

SURFACE VEHICLE INFORMATION REPORT

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Vehicle System Voltage—Initial Recommendations

Foreword—It is the opinion of the committee that a set of guidelines and standards related to higher voltage levels will ensure the safety, shorten the introduction time, and lower the cost of such systems. A primary area of concern has been the potential for an increase in electrical shock hazard. Of secondary importance has been the need for some standardization of higher voltage levels. The committee feels that settling these broad issues now will allow development efforts to be more focused, thus shortening the total development time for higher voltage systems. The committee's review of the available technical literature and the industry expertise of our members leads to the recommendations discussed as follows.

1. Scope—This SAE Information Report is a summary of the initial recommendations of the SAE committee on Dual/Higher Voltage Vehicle Electrical Systems regarding the application of higher voltages in vehicle systems. This document does not attempt to address the technical merits of specific voltages or electrical system architectures.

2. References

2.1 Applicable Publications—The following publications form a part of the specification to the extent specified herein. Unless otherwise indicated, the latest revision of SAE publications shall apply.

2.1.1 SAE PUBLICATION—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

R. J. Sandel and J. V. Hellmann, "Activities of the SAE Committee on Dual/Higher Voltage Vehicle Electrical Systems," presented at the 1991 SAE Future Transportation Technology Conference, Portland, Oregon.

2.1.2 IEC PUBLICATIONS—Available from International Electrotechnical Commission, 3, rue de Verambe, P.O. Box 131, 1211 Geneva 20, Switzerland.

"Effects of Current Passing Through the Human Body, Part 1: General Aspects," International Electrotechnical Commission Report IEC-479 Part 1, Second edition, 1984

"Effects of Current Passing Through the Human Body, Part 2: Special Aspects," International Electrotechnical Commission Report IEC-479 Part 2, Second edition, 1987

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3. *Technical Requirements*

- 3.1 Protection From Contact**—Protection against direct contact to electrical circuits shall not be necessary if the possible contact voltages do not exceed the permissible levels of 65 VDC, including periodic ripple, or 50 VAC, RMS. The application of voltages above these levels shall not be discouraged, but additional protection against direct contact shall be necessary.

A study of previous work in relation to human tolerance to electrical shock was conducted and the various information sources were examined and thoroughly discussed by the members of the committee. Based on this study, an understanding of present vehicle wiring practices, and the safety record of today's 12 and 24 V systems, the 65 VDC and 50 VAC levels are seen as appropriate from a practical standpoint. Particularly useful in the formation of this recommendation has been the International Electrotechnical Commission's (IEC) Publication 479, parts 1 and 2.

It is recognized that with a system of present architecture utilizing a higher system voltage, say 50 VDC, transient levels will exceed 65 V. The committee has deferred consideration of the shock hazard of non-periodic transient (less than 300 ms) voltages to a future time. Also, the committee has not addressed the protection against contact necessary for voltages above the recommended limits. However, other industries demonstrate daily that such contact can be appropriately prevented.

- 3.2 Standard Storage Voltages**—Standard storage battery voltages shall be defined as those normally associated with 3, 6, 12, and 24 cell lead-acid storage batteries (6, 12, 24, and 50 VDC nominal, respectively). The application of battery systems other than lead-acid shall not be discouraged. Additionally, the number of distinct generation, supply, or storage voltages that may be present in a vehicle shall not be limited.

The lead-acid battery system is currently the only system used commercially in starting, lighting, and ignition (SLI) applications on internal combustion engine automobiles. The committee feels that lead-acid will continue to be the SLI system of choice for a significant period of time. Standard voltages higher than 50 V may be defined in the future but will require a yet undefined degree of contact protection as their charge voltage will likely exceed 65 V.

As vehicle electrical requirements continue to evolve, battery systems other than lead-acid may become a viable alternative and should be able to meet the same nominal storage voltages as lead-acid. We feel that this option should not be limited. Similarly, limiting the voltage levels in magnitude or count will only restrict system options that may otherwise be appropriate solutions.

4. *Notes*

- 4.1 Key Words**—Human Shock Tolerance, Personnel Protection, Shock Tolerance, Standard Voltage, System Voltage, Admissible Contact Voltage, High Voltage, Electrical System

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