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ASSEMBLY — 37TH SESSION

TECHNICAL COMMISSION

Agenda Item 33: Halon replacement

HALON REPLACEMENT – CHALLENGES AND SOLUTIONS

(Presented by the International Coordinating Council of
Aerospace Industries Associations (ICCAIA))

EXECUTIVE SUMMARY

The International Coordinating Council of Aerospace Industries Associations (ICCAIA) supports draft Assembly Resolution 33/1: Halon Replacement, as presented in A37-WP/67. We are committed to meet the timeframes in the proposed resolution, and support the requirement for regular reviews to ensure all stakeholders remain engaged. The industry has been active in researching halon alternatives and in working with suppliers and regulatory agencies to address all associated safety, environmental, and operational requirements. This paper provides information on the ongoing work to address the inherent challenges and find solutions.

Strategic Objectives:	This working paper relates to Strategic Objective A.
Financial implications:	See paragraph 3.
References:	Doc 9902, *Assembly Resolutions in Force* (as of 28 September 2007) A37-WP/67, TE/20

1. NEED FOR HALON REPLACEMENT

1.1 Halon has been used as an effective fire extinguishing agent on aircraft since the 1960s in lavatories, cabins and flight decks (handheld fire extinguishers), engines and auxiliary power units (APUs), and cargo compartments. The production of halon, an ozone-depleting substance, has been phased out since 1994 under the requirements of the United Nations Montreal Protocol on Substances that Deplete the Ozone Layer. However, due to the safety-critical nature of aviation, a halon "critical use" exemption has been in place.

1.2 Assembly Resolution A36-12 agreed with the urgent need to develop and implement halon replacements for civil aviation, and A37-WP/67 proposes a replacement resolution with specific timeframes for the replacement of halon in lavatory, hand-held and engine and auxiliary power unit fire extinguishing systems. Also, in recent years there has been increased emphasis by the United Nations and the European Union to phase out all "critical use" exemptions for halon, including its use on aircraft, and setting specific deadlines for doing so.

1.3 The aviation industry has long recognized the need for replacement of halon with safe, reliable and effective alternative agents that do not pose undue environmental or health risks. In fact, the aviation industry is committed to applying environmentally progressive solutions in all its products, services and operations. The industry has expedited research and development on halon alternatives for its various aircraft applications since the late 1990s, and installation in lavatory systems has started in 2006.

2. MULTIPLE REQUIREMENTS

2.1 As ICAO establishes deadlines for implementing halon replacements, there are multiple requirements that must be considered and balanced, including effectiveness, environmental trade-offs, installation and operational impacts of alternatives. Some elements of these factors are under the purview of national regulatory agencies and not within industry control.

2.2 Most of the alternatives that may exist at present have not been proven against the multitude of safety requirements for each application imposed by governmental aviation safety authorities. For example, in the United States, the Federal Aviation Administration (FAA) requires that fire protection agents/systems demonstrate that they are as effective as halon in suppressing or extinguishing fires via their minimum performance standards (MPS). Additionally, the FAA enforces numerous safety regulations through their aircraft certification requirements. Furthermore, the Environmental Protection Agency requires approval of alternatives through its Significant New Alternatives Policy (SNAP) regulation, which is based on toxicity and environmental benefits/impacts.

2.3 Similarly, in the European Union any new chemical agent must undergo a comprehensive evaluation by the European Chemical Agency (ECHA) under the relatively new chemical regulation known as REACH (Registration, Evaluation, Authorisation and Restriction of Chemical substances). Compliance is also required for the European Commission Regulation (EC) No 1005/2009 on substances that deplete the ozone layer, with regard to the critical uses of halons. Annex VI to this Regulation, as adopted in a recent amendment [Commission Regulation (EU) No. 744/2010 of 18 August 2010], contains more extensive requirements (such as for cargo compartments and retrofit) and, in some cases, more stringent timeframes compared to the proposed Assembly Resolution. Finally, the alternative agent and system must meet all European Aviation Safety Agency (EASA) certification requirements.

2.4 Adequate time is required to ensure aircraft design, testing, qualification and certification standards can be met for all planned halon replacement applications. Suitable halon replacements have not yet been identified for all aircraft applications that meet all current and potential environmental requirements, are technically achievable, and are economically reasonable.

2.5 It is imperative that all stakeholders cooperate in achieving the common goal of an orderly and timely phase-out of halon in aircraft applications, without compromising safety. It is for ICAO to manage the process, aimed at global uniformity in regulations and proper consideration of multiple, sometimes conflicting, requirements in this respect. ICCAIA fully supports the Assembly Resolution proposed in A37-WP/67, including the timeframes stipulated and regular reviews involving all stakeholders to support the agreed implementation dates.

3. ADDRESSING CHALLENGES

3.1 Lavatory systems

3.1.1 It requires several years for an Original Equipment Manufacturer (OEM) to ensure that a replacement meets all safety, performance and certification requirements for aircraft installation, once the alternative has successfully passed FAA MPS testing. To date, only the lavatory alternative has been tested and demonstrated to meet all regulatory and certification requirements for installation on new aircraft. Industry began installing a halon alternative for aircraft lavatory use in 2006, and agrees that the use of halon in lavatory waste receptacle fire extinguishers can be phased out in aircraft currently in production and is not required in new aircraft types.

3.2 Hand-held fire extinguishers

3.2.1 Industry is committed to working toward the proposed phase out dates for handheld fire extinguishers, though there are numerous challenges ahead. Safety concerns, installation and operational challenges, cost and environmental impact need to be addressed, for both existing alternatives and a promising new alternative.

Existing alternatives

3.2.2 *Safety*. The current alternatives for handheld fire extinguishers used in aircraft are less effective in fire fighting. This could lead to decreased safety margins in case of on-board fires. Although a minimum performance standard has been developed for some alternatives, they do not meet the airline industry need for high safety standards without significant aircraft design changes. In-flight fire is a major aviation hazard, and therefore effective handheld fire extinguishers are essential. Safety should be paramount.

3.2.3 *Installation and operational challenges*. The alternatives also pose significant installation and operational challenges. Because the alternative extinguishers are between 4 to 6 pounds heavier and 1.5 to 2.0 times larger, design and structural changes to current production aircraft will be required; e.g., increased bracket support and potentially additional sidewall structural support. In some aircraft, extinguishers are located in small cabinets, underneath seats, or below flight decks. Those locations may not be large enough for the bigger extinguishers, may require reconfiguration, and may necessitate the relocation of other equipment elsewhere in the cabin and/or flight deck. One aircraft type alone has over 80 different fire extinguisher configurations in the passenger cabin and 12 for the flight deck.

3.2.4 *Cost*. As a result of installation requirements, the increased weight of the aircraft, and the training required, the cost impact on airlines and airplanes manufacturers would be significant.

3.2.5 *Environmental impact.* All alternatives have a weight penalty which would result in additional CO2 emissions. Also, some of the potential alternatives have higher attributed global warming potential (GWP) values compared to halon, with little substantive change in the actual release of ozone-depleting substances. Handheld fire extinguishers are used only in the rare event of actual smoke or fire in aircraft. Two of the alternatives for hand-held extinguishers are hydrofluorocarbons (HFCs) (HFC-236fa and HFC-227ea); they have global warming potential (GWP) values 2.6 and 7.2 times greater than halon 1211, and are designated greenhouse gases under the Kyoto Protocol. It is anticipated that regulatory restrictions or bans will be imposed on HFCs in fire protection applications. In fact, the EU recently adopted a regulation mandating requirements for HFC management, and at least one country has banned the use of HFCs for fire protection. Two other European countries also have restrictions in place. The third alternative agent for handhelds, HCFC-123, has a lower ozone depleting potential (ODP) than halon 1211, but is the subject of a United States production phase-out in 2015 and its use for fire extinguishing applications is not permitted under Regulation (EC) No. 2037/2000. Regardless of which agent is selected, the increased weight will increase fuel burn and hence, could increase CO2 emissions by thousands of kilograms annually, depending on the aircraft and number of extinguishers. A comparison of alternative agents for hand-held extinguishers is at the appendix.

New alternative

3.2.6 There is another possible replacement agent under investigation (bromotrifluoropropene, 2-BTP) that is not listed as a greenhouse gas under the Kyoto Protocol nor an ozone depleting substance under the Montreal Protocol. The significant environmental and economical benefits promised by 2-BTP justify the timeframe to replace halons in hand-held fire extinguishers proposed in the draft Assembly Resolution in A37-WP/67. It is noted that 2-BTP has passed UL 5B testing and FAA MPS hidden fire testing, which establishes it as a drop-in replacement. However, it will take two to three years to complete the numerous steps required to make a final determination of its viability as a Halon 1211 replacement. Those steps include extensive toxicology testing, environmental agency approvals, supplier qualifications and structural aircraft changes to support the new system.

3.2.7 Because it is a drop-in replacement, 2-BTP will also have potential as a replacement for spares and retrofit.

3.3 **Engine and APU**

3.3.1 Industry agrees with the proposed timeframe for engine and APU halon replacements, although no alternatives have yet been fully tested, certified and implemented on commercial transport aircraft. While two OEMs have been actively working with the FAA on a number of candidates, significant testing requirements for certification approval have not yet been defined.

3.4 **Cargo compartment**

3.4.1 Industry concurs with ICAO that it is still premature to specify timeframes for cargo compartment applications, given the status of the challenging research work on alternatives for that application and the lack of alternatives successfully meeting the FAA MPS test requirements.

4. CONCLUSION

4.1.1 Halon replacement will require full cooperation of all stakeholders and coordination to achieve uniform and orderly implementation of optimal alternative solutions for halon replacement, which provide adequate technical performance, certification, and long-term environmental benefit. Stakeholders include environmental and aviation regulatory agencies, manufacturers, including chemical agent manufacturers, airlines, and halon recyclers. Industry agrees that the Council of ICAO should conduct regular reviews of the status of potential halon alternatives to ensure that replacement dates set by ICAO continue to be appropriate. These reviews support a “roadmap to success” as a way forward for all stakeholders to collaborate under the auspices of ICAO.

4.1.2 The aviation industry supports draft Resolution 33/1 in A37-WP/67, and emphasizes the need for stakeholder cooperation and regular reviews to ensure all stakeholders remain engaged. To support this process, it is necessary and urgent that ICAO set international Standards and Recommended Practices (SARPs) with respect to halon replacement.

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APPENDIX

COMPARISON OF ALTERNATIVES FOR HANDHELD EXTINGUISHERS

Agent Summary

Agent	UL 711 Rating	Agent Weight (#)	Total Weight (#)	Dimensions (H x W x D)	ODP	GWP (100 year)
Halon 1211	**5 BC**	**2.5**	**3.93**	**17 x 4.8 x 3.25**	**7.1[1]**	**1890 [1]**
BTP	**5 BC**	**3.75**	**5.6**	**15.75 x 5 x 3.5**	**<0.0005[2] (2D -model)**	**0.007-0.03[2]**
Halotron 1 (HCFC Blend B)	**5 BC**	**5.5** (tentative 5.0)	**9.3** (tentative UL listing for 7.3 Lb model)	**15 x 5 x 4.25**	**.0098 [1]**	77 [1] (Based on HCFC-123)
FE-36 (HFC-236fa)	**5 BC**	**4.75**	**9.5**	**15.9 x 8 x 4.5**	**0 [1]**	**9810 [1]**
FM-200 (HFC-227ea)	**5 BC**	**5.75**	**9.8**	**18.5 x 6.5 x 5.5**	**0 [1]**	**3220 [1]**

1. World Meteorological Organization Report No. 50 – "Scientific Assessment of Ozone Depletion: 2006."

2. NIST Report "Photochemical Properties of 2-BROMO-3,3,3-TRIFLUOROPROPENE and Semi-Empirical Kinetic Estimations of its Global Impacts on the Atmosphere" dated July 20, 2004, Author Vadimir Orkin. (Note that ODP/GWP values vary by latitude, and values presented are valid for the latitudes encompassing the U.S. and EU).

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