



Halon Replacement for Airplane Hand Held Fire Extinguishers - The Challenges

International Aircraft Systems Fire Protection Working Group

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Objective

Provide a comprehensive overview of the challenges for developing and certifying safe, reliable, and environmentally acceptable Halon replacement hand held fire extinguishers for use on large commercial passenger and freighter aircraft.

Agenda

- Requirements (multi-agency, complex)
- Replacement agents (three agents approved)
- Replacement performance (more agent required, heavier, larger)
- Environmental issues (one banned by Montreal protocol, two high GWP)
- In-service (Replacements not 'drop-in'/interchangeable)
- Boeing strategy (develop a 'drop-in', customer focused)
- Conclusion

Requirements

- **FAA Minimum Performance Standards, MPS AR-01/37 (Passenger Cabin Only)**
- **AC 20-42D – Draft (advisory material)**
- **14CFR25.851 plus installation regulations**
- **UL 711 5BC rated (passenger cabin)**
- **UL 2129, NFPA 10...**
- **Non-corrosive to aircraft**
- **No powder obscuration or residue**
- **SNAP approved**
- **Low GWP**
- **Operating temperature -40C to 49C**
- **Approximately 40 other requirements**

Requirements

FAA Minimum Performance Standards, MPS AR-01/37 (passenger cabin only)

- This standard describes the tests required to show that the performance of the replacement agents equals or exceeds the performance of the current Halon 1211 fire extinguishers.”
- “The environmental characteristics of a replacement agent that need to be addressed are ozone depletion potential (ODP), global warming potential (GWP), and atmospheric lifetime.”

■ MPS requirements of replacement agent:

- UL 711 5BC rated
- Hidden fire test
- Seat fire/toxicity test

■ Three agents in multiple extinguishers with “equivalent performance” have received FAA approval for passing MPS testing.

Agent Summary

Agent	UL 711 Rating	Agent Weight (#)	Total Weight (#)	Dimensions (H x W x D)	ODP	GWP
Halon 1211	5 BC	2.5	3.93	17.62x4.92x3.285	5.1	1300
Halotron 1 (HCFC Blend B)	5 BC	5.5	9	15.5x5.75x4.25	.0098	77
FE-36 (HFC-236fa)	5 BC	4.75	9.5	17x8.5x4.44	0	9400
FM-200 (HFC-227ea)	5 BC	5.75	9.8	18.5x6.5x5.5	0	3500

Agent Summary

Three are FAA approved, right, so why not install one of them on the airplane?

- **There are FAA approved 5 BC extinguishers, but they are not FAA approved for installation on Boeing airplanes. Boeing must show compliance to multiple FAA regulations related to structure; design and construction; and installation**
- **Performance (increased size and weight)**
- **Environmental (ODP, GWP)**
- **Economic (not interchangeable/'drop-in')**

Performance

Agent	UL 711 Rating	Agent Weight (#)	Total Weight (#)	Dimensions (H x W x D)	ODP	GWP
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Performance

FAA MPS results state:

- “All of the gaseous replacement agents require approximately twice as much agent by weight as Halon 1211.”
- “All of the replacement agents require more firefighter technique than Halon 1211.”

Halon 5 BC replacement extinguishers weigh about 1.5 times more than Halon 1211:

- 23 pound increase for a 737
- 46 pound increase for a 777

Halon 5 BC replacement extinguishers are about 1.5 times larger

Two agents have high hydrogen fluoride (HF) byproducts which are very irritating (odor, eyes, respiratory, skin).

Performance

Extinguishers weigh more and are larger, so what?

- **Increased size and weight may require relocation and/or extensive configuration/structural changes to the airplane.**
- **A revised/new installation drawing for each location may be required. Most Boeing airplanes have a unique installation for each customer, so hundreds of drawings will be impacted.**
- **Some locations may not be acceptable due to the Flight Attendant's inability to retrieve it.**
- **Impact to Airline customers and environment due to increased fuel burn.**

Performance

The Boeing 737 represents the lowest level of difficulty in meeting the challenges.

- **80 different passenger cabin configurations**
- **12 configurations for the flight deck.**
- **The location of all these extinguishers will have to be examined and evaluated because of the additional weight and volume. The additional weight will require structural analysis and potential design changes. Also the additional volume (up to 3 times the volume) may require the handhelds to be put in entirely different locations.**

Typical Airplane Fire Extinguisher Installation



Environmental Issues

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Environmental Issues

They have an ODP or high GWP , so what?

- **HCFC Blend B (Halotron 1) is subject to US production phase-out in 2015. Supply will be limited to recycling after 2015, same as Halon 1211.**
- **HFCs FE-36 and FM-200 have high GWPs, up to 7.2 times higher than Halon 1211.**
- **Kyoto Protocol requires reduction of green house gasses including HFCs.**
- **EU adopted regulation mandating regulation of HFCs, and two countries have restrictions in place.**
- **Draft US House/Senate bills propose cap-and-trade requirements on HFCs**
- **EPA included HFC's on list of six " greenhouse gases that are responsible for it endanger public health and welfare within the meaning of the Clean Air Act".**

Boeing's goal is to replace fire extinguishers just one time, and with an environmentally acceptable agent.

In-service

What about spares and existing fleet?

- Installing existing FAA approved alternatives would require extensive engineering effort to address all of the variability in installations over the past 30+ years.
 - Without a drop-in replacement, the Halon extinguishers in the fleet are not likely to be replaced.
 - Without a drop-in replacement, airlines will still keep spare Halon extinguishers on their shelves to support their fleet.

A 'drop-in' would allow quicker, less costly replacement of Halon 1211 extinguishers in service.

Boeing Strategy

So what has Boeing been doing?

- **Boeing released a Request for Information (RFI) in 2004 to find a drop-in replacement**
 - Only one potential drop-in agent identified
 - Other agents identified were those tested by the FAA.
- **Boeing evaluated impact of existing available replacement agents.**
- **Boeing released another RFI to approximately 60 companies and research facilities in 2008 to find any potential drop-in replacements.**
 - Several drop-in agents identified, but only one of them had potential for meeting all of the requirements.
 - Informal MPS testing has since eliminated that agent.

As a result, Boeing has started work with a supplier on a new gaseous agent that has the potential to be a drop-in replacement for Halon 1211

Conclusion

- Existing replacement agents have performance, environmental, and economic impacts which make them problematic for immediate use.
- MPS development was based on equivalency to Halon 1211 fire extinguisher.
- Halon 1211 performance is above and beyond all currently approved replacement agents.
- Three approved agents have environmental impact (1 ODP, 2 high GWP).
- Existing airline fleets are likely to maintain Halon 1211 fire extinguishers and spares, until a drop-in is developed.
- Drop-in solution requires a concerted effort by
 - Regulatory agencies and standards owners
 - Agent manufacturers
 - Fire extinguisher manufacturers
 - Airplane manufacturers
 - Airlines