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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 Transport of Dangerous Goods

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Item 5 (b) of the provisional agenda
Transport of gases: miscellaneous

Gas mixtures containing fluorine (UN 1045)

Transmitted by the expert from Germany*

Introduction

1. Fluorine is a strongly oxidizing gas requiring specific safety measures. It reacts spontaneously with almost all organic materials and many metals. Thus, steel pressure receptacles, for example, have to be passivated before they are filled.

2. Due to the strong chemical reactivity of fluorine, the UN Model Regulations (P200) limit the maximum allowable working pressure for gas cylinders to 30 bar. In addition, a minimum test pressure of 200 bar is required.

3. Unfortunately, the UN Model Regulations do not contain any guidance on the maximum allowable working pressure and minimum test pressure for mixtures containing fluorine and gases that are inert towards fluorine, such as nitrogen. In practice, these mixtures are placed on the market and used. Typical mixtures that are commercially available include 1 % fluorine in noble gases and 10 % or 20 % fluorine in nitrogen.

4. Mixtures of fluorine and inert gases are less reactive towards materials than pure fluorine. For this reason, the maximum allowable working pressure may exceed 30 bar.

Proposal

5. Gas mixtures containing 35 % fluorine or more shall be treated like pure fluorine.

6. For mixtures of fluorine and nitrogen, the maximum allowable working pressure shall be chosen so as to ensure that the partial pressure of fluorine in the mixture does not exceed 31 bar (abs.). For mixtures of fluorine and noble gases, the coefficient of nitrogen equivalency (Kk) in accordance with ISO 10156:2017 shall also be taken into account.

7. The minimum test pressure of the pressure receptacle to be used for a fluorine mixture shall continue to be 200 bar.

* 2020 (A/74/6 (Sect.20) and Supplementary, Subprogramme 2)

8. Based on proposals 5 to 7 above, it is suggested that the following text be added to paragraph (5) z of P200:

"Mixtures of fluorine and nitrogen with a fluorine concentration below 35 % by volume may be filled in pressure receptacles up to a maximum allowable working pressure for which the partial pressure of fluorine does not exceed 31 bar (abs.).

working pressure [bar] < $31/x_{fluorine} - 1$
with $x_{fluorine}$ = fluorine concentration in % by volume/100

For mixtures of fluorine and noble gases, the coefficient of nitrogen equivalency in accordance with ISO 10156:2017 shall additionally be taken into account when calculating the partial pressure.

working pressure [bar] < $(31/x_{fluorine}) * (x_{fluorine} + K_k * x_k) - 1$
$x_{fluorine}$ = fluorine concentration in % by volume/100
K_k = coefficient of equivalency of an inert gas relative to nitrogen (coefficient of nitrogen equivalency)
x_k = inert gas concentration in % by volume/100

The maximum working pressure for mixtures of fluorine and inert gases shall be 200 bar. The minimum test pressure of pressure receptacles for mixtures of fluorine and inert gases equals 1.5 times the working pressure or 200 bar, with the greater value to be applied."

Justification

9. This procedure is set out in EIGA Code of Practice 140/18 and is internationally applied. The document is harmonized among the European Gas Association (EIGA), the Compressed Gas Association (CGA) and the Japan Industrial and Medical Gases Association (JIMGA).