Second Revision No. 12-NFPA 67-2015 [ Global Comment ]

Change all references of "Shepherd (2006)" in Chapter 7 to "Shepherd (2009)".

Submitter Information Verification

Submitter Full Name: Laura Montville
Organization: [ Not Specified ]
Street Address:
City:
State:
Zip:
Submittal Date: Mon Apr 06 16:13:06 EDT 2015

Committee Statement

Committee Statement: The Chapter 2 reference was updated in the First Draft. The parenthetical reference should have been carried through to Chapter 7.
### Second Revision No. 1-NFPA 67-2015 [ Section No. 2.3.3 ]

**2.3.3 ASTM Publications.**

ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.


### Submitter Information Verification

<table>
<thead>
<tr>
<th>Submitter Full Name:</th>
<th>Laura Montville</th>
</tr>
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<tbody>
<tr>
<td>Organization:</td>
<td>[ Not Specified ]</td>
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<td>Submittal Date:</td>
<td>Mon Mar 30 16:51:53 EDT 2015</td>
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### Committee Statement

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<tr>
<th>Committee Statement:</th>
<th>Updated edition reference</th>
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<td>Response Message:</td>
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2.3.6 Other Publications.


OECD Nuclear Energy Agency, “Flame Acceleration and Deflagration-to-Detonation Transition in Nuclear


Technical Regulations for Flammable Liquids (TRbF) 20, Germany.


Submitter Information Verification

Submitter Full Name: Laura Montville
Organization: [ Not Specified ]
Street Address: [ Not Specified ]
City: [ Not Specified ]
State: [ Not Specified ]
Zip: [ Not Specified ]
Submittal Date: Mon Apr 06 16:36:14 EDT 2015

Committee Statement

Committee Statement: This is an editorial correction.
Response Message: [ Not Specified ]
2.4 References for Extracts in Advisory Sections.

Submitter Information Verification
Submitter Full Name: Laura Montville
Organization: [ Not Specified ]
Street Address:  
City:  
State:  
Zip:  
Submittal Date: Mon Apr 06 16:09:51 EDT 2015

Committee Statement
Committee Statement: The definition of “flame arrester” has been added in Chapter 3 and extracted from NFPA 69.
Response Message: 
3.3.1 Burning Velocity ($S_u$).
The rate of flame propagation relative to the velocity of the unburned gas that is ahead of it. [68, 2013]

3.3.1.1 Fundamental Burning Velocity.
The burning velocity of a laminar flame under stated conditions of composition, temperature, and pressure of the unburned gas. [68, 2013]

Submitter Information Verification

Submitter Full Name: Laura Montville
Organization: [Not Specified]
Street Address: [Not Specified]
City: [Not Specified]
State: [Not Specified]
Zip: [Not Specified]
Submittal Date: Tue Mar 31 12:24:05 EDT 2015

Committee Statement

Committee Statement: Su is used in equations within NFPA 67 and needs to be defined.
Response Message:
Second Revision No. 5-NFPA 67-2015 [ New Section after 3.3.8 ]

<table>
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<tr>
<th>3.3.9*</th>
<th>Flame Arrester.</th>
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<td>A device that prevents the transmission of a flame through a flammable gas/air mixture by quenching the flame on the surfaces of an array of small passages through which the flame must pass. [69, 2014]</td>
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Supplemental Information

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Submitter Information Verification

- **Submitter Full Name:** Laura Montville
- **Organization:** [Not Specified]
- **Street Address:** 
- **City:** 
- **State:** 
- **Zip:** 
- **Submittal Date:** Tue Mar 31 12:33:14 EDT 2015

Committee Statement

- **Committee Statement:** The term flame arrester is used throughout the document, and providing an appropriate definition is correcting an oversight. The definition is extracted from NFPA 69.
SR-5, New annex material

A.3.3.9 Flame Arrester.

The emerging gases are sufficiently cooled to prevent ignition on the protected side [NFPA 69].
Physical barriers are fast-acting valves that provide a mechanical barrier against the flame front of an explosion. The mechanical barrier is activated to assume a closed position, thus blocking the cross section of a duct. The closing time strongly depends on the diameter of the pipe. For example, in one particular design the closing time varies from 10 ms for a 50 mm diameter up to 67 ms for a diameter of 650 mm. Explosion isolation valves must be sufficiently strong to withstand the high pressure of an explosion. For deflagrations starting at or below atmospheric pressure, pressure resistance to 10 to 20 bar-g is sufficient. For detonations, generated overpressures are so high (particularly due to reflected pressures) that application of an isolation valve alone is not a reliable solution. However, in combination with other systems (venting, explosion suppression) whose actions reduce the pressure reaching the valve, such a solution is practicable (Going and Snoeys, 2002). After every action, the fast-acting valves (i.e., gate valve, slide valve, pinch valve, float valve, and flap valve) must be reopened. In the case of an explosive charge or pressure-actuated valves, some parts, such as the driving force (explosive charge or pressurized cartridge) and a shock absorber, have to be replaced. The replacement operation is short — typically less than 1 hour. (See NFPA 69 for maintenance and additional limitations.)

Submitter Information Verification

Submitter Full Name: Laura Montville
Organization: [ Not Specified ]
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Tue Mar 31 12:37:05 EDT 2015

Committee Statement

Committee Statement: Keeping the order of magnitude of the closing time is important, but it was not intended to be universal.
7.5.1.3
Cross-section reductions in piping have to be located a distance of at least 120 pipe diameters before the detonation flame arrester.

Submitter Information Verification

Submitter Full Name: Laura Montville
Organization: [ Not Specified ]
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Tue Mar 31 12:44:26 EDT 2015

Committee Statement

Committee Statement: The distance should be 120 pipe diameters or greater.
Response Message:
Section No. 8.2.2

Assuming simplified assumption such as the boundary conditions being constant over time and neglecting radiation losses, which is valid for small gaps, the critical $Pe_{\text{crit}}$ number can be expressed by the following:

$$Pe_{\text{crit}} = \frac{\rho_{\text{um}} c_{\text{bm}} d_{\text{crit}}}{\lambda_{\text{um}}}$$

where:

- $\rho_{\text{um}}$ = density of the unburnt mixture
- $S_U$ = laminar burning velocity
- $c_{\text{bm}}$ = specific heat of the burnt mixture
- $d_{\text{crit}}$ = hydraulic diameter of the gap that leads to quenching
- $\lambda_{\text{um}}$ = thermal conductivity of the unburnt mixture

Supplemental Information

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Submitter Information Verification

**Submitter Full Name**: Laura Montville  
**Organization**: [ Not Specified ]  
**Street Address**:  
**City**:  
**State**:  
**Zip**:  
**Submittal Date**: Tue Mar 31 12:28:14 EDT 2015

Committee Statement

**Committee Statement**: In the interest of consistency, the term for burning velocity in the equation is changed to $Su$.  

Response Message: [Link](http://submittals.nfpa.org/TerraViewWeb/ContentFetcher?commentPara...)}
\[ Pe_{\text{crii}} = \frac{\rho_{\text{um}} S_{\text{uc}} c_{\text{bm}} d_{\text{crii}}}{\lambda_{\text{um}}} \]
Second Revision No. 8-NFPA 67-2015 [ Section No. 9.1.3 ]

9.1.3
The distance between the deflagration flame arrester and the possible ignition location and the fittings arranged hereto have to correspond to the stipulated requirements as per the EC type examination certificate. Detonation arresters can be used for open and closed pipe work to prevent flame propagation from the unprotected side to the protected side of the pipe work.

9.1.3.1
High stresses exerted on the fixing points of the flame arrester and on the unprotected side of the piping, especially in the case of a detonation, should be considered; stresses from adjoining pipe work should be limited to acceptable levels by appropriate installation, construction, and selection of material.

9.1.3.2
Detonation arresters should be installed in a way that they can be easily maintained. They should be installed close to the plant component to be protected or close to the ignition source, if known (e.g., an incinerator).

9.1.3.3
The nominal sizes of the pipelines connected on the side of the ignition source (i.e., the unprotected side) should be less than or equal to the devices' nominal size. The pipe diameter on the protected side should be no less than the pipe diameter on the unprotected side.

9.1.3.4
Flame pressures and velocities can be enhanced by upstream turbulence, which can be caused by valves, bends, or any change of cross section in the pipe. Shut-off valves can be installed in a pipeline if they are maintained fully open during operation and do not reduce the free flow area.

Submitter Information Verification

Submitter Full Name: Laura Montville
Organization: [ Not Specified ]
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Mon Apr 06 15:57:47 EDT 2015

Committee Statement

Committee Statement: The new text provides additional guidance on proper application of detonation arresters.
Response Message: 
10.4.1 Thermally Regenerated.

To avoid hot spotting resulting from adsorption heat release, the vapor concentration is brought down to 50 percent below LFL. This measure, if controlled properly, is the primary measure for explosion prevention. Additional explosion isolation measures are needed since the carbon adsorption vessels are not designed to be explosion-pressure proof, and during the regenerative cycles it cannot be ensured that the vapor air mixture will remain below 50 percent of LFL. For that reason, secondary measures in the form of flame arresters are recommended for enhancing safety. Figure 10.4.1 shows the recommended position of different flame and detonation arresters. The inlet line to the carbon adsorption unit should be equipped with a detonation arrester (1 in the figure), because the distance of the ignition source might be a long way. Additionally, the bypass line should be equipped with end-of-line endurance burning flame arresters (2 in the figure) for process upset conditions. In addition, it is recommended that either end-of-line flame arresters or in-line flame arresters be installed at the discharge side of the adsorption vessel. The inlet side of the adsorption vessel should be equipped with in-line detonation arresters or explosion volume–proof flame arresters (Schampel, 1988).

Figure 10.4.1 Protection Strategy for One Type of a Typical Thermal Regenerated Carbon Adsorption Unit for Solvent Recovery.
10.4.2 Vacuum-Regenerated Carbon Bed Adsorption Systems. (Reserved)

10.4.2.1 Carbon bed flammable vapor adsorption systems often use vacuum regeneration of the carbon bed after it has been highly saturated with hydrocarbons. Flammable vapor-air mixtures can form in piping leading to the adsorbing mode carbon bed, and in the piping between the vacuum pump and the twin carbon bed unit operating in the vacuum generation mode. (See Figure 10.4.2.1)

Figure 10.4.2.1 Typical Simplified Diagram of a Vacuum-Regenerated Carbon Adsorption Unit.

10.4.2.2 Although many of these systems have operated safely for a long time, the potential for an ignition source to occur in the equipment or instrumentation connected to this flammable mixture piping cannot be ruled out. During the desorbing process the dry running vacuum pump can potentially act as an ignition source. High temperatures in the active carbon bed due to high inlet vapor loads can also represent a potential ignition source. The result would be flame propagation and explosion development in the piping.

10.4.2.3 Explosion protection considerations for the pertinent piping in these systems should consist first of an analysis of the piping strength and the potential closed vessel deflagration pressures associated with pertinent hydrocarbon vapor–air mixtures. The potential for deflagration-to-detonation transition in the piping should also be evaluated.

10.4.2.4 Based on the results of the evaluations described in 10.4.2.3, the need for a deflagration arrester or detonation arrester should be determined. Special requirements in regards to temperature and pressure need to be considered if dry running vacuum pumps are equipped with in-line flame or detonation arresters. The decision making analysis and conclusions should be documented and reviewed as part of any management of change analysis.

Supplemental Information

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Submitter Information Verification
**Submitter Full Name:** Laura Montville  
**Organization:** [ Not Specified ]  
**Street Address:**  
**City:**  
**State:**  
**Zip:**  
**Submittal Date:** Mon Apr 06 16:05:47 EDT 2015

### Committee Statement

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<th>Committee Statement</th>
<th>Information on vacuum regenerated carbon adsorption units has been added to the “reserved” section created at the First Draft Meeting.</th>
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