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**COMMITTEE OF EXPERTS ON THE TRANSPORT OF
DANGEROUS GOODS AND ON THE GLOBALLY
HARMONIZED SYSTEM OF CLASSIFICATION
AND LABELLING OF CHEMICALS**

Sub-Committee of Experts on the Globally Harmonized System
of Classification and Labelling of Chemicals

Seventh session, 14-16 July 2004
Item 2 (b) (ii) of the provisional agenda

UPDATING OF THE GLOBALLY HARMONIZED SYSTEM OF CLASSIFICATION
AND LABELLING OF CHEMICALS (GHS)

Health hazards
Toxic Gas Mixtures (TGM)

Classification of gas mixtures for toxic effect

Transmitted by the expert from Belgium

1. At its sixth session, the Sub-Committee decided to set up a Correspondence Group which task is to reconsider the classification criteria of toxic gas mixtures (TGM) as they currently appear in Chapter 3.10 of the GHS. The Correspondence Group is lead by the expert from Belgium. Its membership includes experts from Austria, Canada, France, Germany, Italy, Japan, Norway, United States of America and ICCA.

The issues

2. In practice, the transition from pure products to gas mixtures usually happens at concentrations which differ from those of solid/liquid mixtures and the dilution factor is important. For gas preparations where there is no human experience of their toxic effects as a mixture, a calculation method needs to be applied. As presently described in the GHS, the provisions of Note (e)(ii) to Table 3.1.1 (ST/SG/AC.10/30) would lead to different classifications depending on the person performing the calculation.
Therefore, the overall toxicity of the gas mixture has to be determined by means of a calculation based on the measured toxicity of individual components in order to ensure a consistent and unequivocal classification.

3. Under its paragraph 3.1.3.6, the GHS allows a general additivity formula to be used for mixtures. It details principles that enables the classification of mixtures for acute toxic effects in respect of oral, dermal or inhalation toxicity and provides a formula that allows the calculation of the Acute Toxicity Estimate (ATE) when data are available for all ingredients. The following formula has been adopted under 3.1.3.6.1:

“The ATE of the mixture is determined by calculation from the ATE values for all relevant ingredients according to the following formula below for Oral, Dermal or Inhalation Toxicity:

$$\frac{100}{ATE_{mix}} = \sum \frac{C_i}{ATE_i}$$

where:

C_i = concentration of ingredient i
 n ingredients and i is running from 1 to n
 ATE_i = Acute Toxicity Estimate of ingredient i .”

4. A series of issues are of concern as follows:

Issue 1: This formula has been in use for many years in the transport regulations but when applied to gases, there are concerns that the formula may give an understatement of the hazard.

Issue 2: Should the GHS be using LC₅₀ 1 hour values or LC₅₀ 4 hour values? Based on case study of Hydrogen Sulphide, the effects seen manifested themselves in minutes, not hours.

Issue 3: If LC₅₀ 4 hour values has to be used, then is the conversion factor in Note (a) to Table 3.1.1 sustainable. It appears that the relationship between LC₅₀ 1 hour values and LC₅₀ 4 hour values is not a 2:1 relationship and this raises the question of whether this relationship has been validated, and how in the GHS data from studies where the data is not based on LC₅₀ 4 hour values should be used.

Issue 4: In case LC₅₀ 4 hour values have to be used, then ISO10298 should be revised and be based on actual LC₅₀ 4 hour data values rather than LC₅₀ 1 hour values. It seems incongruous to have an ISO standard based on 1 hour values being used, when the GHS is supposed to be the basis for all classification schemes and systems worldwide and it is using 4 hour values.

Issue 5: Further discrepancy between GHS and TGD: in the Acute Toxicity Criteria for the oral and dermal routes, in the GHS we have :

Category 1 which is equivalent to Transport Packing Group I
 Category 2 which is equivalent to Transport Packing Group II
 Category 3 which is equivalent to Transport Packing Group III
 Category 4 which is not used in the transport system, but is used for the workplace/Supply setting

For Acute toxicity by inhalation for gases, there are the 4 GHS categories (5??). The limiting value for classification in the GHS is 5000 ppm. In the transport classification for gases, toxic gases are classified in Division 2.3, which has a limiting value of 5000 ppm. This limiting value of 5000 ppm is the same as the GHS limiting value for category 4 of 5000 ppm. This is inconsistent with the oral and dermal criteria, where transport ends at category 3 and supply/workplace has a further additional category(s).

The transport criteria for toxic gases do not use packing groups and the UN RTDG criteria is given below:

"(c) *Division 2.3 Toxic gases*

Gases which:

- (i) *are known to be so toxic or corrosive to humans as to pose a hazard to health; or*
- (ii) *are presumed to be toxic or corrosive to humans because they have an LC value (as defined in 2.6.2.1) equal to or less than 5000 ml/m³ (ppm)."*

5. At the time this paper is submitted, discussions are still going on at the Correspondence Group level. In addition to this document an informal paper on the further progress achieved will be submitted at a later stage.

Proposals

6. The solutions may fall within the following options:

The options

Option 1: Chapter 3.1 of the GHS needs to be revised in respect of the criteria for the inhalation toxicity of gases; or

Option 2: Leave the procedure as it is and accept a reduced level of protection of the user; or

Option 3: After 3.1.3.6.1, add an additional paragraph with reference to 1.3.3.2.2 specifically allowing this provision for gases; or

Option 4: Include a specific note for gases referring to cut-off limits presented in Table 2 and/or Table 3 of this document to be used as cut-off values (to be modified, if necessary); or

Option 5: Include the issue in a guidance document on the use of the formula, to be elaborated on a later stage; or

Option 6: Make compulsory the use of a precautionary statement specifically designed for gas mixtures and based on the cut-off values.

* * * * *

ANNEX (in English only)

Table 1 in the following pages provides the information detailed below:

- (1) The name of the substance together with additional information where it has been identified
 - (i) The CAS number
 - (ii) The EU Annex I Index Number
 - (iii) The EU Risk Phrase Codes
 - (iv) Additional information, e.g. an EU Annex I entry for a group of substances
- (2) The LC₅₀ 1 Hour value
- (3) The LC₅₀ 4 Hour value converted from the 1 Hour value
- (4) The GHS Classification Hazard Category
- (5) The GHS Concentration limits for that Hazard Category derived from the LC₅₀ 4 Hour value and the criteria
- (6) The EU Classification level for Acute Toxicity (T+, T or Xn)
- (7) The default or specific EU concentration limits for that substance hazard level
- (8) The proposed EIGA concentration limits for the relevant GHS hazard category
- (9) The United Nations Transport classification

In the transport classification column, the following information is provided for each entry for each substance:

- Top Line – The UN Number
- Bottom line – The UN Transport Hazard Classes, i.e. that generates a pictogram on the packaging.
- For a few entries there is an additional centre line with the Text “N.O.S.”. This indicates that there is no specific entry for that substance in the transport regulations and that a ‘generic’ entry has been used. All other substances have a prescribed classification entry in the transport regulations.

For the designation of the transport hazard classes, these are shown by a number in front of a forward slash “/”, followed in most cases by another number(s) after the forward slash.

The number in front of the forward slash is the primary hazard.

The number(s) after the forward slash is/are the subsidiary hazard(s).

In some cases there is no number after the forward slash which indicates that there is only a single hazard attributed to the substance for transport.

The meaning of the numbers are as follows:-

- 2.1 Flammable Gas
- 2.2 Non-flammable, non-toxic gas
- 2.3 Toxic gas
- 5.1 Oxidising gas
- 6.1 Acute Toxicity
- 8 Corrosivity

Some substance names have a “*” or a “**” against them to indicate the source of the LC₅₀ value as follows:-

* LC₅₀ from ISO10298

** LC₅₀ UNKNOWN SOURCE

Table 1: Classification of gas according to different regulations

Name	LC ₅₀ 1 hr	LC ₅₀ 4 hr	GHS Cat.	GHS Conc. Limits	EU Class	EU Conc. Limits	UN TDG Classes
Hydrogen Selenide, Anhydrous CAS: ----- Annex I: 034-002-00-8 R Phrases: R23/25, R33, R50/53 (Selenium Compounds)	2	1	Cat.1	> 1			UN2202 2.3/2.1
			Cat.2	0.2 – 1	T+	> 1	
			Cat.3	0.04 – 0.2	T	0.2 – 1	
			Cat.4	0.02 – 0.04	Xn	0.02 – 0.2	
			N/C	< 0.02	N/C	< 0.02	
Hydrogen Telluride * CAS: ----- Annex I: R Phrases:	2	1	Cat.1	> 1			UN3160 N.O.S. 2.3/2.1
			Cat.2	0.2 – 1	T+	> 1	
			Cat.3	0.04 – 0.2	T	0.2 – 1	
			Cat.4	0.02 – 0.04	Xn	0.02 – 0.2	
			N/C	< 0.02	N/C	< 0.02	
Phosgene CAS: 75-44-5 Annex I: 006-002-00-8 R Phrases: R26, R36	5	2.5	Cat.1	> 2.5			UN1076 2.3/8
			Cat.2	0.5 – 2.5	T+	> 1	
			Cat.3	0.1 – 0.5	T	0.2 – 1	
			Cat.4	0.05 – 0.1	Xn	0.02 – 0.2	
			N/C	< 0.05	N/C	< 0.02	
Arsenic Pentafluoride * CAS: ----- Annex I: 033-002-00-5 R Phrases: R23/25, R50/53 (Arsenic Compounds)	20	10	Cat.1	> 10			UN3308 N.O.S. 2.3/8
			Cat.2	2 – 10	T+		
			Cat.3	0.4 – 2	T	> 0.2	
			Cat.4	0.2 – 0.4	Xn	0.1 – 0.2	
			N/C	< 0.2	N/C	< 0.1	
Arsine CAS: 7784-42-1 Annex I: 033-006-00-7 R Phrases: R12, R26, R48/20, R53	20	10	Cat.1	> 10			UN2188 2.3/2.1
			Cat.2	2 – 10	T+	> 1	
			Cat.3	0.4 – 2	T	0.2 – 1	
			Cat.4	0.2 – 0.4	Xn	0.02 – 0.2	
			N/C	< 0.2	N/C	< 0.02	
Phosphine CAS: 7803-51-2 Annex I: 015-181-00-6 R Phrases: R12, R17, R26, R34, R50	20	10	Cat.1	> 10			UN2199 2.3/2.1
			Cat.2	2 – 10	T+	> 1	
			Cat.3	0.4 – 2	T	0.2 – 1	
			Cat.4	0.2 – 0.4	Xn	0.02 – 0.2	
			N/C	< 0.2	N/C	< 0.02	
Stibine CAS: ----- Annex I: R Phrases:	20	10	Cat.1	> 10			UN2676 2.3/2.1
			Cat.2	2 – 10	T+	> 1	
			Cat.3	0.4 – 2	T	0.2 – 1	
			Cat.4	0.2 – 0.4	Xn	0.02 – 0.2	
			N/C	< 0.2	N/C	< 0.02	
Nitrosyl Chloride CAS: ----- Annex I: R Phrases:	35	17.5	Cat.1	> 17.5			UN1069 2.3/8
			Cat.2	3.5 – 17.5	T+	> 1	
			Cat.3	0.7 – 3.5	T	0.2 – 1	
			Cat.4	0.35 – 0.7	Xn	0.02 – 0.2	
			N/C	< 0.35	N/C	< 0.02	
Sulphur Tetrafluoride CAS: ----- Annex I: R Phrases:	40	20	Cat.1	> 20			UN2418 2.3/8
			Cat.2	4 – 20	T+	> 1	
			Cat.3	0.8 – 4	T	0.2 – 1	
			Cat.4	0.4 – 0.8	Xn	0.02 – 0.2	
			N/C	< 0.4	N/C	< 0.02	
Selenium Hexafluoride CAS: ----- Annex I: 034-002-00-8 R Phrases: R23/25, R33, R50/53 (Selenium Compounds)	50	25	Cat.1	> 25			UN2194 2.3/8
			Cat.2	5 – 25	T+	> 1	
			Cat.3	1 – 5	T	0.2 – 1	
			Cat.4	0.5 – 1	Xn	0.02 – 0.2	
			N/C	< 0.5	N/C	< 0.02	
Cyanogen Chloride, Stabilised CAS: ----- Annex I: R Phrases:	80	40	Cat.1	> 40			UN1589 2.3/8
			Cat.2	8 – 40	T+	> 1	
			Cat.3	1.6 – 8	T	0.2 – 1	
			Cat.4	0.8 – 1.6	Xn	0.02 – 0.2	
			N/C	< 0.8	N/C	< 0.02	
Diborane CAS: ----- Annex I: R Phrases:	80	40	Cat.1	> 40			UN1911 2.3/2.1
			Cat.2	8 – 40	T+	> 1	
			Cat.3	1.6 – 8	T	0.2 – 1	
			Cat.4	0.8 – 1.6	Xn	0.02 – 0.2	
			N/C	< 0.8	N/C	< 0.02	

Name	LC ₅₀ 1 hr	LC ₅₀ 4 hr	GHS Cat.	GHS Conc. Limits	EU Class	EU Conc. Limits	UN TDG Classes
Nitric Oxide CAS: Annex I: R Phrases:	115	57.5	Cat.1	> 57.5			UN1660 2.3/5.1,8
			Cat.2	11.5 – 57.5	T+	> 10	
			Cat.3	2.3 – 11.5	T	1 – 10	
			Cat.4	1.15 – 2.3	Xn	0.1 – 1	
			N/C	< 1.15	N/C	< 0.1	
(1) Nitrogen Dioxide/ (2) Dinitrogen Tetraoxide CAS: Annex I: R Phrases:	115	57.5	Cat.1	> 57.5			UN1067 2.3/5.1,8
			Cat.2	11.5 – 57.5	T+	> 10	
			Cat.3	2.3 – 11.5	T	1 – 10	
			Cat.4	1.15 – 2.3	Xn	0.1 – 1	
			N/C	< 1.15	N/C	< 0.1	
Chlorine Pentafluoride CAS: Annex I: R Phrases:	122	61	Cat.1	> 61			UN2548 2.3/5.1,8
			Cat.2	12.2 – 61	T+	> 1	
			Cat.3	2.44 – 12.2	T	0.2 – 1	
			Cat.4	1.22 – 2.44	Xn	0.02 – 0.2	
			N/C	< 1.22	N/C	< 0.02	
Tungsten Hexafluoride CAS: Annex I: R Phrases:	160	80	Cat.1	> 80			UN2196 2.3/8
			Cat.2	16 – 80	T+	> 1	
			Cat.3	3.2 – 16	T	0.2 – 1	
			Cat.4	1.6 – 3.2	Xn	0.02 – 0.2	
			N/C	< 1.6	N/C	< 0.02	
Fluorine CAS: Annex I: R Phrases:	185	92.5	Cat.1	> 92.5			UN1045 2.3/5.1,8
			Cat.2	18.5 – 92.5	T+	> 1	
			Cat.3	3.7 – 18.5	T	0.2 – 1	
			Cat.4	1.85 – 3.7	Xn	0.02 – 0.2	
			N/C	< 1.85	N/C	< 0.02	
Phosphorus Pentafluoride CAS: Annex I: R Phrases:	190	95	Cat.1	> 95			UN2198 2.3/
			Cat.2	19 – 95	T+	> 1	
			Cat.3	3.8 – 19	T	0.2 – 1	
			Cat.4	1.9 – 3.8	Xn	0.02 – 0.2	
			N/C	< 1.9	N/C	< 0.02	
Chlorine CAS: Annex I: R Phrases:	293	146.5	Cat.1				UN1017 2.3/8
			Cat.2	29.3 – 100	T+		
			Cat.3	5.86 – 29.3	T	> 5	
			Cat.4	2.93 – 5.86	Xn	0.5 – 5	
			N/C	< 2.93	N/C	< 0.5	
Chlorine Trifluoride CAS: Annex I: R Phrases:	299	149.5	Cat.1				UN1749 2.3/5.1,8
			Cat.2	29.9 – 100	T+		
			Cat.3	5.98 – 29.9	T	> 5	
			Cat.4	2.99 – 5.98	Xn	0.5 – 5	
			N/C	< 2.99	N/C	< 0.5	
Dichlorosilane CAS: Annex I: R Phrases:	314	157	Cat.1				UN2189 2.3/2.1,8
			Cat.2	31.4 – 100	T+		
			Cat.3	6.28 – 31.4	T	> 5	
			Cat.4	3.14 – 6.28	Xn	0.5 – 5	
			N/C	< 3.14	N/C	< 0.5	
Cyanogen CAS: Annex I: R Phrases:	350	175	Cat.1				UN1026 2.3/2.1
			Cat.2	35 – 100	T+		
			Cat.3	7 – 35	T	> 5	
			Cat.4	3.5 – 7	Xn	0.5 – 5	
			N/C	< 3.5	N/C	< 0.5	
Carbonyl Fluoride CAS: Annex I: R Phrases:	360	180	Cat.1				UN2417 2.3/8
			Cat.2	36 – 100	T+		
			Cat.3	7.2 – 36	T	> 5	
			Cat.4	3.6 – 7.2	Xn	0.5 – 5	
			N/C	< 3.6	N/C	< 0.5	
Boron Trifluoride CAS: Annex I: R Phrases:	387	193.5	Cat.1				UN1008 2.3/8
			Cat.2	38.7 – 100	T+	> 1	
			Cat.3	7.74 – 38.7	T	0.2 – 1	
			Cat.4	3.87 – 7.74	Xn	0.02 – 0.2	
			N/C	< 3.87	N/C	< 0.02	
Phosphorus Trifluoride * CAS: Annex I: R Phrases:	420	210	Cat.1				UN3308 N.O.S. 2.3/8
			Cat.2	42 – 100	T+		
			Cat.3	8.4 – 42	T	> 5	
			Cat.4	4.2 – 8.4	Xn	0.5 – 5	
			N/C	< 4.2	N/C	< 0.5	

Name	LC ₅₀ 1 hr	LC ₅₀ 4 hr	GHS Cat.	GHS Conc. Limits	EU Class	EU Conc. Limits	UN TDG Classes
Silicon Tetrafluoride CAS: Annex I: R Phrases:	450	225	Cat.1				UN1859 2.3/8
			Cat.2	45 – 100	T+		
			Cat.3	9 – 45	T	> 5	
			Cat.4	4.5 – 9	Xn	0.5 – 5	
			N/C	< 4.5	N/C	< 0.5	
Hexafluoroacetone CAS: Annex I: R Phrases:	470	235	Cat.1				UN2420 2.3/8
			Cat.2	47 – 100	T+		
			Cat.3	9.4 – 47	T	> 5	
			Cat.4	4.7 – 9.4	Xn	0.5 – 5	
			N/C	< 4.7	N/C	< 0.5	
Germane CAS: Annex I: R Phrases:	620	310	Cat.1				UN2192 2.3/2.1
			Cat.2	62 – 100	T+	> 1	
			Cat.3	12.4 – 62	T	0.2 – 1	
			Cat.4	6.2 – 12.4	Xn	0.02 – 0.2	
			N/C	< 6.2	N/C	< 0.02	
Hydrogen Sulphide CAS: 7783-06-4 Annex I: 016-001-00-4 R Phrases: R12, R26, R50	712	356	Cat.1				UN1053 2.3/2.1
			Cat.2	71.2 – 100	T+	> 10	
			Cat.3	14.24 – 71.2	T	5 – 10	
			Cat.4	7.12 – 14.24	Xn	1 – 5	
			N/C	< 7.12	N/C	< 1	
Bromomethane (Methyl Bromide) CAS: 74-83-9 Annex I: 602-002-00-2 R Phrases: R68, R23/25, R48/20, R36/37/38, R50, R59	850	425	Cat.1				UN1062 2.3/
			Cat.2	85 – 100	T+		
			Cat.3	17 – 85	T	> 5	
			Cat.4	8.5 – 17	Xn	0.5 – 5	
			N/C	< 8.5	N/C	< 0.5	
Hydrogen Fluoride, Anhydrous CAS: 7664-39-3 Annex I: 009-002-00-6 R Phrases: R26/27/28, R35	966	483	Cat.1				UN1052 8/6.1
			Cat.2	96.6 – 100	T+	> 1	
			Cat.3	19.32 – 96.6	T	0.2 – 1	
			Cat.4	9.66 – 19.32	Xn	0.02 – 0.2	
			N/C	< 9.66	N/C	< 0.02	
Hexafluoro-1,3-Butadiene ** CAS: Annex I: R Phrases:	1300	650	Cat.1				UN3160 N.O.S. 2.3/ <u>2.1</u>
			Cat.2		T+		
			Cat.3	26 – 100	T		
			Cat.4	13 – 26	Xn	> 5	
			N/C	< 13	N/C	< 5	
Methyl Mercaptan CAS: 74-93-1 Annex I: 016-021-00-3 R Phrases: R12, R20, R53	1350	675	Cat.1				UN1064 2.3/2.1
			Cat.2		T+		
			Cat.3	27 – 100	T		
			Cat.4	13.5 – 27	Xn	> 5	
			N/C	< 13.5	N/C	< 5	
Carbonyl Sulphide CAS: Annex I: R Phrases:	1700	850	Cat.1				UN2204 2.3/2.1
			Cat.2		T+		
			Cat.3	34 – 100	T	> 5	
			Cat.4	17 – 34	Xn	0.5 – 5	
			N/C	< 17	N/C	< 0.5	
Bromotrifluoroethylene ** CAS: Annex I: R Phrases:	2000	1000	Cat.1				UN2419 2.1/
			Cat.2		T+		
			Cat.3	40 – 100	T		
			Cat.4	20 – 40	Xn	> 5	
			N/C	< 20	N/C	< 5	
Trifluorochloroethylene CAS: Annex I: R Phrases:	2000	1000	Cat.1				UN1082 2.3/2.1
			Cat.2		T+		
			Cat.3	40 – 100	T	> 5	
			Cat.4	20 – 40	Xn	0.5 – 5	
			N/C	< 20	N/C	< 0.5	
Sulphur Dioxide CAS: 7446-09-5 Annex I: 016-011-00-9 R Phrases: R23, R34	2520	1260	Cat.1				UN1079 2.3/8
			Cat.2		T+		
			Cat.3	50.4 – 100	T	> 20	
			Cat.4	25.2 – 50.4	Xn	5 – 20	
			N/C	< 25.2	N/C	< 5	
Boron Trichloride CAS: 10294-34-5 Annex I: 005-002-00-5 R Phrases: R14, R26/28, R36	2541	1270.5	Cat.1				UN1741 2.3/8
			Cat.2		T+	> 1	
			Cat.3	50.82 – 100	T	0.2 – 1	
			Cat.4	25.41 – 50.82	Xn	0.02 – 0.2	
			N/C	< 25.41	N/C	< 0.02	

Name	LC ₅₀ 1 hr	LC ₅₀ 4 hr	GHS Cat.	GHS Conc. Limits	EU Class	EU Conc. Limits	UN TDG Classes
Hexafluoroisobutene ** CAS: Annex I: R Phrases:	2650	1325	Cat.1				UN3162 N.O.S. 2.3/
			Cat.2		T+		
			Cat.3	53 – 100	T	> 5	
			Cat.4	26.5 – 53	Xn	0.5 – 5	
			N/C	< 26.5	N/C	< 0.5	
Hydrogen Chloride, Anhydrous CAS: 7641-01-0 Annex I: 017-002-00-2 R Phrases: R23, R35	2810	1405	Cat.1				UN1050 2.3/8
			Cat.2		T+		
			Cat.3	56.2 – 100	T	> 5	
			Cat.4	28.1 – 56.2	Xn	0.5 – 5	
			N/C	< 28.1	N/C	< 0.5	
Hydrogen Bromide, Anhydrous CAS: 10035-10-6 Annex I: 035-002-00-0 R Phrases: R35, R37	2860	1430	Cat.1				UN1048 2.3/8
			Cat.2		T+		
			Cat.3	57.2 – 100	T		
			Cat.4	28.6 – 57.2	Xn		
			N/C	< 28.6	N/C		
Hydrogen Iodide, Anhydrous CAS: 10034-85-2 Annex I: 053-002-00-9 R Phrases: R35	2860	1430	Cat.1				UN2197 2.3/8
			Cat.2		T+		
			Cat.3	57.2 – 100	T		
			Cat.4	28.6 – 57.2	Xn		
			N/C	< 28.6	N/C		
Ethylene Oxide CAS: 75-21-8 Annex I: 603-023-00-X R Phrases: R12, R45, R46, R23, R36/37/38	2900	1450	Cat.1				UN1040 2.3/2.1
			Cat.2		T+		
			Cat.3	58 – 100	T	> 5	
			Cat.4	29 – 58	Xn	0.5 – 5	
			N/C	< 29	N/C	< 0.5	
Sulphuryl Fluoride CAS: [2699-79-8] Annex I: [009-015-00-7] R Phrases: [R23, R48/20, R50] (Sulphuryl Difluoride? ATP29)	3020	1510	Cat.1				UN2191 2.3/
			Cat.2		T+		
			Cat.3	60.4 – 100	T	> 5	
			Cat.4	30.2 – 60.4	Xn	0.5 – 5	
			N/C	< 30.2	N/C	< 0.5	
Carbon Monoxide CAS: 630-08-0 Annex I: 006-001-00-2 R Phrases: R12, R61, R23, R48/23	3760	1880	Cat.1				UN1016 2.3/2.1
			Cat.2		T+		
			Cat.3	75.2 – 100	T	> 5	
			Cat.4	37.6 – 75.2	Xn	0.5 – 5	
			N/C	< 37.6	N/C	< 0.5	
Ammonia, Anhydrous CAS: 7664-41-7 Annex I: 007-001-00-0 R Phrases: R10, R23, R34, R50	4000	2000	Cat.1				UN1005 2.3/8
			Cat.2		T+		
			Cat.3	80 – 100	T	> 5	
			Cat.4	40 – 80	Xn	0.5 – 5	
			N/C	< 40	N/C	< 0.5	
Hexafluoropropylene ** CAS: 116-15-4 Annex I: 602-061-00-4 R Phrases: R20, R37	5600	2800	Cat.1				UN1858 2.2/
			Cat.2		T+		
			Cat.3		T		
			Cat.4	56 – 100	Xn	> 5	
			N/C	< 56	N/C	< 5	
Nitrogen Trifluoride ** CAS: Annex I: R Phrases:	6700	3350	Cat.1				UN2451 2.2/ 5.1
			Cat.2		T+		
			Cat.3		T		
			Cat.4	67 – 100	Xn		
			N/C	< 67	N/C		
Methylamine, Anhydrous * CAS: 74-89-5 Annex I: 612-001-00-9 R Phrases: R12, R20, R37/38, R41	7000	3500	Cat.1				UN1061 2.1/
			Cat.2		T+		
			Cat.3		T		
			Cat.4	70 – 100	Xn	> 5	
			N/C	< 100	N/C	< 5	
Trimethylamine, Anhydrous * CAS: 75-50-3 Annex I: 612-001-00-9 R Phrases: R12, R20, R37/38, R41	7000	3500	Cat.1				UN1083 2.1/
			Cat.2		T+		
			Cat.3		T		
			Cat.4	70 – 100	Xn	> 5	
			N/C	< 100	N/C	< 5	
Chloromethane (Methyl Chloride) CAS: 74-87-3 Annex I: 602-001-00-7 R Phrases: R12, R40, R48/20	8300	4150	Cat.1				UN1063 2.1/
			Cat.2		T+		
			Cat.3		T		
			Cat.4	83 – 100	Xn		
			N/C	< 83	N/C		

Name	LC ₅₀ 1 hr	LC ₅₀ 4 hr	GHS Cat.	GHS Conc. Limits	EU Class	EU Conc. Limits	UN TDG Classes
Dimethylamine, Anhydrous * CAS: 124-40-3 Annex I: 612-001-00-9 R Phrases: R12, R20, R37/38, R41	11000	5500	Cat.1				UN1032 2.1/
			Cat.2		T+		
			Cat.3		T		
			Cat.4		Xn	> 5	
			N/C		N/C	< 5	
Octafluorobutene **	12200	6100	Cat.1				UN2422 2.2/
			Cat.2		T+		
			Cat.3		T		
			Cat.4		Xn	> 5	
			N/C		N/C	< 5	
Silane	19000	9500	Cat.1				UN2203 2.1/
			Cat.2		T+		
			Cat.3		T		
			Cat.4		Xn		
			N/C		N/C		

Table 2: Proposal for cut-off values for gas mixtures

Gas classified	Concentration limits triggering classification of the mixture as			
	Category 1 *100 ppmV	Category 2 *500ppmV	Category 3 *2500ppmV	Category 4 *5000ppmV
Category 1	More than 1%	1.0-0.5%	0.5-0.2%	0.2-0.02%
Category 2		More than 2.0%	2.0-1.0%	1.0-0.2%
Category 3			More than 5%	5-0.5%
Category 4				More than 5%

• LC₅₀- 4 Hours.

Table 3: Gas mixtures classification according to the cut-off values

Name	LC ₅₀ 1 hr	LC ₅₀ 4 hr	GHS Cat.	Gas mixtures cut-off values
Hydrogen Selenide, Anhydrous CAS: -----	2	1	Cat.1	> 1
			Cat.2	0.5 – 1
			Cat.3	0.2 – 0.5
			Cat.4	0.02 – 0.2
			N/C	< 0.02
Hydrogen Telluride * CAS:	2	1	Cat.1	> 1
			Cat.2	0.5 – 1
			Cat.3	0.2 – 0.5
			Cat.4	0.02 – 0.2
			N/C	< 0.02
Phosgene CAS: 75-44-5	5	2.5	Cat.1	> 1
			Cat.2	0.5 – 1
			Cat.3	0.2 – 0.5
			Cat.4	0.02 – 0.2
			N/C	< 0.02
Arsenic Pentafluoride * CAS: -----	20	10	Cat.1	> 1
			Cat.2	0.5 – 1
			Cat.3	0.2 – 0.5
			Cat.4	0.02 – 0.2
			N/C	< 0.02
Arsine CAS: 7784-42-1	20	10	Cat.1	> 1
			Cat.2	0.5 – 1
			Cat.3	0.2 – 0.5
			Cat.4	0.02 – 0.2
			N/C	< 0.02
Phosphine CAS: 7803-51-2	20	10	Cat.1	> 1
			Cat.2	0.5 – 1
			Cat.3	0.2 – 0.5
			Cat.4	0.02 – 0.2
			N/C	< 0.02
Stibine CAS:	20	10	Cat.1	> 1
			Cat.2	0.5 – 1
			Cat.3	0.2 – 0.5
			Cat.4	0.02 – 0.2
			N/C	< 0.02
Nitrosyl Chloride CAS: Annex I: R Phrases:	35	17.5	Cat.1	> 1
			Cat.2	0.5 – 1
			Cat.3	0.2 – 0.5
			Cat.4	0.02 – 0.2
			N/C	< 0.02

Name	LC ₅₀ 1 hr	LC ₅₀ 4 hr	GHS Cat.	Gas mixtures cut-off values
Sulphur Tetrafluoride CAS:	40	20	Cat.1	> 1
			Cat.2	0.5 - 1
			Cat.3	0.2 - 0.5
			Cat.4	0.02 - 0.2
			N/C	< 0.02
Selenium Hexafluoride CAS: -----	50	25	Cat.1	> 1
			Cat.2	0.5 - 1
			Cat.3	0.2 - 0.5
			Cat.4	0.02 - 0.2
			N/C	< 0.02
Cyanogen Chloride, Stabilised CAS:	80	40	Cat.1	> 1
			Cat.2	0.5 - 1
			Cat.3	0.2 - 0.5
			Cat.4	0.02 - 0.2
			N/C	< 0.02
Diborane CAS:	80	40	Cat.1	> 1
			Cat.2	0.5 - 1
			Cat.3	0.2 - 0.5
			Cat.4	0.02 - 0.2
			N/C	< 0.02
Nitric Oxide CAS:	115	57.5	Cat.1	> 1
			Cat.2	0.5 - 1
			Cat.3	0.2 - 0.5
			Cat.4	0.02 - 0.2
			N/C	< 0.02
(1) Nitrogen Dioxide/ (2) Dinitrogen Tetraoxide CAS: 10102-44-0 [1], 10544-72-6 [2] 007-002-00-0	115	57.5	Cat.1	> 1
			Cat.2	0.5 - 1
			Cat.3	0.2 - 0.5
			Cat.4	0.02 - 0.2
			N/C	< 0.02
Chlorine Pentafluoride CAS:	122	61	Cat.1	> 1
			Cat.2	0.5 - 1
			Cat.3	0.2 - 0.5
			Cat.4	0.02 - 0.2
			N/C	< 0.02
Tungsten Hexafluoride CAS:	160	80	Cat.1	> 1
			Cat.2	0.5 - 1
			Cat.3	0.2 - 0.5
			Cat.4	0.02 - 0.2
			N/C	< 0.02
Fluorine CAS: 7782-41-4	185	92.5	Cat.1	> 1
			Cat.2	0.5 - 1
			Cat.3	0.2 - 0.5
			Cat.4	0.02 - 0.2
			N/C	< 0.02
Phosphorus Pentafluoride CAS:	190	95	Cat.1	> 1
			Cat.2	0.5 - 1
			Cat.3	0.2 - 0.5
			Cat.4	0.02 - 0.2
			N/C	< 0.02
Chlorine CAS: 7782-50-5	293	146.5	Cat.1	> 1
			Cat.2	2 - 100
			Cat.3	1 - 2
			Cat.4	0.2 - 1
			N/C	< 0.2
Chlorine Trifluoride CAS:	299	149.5	Cat.1	> 1
			Cat.2	2 - 100
			Cat.3	1 - 2
			Cat.4	0.2 - 1
			N/C	< 0.2
Dichlorosilane CAS:	314	157	Cat.1	> 1
			Cat.2	2 - 100
			Cat.3	1 - 2
			Cat.4	0.2 - 1
			N/C	< 0.2

Name	LC ₅₀ 1 hr	LC ₅₀ 4 hr	GHS Cat.	Gas mixtures cut-off values
Cyanogen CAS: 460-19-5	350	175	Cat.1	
			Cat.2	2 – 100
			Cat.3	1 – 2
			Cat.4	0.2 – 1
			N/C	< 0.2
Carbonyl Fluoride CAS:	360	180	Cat.1	
			Cat.2	2 – 100
			Cat.3	1 – 2
			Cat.4	0.2 – 1
			N/C	< 0.2
Boron Trifluoride CAS:	387	193.5	Cat.1	
			Cat.2	2 – 100
			Cat.3	1 – 2
			Cat.4	0.2 – 1
			N/C	< 0.2
Phosphorus Trifluoride * CAS: 7637-07-2	420	210	Cat.1	
			Cat.2	2 – 100
			Cat.3	1 – 2
			Cat.4	0.2 – 1
			N/C	< 0.2
Silicon Tetrafluoride CAS:	450	225	Cat.1	
			Cat.2	2 – 100
			Cat.3	1 – 2
			Cat.4	0.2 – 1
			N/C	< 0.2
Hexafluoroacetone CAS:	470	235	Cat.1	
			Cat.2	2 – 100
			Cat.3	1 – 2
			Cat.4	0.2 – 1
			N/C	< 0.2
Germane CAS:	620	310	Cat.1	
			Cat.2	2 – 100
			Cat.3	1 – 2
			Cat.4	0.2 – 1
			N/C	< 0.2
Hydrogen Sulphide CAS: 7783-06-4	712	356	Cat.1	
			Cat.2	2 – 100
			Cat.3	1 – 2
			Cat.4	0.2 – 1
			N/C	< 0.2
Bromomethane (Methyl Bromide) CAS: 74-83-9	850	425	Cat.1	
			Cat.2	2 – 100
			Cat.3	1 – 2
			Cat.4	0.2 – 1
			N/C	< 0.2
Hydrogen Fluoride, Anhydrous CAS: 7664-39-3	966	483	Cat.1	
			Cat.2	2 – 100
			Cat.3	1 – 2
			Cat.4	0.2 – 1
			N/C	< 0.2
Hexafluoro-1,3-Butadiene ** CAS:	1300	650	Cat.1	
			Cat.2	
			Cat.3	5 – 100
			Cat.4	0.5 – 5
			N/C	< 0.5
Methyl Mercaptan CAS: 74-93-1	1350	675	Cat.1	
			Cat.2	
			Cat.3	5 – 100
			Cat.4	0.5 – 5
			N/C	< 0.5
Carbonyl Sulphide CAS:	1700	850	Cat.1	
			Cat.2	
			Cat.3	5 – 100
			Cat.4	0.5 – 5
			N/C	< 0.5

Name	LC ₅₀ 1 hr	LC ₅₀ 4 hr	GHS Cat.	Gas mixtures cut-off values
Bromotrifluoroethylene ** CAS:	2000	1000	Cat.1	
			Cat.2	
			Cat.3	5 - 100
			Cat.4	0.5 - 5
			N/C	< 0.5
Trifluorochloroethylene CAS:	2000	1000	Cat.1	
			Cat.2	
			Cat.3	5 - 100
			Cat.4	0.5 - 5
			N/C	< 0.5
Sulphur Dioxide CAS: 7446-09-5	2520	1260	Cat.1	
			Cat.2	
			Cat.3	5 - 100
			Cat.4	0.5 - 5
			N/C	< 0.5
Boron Trichloride CAS: 10294-34-5	2541	1270.5	Cat.1	
			Cat.2	
			Cat.3	5 - 100
			Cat.4	0.5 - 5
			N/C	< 0.5
Hexafluoroisobutene ** CAS:	2650	1325	Cat.1	
			Cat.2	
			Cat.3	5 - 100
			Cat.4	0.5 - 5
			N/C	< 0.5
Hydrogen Chloride, Anhydrous CAS: 7641-01-0	2810	1405	Cat.1	
			Cat.2	
			Cat.3	5 - 100
			Cat.4	0.5 - 5
			N/C	< 0.5
Hydrogen Bromide, Anhydrous CAS: 10035-10-6	2860	1430	Cat.1	
			Cat.2	
			Cat.3	5 - 100
			Cat.4	0.5 - 5
			N/C	< 0.5
Hydrogen Iodide, Anhydrous CAS: 10034-85-2	2860	1430	Cat.1	
			Cat.2	
			Cat.3	5 - 100
			Cat.4	0.5 - 5
			N/C	< 0.5
Ethylene Oxide CAS: 75-21-8	2900	1450	Cat.1	
			Cat.2	
			Cat.3	5 - 100
			Cat.4	0.5 - 5
			N/C	< 0.5
Sulphuryl Fluoride CAS: [2699-79-8]	3020	1510	Cat.1	
			Cat.2	
			Cat.3	5 - 100
			Cat.4	0.5 - 5
			N/C	< 0.5
Carbon Monoxide CAS: 630-08-0	3760	1880	Cat.1	
			Cat.2	
			Cat.3	5 - 100
			Cat.4	0.5 - 5
			N/C	< 0.5
Ammonia, Anhydrous CAS: 7664-41-7	4000	2000	Cat.1	
			Cat.2	
			Cat.3	5 - 100
			Cat.4	0.5 - 5
			N/C	< 0.5
Hexafluoropropylene ** CAS: 116-15-4	5600	2800	Cat.1	
			Cat.2	
			Cat.3	
			Cat.4	5 - 100
			N/C	< 5

Name	LC ₅₀ 1 hr	LC ₅₀ 4 hr	GHS Cat.	Gas mixtures cut-off values
Nitrogen Trifluoride ** CAS:	6700	3350	Cat.1	
			Cat.2	
			Cat.3	
			Cat.4	5 – 100
			N/C	< 5
Methylamine, Anhydrous * CAS: 74-89-5	7000	3500	Cat.1	
			Cat.2	
			Cat.3	
			Cat.4	5 – 100
			N/C	< 5
Trimethylamine, Anhydrous * CAS: 75-50-3	7000	3500	Cat.1	
			Cat.2	
			Cat.3	
			Cat.4	5 – 100
			N/C	< 5
Chloromethane (Methyl Chloride) CAS: 74-87-3	8300	4150	Cat.1	
			Cat.2	
			Cat.3	
			Cat.4	5 – 100
			N/C	< 5
Dimethylamine, Anhydrous * CAS: 124-40-3 Annex I: 612-001-00-9 R Phrases: R12, R20, R37/38, R41	11000	5500	Cat.1	
			Cat.2	
			Cat.3	
			Cat.4	
			N/C	
Octafluorobutene ** CAS:	12200	6100	Cat.1	
			Cat.2	
			Cat.3	
			Cat.4	
			N/C	
Silane CAS:	19000	9500	Cat.1	
			Cat.2	
			Cat.3	
			Cat.4	
			N/C	