Organisation de l'aviation civile internationale

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NOTE DE TRAVAIL

GROUPE D'EXPERTS SUR LES MARCHANDISES DANGEREUSES (DGP)

VINGT-DEUXIÈME RÉUNION

Montréal, 5 – 16 octobre 2009

Point 2 : Élaboration de recommandations relatives à des amendements des *Instructions techniques pour la sécurité du transport aérien des marchandises dangereuses* (Doc 9284) à introduire dans l'édition de 2011-2012

CLASSIFICATION DU BROMURE D'ÉTHYLE EN FONCTION DU RISQUE D'INFLAMMATION

(Note présentée par J. Rui)

(Faute de ressources, seuls le sommaire et l'appendice ont été traduits.)

SOMMAIRE

La présente note de travail propose de faire passer de « toxicité » à « inflammabilité » le risque principal présenté par le **bromure d'éthyle**.

Suite à donner par le DGP : Le DGP est invité à faire passer de « toxicité » à « inflammabilité » le risque principal présenté par le **bromure d'éthyle** indiqué dans le Tableau 3-1 du Chapitre 2 de la Partie 3 des *Instructions techniques pour la sécurité du transport aérien des marchandises dangereuses* (Doc 9284).

1. INTRODUCTION

1.1 In Part 3;2, Table 3-1 of the 2009-2010 Edition of the Technical Instructions, **Ethyl bromide** is listed by name, UN 1891 6.1/II. It is classified as toxic liquid without flammability hazard. But evidence collected indicates that the flammability of **Ethyl bromide** needs to be reconsidered.

1.2 The flash point and boiling point of **Ethyl bromide** obtained from various sources are presented in Table 1. Except for the data provided by Alfa, the data from other sources coincide with each other. Based on the data, the substance has an intrinsic flammable hazard according to the classification criteria of Class 3 stated in 2;3.1 of the Technical Instructions Part 2;3.1.

Table 1. Available flash point and boiling point data for Ethyl bromide

Source of the literature data	Flash point(°C)	Boiling point(°C)
Merck	-20	37-39
Sigma-aldrich	-23	37-40
Acros	-23	37-40
Sciencelab	-10	38.04
Alfa	>60	38
The Physical and Theoretical Chemistry Laboratory, Oxford University	-23	38
Wiley Guide to Chemical Incompatibilities 2nd ed.	-20	
International Chemical Safety Cards	-20	38.4

1.3 As shown in Figure 1, flash point is the temperature at which the concentration of the vapour is at the lower explosion limit.

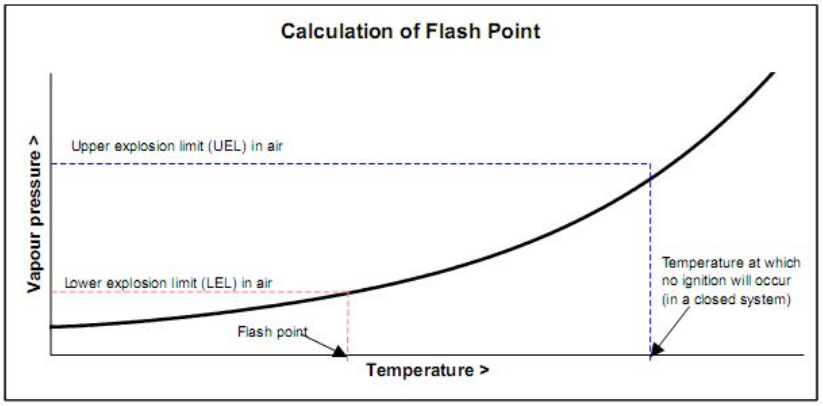

Figure 1. Temperature vs. vapour pressure

According to Antoine equation:

$\log_{10}(Vp) = A - B/(t + C)$ where Vp is the vapour pressure in mm of mercury; t is the temperature in ℃; A, B and C are constants. So, the flash point can be calculated as:

$$t = \frac{B}{A - \log_{10}(760 * LEL/100)} - C$$

The explosion limits and Antoine constants obtained from Lange's Handbook of Chemistry, 16th Edition are shown in Table 2.

Table 2. Explosion limits Antoine constants of Ethyl bromide

Substance	Explosion limits(vol % in air, 760mmHg)		Antoine constants		
	LEL	UEL	A	B	C
Ethyl bromide	6.8	8.0	6.9886	1121.9	234.7

The calculated flash point is:

t = -22°C

The flash point value calculated is normally slightly lower than the one measured because true equilibrium condition is never achieved under test conditions. However, when comparing the calculated flash point and experimental values from different labs which are summarized in Table 1, the values are almost the same. Therefore, the flammability of **Ethyl bromide** is confirmed.

1.4 The other way to further examine if flammable is warranted is to look at the flammability of related compounds of **Ethyl bromide**. Table 3 shows the list of these compounds, molecular weight, associated flash points and current UN classification data.

1.5 It can be seen from the table that, in line with what would be expected, as the molecular weight of the substance increases so does the flash point. What is apparent is that all of the substances are flammable. Thus, the flammability of **Ethyl bromide** does not appear to be out of line with related substances.

Table 3. The classification of relate compounds of Ethyl bromide

Chemical Name		Molecular weight	Flash point(□)	UN No.	Hazard	Packing Group
Methyl bromide		93.94	N/A (Gas)	UN 1062	2.3	N/A
Ethyl bromide		108.97	-20	UN 1891	6.1	II
Bromopropanes	1-bromopropane	121.97	-4.5	UN 2344	3	II/III
	2-bromopropane		1			
1-bromobutane		137.02	18	UN 1126	3	II
2-bromobutane		137.02	21	UN 2339	3	II
Bromomethylpropanes	2-bromo-2-methylpropane	137.02	16	UN 2342	3	II
	1-bromo-2-methylpropane		18			
2-bromopentane		151.04	20	UN 2343	3	II
1-bromo-3-methylbutane		151.04	21	UN 2341	3	III
1-bromopentane		151.04	32	UN 1993	3	III

1.6 A flash point test was undertaken according to ISO 3679:2004 in a lab. The result is

$t \leq 0$°C

Due to the limited testing range of apparatus, the exact flash point can not be determined. But the result has fallen into the category of flammable liquid with the Packing Group I or II, because it is below 23°.

1.7 By looking through the flash point of **Ethyl bromide** from literature, calculating the value according to theory, examining the similar structured compound and the experimental result, **Ethyl bromide** should be classified as flammable. The boiling point of **Ethyl bromide** is 37-40° from literature. Therefore the packing group of flammable is II. According to Part 2; Introductory Chapter, Table 2-1, 3/II takes precedence over 6.1/II. Then, **Ethyl bromide**'s primary hazard is Class 3, sub risk Division 6.1.

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APPENDICE

PROPOSITION D'AMENDEMENT DES INSTRUCTIONS TECHNIQUES

Partie 3

LISTE DES MARCHANDISES DANGEREUSES, DISPOSITIONS PARTICULIÈRES ET QUANTITÉS LIMITÉES ET EXEMPTÉES

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Chapitre 2

AGENCEMENT DE LA LISTE DES MARCHANDISES DANGEREUSES (TABLEAU 3-1)

Certaines parties du présent chapitre font l'objet des divergences d'État AU 1, AU 2, AU 3, BE 3, CA 7, CA 8, CA 10, CA 11, CA 13, GB 3, IR 3, JP 21, NL 1, US 2, US 3, US 6, US 15 et ZA 1 ; voir Tableau A-1.

2.1 AGENCEMENT DE LA LISTE DES MARCHANDISES DANGEREUSES (TABLEAU 3-1)

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Matière ou objet	*N° ONU*	*Classe ou division*	*Risques subsidiaires*	*Étiquettes*	*Divergences des États*	*Dispositions particulières*	*Groupe d'emballage ONU*	*Quantité exemptée*	*Aéronefs de passagers*		*Aéronefs cargos*	
									Instruction d'emballage	*Quantité nette maximale par colis*	*Instruction d'emballage*	*Quantité nette maximale par colis*
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*
Bromure d'éthyle	1891	~~6.1~~ 3	6.1	Liquide inflammable & Toxique			II	~~E4~~ E2	~~609~~ 305 ~~Y609~~ Y305	~~5 L~~ 1 L 1 L	~~611~~ 307	60 L

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