Organización de Aviación Civil Internacional

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NOTA DE ESTUDIO

GRUPO DE EXPERTOS SOBRE MERCANCÍAS PELIGROSAS (DGP)

VIGESIMOSEGUNDA REUNIÓN

Montreal, 5 - 16 de octubre de 2009

Cuestión 2 del orden del día: **Formulación de recomendaciones sobre las enmiendas de las *Instrucciones Técnicas para el transporte sin riesgos de mercancías peligrosas por vía aérea* (Doc 9284) que haya que incorporar en la edición de 2011-2012**

CLASIFICACIÓN DEL BROMURO DE ETILO POR RIESGO DE INFLAMABILIDAD

(Nota presentada por J. Rui)

RESUMEN

Debido a la falta de recursos, sólo se han traducido el resumen y las enmiendas que figuran en el Apéndice

En esta nota de estudio se propone cambiar el riesgo primario del **Bromuro de etilo** de tóxico a inflamable.

Medidas recomendadas al DGP: Se invita al DGP a cambiar de tóxico a inflamable el riesgo primario del **Bromuro de etilo** en la Parte 3;2, Tabla 3-1 de las *Instrucciones Técnicas para el transporte sin riesgos de mercancías peligrosas por vía aérea* (Doc 9284), según se indica en el Apéndice.

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

Source of the literature data	Flash point(°C)	Boiling point(°C)
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.

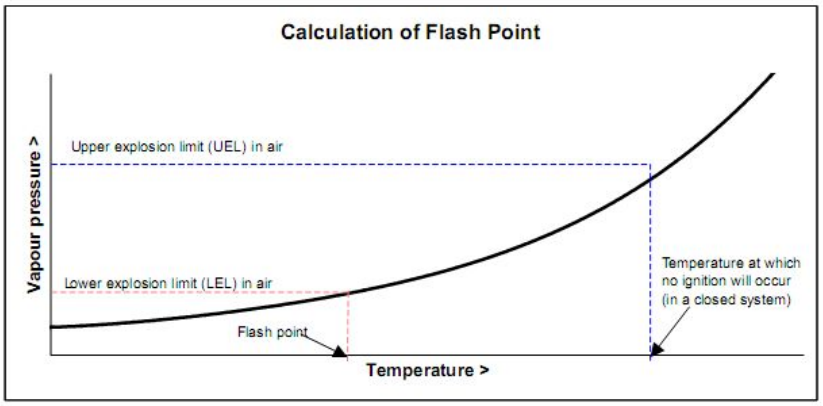

Figure 1. Temperature vs. vapour pressure

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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APÉNDICE

PROPUESTA DE ENMIENDA DE LAS INSTRUCCIONES TÉCNICAS

Parte 3

LISTA DE MERCANCÍAS PELIGROSAS, DISPOSICIONES ESPECIALES Y CANTIDADES LIMITADAS Y EXCEPTUADAS

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Capítulo 2

ORDENACIÓN DE LA LISTA DE MERCANCÍAS PELIGROSAS (TABLA 3-1)

Partes de este capítulo resultan afectadas por las discrepancias estatales 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, ZA 1; véase la Tabla A-1

2.1 ORDENACIÓN DE LA LISTA DE MERCANCÍAS PELIGROSAS (TABLA 3-1)

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Denominación	*Núm. ONU.*	*Clase o división*	*Riesgo secundario*	*Etiquetas*	*Discrepancias estatales*	*Disposiciones especiales*	*Grupo de embalaje ONU*	*Cantidad exceptuada*	*Aeronaves de pasajeros*		*Aeronaves de carga*	
									Instrucciones de embalaje	*Cantidad neta máxima por bulto*	*Instrucciones de embalaje*	*Cantidad neta máxima por bulto*
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*
Bromuro de etilo	1891	~~6.1~~3	6.1	Líquido inflamable y Tóxico			II	~~E4~~E2	~~609~~305 ~~Y609~~ Y305	~~5 L~~ 1 L 1 L	~~611~~307	60 L

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