackened appearance. Local blood flow is terminated. The burn is painless because it destroys nerves in the skin. Scar formation and contractures are likely complications that often require grafting.

(adapted from *Taber's Cyclopedic Medical Dictionary*, F.A. Davis Co., Philadelphia)

This committee's recommendation deals with preventing first degree burns. By preventing this level of burn, more severe burns are also avoided.

The fundamental research for the effect of hot temperatures on human skin was performed using human experiments and mathematical modeling by A.R. Moritz and F.C. Henriques. They established 44 °C as the minimum temperature needed to cause a first degree contact burn on bare human skin. This data was tabulated in Henriques's *Studies of Thermal Injury V* on page 494:

Table A1 - Exposure time and skin surface temperature for first degree burn thresholds based on experimental research, compared to the recommended practice's calculated results

			Henriques Experimental data	**Equation 1 Calculated Data**	**delta**
Time (hr)	**Time (min)**	**Time (s)**	**Temp °C**		
0.000	0.0	**1.0**	**65**	54.8	-10.2
0.001	0.0	**2.6**	**60**	53.6	-6.4
0.002	0.1	**8.3**	**56**	52.2	-3.8
0.005	0.3	**18.0**	**54**	51.4	-2.6
0.012	0.7	**44.0**	**52**	50.3	-1.7
0.021	1.3	**75.0**	**51**	49.7	-1.3
0.036	2.2	**130.0**	**50**	49.1	-0.9
0.072	4.3	**260.0**	**49**	48.4	-0.6
0.156	9.3	**560.0**	**48**	47.6	-0.4
0.361	21.7	**1,300.0**	**47**	46.7	-0.3
0.833	50.0	**3,000.0**	**46**	45.8	-0.2
2.000	120.0	**7,200.0**	**45**	45.0	0.0
5.000	300.0	**18,000.0**	**44**	44.0	0.0
6.944	416.7	25,000.0		43.7	n/a
8.000	480.0	28,800.0		43.6	n/a
10.000	600.0	36,000.0		43.4	n/a
12.000	720.0	43,200.0		43.2	n/a

(Henriques, F.C., 1947, *Studies of Thermal Injury V: The Predictability and the Significance of Thermally Induced Rate Processes Leading to Irreversible Epidermal Injury*, Arch Pathol 23, 489-502)