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**COMMITTEE OF EXPERTS ON THE TRANSPORT
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ACTIVITIES RELATED TO THE IMPLEMENTATION OF AGENDA 21

Global harmonization of systems of classification and labelling of chemicals

Criteria for flammable aerosols

Transmitted by the expert from the United States of America

Introduction

1. In considering the discussions on criteria for flammable aerosols that has taken place within the UN/ILO working group, it appears that the basic principles for the criteria should be identified so that the working group has a common understanding when specific criteria are discussed. Principles for classifying aerosols as flammable in the United States of America are provided below along with a proposal for harmonized criteria that can be used for communicating the hazards of flammable aerosols in use, storage and transport settings.

Purposes of Classification Criteria/ Single System

2. The United States of America, consistent with the decisions of the working group to date, believes that a single set of flammability hazard classification criteria for aerosols should be developed for hazard communication purposes. These criteria would be used to communicate aerosol flammability hazards to consumers and to workers. They would also be used to communicate the flammability hazards aerosols pose in transport and in storage. Of course, this could only be achieved if the common criteria were appropriate for each of these uses. Even though the hazards stemming from use of aerosols by consumers and workers are related to the operation of the aerosol and the hazards in transport and storage are primarily from exposure to fire, it appears possible to arrive at a single set of classification criteria.

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Principles for Communicating Flammability Hazards to Consumers/Workers

3. Criteria for flammability for purposes of warning consumers and workers should be based on the following principles:

- Consumers and workers should be warned of a flammability hazard if there is the potential of them endangering themselves or others by flammability.
- Warning is appropriate if there is the potential for harm under reasonable use and misuse conditions. Flagrant abuse need not be considered.
- There must be an expectation that the flammable warning will change consumer or worker behavior.
- Overly conservative labelling should be avoided because over time consumers might begin to ignore cautionary labels if they believe the warnings are unrealistic.
- Aerosols are considered to pose the following hazards to consumers and workers related to their flammability:
 - the potential of the aerosol spray being ignited by a flame source during use,
 - releasing flammable vapours into a confined space and forming a flammable atmosphere in the presence of an ignition source

Transport/Storage Principles

4. While transport regulations have historically used consumer use criteria for purposes of classifying aerosols as flammable, the hazards of aerosols in transport are more closely related to the hazards that aerosols pose in storage. For purposes of transport and storage, criteria for flammability should be based on the following principles:

- The application of flammable labels should provide a level of safety which is consistent with that provided through the application of flammable labels to flammable liquids and solids.
- Aerosols are considered to pose the following hazards in transport and storage related to their flammability:
 - exposure of the aerosol container to fire and burning of the aerosol or spreading of the fire,
 - releasing flammable vapours into a confined space and forming a flammable atmosphere in the presence of an ignition source.

Levels of Flammability

5. The working group discussed the number of levels of flammability risk that should be provided but could not reach a consensus. In the United States of America, for consumer purposes two levels are used, flammable and extremely flammable. It is not considered likely that consumers would be able to discriminate between more than two levels of flammability. For storage, two levels of flammability are used based on National Fire Protection Association Publication 30B. For transport a single level is currently used. However, the ICAO Technical Instructions regulate aerosols containing engine starting fluid differently than other aerosols. This can be attributed to the high ether content of these aerosols.

If extremely flammable aerosol criteria were developed these criteria might also have application in regulating air transport of these articles. Two levels of aerosol flammability are recommended.

Storage Criteria (NFPA 30B)

6. The Montreal Protocol caused a transition away from the use of chlorofluorocarbons as propellant gases and a shift into more flammable propellant gases. This shift occurred in North America in the late 1970's and the 1990's in Europe. A change in the flammability hazard of aerosols associated with their storage was first made apparent by several major warehouse fires in the United States of America in the late 1970's and early 1980's. In 1979, the United States of America aerosol industry and insurance industry undertook a multimillion dollar research program to evaluate the risks of flammable aerosols in storage.

7. The study involved a range of tests including small scale single can tests and fire tests of multiple pallets of aerosol products stacked up to 25 feet high. The major conclusions of the study were:

- for storage purposes, aerosols could be classified into three (two flammability levels) levels warranting different fire protection measures (i.e.; sprinkler system specifications, containment systems) based on the calculated heat of combustion (expressed in kJ/g) as obtained by oxygen calorimetry and the combustion efficiency of the aerosol components and weighing the heats of combustion according to their weight percent in the aerosol;
- aerosols with a heat of combustion of less than or equal to 20 kJ/g (NFPA level 1) could be regarded as having no greater fire hazard than ordinary combustible materials such as paper. These aerosols do not require any labelling relating to flammability. Examples are water based air fresheners, insect spray and cleaning products. In a warehouse fire, the characteristic behavior of these aerosols is to have a brief flash of flame as a container ruptures with almost all remains being non-combustible.
- aerosols with a heat of combustion higher than 20 kJ/g but less than or equal to 30 kJ/g (NFPA level 2) require specialized fire protection. Examples are alcohol based hair sprays, insect repellents and other personal care products. In a warehouse fire, the characteristic behavior of these aerosols is to have a larger flash of flame producing more heat as a container ruptures with most remains being flammable, but water soluble.
- aerosols with a heat of combustion higher than 30 kJ/g (NFPA level 3) require even more extensive fire protection. Examples are petroleum solvent based paints, insect sprays and engine starting fluids. In a warehouse fire, the characteristic behavior of these aerosols is to have a large flash of flame producing even more heat with most remains being flammable and non-water soluble.
- for purposes of assessing the risk in storage, the base product flashpoint criterion could not be considered independently to adequately predict the risk of fire hazard.

Proposal for Aerosol classification

8. In comparing flammability classifications of aerosols for purposes of use, storage and transport it appears that a single set of classifications can be developed. This could be accomplished by merging the use and storage criteria. The proposed set of criteria are:

Flammable

An aerosol is regarded as being flammable if:

- .1 in the case of an aerosol emitting its product in the form of a spray, when tested in accordance with the Ignition Distance Test, there is ignition at 15 cm or more;
- .2 in the case of an aerosol emitting its product in the form of a spray, when tested in accordance with the Enclosed Space Ignition Test, the equivalent time is less than or equal to 150 seconds/m³; or the chemical heat of combustion is greater than 20 kJ/g and less than or equal to 30 kJg; or
- .3 in the case of an aerosol emitting its product in the form of a foam, mousse, gel or paste, when tested in accordance with the Aerosol Foam Flammability Test, the flame height exceeds 4 cm and the burning time exceeds 2 seconds.

{Note that an aerosol meeting any one of these conditions should be regarded as flammable.}

Extremely flammable:

An aerosol is regarded as extremely flammable if:

- .1 in the case of an aerosol emitting its product in the form of a spray, when tested in accordance with the Ignition Distance Test at 15 centimetres, a flashback (a flame extending back to the actuator) is obtained at any degree of valve opening and the flash point of the base product is less than -5 °C; or
- .2 the chemical heat of combustion is greater than 30 kJ/g.

{Note that an aerosol meeting any one of these conditions should be regarded as extremely flammable.}

Chemical heat of combustion is defined as combustion efficiency times the net heat of combustion as obtained by an oxygen bomb calorimeter or equivalents. It is also referred to as effective heat of combustion and referenced in ASTM E-1354-97 in 3.1.2 and in ISO/FDIS 13943:1999 (E/F) 86.1.
