



# DC ARC FLASH UPDATE FROM OEM MANUFACTURES

## Background to DC Arc Hazards

Arc flash can simply be described as the light and heat energy that is generated following an arc fault explosion. Temperatures experienced during an arc flash event will often exceed 10,000 degrees °C. To give further some perspective and context; the temperature at the surface of the sun is approximately 5,500 °C. When an arc flash occurs, temperatures can easily ignite an exposed worker's clothing and it is likely to severely burn anyone within the arc flash boundary unless the designated PPE is utilized.

**Arc flash has the ability to melt metal, cause lung and eyesight damage and will likely lead to the hospitalization and/or death of those working on impacted equipment.**

Arc flash associated with alternating current (AC) systems is well understood in the electric power industry and with equipment using AC systems. DC arc flash associated with battery electric systems has some nuances that are not currently as well understood and some of the hazards are potentially different at the same incident energy levels.

## OEM Efforts in the Development of Electrical Energy Products

OEMs of earthmoving (construction and mining) equipment are fully committed to the decarbonization of products which introduces new product designs with potential hazards that have not previously been encountered in traditional earthmoving machinery.

OEMs support the elimination of hazards and risks associated with the deployment of products utilizing DC voltage which will be placed into global markets. The elimination of live work will continue to be a priority for OEMs; however, it is recognized that elimination of live work may not be possible in all situations. Therefore, OEMs will collaborate across industry within the constraints of any legal and competitive boundaries in pursuit of safe people, safe equipment, and safe systems.

## Industry Position on DC Arc Flash

A group of manufacturing OEM electrical experts based in North America convened to discuss and evaluate DC arc flash (with emphasis on >1000 Volts DC). In initial discussions, OEMs recognize the challenges of implementing a robust conformity strategy for alternative powered products and fully understand that a DC arc flash is a hazard that is likely to be encountered. There will be an evolution of new technical standards that will need to be written to support developments in alternative powered products. The development of these new products is outpacing the availability of new technical safety standards and will do so for the near future.



Pertaining to DC arc flash, it is understood there is some variability in results that are generated from currently available calculation methods which are used to determine DC arc flash energy and arc flash boundary. Furthermore, methods available in industry technical standards are limited in application to 1000 VDC or less. Available research indicates that above 1000 volts some methods may underestimate the arc flash incident energy, while others, such as the maximum energy method (“Doan method”), yield conservative (over-estimated) results. Industry is developing limited products that will utilize >1000 volts DC systems, and current available methods require some interpretation at these voltages. The Earthmoving Machinery industry is committed to expand its understanding of DC arc flash across all voltage ranges and mitigate hazards accordingly.

## In Summary

Our industry sector will aim to implement the best available solutions that can mitigate identified electrical hazards and contribute to the safety of anyone working on DC electrical systems. As part of ongoing development, research will be conducted to evaluate emerging arc flash assessment methods that are capable of predicting arc flash potentials and seek to evaluate the engineering controls that can mitigate this type of hazard. OEMs are in alignment about risk mitigation and elimination of live work whenever possible. However, it is recognized that in a limited number of operational instances it is not possible to completely eliminate arc-flash potential, particularly where work involves working on residual energy devices such as batteries and capacitors etc. In such cases, arc flash potential is likely to be present and the use of personal protective equipment will be necessary. Given the particularly severe nature of DC arc flash events coupled with the minimal availability of research to quantify results, it is the express opinion of OEMs that a conservative calculation method is required to confidently calculate exposure potential. Ultimately, OEMs consider the use of personal protective equipment to be a prerequisite for some electrical tasks and PPE will be unavoidable as a safety precaution for any DC arc flash exposure.

Finally, it is the collective understanding that safe systems of work and associated permit-to-work processes are necessary to reinforce PPE requirements/mandates. PPE is most commonly cited as the final resort for the protection of persons exposed; however, in this case it will be a critically important control measure for maintenance work on mobile applications.

The industry welcomes participation by additional OEMs, mining companies, and other interested parties in ongoing discussions and developments on this topic (subject to the approval of the participating equipment manufacturers). The industry is committed to continued collaboration on strategies and best practices for addressing arc flash hazards in electrified equipment.