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**Economic Commission for Europe****Inland Transport Committee****Working Party on the Transport of Dangerous Goods****Joint Meeting of Experts on the Regulations annexed to the European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways (ADN) (ADN Safety Committee)****Fortieth session**

Geneva, 22–26 August 2022

Item 4 (b) of the provisional agenda

**Proposals for amendments to the Regulations annexed to ADN:  
other proposals****Deflagration, detonation and steady burning****Submitted by the Group of Recommended ADN Classification Societies\*\****Summary*

<b>Executive summary:</b>	Proposed amendments to the Regulations annexed to ADN.
<b>Action to be taken:</b>	9.3.2.22.4 (b), 1.2.1 and 3.2.3.1 to be amended.
<b>Related documents:</b>	Informal document INF.22 of the thirty-fifth session; ADN 2021.

**I. Some definitions from 1.2.1**

*"Deflagration:* means an explosion which propagates at subsonic speed (see EN 13237:2011);".

*Note:*→Deflagration arresters do NOT provide safety against detonations and NOT against endurance burning.

*"Detonation:* means an explosion which propagates at supersonic speed and is characterized by a shock wave (see EN 13237:2011);".

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\*\* A/76/6 (Sect.20), para. 20.76.



*Note:*→Detonation arresters provide safety for deflagration and detonation<sup>1</sup>; they are NOT safe for endurance burning.

*"Steady burning:* means combustion stabilized for an indeterminate period (see ISO 16852:2016);".

*"Device for the safe depressurization of cargo tanks* means a manually operated or remote-operated device which is mounted in such a way as to allow the cargo tanks to be depressurized in safety. When the list of substances on the vessel according to 1.16.1.2.5 contains substances for which explosion protection is required in column (17) of Table C of Chapter 3.2, the device shall be deflagration safe and capable of withstanding steady burning for the most critical substance in the vessel substance list. The deflagration safety shall be tested according to international standard ISO 16852:2016 and evidence of compliance with the applicable requirements (e.g., conformity assessment procedure according to Directive 2014/34/EU, ECE/TRADE/391 or at least equivalent) shall be supplied. The deflagration safety may be ensured by an integrated flame arrester plate stack capable of withstanding steady burning or a flame arrester capable of withstanding steady burning (protection against deflagrations);".

*"Vacuum valve* means an automatically activated safety valve the purpose of which is to protect the cargo tank against unacceptable negative internal pressure. When the list of substances on the vessel according to 1.16.1.2.5 contains substances for which explosion protection is required in column (17) of Table C of Chapter 3.2, it shall be deflagration safe against atmospheric explosions of the most critical substance in the list of substances. The deflagration safety shall be tested according to international standard ISO 16852:2016 and evidence of compliance with the applicable requirements (e.g., conformity assessment procedure according to Directive 2014/34/EU, ECE/TRADE/391 or at least equivalent) shall be supplied. The deflagration safety may be ensured by an integrated flame arrester plate stack or a flame arrester (protection against deflagrations);".

*"Autonomous protection systems* means all devices which are intended to halt incipient explosions immediately and/or to limit the effective range of an explosion and which are separately made available on the market for use as self-contained systems. This includes flame arresters, high velocity vent valves, deflagration safe vacuum valves and devices for the safe depressurization of cargo tanks capable of withstanding a deflagration (see also *Flame arrester, High velocity vent valve, Vacuum valve, Devices for the safe depressurization of cargo tanks and Deflagration*);".

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<sup>1</sup> If explosive gas ignites in a container or in a pipe, a deflagration (explosion) is triggered. If a flame front runs through a pipe, the flame speed increases with the pipe length. Up to a certain pipe length / pipe inner diameter ratio, the flame propagates at subsonic speed. If this length is exceeded, the flame accelerates from subsonic to supersonic speed. To stop a flame from propagating at supersonic speed, flame arresters tested as inline detonation flame arresters are required.

The installation position of the inline detonation flame arrester is independent of the distance to the ignition source. Detonation flame arresters are also certified as deflagration flame arresters. *Source:* <https://flammergbh.de/en/inline-detonation-flame-arrester-concentric>

## II. Contradiction between 1.2.1 and 9.3.2.22.4 (b)

1. In 9.3.2.22.4 (b) the provisions read<sup>2</sup>:

"When the list of substances on the vessel according to 1.16.1.2.5 is going to include substances for which explosion protection is required in column (17) of Table C of Chapter 3.2:

- At the connection to each cargo tank, the venting piping and the vacuum valve shall be equipped with a flame arrester capable of withstanding a detonation; and
- The device for the safe depressurization of cargo tanks shall be deflagration safe and capable of withstanding steady burning;"

2. But in the definition of 'vacuum valve', it reads that when explosion protection is required the vacuum valve shall (only) be "deflagration safe".

3. It seems that there is a contradiction between the definition in 1.2.1 and the prescription in 9.3.2.22.4 (b):

- the definition in 1.2.1 requires a flame arrester capable of withstanding a deflagration,
- 9.3.2.22.4 (b) requires a flame arrester capable of withstanding a detonation.

4. However, deflagration arresters do not provide safety against detonations.

### **Proposal 1**

5. Amend 9.3.2.22.4 (b) to read (new text is in bold, deleted text in strikethrough):

"When the list of substances on the vessel according to 1.16.1.2.5 is going to include substances for which explosion protection is required in column (17) of Table C of Chapter 3.2:

- At the connection to each cargo tank, the venting piping ~~and the vacuum valve~~ shall be equipped with a flame arrester capable of withstanding a detonation **and the vacuum valve shall be equipped with a flame arrester capable of withstanding a deflagration**; and
- The device for the safe depressurization of cargo tanks shall be deflagration safe and capable of withstanding steady burning;"

6. A transitional provision for this amendment is not required.

## III. Autonomous protection systems<sup>3</sup>

7. In the definition of "autonomous protection systems" in 1.2.1, the list is not exhaustive:

"... this includes:

- flame arresters,
- high velocity vent valves,
- deflagration safe vacuum valves,

<sup>2</sup> There is no such contradiction between 1.2.1 and 9.3.3.22.4 (d) (closed Type N):

"If the list of substances on the vessel according to 1.16.1.2.5 is going to include substances that require explosion protection in accordance with column (17) of Table C of Chapter 3.2, then:

- At the connection to each cargo tank, the venting piping shall be equipped with a flame arrester capable of withstanding a detonation;
- The vacuum valve and the safe depressurization device for cargo tanks shall be deflagration safe. The deflagration safety may also be ensured by a flame arrester; and
- The pressure relief device shall be designed as a high velocity vent valve, with the gases discharged upwards; ..."

<sup>3</sup> In the ADN 2019 (and previous versions) the wording "self-contained protection systems" was used.

- and devices for the safe depressurization of cargo tanks capable of withstanding a deflagration."
8. In 3.2.3.1 (Explanations concerning Table C, Col 16) the list is limited to five devices:  
 " relevant autonomous protection systems:
- flame arresters,
  - vacuum relief valves,
  - pressure relief valves
  - high velocity vent valves
  - and devices for safe pressure relief of cargo tanks with integrated flame arrester plate stack."
9. Thus, it would be better to:
- (a) have an exhaustive list of all the devices mentioned in the text of the ADN Regulations that must be considered as "autonomous protection systems", and
  - (b) insert this list only in 1.2.1 of ADN.
10. In 1.2.1 it is indicated "deflagration safe vacuum valves" but in 3.2.3.1 it is indicated the "vacuum relief valves" (assuming that both "deflagration" and "detonation" are considered here).
11. In 1.2.1 the "pressure relief valves" are not included.
12. In 3.2.3.1 the classification societies prefer to read "devices for the safe depressurization of cargo tanks..." instead of "devices for safe pressure relief of cargo tanks...".

**Proposal 2**

13. In 1.2.1 amend the definition of "autonomous protection systems" to read (new text is in bold, deleted text in strikethrough):
- "*Autonomous protection systems* means all devices which are intended to halt incipient explosions immediately and/or to limit the effective range of an explosion and which are separately made available on the market for use as self-contained systems. This includes flame arresters, high velocity vent valves, ~~deflagration safe vacuum valves~~ **vacuum relief valves, pressure relief valves** and devices for the safe depressurization of cargo tanks capable of withstanding a deflagration (see also Flame arrester, High velocity vent valve, Vacuum valve, Devices for the safe depressurization of cargo tanks and Deflagration);"
14. In 3.2.3.1 Column (16) - Explosion group, amend to read:
- "Contains the explosion group of the substance.
- Values between square brackets indicate the explosion group II B subgroups to be used in selecting the relevant autonomous protection systems (~~flame arresters, vacuum relief valves, pressure relief valves/high velocity vent valves and devices for safe pressure relief of cargo tanks with integrated flame arrester plate stack~~)."
15. A transitional provision for this amendment is not required.