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ANNUAL CONFERENCE ON FIRE RESEARCH
Book of Abstracts
November 2-5, 1998

Kellie Ann Beall, Editor

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Gaithersburg, Maryland 20899

United States Department of Commerce
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Toxic Gas Analysis and Fire Detection in the Crew Compartment of Ground Combat Vehicles

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Background

The Halon 1301 replacement program for ground combat vehicles is organized into three different components. These components focus on the engine compartment; crew compartment and hand held fire extinguishers HHFE). The engine compartment program received the most attention initially because the engine compartment had the earliest retrofit requirement. Test criteria such as time of suppression, maximum temperature and toxic fumes for the engine compartment were much less stringent than for the crew compartment. Major Army system Program Managers (PM's) have identified Halon 1301 replacements for the engine compartment only. Retrofit will begin in fiscal year 99.

The crew program is now receiving the most emphasis and will build on the experience gained during the engine compartment phase. The HHFE program is continuing concurrent with the engine and crew compartment programs.

Test Objective and Description

The main threat to the crew compartment is ballistic penetration of a fuel cell. The crew compartment test program is a three-phase program. The first two phases are being sponsored by the U.S. Army Tank-Automotive and Armaments Research, Development and Engineering Center (TARDEC). Phase III will be sponsored by the individual vehicle program managers. This technical approach is an adaptation of engine compartment test methodology.

Phase I is on track for completion in September 1998. This first phase involved seven different vendors. Phase II will include a more stringent scenario and will involve only those vendors who performed well in Phase I. Phase III will be sponsored by individual program managers and will customize fire suppression systems for specific vehicles.

Test Fixture Description

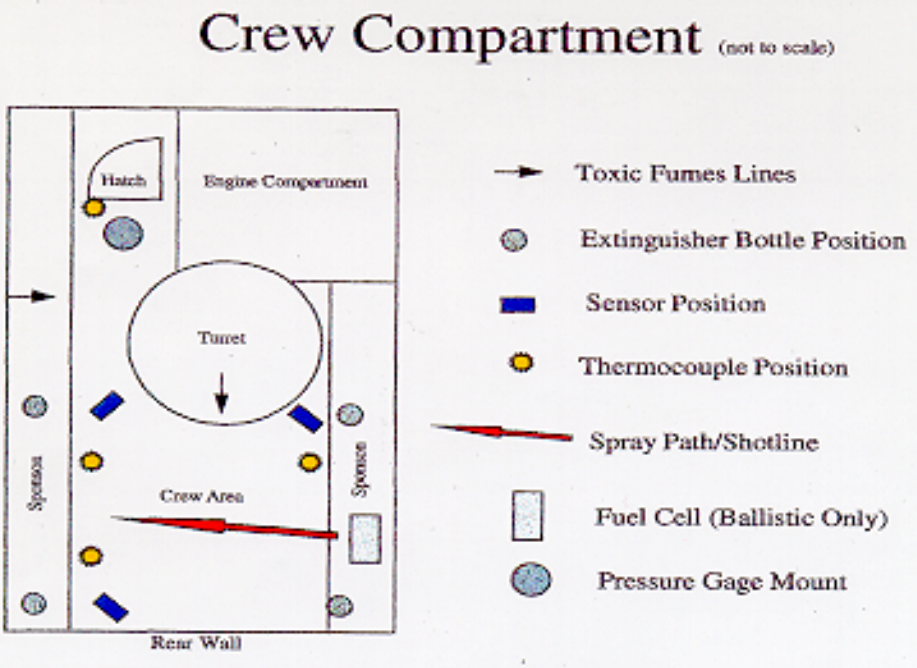
Testing is being conducted in modified Bradley Fighting Vehicle, which was used previously for ballistic testing. This vehicle looks like an operational vehicle from the outside, but there are almost none of the working components on the inside.

Vendors systems are brought to the range individually for three-four weeks to demonstrate system performance against a "standard test sequence". Initially the system is fine tuned against an ATC developed Fireball Generator . After achieving successful results at this stage, the system is then used against a fire initiated by a shaped charge penetrating a fuel cell.

Vendors are provided considerable latitude with regard to the number, size and location of fire bottles. Fire suppression agents under test have been either water-based or fluorinated hydrocarbons. While water-based systems present less toxicity issues, they are not as effective at suppressing fires.

Instrumentation

Typical test measurements used in the evaluation of each system include temperature, heat flux, toxic fumes and fire intensity as seen by video and infrared-sensors. Approximate instrumentation locations are shown in the following diagram.



Toxic gases including CO, Co_2, HF and COF_2 are measured at 1.6-second intervals using a Fourier Transform InfraRed Spectrometer (FTIR). The reactivity of hydrofluoric acid gas dictates the very near proximity of the FTIR to the test vehicle. The use of shaped-charges to initiate the fires subjects the FTIR to shock and blast overpressure and creates a difficult operating environment. Acid Gas Analyzers, developed by the U.S. Army Center for Health Promotion and Preventive Medicine (CHPPM) are used to measure the total fluoride ion. Oxygen levels are also measured to assess crew survivability.

Three solid state infrared detectors in testing. For the Fireball generator tests, the detectors are used to initiate the suppression activation when the fire reaches a specified intensity. For the ballistic tests the detectors are used to measure the fire duration. The sensors also have to operate in an extremely hostile environment with high temperatures, shock waves and highly reactive chemicals.

Future Plans

Phase II crew compartment testing will be conducted in FY 99. This phase will be conducted in the same fixture, but will include clutter representing the vehicle crew and equipment stowage. This will greatly complicate the distribution of fire suppressant.

Subsequent testing will occur in the Fire Safety Test Enclosure (FSTE). This new facility, which will become operational in the fall of 1998, will allow testing of full-scale test items while containing all liquid and gaseous test effluents.