



Halon Replacement for Airplane Portable Fire Extinguishers - Progress Report

**8th Triennial International Aircraft Fire
and Cabin Safety Research Conference**

Atlantic City, NJ
October 24-27, 2016

Al Carlo

Objective

**Provide a progress report on the development of
BTP (2-bromo-3,3,3-trifluoropropene),
a promising new environmentally progressive
Halon 1211 replacement agent for
handheld fire extinguishers**

Agenda

→ **Steps to Commercialization**

→ **BTP Development Time Line**

→ **Current Progress**

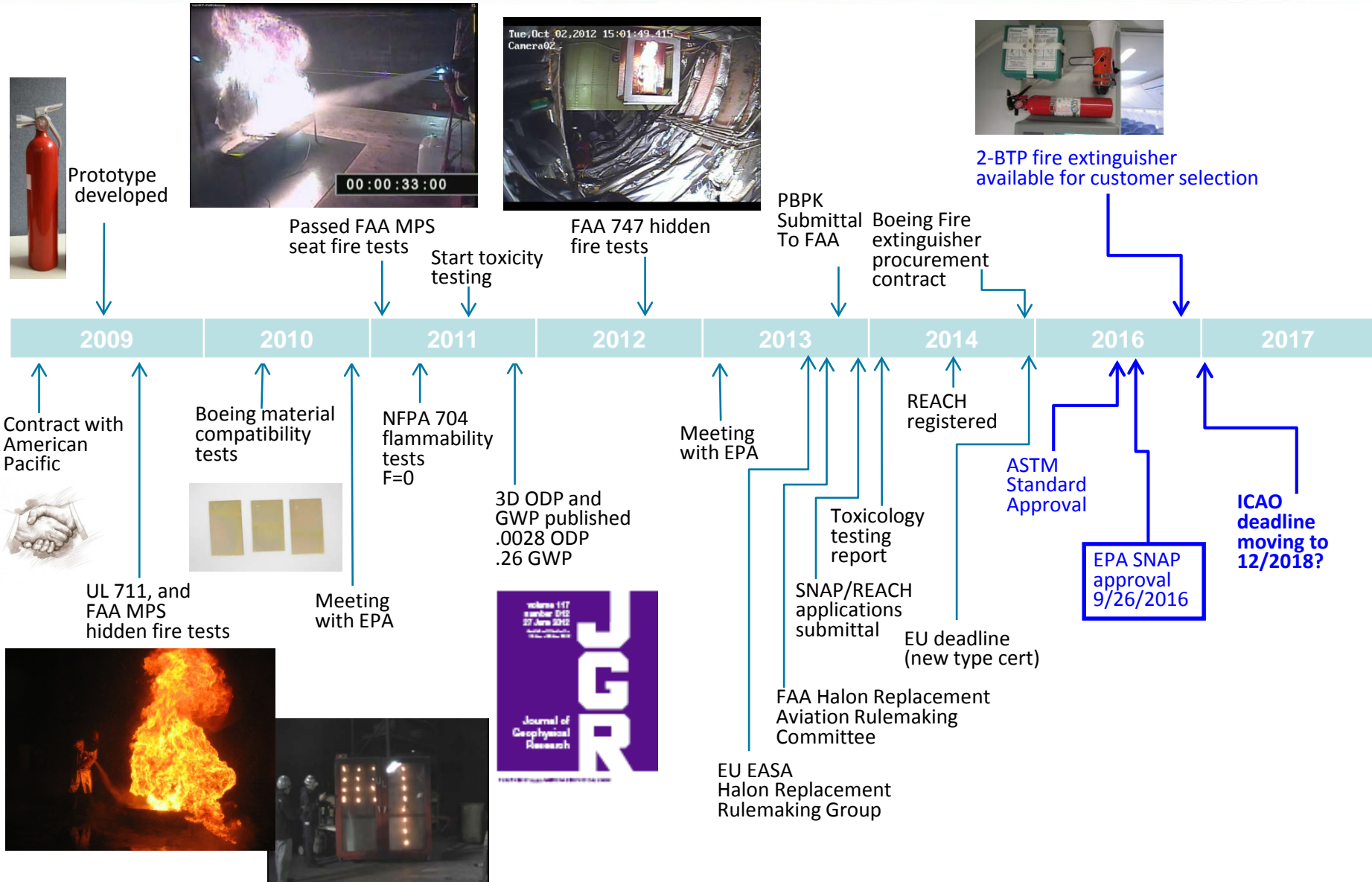
→ **Future**

→ **Questions**

Steps to Commercialization

- ✓ **Cup burner testing - 2002**
- ✓ **Initial toxicity tests (Ames, cardiotox...) - 2002**
- ✓ **2-Dimensional Ozone Depleting Potential (ODP), Global Warming Potential (GWP), atmospheric lifetime - 2004**
- ✓ **Prototype extinguisher, near drop-in replacement for Boeing 1211 extinguisher - 2009**
- ✓ **Underwriters' Laboratory (UL) 711 5B pan fire tests - 2009**
- ✓ **UL 711 cold temperature pan fire test - 2009**
- ✓ **Federal Aviation Administration (FAA) Minimum Performance Standard (MPS) AR-01/37 hidden fire tests - 2009**
- ✓ **3-Dimensional model analysis of ODP and GWP - 2010**
- ✓ **FAA MPS AR-01/37 seat fire toxicity tests - 2011**
- ✓ **American Society for Testing and Materials (ASTM) flammability tests (per NFPA 704) - 2011**
- ✓ **Airplane material compatibility tests - 2011**
- ✓ **Synthesis of BTP for toxicology testing - 2011**
- ✓ **Publication of 3D ODP/GWP scientific paper - 2011**
- ✓ **Additional BTP physical properties testing – 2011**
- ✓ **Physiologically based pharmacokinetic (PBPK) testing and modeling –2013**
- ✓ **Toxicology testing – 2013**
- ✓ **Provide PBPK data to FAA for inclusion in Advisory Circular (AC) 20-42D & FAA/AR-08/3 – 2013**
- ✓ **US EPA Significant New Alternatives Policy (SNAP) application – 2013**
- ✓ **EU Registration, Evaluation, Authorization & Restriction of Chemicals (REACH) application - 2014**
- ✓ **European Chemicals Agency (ECHA) REACH registration - 2014**
- ✓ **US EPA Toxic Substances Control Act (TSCA) inventory listing - 2016**
- ✓ **US EPA SNAP approval – 2016**
- ✓ **ASTM standards for BTP - 2016**
- **3.25” diameter bottle for Boeing production/retrofit - 2016**
- **UL 2129 fire extinguisher bottle tests and UL listing - 2016**

BTP Development Time Line



BTP Current Progress

❑ US EPA SNAP/TSCA approval:

- ✓ **US EPA has SNAP approved 2-BTP for the uses identified on the application:**
 - ➔ **Total flooding agent for use in engine nacelles and auxiliary power units (APUs) on aircraft.**
 - ➔ **Streaming agent for use in handheld fire extinguishers in aircraft.**

https://www.epa.gov/sites/production/files/2016-09/documents/snap_status_change_rule_2_2060_as80.pdf

BTP Current Progress

□ **ASTM Standards:**

- **FAA AC 20-42D, Hand Fire Extinguishers for use in Aircraft**
 - **“New Halon 1211 replacement agents must have and meet an applicable ASTM or equivalent specification.”**

- ✓ **ASTM D26 Committee on Halogenated Organic Solvents and Fire Extinguishing Agents approved:**
 - **D8060-16, Standard Specification for 2-Bromo-3,3,3-Trifluoro-1-Propene (CF₃CB_r=CH₂) Standards have passed sub-committee ballot**
 - **D8061-16, Standard Practice for Handling, Transportation, and Storage of 2-Bromo-3,3,3-Trifluoro-1-Propene (CF₃CB_r=CH₂) If approved, standards will be available online ~6 weeks later**

ASTM Standards Available

BTP Current Progress

☐ **UL2129 Tests:**

✓ **Underwriter's Laboratories**

- **AC 20-42D and SAE AS6271 require UL711 and UL2129**
- **Multiple OEMs have successfully passed the 5B & hidden fire tests**
- **Final UL listings starting in late 2016**

Future

- ❑ **UL approval and listing of Halotron BrX (BTP) UL 5B:C fire extinguisher is pending.**
- ❑ **FAA certification is in progress.**
- ❑ **Boeing is proceeding with airplane implementation.**

Non-ODS BTP near drop-in fire extinguisher with GWP < 1

Questions?