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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
(Twenty-fourth session, 3-10 December 2003,
agenda item 2)

TRANSPORT OF GASES

Alternatives to the Waterbath Test for Aerosol Dispensers

Transmitted by the European Aerosol Federation (FEA)

Executive summary

Every filled UN 1950 aerosol is subjected to a test performed in a hot water bath. This requirement is laid down in 6.2.4.
This document proposes to separate requirements for UN 1950 aerosols from requirements for small receptacles containing gas (UN 2037 gas cartridges) and to include requirements for alternatives to the water bath test for aerosol dispensers.

Related documents

UN/SCETDG/23/INF.14 - (FEA) Alternative leakproofness test for aerosols.

Background

1. At the meeting of the Subcommittee in July 2003, FEA announced its intention to prepare a proposal to explain how an alternative system to the water bath can be validated and use the current trial as a detailed example of how this was done.

2. Aerosols are non-refillable pressurised receptacles which in many cases contain flammable ingredients and liquefied propellant gas. It has been determined that in hot climates during storage, transport and distribution, the temperature of aerosols may rise to around 50 °C.

3. Therefore in the 1940's a method was developed to test the integrity of filled aerosols prior to leaving the factory. In this method every filled aerosol is immersed in a hot water bath for sufficient time to allow the contents to reach the internal pressure that would be achieved if the aerosol was allowed to equilibrate at 55 °C (50 °C if the liquid capacity does not exceed 95% of the capacity of the aerosol at 50 °C). In order to achieve this condition most aerosols need to remain in the hot water bath for between 2 and 3 minutes.

4. When the aerosols are fully immersed in water, leaking aerosols can be identified by visual observation or automatic detection of gas bubbles escaping from the point of the leak. Based on historical evidence over many years, leakage below the rate detectable by a water bath does not constitute a fire risk in transport, distribution or consumer use.

Why an alternative

5. When the water bath was developed typical line speeds were about 40-60 aerosols per minute. However with modern manufacturing equipment, current line speeds may be up to 350 aerosols per minute. The consequence is that today a modern water bath needs to be up to 10 times larger than one needed when the test method was developed over fifty years ago. There can be real problems at existing factories with larger water baths, not because of their effectiveness in pressure testing aerosols, but in achieving the environmental and manufacturing efficiencies required today.

6. For a number of years the European Aerosol Federation (FEA) has been investigating possible ‘alternative test systems’ to the water bath and has identified a number that are under development. FEA concluded, however, that before any alternative system can be accepted it will be necessary to demonstrate it to be as effective as the water bath in an extended trial. FEA has therefore developed a protocol to demonstrate that a chosen ‘alternative test system’ is as effective as a water bath at eliminating weak or leaking aerosols.

Protocol for validating alternatives to the water bath

7. The protocol proposed by FEA is as follows:

Any ‘water bath alternative’ system must be validated by running it prior to and in series with a fully functioning water bath for a significant number of aerosols, to be defined and agreed prior to commencing the trial. During the trial no aerosols shall burst on the line or in the water bath under normal running conditions and the ‘alternative system’ shall be as effective as the water bath in identifying aerosols that leak. The trial shall be verified by a suitably qualified independent inspection body.

FEA trial of the protocol

8. To demonstrate that the protocol to validate alternative methods will work FEA conducted an integrated trial on a selected ‘alternative’ at tinplate can and valve manufacturers and an aerosol filler in Germany. The ‘alternative system’ chosen to test the protocol consisted of an integrated package of measures that involved:
   - High level quality assurance procedures in place for can and valve manufacture to ensure only high quality components are used by the filler;

- A pressure test for all empty cans by the can manufacturer to a pressure equal to or in excess of the maximum expected in the filled aerosols at 50 °C;
- High level quality assurance procedures in place during aerosol handling and filling to ensure that only high quality aerosols are produced that include:
  - Checks on setting and maintaining the correct valve crimp dimensions;
  - In-line check weigher system to ensure over-filled aerosols are rejected;
- A micro-leak detector on the production line to test the valve and valve crimp of all filled aerosols for leaks.

9. Burgoyne Consultants Ltd (www.burgoynes.co.uk) was appointed as the independent inspection body for the trial.

10. The trial ran for twelve months from the beginning of July 2002 during which time over 12 million tinplate aerosols were tested. During this period no tinplate aerosols were found to burst in the water bath and 96 were found to be leaking by both the 'alternative system' and the water bath. A further 11 were detected by the water bath only and 8 by the 'alternative system' only.

11. The inspection body verified that the trial adhered to the protocol and produced true and accurate results. Based on the inspection body's trial report, the FEA concluded that the protocol is a suitable method to validate a water bath alternative system.

12. Based on the results, it was also possible to conclude that this particular example of an 'alternative system' as described in paragraph 8 is as effective as a water bath.

Proposal

The following proposal suggests a new form of words for the clause 6.2.4. Requirements for aerosol dispensers and small receptacles containing gas (gas cartridges):

"6.2.4 Requirements for aerosol dispensers and small receptacles containing gas (gas cartridges)

6.2.4.1 ***Small receptacles containing gas (gas cartridges)***

6.2.4.1.1 Each receptacle shall be subjected to a test performed in a hot water bath; the temperature of the bath and the duration of the test shall be such that the internal pressure reaches that which would be reached at 55 °C (50 °C if the liquid phase does not exceed 95% of the capacity of the receptacle at 50 °C). If the contents are sensitive to heat or if the receptacles are made of plastic material which softens at this temperature, the temperature of the bath shall be set at between 20 °C and 30 °C but, in addition, one receptacle in 2000 shall be tested at the higher temperature.

6.2.4.1.2 No leakage or permanent deformation of the receptacle may occur, except that a plastic receptacle may be deformed through softening provided that it does not leak.

6.2.4.2 ***Aerosol dispensers***

Each filled aerosol shall be subjected to a test performed in a hot water bath or a validated water bath alternative.

6.2.4.2.1 Hot waterbath test

6.2.4.2.1.1 The temperature of the water bath and the duration of the test shall be such that the internal

pressure reaches that which would be reached at 55 °C (50 °C if the liquid phase does not exceed 95% of the capacity of the aerosol dispenser at 50 °C). If the contents are sensitive to heat or if the aerosol dispensers are made of plastics material which softens at this test temperature, the temperature of the bath shall be set at between 20 °C and 30 °C but, in addition, one aerosol dispenser in 2000 shall be tested at higher temperature.

6.2.4.2.1.2 No leakage or permanent deformation of a aerosol dispenser may occur, except that a plastic aerosol dispenser may be deformed through softening provided that it does not leak.

6.2.4.2.2 Alternative tests

6.2.4.2.2.1 Validation of an alternative

6.2.4.2.2.1.1 Any water bath alternative system shall be validated by running it prior to and in series with a fully functioning water bath for a significant number of aerosols, to be defined and agreed by an inspection body prior to commencing the trial.

6.2.4.2.2.1.2 During the trial no aerosols shall burst on the line or in the water bath under normal running conditions and the water bath alternative shall be as effective as the water bath in identifying aerosols that leak.

6.2.4.2.2.1.3 An inspection body shall validate the water bath alternative (see 6.2.1.8).

6.2.4.2.2.2 Alternatives using heat

6.2.4.2.2.2.1 Heat sources others than a hot water bath are acceptable provided that the equilibrium temperature experienced by the aerosol dispenser and the duration of the test shall be such that the internal pressure reaches that which would be reached at 55 °C (50 °C if the liquid phase does not exceed 95% of the capacity of the aerosol dispenser at 50 °C). If the contents are sensitive to heat or if the aerosol dispensers are made of plastic material which softens at this temperature, the temperature shall be set at between 20 °C and 30 °C but, in addition, one aerosol dispenser in 2000 shall be tested at the higher temperature.

6.2.4.2.2.2.2 A means of observing or detecting leaking aerosol dispensers must be included.

6.2.4.2.2.2.3 No leakage or permanent deformation of the aerosol dispenser may occur, except that a plastic aerosol dispenser may be deformed through softening provided that it does not leak.

6.2.4.2.2.3 Alternatives not using heat

6.2.4.2.2.3.1 An alternative system must include at least the following parameters:

(a) A pressure test for all empty cans to achieve a pressure equal to or in excess of the maximum expected in the filled aerosols at 55 °C (50 °C if the liquid phase does not exceed 95% of the capacity of the aerosol dispenser at 50 °C);

(b) Procedures in place during aerosol handling and filling to ensure that only high quality aerosols are produced that include:

- checks on setting and maintaining the correct valve crimp dimensions;
- an in-line system to ensure over-filled aerosols are rejected;

(c) A micro-leak detector on the production line to test the valve and valve crimp of all filled aerosols for leaks."
