

# BTP on Track to Replace 1211 in Commercial Aviation

## Halon Replacement for Aircraft Portable Fire Extinguishers – Progress Report

### PRESENTATION TO:

7th Triennial International Aircraft Fire and Cabin Safety Research Conference

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## Overview

- **Three halon 1211 alternatives are currently FAA and UL approved**
  - HCFC Blend B
  - HFC-236fa
  - HFC-227ea
- **2-Bromo-3,3,3-trifluoropropene (2-BTP or BTP) in development**
  - Boeing supporting research
  - SNAP application was expected earlier in the year
    - Just recently filed
    - Additional testing ongoing



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## Property Comparison

	HALON 1211	HCFC Blend B	HFC-236fa	HFC-227ea	BTP
Chemical Formula	CF <sub>2</sub> ClBr	CF <sub>2</sub> CHCl <sub>2</sub> + gases (Ar, CF <sub>4</sub> )	CF <sub>3</sub> CH <sub>2</sub> CF <sub>3</sub>	CF <sub>3</sub> CHFCF <sub>3</sub>	CF <sub>3</sub> CBr=CH <sub>2</sub>
Molecular Weight	165.4	150.7	152.0	170.0	174.9
Boiling Point @ 1 Atm.	26 °F (-3 °C)	81 °F (27 °C)	30 °F (-1 °C)	2 °F (-16 °C)	93 °F (34 °C)
Specific Gravity, Liquid	1.83	1.48	1.36	1.40	1.65
Atmospheric Lifetime	16 years	1.3 years <sup>(1)</sup>	242 years	39 years	7 days
LC 50 (4 hr rat), ppm	31,000 – 100,000	30,000 – 35,000	>189,000	>800,000	> 20,000
Cardio-Tox LOAEL, %vol.	1%	2%	15.0%	10.5%	1%
Cardio-Tox NOAEL, %vol.	0.5%	1%	10%	9%	0.5%
Cup Burner, heptane, %vol.	3.2%	6.5%	6.3%	6.5%	4.7%

1. Value based on HCFC-123. Also contains one PFC in small proportion



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## Bottle Details – UL/FAA Approved 5B:C

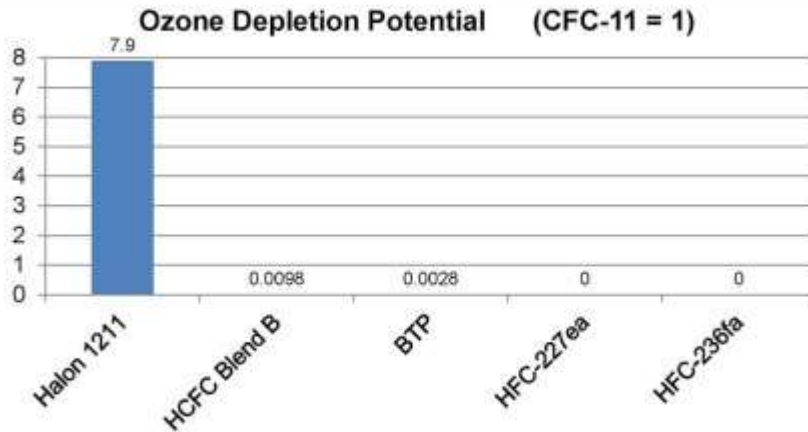
	HALON 1211	HCFC Blend B	HFC-236fa	HFC-227ea	BTP
Bottle Dimensions, in.	17 x 4.8 x 3.25	15 x 5 x 4.25	15.9 x 8 x 4.5	16.6 x 6.5 x 4.4	~17 x 5 x 3.25
Agent Weight, Lb.	2.5	5.5	4.75	5.75	3.75
Gross Weight, Lb.	3.93	9.3	9.5	9.8	5.6
Bottle Construction	Aluminum	Carbon Steel	Carbon Steel	Carbon Steel	Aluminum

- **Current approved alternatives gross weight based on carbon steel bottles**
  - Reductions possible
- **BTP bottle is a drop-in for current Boeing Halon 1211 unit**
  - May be different in size than other airframe manufacturers



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## Environmental Profile - ODP

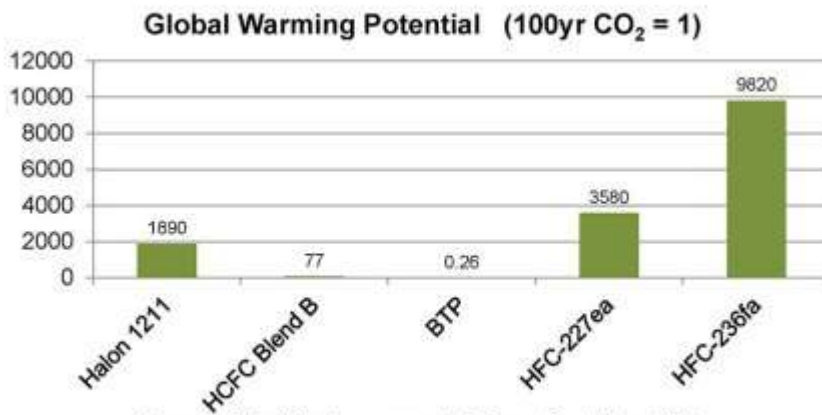


Source: Scientific Assessment of Ozone Depletion, 2010  
For BTP: Journal of Geophysical Research, Vol. 117, 2012



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## Environmental Profile - GWP



Source: Scientific Assessment of Ozone Depletion, 2010  
For BTP: Journal of Geophysical Research, Vol. 117, 2012

HCFC Blend B value based on HCFC-123, also contains small proportion PFC



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## Balancing ODP and GWP



- **Korean Green Mark**
  - Criteria
    - ODP less than 0.055
    - GWP less than 3000
- BTP meets criteria
- Mark has been issued for HCFC Blend B
- HFCs do not meet criteria

## BTP Development – FAA/UL

- **AC20-42D, Hand Fire Extinguishers for Use In Aircraft**
  - Requires
    - UL listing for 5B:C
    - FAA Hidden Fire Test
      - Conducted at UL
    - FAA Seat Fire / Toxicity Test

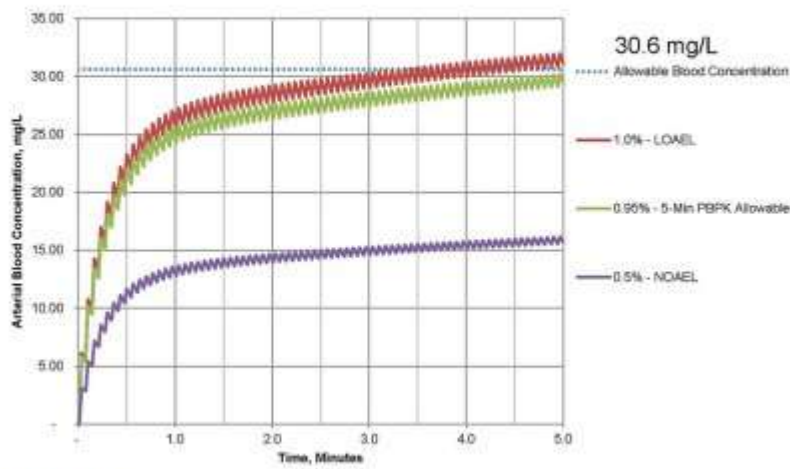
## BTP Development

- **Extensive Toxicity Test Program Required for SNAP/TSCA, REACH, and FAA**
  - Rat Micronucleus
  - Eye Irritation
  - Skin Irritation
  - Acute Dermal
  - 90-day Sub-Chronic Inhalation
  - Reproductive and Development Screen
  - Acute Fish Toxicity
  - Activated Sludge Respiration Inhibition
  - Biodegradation
  - Partition Coefficients
  - Physiologically Based Pharmacokinetic (PBPK) Modeling
- **All testing in this series complete**

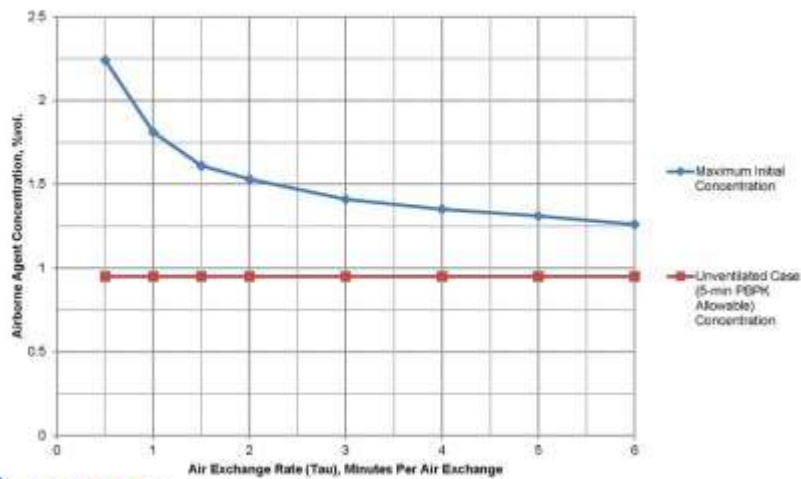
## BTP REPRODUCTIVE AND DEVELOPMENTAL

- **Initial Reproductive and Developmental Screen (COMPLETE)**
  - 6 hours/day, 7 days/week exposure
  - Not mutagenic and no birth defects noted
  - Effects to reproductive cycle observed
  - NOAEL not determined
- **Second Reproductive and Developmental Screen (ONGOING)**
  - Testing underway
  - Desire to find NOAEL and evaluate short term effects, if any, from exposure to discharge
  - 6 hours/day, 7 days/week exposure
    - Lower exposure levels than initial test
  - 5 minutes/day, 7 days/week exposure
    - Discharge exposure (1% for 5-minutes)
  - Report Tentative Completion - 1Q2014

## BTP PBPK Model Results



## BTP - PBPK - Concentration Vs Air Exchange



## BTP Schedule

- **US EPA SNAP and EU ECHA REACH submittals should have been made**
  - Additional reproductive test report will be filed toward end of 1Q2014
- **UL fire performance complete**
- **UL hardware tests ongoing**
  - 1 year leak
  - Misc. hardware tests
- **Regulatory review anticipated to be complete by end of 2014**
  - US Federal Register notice may take longer
- **Commercialization to support airplane manufacture's implementation dates to meet ICAO's December 31, 2015 date**