# Pyrotechnic Initiator Research at the University of Idaho

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**Poster Abstract**

Electro-explosive devices, for example pyrotechnic initiators, are extensively used in inflatable restraint systems intended to provide supplemental occupant protection in automobiles. Of course, in this particular application, it is critical that these initiators perform reliably without failure or diminished performance for the entire service life of the vehicle. Current research indicates that not all of these devices are able to meet the stringent quality control requirements specified for the other electronic elements of the ignition train.

The competing demands for minimum size and maximum output of pyrotechnic initiators has lead to designs that feature very small internal cavities ($10^{-2}$ cc to $10^{-6}$ cc, or less) that contain critical components. Examples of such critical components include fine bridge wires or bridge circuits designed to transfer heat derived from an appropriate electrical signal into the surrounding pyrotechnic charge that, in turn, acts to initiate the airbag gas generating mechanism. Bridge wires and bridge circuits are typically supported on a "header" assembly that features dissimilar metal electrical pin connections and a glass-to-metal (or sometimes plastic) seal, surrounded by a shell or outer covering. The entire assembly is intended to be impervious (commonly termed "hermetic") to the surrounding deleterious environment. But, due to the complex design of the internal components and the very small internal cavities involved, leak detection is notoriously difficult and involves specialized instrumentation, methodologies, and technological innovations.

Due to these inherent difficulties, a number of phenomena that may adversely affect propellant combustion – either directly or indirectly – need to be examined. For example, given presence of a moisture-containing gas in the bridge wire cavity, corrosion of the wire and/or degradation of the pyrotechnic charge have already known to have occurred in some devices. Gettering materials may be added to enhance tracer gas leak detection processes, but this must consider the specifics of the design of the initiator in conjunction with the methodology of leak detection. At the same time, it is necessary to understand the effect of a gettering material on the combustion of the pyrotechnic charge. Technological advancements have led to the development of additives that protect against the effects of moisture ingestion, do not adversely affect the long-term stability of the pyrotechnic, and yet may enhance the calorific output of the device.

The poster summarizes work-in-progress at the University of Idaho aimed at clarifying and quantifying many of the unresolved technical issues surrounding hermeticity of pyrotechnic initiators. In particular, results concerning the effects of moisture ingestion on initiator bridge wire and bridge circuits, pyrotechnic performance, as well as the ramifications of the results of some of these studies on initiator design are presented.

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