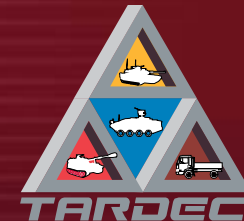


FIRE PROTECTION FOR MILITARY GROUND VEHICLES

Steve McCormick
US Army RDECOM-TARDEC
(586) 753-2610
steven.j.mccormick@us.army.mil



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MILESTONES



Dist A.

WW I	Introduction of tanks and flamethrowers
WW II	M4 Sherman tank
1949	Army/Purdue study identifies halon 1301
1960s – 70s	Conversion from gasoline to diesel fuel
1980	Halon 1301 automatic fire extinguishing systems fielded
Early 1990s	JP-8 selected as Single Fuel on the Battlefield
1995	Production of halons ended due to environmental impact

CREW PROTECTION

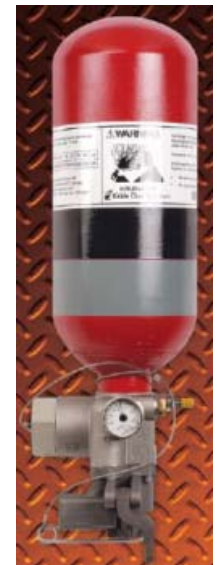


Parameter	Requirement ⁽¹⁾
Fire Suppression	Extinguish all flames without reflash
Skin Burns	Less than second degree burns or <math><2400^{\circ}\text{F}\text{-sec}</math> over 10 seconds heat flux <math><3.9\text{ cal/cm}^2</math>
Overpressure	Less than 11.6 psi
Agent Concentration	Not to exceed LOAEL ⁽²⁾
Acid Gases (HF + HBr + 2COF ₂)	Delayed Incapacitation 746 - 2237 ppm-min (5 min) Immediate Incapacitation 1491- 4473 ppm-min (5 min)
Oxygen Levels	Not below 16% for 5 sec average
Discharge Noise	Below single hearing protection limit (165 dB)
Discharge Forces	Not to exceed 8 G over 30 ms

Dist A.



Detection <math><2\text{ msec}</math>



Opening <math><10\text{ msec}</math>
Discharge <math><165\text{ msec}</math>

1 – Walter Reed Army Institute of Research “Medical Evaluation of Non Fragment Injury Effects in Armored Vehicle Live Fire Tests” Sep 1989
2 - Lowest Observed Adverse Effects Level

- Halon 1301 replaced by FM-200BC in new applications starting in 2001
- High GWPs may restrict use of HFCs, including FM-200

EXTERNAL FIRE THREATS

Dist A.

- A number of vehicles have been lost in theater due to fires caused by ballistic attacks as well as mechanical failures.
- Deep-seated external fires can result in total loss of vehicles and cargo and potential casualties
- Internal extinguishing system and portable extinguishers not intended to address external fires
- Onboard fuel is particularly susceptible to attack
- Tires/track and external stowage represent secondary fire vulnerabilities



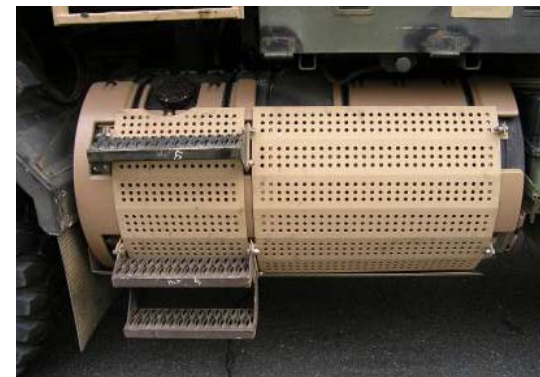
FUEL TANK PROTECTION

Dist A.



Baseline

Panel



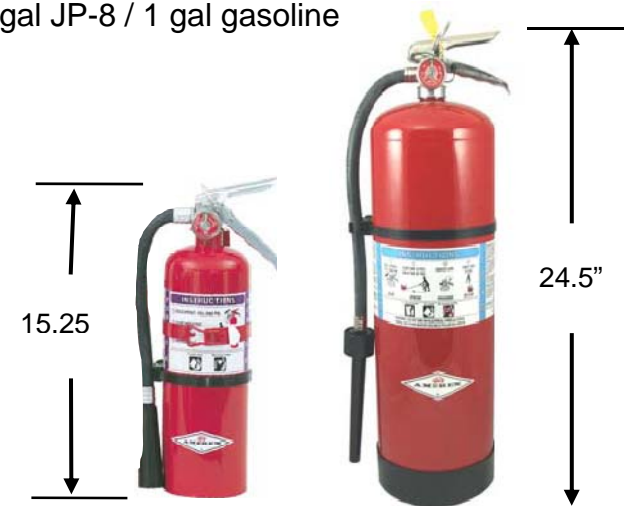
TIRE FIRE PROTECTION

Dist A.

- Current vehicle fire extinguishers were selected primarily to address POL fires
 - Limited effectiveness against *deep-seated* tire fires
- Water-based agents in 2.5 gal portable have successfully extinguished tire fires
- Fixed systems w/ heat detection have successfully extinguished test fires
 - dry chemical
 - aqueous foam
- Tire fires need to be detected and extinguished quickly



5 gal JP-8 / 1 gal gasoline



FIXED



SUMMARY



Dist A.

- Fire remains a significant risk to military ground vehicles and their crews
 - ballistic damage
 - mechanical or electrical malfunction
- Fire protection improvements continue to be made on tactical, as well as combat, vehicles
- Passive fire protection techniques needed to operate effectively in emerging combat conditions
- Further advances are required in the following areas:
 - external fire protection
 - environmentally superior extinguishing agents
 - smaller and lighter components
 - more field-supportable products