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| **UN/SCETDG/50/INF.12**  **UN/SCEGHS/32/INF.9** |
| **Committee of Experts on the Transport of Dangerous Goods and on the Globally Harmonized System of Classification and Labelling of Chemicals 2 November 2016** |

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| **Sub-Committee of Experts on the  Transport of Dangerous Goods** | **Sub-Committee of Experts on the Globally Harmonized System of Classification and Labelling of Chemicals** |
| **Fiftieth session** | **Thirty-second session** |
| Geneva, 28 – 6 December 2016  Item 7 (c) of the provisional agenda  **Issues relating to the Globally Harmonized System of Classification and Labelling of Chemicals: classification criteria for flammable gases** | Geneva, 7– 9 (morning) December 2016  Item 2 (b) of the provisional agenda  **Classification criteria and related hazard communication: work of the TDG Sub-Committee on matters of interest to the GHS Sub-Committee** |

Classification criteria and hazard communication for flammable gases: “track-changes” version of the proposal in document ST/SG/AC.10/C.3/2016/58-ST/SG/AC.10/C.4/2016/12

Transmitted by the experts from Belgium and Japan

This document shows the text of Chapter 2.2 of the GHS and its annexes 1 and 3, as amended by the proposal in ST/SG/AC.10/C.3/2016/58−ST/SG/AC.10/C.4/2016/12 for consideration of both sub-committees.

**Annex I**

**Proposed amendments to Chapter 2.2 of the GHS**

“CHAPTER 2.2

FLAMMABLE GASES

2.2.1 Definitions

2.2.1.1 A *flammable gas* is a gas having a flammable range with air at 20 °C and a standard pressure of 101.3 kPa.

2.2.1.2 A *pyrophoric gas* is a flammable gas that is liable to ignite spontaneously in air at a temperature of 54 ºC or below.

2.2.1.3 A *chemically unstable gas* is a flammable gas that is able to react explosively even in the absence of air or oxygen.

**2.2.2 Classification criteria**

2.2.2.1 A flammable gas is classified in Category 1A, 1B or 2 according to the following table. Flammable gases that are pyrophoric and/or chemically unstable gases are always classified in Category 1A.

**Table 2.2.1: Criteria for categorisation of flammable gases**

|  |  |  |  |
| --- | --- | --- | --- |
| **Category** | | **Criteria** | |
| 1A | Flammable gas | Gases, which at 20 °C and a standard pressure of 101.3 kPa:  (a) are ignitable when in a mixture of 13% or less by volume in air; or  (b) have a flammable range with air of at least 12 percentage points regardless of the lower flammable limit.  unless data shows them to meet the criteria of category 1B | |
| Pyrophoric gas | Flammable gases that ignite spontaneously in air at a temperature of 54 ºC or below | |
| Chemically Unstable gas | A | Flammable gases which are chemically unstable at 20°C and a standard pressure of 101.3 kPa |
| B | Flammable gases which are chemically unstable at a temperature greater than 20°C and/or a pressure greater than 101.3 kPa |
| 1B | Flammable gas | Gases which meet the flammability criteria for Category 1A, but which are not pyrophoric, nor chemically unstable, and which have at least either:  (a) a lower flammability limit of more than 6% by volume in air; or  (b) a fundamental burning velocity of less than 10 cm/s; | |
| 2 | Flammable gas | Gases, other than those of Category 1, which, at 20 °C and a standard pressure of 101.3 kPa, have a flammable range while mixed in air | |

***NOTE 1****: Ammonia and methyl bromide may be regarded as special cases for some regulatory purposes.*

***NOTE 2:*** *Aerosols should not be classified as flammable gases. See Chapter 2.3.*

***NOTE 3:*** *In the absence of data allowing classification into Category 1B, a flammable gas that meets the criteria for Category 1A is classified per default in Category 1A.*

***NOTE 4:*** *Spontaneous ignition for pyrophoric gases is not always immediate, and there may be a delay.*

***NOTE 5:*** *In the absence of data on its pyrophoricity, a flammable gas mixture should be classified as a pyrophoric gas if it contains more than 1% (by volume) of pyrophoric component(s).*







2.2.3 Hazard communication

2.2.3.1 General and specific considerations concerning labelling requirements are provided in *Hazard communication: Labelling* (Chapter 1.4). Annex 1 contains summary tables about classification and labelling. Annex 3 contains examples of precautionary statements and pictograms which can be used where allowed by the competent authority.

## **Table 2.2.2: Label elements for flammable gases**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Category 1A** | **Gases categorized as 1A by meeting**  **pyrophoric or unstable gas A/B criteria** | | | **Category 1B** | **Category 2** |
| **Pyrophoric gas** | **Chemically unstable gas**  **Category A** | **Chemically unstable gas**  **Category B** |
| **Symbol** | Flame | Flame | Flame | Flame | Flame | *No symbol* |
| **Signal word** | Danger | Danger | Danger | Danger | Danger | Warning |
| **Hazard statement** | Extremely flammable gas | Extremely flammable gas  May ignite spontaneously if exposed to air | Extremely flammable gas  May react explosively even in the absence of air | Extremely flammable gas  May react explosively even in the absence of air at elevated pressure and/or temperature | Flammable gas | Flammable gas |

2.2.3.2 If a flammable gas or gas mixture is classified as pyrophoric and/or chemically unstable, then all relevant classification(s) should be communicated on the safety data sheet as specified in Annex 4, and the relevant hazard communication elements included on the label.

2.2.4 Decision logic and guidance

The decision logic and guidance, which follow, are not part of the harmonized classification system, but have been provided here as additional guidance. It is strongly recommended that the person responsible for classification studies the criteria before and during use of the decision logic.

2.2.4.1 *Decision logic* *for flammable gases*

To classify a flammable gas, data on its flammability, on its ability to ignite in air and on its chemical instability are required. In case of categorisation in Category 1B, data on its lower flammability limit or its fundamental burning velocity is required. The classification is according to decision logic 2.2.

Does it have a flammable range with air at 20 °C and a standard pressure of 101.3 kPa?

At 20 °C and a standard pressure of 101.3 kPa, does it:

(a) ignite when in a mixture of 13% or less by volume in air?; or

(b) have a flammable range with air of at least 12 percentage points regardless of the lower flammable limit?

### Not classified

Category 1

**signs04n**

Danger

# Yes

Yes

# No

Gaseous substance or mixture of gases

Category 2

*No symbol*

Warning

Go to decision logics 2.2 (b) and 2.2 (c)

Go to decision logics 2.2 (b) and 2.2 (c)

No

Flammable gas or gas mixture

Does the flammable gas or gas mixture ignite spontaneously in air at a temperature of 54 ºC or below? 1

Yes

Pyrophoric gas

signs04n

Danger

Is it chemically unstable at 20 °C temperature and a standard pressure of 101.3 kPa?

Is it chemically unstable at a temperature greater than   
20 °C and/or a pressure greater than 101.3 kPa?

No

Flammable gas or gas mixture

Yes

Category A   
(chemically unstable gas)

*No additional symbol*

*No additional signal word*

Yes

Category B   
(chemically unstable gas)

*No additional symbol*

*No additional signal word*

Not classified as   
chemically unstable

***Decision logic 2.2***

Category 1A

Danger



Not classified as a flammable gas



Category 1A

Chemically Unstable Gas B

Danger

Category 2

*No Symbol* Warning



Category 1A

Pyrophoric Gas and

Chemically Unstable Gas A

Danger



Category 1A

Pyrophoric Gas and

Chemically Unstable Gas B

Danger



Category 1A

Pyrophoric Gas

Danger



Category 1A

Chemically Unstable Gas A

Danger

Category 1B

Danger



No

Yes

No

Yes

Yes

Yes

No or Unknown

The substance/mixture is a gas

Does it have a flammable range with air at 20°C

and a standard pressure of 101.3 kPa?

Does the flammable gas or gas mixture ignite

spontaneously in air at a temperature of 54 ºC or below?

Is it chemically unstable at 20 °C temperature and a

standard pressure of 101.3 kPa?

Is it chemically unstable at a temperature greater than

20 °C and/or a pressure greater than 101.3 kPa?

Is it chemically unstable at 20 °C temperature and a

standard pressure of 101.3 kPa?

Is it chemically unstable at a temperature greater than

20 °C and/or a pressure greater than 101.3 kPa?

At 20 °C and a standard pressure of 101.3 kPa, does it:

(a) ignite when in a mixture of 13% or less by volume in air?; or

(b) have a flammable range with air of at least 12 percentage points regardless of the lower flammable limit?

Does it have a LFL>6% by volume in air, and/or

does it have a FBV < 10 cm /s?

Yes

No

Yes

No

No

No

No

Yes

Yes

*1 In the absence of data on its pyrophoricity, a flammable gas mixture should be classified as a pyrophoric gas if it contains more than 1% (by volume) of pyrophoric component(s).*

**2.2.4.4 *Guidance***

2.2.4.4.1 Flammability should be determined by tests or by calculation in accordance with methods adopted by ISO (see ISO 10156:2010 “Gases and gas mixtures – Determination of fire potential and oxidizing ability for the selection of cylinder valve outlets” and, if using fundamental burning velocity for Category 1B, see ISO 817:2014 “Refrigerants-Designation and safety classification, Annex C: Method of test for burning velocity measurement of flammable gases”). Where insufficient data are available to use these methods, tests by a comparable method recognized by the competent authority may be used.

2.2.4.4.2 Pyrophoricity should be determined at 54°C in accordance with either IEC 60079-20-1 ed1.0 (2010-01) “Explosive atmospheres – Part 20-1: Material characteristics for gas and vapour classification – Test methods and data” or DIN 51794 “Determining the ignition temperature of petroleum products”.

2.2.4.4.3 The classification procedure for pyrophoric gases need not be applied when experience in production or handling shows that the substance does not ignite spontaneously on coming into contact with air at a temperature of 54 ºC or below. Flammable gas mixtures, which have not been tested for pyrophoricity and contain more than one percent pyrophoric components, should be classified as a pyrophoric gas. Expert judgement on the properties and physical hazards of pyrophoric gases and their mixtures should be used in assessing the need for classification of flammable gas mixtures containing one percent or less pyrophoric components. In this case, testing need only be considered if expert judgement indicates a need for additional data to support the classification process.

2.2.4.4.4 Chemical instability should be determined in accordance with the method described in Part III of the Manual of Tests and Criteria. If the calculations in accordance with ISO 10156:2010 show that a gas mixture is not flammable it is not necessary to carry out the tests for determining chemical instability for classification purposes.

**2.2.5 Example: Classification of a flammable gas mixture by calculation according to ISO 10156:2010**

Formula



where:

Vi % = the equivalent flammable gas content;

Tci = the maximum concentration of a flammable gas in nitrogen at which the mixture is still not flammable in air;

i = the first gas in the mixture;

n = the nth gas in the mixture;

Ki = the equivalency factor for an inert gas versus nitrogen;

Where a gas mixture contains an inert diluent other than nitrogen, the volume of this diluent is adjusted to the equivalent volume of nitrogen using the equivalency factor for the inert gas (Ki).

Criterion:

**

Gas mixture

For the purpose of this example the following is the gas mixture to be used

2% (H2) + 6%(CH4) + 27%(Ar) + 65%(He)

Calculation

1. Ascertain the equivalency factors (Ki) for the inert gases versus nitrogen:

Ki (Ar) = 0.55

Ki (He) = 0.9

2. Calculate the equivalent mixture with nitrogen as balance gas using the Ki figures for the inert gases:

2%(H2) + 6%(CH4) + [27% × 0.55 + 65% × 0.9](N2) = 2%(H2).+ 6%(CH4) + 73.35%(N2) = 81.35%

3. Adjust the sum of the contents to 100%:

 × [2%(H2)+ 6%(CH4) + 73.35%(N2)] = 2.46%(H2)+ 7.37%(CH4) + 85.2%(N2)

4. Ascertain the Tci coefficients for the flammable gases:

Tci H2 = 5.5%

Tci CH4 = 8.7%

5. Calculate the flammability of the equivalent mixture using the formula:

  + = 1.29 **1.29 > 1**

Therefore the mixture is flammable in air.

**Annex II**

**Consequential amendments to Annex 1, Table A1.2 of the GHS**

**A1.2 Flammable gases** (see Chapter 2.2 for classification criteria)

| **Classification** | | | | **Labelling** | | | | **Hazard statement codes** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Hazard class** | **Hazard category** | | | **Pictogram** | | **Signal word** | **Hazard statement** |
| **GHS** | **UN Model Regulationsa** |
| **Flammable gases** | **category**  **1A** | **Flammable gas** | | **Description: Beskrivning: H:\Mina Dokument\KemI Internationellt\GHS\Pictograms\flamme.tif** | **Description: Beskrivning: H:\Mina Dokument\KemI Internationellt\GHS\Pictograms\rouge2.tif** | **Danger** | Extremely flammable gas | H220 |
| **Pyrophoric gas** | | **Description: Beskrivning: H:\Mina Dokument\KemI Internationellt\GHS\Pictograms\flamme.tif** | *See note b* | **Danger** | Extremely flammable gas  May ignite spontaneously if exposed to air | H220  H232 |
| **Chemically unstable gas** | **A** | **Description: Beskrivning: H:\Mina Dokument\KemI Internationellt\GHS\Pictograms\flamme.tif** | *See note b* | **Danger** | Extremely flammable gas  May react explosively even in the absence of air | H220  H230 |
| **B** | **Description: Beskrivning: H:\Mina Dokument\KemI Internationellt\GHS\Pictograms\flamme.tif** | *See note b* | **Danger** | Extremely flammable gas  May react explosively even in the absence of air at elevated pressure and/or temperature | H220  H231 |
| **category**  **1B** | | | **Description: Beskrivning: H:\Mina Dokument\KemI Internationellt\GHS\Pictograms\flamme.tif** | **Description: Beskrivning: H:\Mina Dokument\KemI Internationellt\GHS\Pictograms\rouge2.tif** | **Danger** | Flammable gas | H221 |
| **category**  **2** | | | *No pictogram* | *Not required* | **Warning** | Flammable gas | H221 |

a *Under the UN Recommendations on the Transport of Dangerous Goods, Model Regulations, the symbol, number and border line may be shown in black instead of white. The background colour stays red in both cases.*

*b Pyrophoric and chemical unstable gases are covered differently under the UN Recommendations on the Transport of Dangerous Goods, Model Regulations.*

**Annex III**

**Consequential amendments to Annex 3 of the GHS**

**Section 1, Table A3.1.1**

**For H220**

In column 4, under “hazard category”, replace “1” with “1A”.

**For H221**

In column 4, under “hazard category”, replace “2” with “1B, 2”.

**Section 2, Table A3.2.2**

**For P210**

In column (4), under “hazard category”, for “flammable gases” replace “1, 2” with “1A, 1B, 2”

**Section 2, Table A3.2.3**

**For P377**

In column (4), under “hazard category”, for “flammable gases” replace “1, 2” with “1A, 1B, 2”

**For P381**

In column (4), under “hazard category”, for “flammable gases” replace “1, 2” with “1A, 1B, 2”

**Section 2, Table A3.2.4**

**For P403**

In column (4), under “hazard category”, for “flammable gases” replace “1, 2” with “1A, 1B, 2”

**Section 3, paragraph A3.3.5**

Amend the matrix tables for flammable gases as follows and move the tables of flammable gases of Category 1B and Category 2 after the tables dealing with pyrophoric gases and chemically unstable gases as these gases are always flammable gases of Category 1A:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **FLAMMABLE GASES**  **(Chapter 2.2)** | | | | | | | |
|  |  | |  | | | | **Symbol**  Flame |
| **Hazard category** | **Signal word** | | **Hazard statement** | | | |  |
| 1A | Danger | | H220 | Extremely flammable gas | | |
| **Precautionary statements** | | | | | | | |
| **Prevention** | | **Response** | | | **Storage** | **Disposal** | |
| P210 **Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.** | | P377 **Leaking gas fire: Do not extinguish, unless leak can be stopped safely.**  P381 **In case of leakage, eliminate all ignition sources.** | | | P403 **Store in a well-ventilated place.** |  | |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **FLAMMABLE GASES**  **(CHAPTER 2.2)** | | | | | | | |
|  |  | |  | | | | **Symbol**  Flame |
| **Hazard category** | **Signal word** | | **Hazard statement** | | | |  |
| 1A, Pyrophoric gas | Danger | | H220  H232 | Extremely flammable gas  May ignite spontaneously if exposed to air | | |
| **Precautionary statements** | | | | | | | |
| **Prevention** | | **Response** | | | **Storage** | **Disposal** | |
| P210 **Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.**  P222 **Do not allow contact with air. –** *if emphasis of the hazard statement is deemed necessary.*  P280 **Wear protective gloves/protective clothing/eye protection/face protection.** Manufacturer/supplier or the competent authority to specify the appropriate type of equipment. | | P377 **Leaking gas fire: Do not extinguish, unless leak can be stopped safely.**  P381 **In case of leakage, eliminate all ignition sources.** | | | P403 **Store in a well-ventilated place.** |  | |

***Note****: This table lists only precautionary statements that are assigned due to the flammability and the pyrophoricity of the gas. For the other precautionary statements that are assigned based on chemical instability, see the respective table for Chemically Unstable Gases A and B..*

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **FLAMMABLE GASES**  **(Chapter 2.2)** | | | | | | | |
|  |  | |  | | | | **Symbol**  *Flame* |
| **Hazard category** | **Signal word** | | **Hazard statement** | | | |  |
| 1A, Chemically Unstable gas A | *Danger* | | H220  H230 | Extremely flammable gas  May react explosively even in the absence of air | | |
| 1A, Chemically Unstable gas B | *Danger* | | H220  H231 | Extremely flammable gas  May react explosively even in the absence of air at elevated pressure and/or temperature | | |
| **Precautionary statements** | | | | | | | |
| **Prevention** | | **Response** | | | **Storage** | **Disposal** | |
| P210 **Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.**  P202 **Do not handle until all safety precautions have been read and understood.** | | P377 **Leaking gas fire: Do not extinguish, unless leak can be stopped safely.**  P381 **In case of leakage, eliminate all ignition sources.** | | | P403 **Store in a well-ventilated place.** |  | |

***Note:*** *This table lists only the precautionary statements that are assigned due to the flammability and the chemical instability of the gas. For the other precautionary statements that are assigned based on the pyrophoricity see the respective table for Pyrophoric gas.*

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **FLAMMABLE GASES**  **(Chapter 2.2)** | | | | | | | |
|  |  | |  | | | | **Symbol**  *flame* |
| **Hazard category** | **Signal word** | | **Hazard statement** | | | |  |
| 1B | Danger | | H221 | Flammable gas | | |
| **Precautionary statements** | | | | | | | |
| **Prevention** | | **Response** | | | **Storage** | **Disposal** | |
| P210 **Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.** | | P377 **Leaking gas fire: Do not extinguish, unless leak can be stopped safely.**  P381 **In case of leakage, eliminate all ignition sources.** | | | P403  **Store in a well-ventilated place.** |  | |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **FLAMMABLE GASES**  **(Chapter 2.2)** | | | | | | | |
|  |  | |  | | | | **Symbol**  *No symbol* |
| **Hazard category** | **Signal word** | | **Hazard statement** | | | |  |
| 2 | Warning | | H221 | Flammable gas | | |
| **Precautionary statements** | | | | | | | |
| **Prevention** | | **Response** | | | **Storage** | **Disposal** | |
| P210 **Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.** | | P377 **Leaking gas fire: Do not extinguish, unless leak can be stopped safely.**  P381 **In case of leakage, eliminate all ignition sources.** | | | P403  **Store in a well-ventilated place.** |  | |

**Annex IV**

**Guidance on the preparation of Safety Data Sheets (SDS)**

In paragraph A4.3.9, table A 4.3.9.2, amend the text in column 3 for the row applicable to chapter 2.2 as follows:

| **Chapter** | **Hazard class** | **Property/Safety characteristic/Test result and  Remarks/Guidance** |
| --- | --- | --- |
| 2.2 | Flammable gases | for pure flammable gases:  − no data on the explosion / flammability limits is needed because these are indicated based on Table A4.3.9.1  − indicate the *TCi* (maximum content of flammable gas which, when mixed with nitrogen, is not flammable in air, in %) as per ISO 10156  indicate the Fundamental Burning Velocity (FBV) if the gas is classified as Category 1B based on FBV, generally determined by ISO 817:2014, Annex C  for flammable gas mixtures:  − indicate the explosion / flammability limits, if tested or indicate whether the classification and category assignment is based on the calculation as per ISO 10156.  indicate the Fundamental Burning Velocity (FBV) if the gas mixture is classified as Category 1B based on FBV, generally determined by ISO 817:2014, Annex C |
|  |  |  |