# Motor Vehicle Fire Research Institute
# Awarded Contracts

**Title:** Under-Hood Foam Fire Suppression System

**Contractor:** University of Maryland

**Duration:** November, 2003 – November, 2004

**Purpose:**

Under-hood fire constitutes a significant hazard to vehicle occupants in accidents where the occupants are trapped and/or incapacitated. This project considers the possibility of implementing fire protection measures that would mitigate the effect of under-hood fire. These measures are temporary in nature and would aim at preventing fire spread from the engine compartment to the passenger cabin. The idea is to suppress fire sources originating immediately after the crash till the first responders arrive on the scene. This time is estimated at about 20-30 minutes.

To achieve these results an inerted atmosphere must be established and maintained in the engine compartment and specifically in the region separating the engine compartment from the passenger cabin. Foam products in conjunction with an inert gas provide the desired combination to inert the space and to maintain the inert gas in place for the required time. Previous investigations on foams have identified radiant heat transfer as the key mechanisms leading to foam degradation. The metallic surfaces of the engine have limited radiant surfaces due to the moderate temperatures and due to the low emissivities. These features suggest a limited impact of the engine temperature on the foam degradation. Water-based foam with high expansion ratio characteristics and with good vertical surface adhesion and holding power in combination with nitrogen is the proposed system.

Previous work sponsored by General Motors and the Department of Transportation has focused on identifying properties of the various combustible materials used in manufacturing motor vehicles. Investigators have considered alternative fire suppression techniques based on quick gas releases and other agents to be deployed under the hood to extinguish or mitigate potential fires.

The program is subdivided in two phases. The first phase focuses on a review of previous work while phase two works to develop a simple prototype suppression system. Further detail is as follows:

- Task 1 – Literature Review for Fire Propagation and Suppression

The first phase encompasses a review of the relevant studies conducted by GM/DOT. An in-depth review of these studies will be performed. Particular attention will be given to the findings of several investigations at NIST. Dr. Ohlemiller and co-workers have considered fire-spread characteristics between the engine compartment and the passenger cabin as well as gasoline pool fires under the vehicle. Dr. Hammins has investigated intumescing materials for under-hood fire suppression as well as a variety of other agents among them powder and fast-delivered gaseous systems were found most effective. A feasibility report will describe a proposed suppression system based on the previous findings and relevant experiences with foaming agents.

- Task 2 – Development of Simple Suppression System

The second phase of the project will include the implementation of a simple foam generator for

placement under the hood of a car with foam deployment characteristics consistent with the objectives of the feasibility report. A sequentially-organized test matrix will allow exploring several issues associated with the proposed system and will provide data for its performance assessment. The first set of data will be obtained with the foam generator optimizing the foam expansion ratio for maximum adhesion and cohesion of the foam. The second set of tests will be performed in the engine compartment in cold conditions to study the optimal foam distribution and to assess the extent of foam relocation outside the engine compartment. The third series of test will be conducted heating the engine block and assessing the effect of engine temperature on the foam performance. The fourth series of tests will identify the parameters for fire ignition sources and fire growth in order to obtain a base line for the extinguishment and re-ignition prevention tests. One car will be burned in this series. Finally the full fire tests will be conducted on four cars to assess the foam extinguishment capabilities and the subsequent re-ignition prevention characteristics of the foam system.