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COMMITTEE OF EXPERTS ON THE TRANSPORT OF DANGEROUS GOODS

**(Twenty-first session,
4-13 December 2000,
agenda item 4 (a)(iii))**

ACTIVITIES RELATED TO THE IMPLEMENTATION OF AGENDA 21

Global harmonization of systems of classification and labelling of chemicals

United Nations/ILO Working Group on the Harmonisation of the Classification Criteria for Physical Hazards (aerosols)

Proposal transmitted from the European Aerosol Federation (FEA)

For the eighteenth session of the Sub-Committee of Experts (Geneva, 3-14 July 2000), the European Aerosol Federation submitted a proposal for the determination of aerosol flammability criteria (UN/SCETDG/18/INF.7) together with a background paper explaining how the proposal was developed (UN/SCETDG/18/INF.12).

The basis for this proposal was to carefully consider the secondary hazard presented by many aerosols, in that they can contain flammable components (the primary hazard being that they are pressurised containers). The proposal argued that the classification of physical hazard relates to whether or not the aerosol product is flammable, i.e. a measure of the **intrinsic property** of the filled aerosol. The proposal further argued that the classification could be determined by answering a simple yes/no to the question "did ignition occur?". A number of test methods to determine if the aerosol contents could be ignited were also jointly submitted by FEA and the Chemical Speciality Manufacturers' Association (CSMA) (ST/SG/AC.10/C.3/2000/34). This proposal, we believed, had the advantage of being simple and straightforward to apply and did not rely on interpretation of results nor complex cut-off values.

At the eighteenth session of the Sub-Committee of Experts, there was considerable discussion as to how many "hazard" levels were required. Arguments were put forward for one level (non-flammable/flammable) and for multiple levels (Extremely Flammable/Easily (Highly) Flammable/Flammable).

It was also stated during the discussions that the number of criteria recommended by this Working Group would determine the number of criteria which could be used in the future, i.e. new criteria can't be introduced at a later date. FEA has interpreted this as determining the number of criteria that could be subsequently used in labelling or communication of the risk.

It is difficult to distinguish "hazard" from "risk", (not helped by their translation in different languages, which is problematical and confusing). Risk can be considered as follows:

Risk = (Hazard) H (Probability of Exposure) + (Consequential effects)

If exposure can be eliminated or reduced, the risk disappears or is similarly reduced, but the hazard remains. This is in line with the discussions currently underway in the ILO working groups on communication.

FEA has considered the outcome of the eighteenth session and believes the basis for its proposal to the eighteenth session is still fundamentally correct. The **physical hazard** being considered is **flammability** and this is an **intrinsic property** of the filled aerosol. Therefore only one **hazard** level is required - flammable/non-flammable.

However, multiple levels of **risk** can arise from this physical hazard, depending on the effects of the degree of exposure and FEA has taken this into account in order to propose ways in which the risk can be communicated.

FEA would suggest that up to three levels of **risk** communication criteria could be proposed by the Working Group. These are "Extremely Flammable", "Highly Flammable" and "Flammable", plus non-flammable as appropriate.

Legislation already exists in Europe for flammable liquids and gases that differentiates between these criteria based on intrinsic physico-chemical properties of the substances, e.g. flash point. Although this principle has been applied to try and label aerosols in Europe, by cross-linking legislation, FEA has always had the view that it can not be applied to the aerosol in practice, as the flash point of the contents cannot be measured. Also, it does not fit with the way risk has been considered above, as it does not take account of the exposure in use.

However, FEA would propose that the test methods, which have been previously jointly submitted by FEA/CSMA and accepted by the Working Group (subject to some minor amendments), could be used to develop multiple risk communication criteria as they take into account probability of exposure to the hazard. These could then be used by the ILO working groups on communication.

FEA, in conjunction with CSMA, have slightly revised the draft test methods, on the basis of the decisions taken at the eighteenth session and the revised texts have been resubmitted separately for consideration by the UN/ILO Working Group at the twenty-first session of the Committee of Experts.

The use of the individual test methods to support the criteria can be considered as follows:

- **Enclosed Space Ignition Test**

This test assesses the flammability of products emitted from aerosol dispensers according to their propensity to ignite in an enclosed or confined space, in the presence of an ignition source. As well as observing if ignition does or doesn't occur, this test also measures the discharge time to achieve ignition. From this the time equivalent to achieve ignition in a unit volume of one cubic metre can be calculated.
The shorter the time required to achieve ignition, the greater the risk as the **exposure** needed to reach a hazardous situation, (a flammable atmosphere) is less, and the **probability of exposure** increases. Therefore, it is feasible to propose multiple risk levels based on increasing times to ignition.

At the eighteenth session, it was agreed that a cut-off limit of 150 s/m^3 as time equivalent needed to achieve ignition in one cubic metre could be adopted. This could be used as the cut-off limit for the "Extremely Flammable" criterion. So products with an equivalent time of 150 s/m^3 or less would be classified as "Extremely Flammable". Highly Flammable could be defined as >150 s/m^3 to 300 s/m^3 and Flammable > 300 s/m^3.

It is not possible to define an exact equivalence between the percentage of flammable content and equivalent time in the Enclosed Space Ignition Test, due to the influence of the valve system on discharge rate; however, substantial testing performed by and on behalf of FEA indicates that that an equivalent time of 150 s/m^3 is usually obtained with products containing a significant flammable content, which could be slightly lower than the current 45% limit. Therefore, in proposing 150 s/m^3 as the cut-off for the Extremely Flammable risk communication criterion, FEA has taken into account the outcome of the eighteenth session, which recalled that the existing limit of 45% flammable contents in the Model Regulations for the Transport of Dangerous Goods had been questioned by the Committee of Experts on the Transport of Dangerous Goods and it had been agreed that it should be reviewed.

FEA believes that the use of equivalent time is appropriate for assessing the risk during Supply and Use, where the product is designed to be released from the container, usually in relatively small amounts, at a controlled discharge rate. It is less appropriate for Transport, where the total contents may be released in an uncontrolled manner if the container is damaged, causing it to leak or rupture and able to produce an explosive atmosphere. Consideration of Deflagration Density, which is a measure of the amount required to be released per unit volume to achieve ignition, is more appropriate for Transport. FEA has previously proposed that if the Deflagration Density is greater than or equal to 600 grams per cubic metre, the aerosols shall be regarded as being in sub-division 2.2 for Transport, otherwise aerosols shall be regarded as being in sub-division 2.1.

This is supported by tests carried out by the independent test laboratory CNPP (Centre National de Prévention et de Protection, Saint Marcel, France) in September 1999, which are summarised in the table which follows and which are shown in full in the addendum to FEA's proposal (UN/SCETDG/18/INF.12) to the eighteenth session. The results indicate that ignition (deflagration) is unlikely to occur for products which contain less than 10% flammable contents in the Enclosed Space Ignition Test. Products containing LPG as the sole flammable material gave Deflagration Density results of just under 600 grams per cubic metre. Therefore FEA has proposed a value of 600 grams per cubic metre based on these data.

DATA FROM CNPP TESTS SEPTEMBER 1999

Aerosols	Total amount of flammable material		Deflagration Density
Flammable contents	Total (%)	Discharged in test vessel (g/m^3)	g/m^3
6% LPG	6	53	No deflagration observed
4% LPG +2% Ethanol	6	115	No deflagration observed
3% LPG+3% DME	6	114	No deflagration observed
4%LPG+2% n-heptane	6	114	No deflagration observed
4%LPG+2% dodecane	6	69	No deflagration observed
5%LPG+5% Ethanol	10	185	No deflagration observed
Proposed limit value			**600**
10%LPG	10	60	590
5%LPG+10%DME	15	78	520
10%LPG+5% n-heptane	15	77	510
10%LPG+10%Ethanol	20	88	440
10%LPG+5%DME	15	63	420
10%LPG+10% dodecane	20	85	420
10%LPG+10% n-heptane	20	83	410
15%LPG	15	57	380
20%LPG	20	63	320
10%LPG+10%DME	20	61	300

NB: Abbreviations used for the propellants:
LPG liquefied petroleum gas DME Dimethyl Ether

We still consider this classification criterion of the intrinsic **hazard** to be appropriate for Transport and would question the need for multiple risk levels.

Note: Equivalent Time and Deflagration Density values are usually not interchangeable, i.e. an equivalent time of 150 s/m^3 does not necessarily equal a deflagration density of 150 g/m^3. The discharge rate of the aerosol will influence the equivalent time, whereas the deflagration density is independent of discharge rate.

- **Ignition Distance of the Spray Jet**

This test measures at which distance from the aerosol actuator a flame can ignite the spray. The further away the spray can be ignited, the greater the risk as the **probability of exposure** is increased. So, it is feasible to propose multiple risk levels, based on decreasing ignition distances. The Extremely Flammable criteria could be defined as an ignition distance of 45cm, with Highly Flammable at 30cm and Flammable at 15cm (under the test methods they are tested at 15cm intervals).

- **Foam Flammability Test**

This test determines the flammability of an aerosol spray emitted in the form of a foam, mousse, gel or paste. The information generated by the test includes whether the product ignites, the maximum flame height in cm and the duration of the flame in seconds. At the eighteenth session it was agreed to define ignition as a stable flame maintained for $\geq$ 2 seconds and a minimum 4cm in height. The longer the duration of the flame and the higher the flame, the greater the risk. So it is feasible to propose multiple risk levels, based on a combination of flame duration and height. The Flammable criterion could be a stable

flame maintained for $\geq$ 2 seconds and a minimum 4cm height, Highly Flammable could be $\geq$ 5secs or a min 15cm height, Extremely Flammable could be $\geq$ 7secs or a min 20cm height.

Therefore, by using the results from the three test methods as described above, it is possible to define multiple **risk** levels connected with the **physical hazard** of **flammability**.

The physical hazard, in our view, remains whether the aerosol contents are flammable or not, i.e. with a simple yes/no criterion.

Based on this, FEA has drafted the attached proposal for the determination of Aerosol Flammability Classification Criteria for Transport and Supply & Use, including Criteria for Risk Levels for Supply and Use.

FEA PROPOSAL
FOR THE DETERMINATION OF AEROSOL FLAMMABILITY CLASSIFICATION CRITERIA FOR TRANSPORT AND SUPPLY & USE, INCLUDING CRITERIA FOR RISK LEVELS FOR SUPPLY & USE

UN GLOBAL HARMONISATION

AEROSOLS

Aerosols containing no (defined as 1% or less) components with a flashpoint of 93°C or less shall be regarded as being NON-FLAMMABLE ***(in sub-division 2.2 for Transport).***

Aerosols containing more than 1% components with a flashpoint of 93°C or less shall be regarded as being FLAMMABLE ***(in sub-division 2.1 for Transport)***. Such aerosols, whose contents are ejected as solid or liquid particles in suspension in a gas, as a powder or in a liquid state or in a gaseous state and which contain flammable components, shall only be regarded as being NON-FLAMMABLE ***(sub-division 2.2 for Transport)*** on the basis of the results obtained with the following test methods:

a. **For Supply & Use**, all spray aerosol products are tested using the **Enclosed Space Ignition Test** and the **Ignition Distance Test**.

b. All aerosol products, which are emitted as foam, mousse, paste, or gel are tested using the **Aerosol Foam Flammability Test**.

If no ignition occurs, as defined in any of the three above mentioned tests, the aerosols shall be regarded as being NON-FLAMMABLE, under normal or reasonably foreseeable conditions of use.

If ignition occurs in either the Enclosed Space Ignition Test or the Ignition Distance Test, the following risk criteria are applied to the aerosol product:

Extremely Flammable:	*Time Equivalent $\leq$ 150 s/m^3* *Or Ignition Distance $\geq$ 45cm*
Highly Flammable:	*Time Equivalent > 150 s/m^3 to 300 s/m^3* *Or Ignition Distance 30cm*
Flammable:	*Time Equivalent > 300s/m^3* *Or Ignition Distance 15cm*

If ignition occurs in the Aerosol Foam Flammability Test, the following risk criteria are applied to the aerosol product:

Extremely Flammable:	*Flame duration $\geq$ 7secs or Height $\geq$ 20cm*
Highly Flammable:	*Flame duration $\geq$ 5secs or Height $\geq$ 15cm*
Flammable:	*Flame duration $\geq$ 2 secs and Height $\geq$ 4cm*

c. **For Transport**, all spray aerosol products are tested using the **Enclosed Space Ignition Test**.

If the Deflagration Density is greater or equal to 600 grams per cubic meter, the aerosols shall be regarded as being in sub-division 2.2.

All aerosol products, which are emitted as a foam, mousse, paste, or gel are tested using the **Aerosol Foam Flammability Test**.

*If no ignition occurs, as defined In the **Foam Flammability Test**, the aerosols shall be regarded as being in sub-division 2.2.*