AGENDA

NFPA Technical Committee on Explosion Protection Systems (EXL-AAA)
NFPA 68 First Draft Meeting (F2027)

March 31, 2026 and May 12, 2026
9:00 a.m. – 5:00 p.m. (ET)

Microsoft Teams Meeting
To join the meeting, please contact SCaldwell@nfpa.org

1. **Call to order.** Thomas Scherpa.
2. **Introductions.** See committee roster attached.
3. **Chair report.** Thomas Scherpa.
4. **Staff liaison report.** Laura Moreno.
5. **Previous meeting minutes.** NFPA 67 and NFPA 69 Second Draft Meeting, May 2023, Microsoft Teams Meeting. See attached.
6. **NFPA 68 First Draft.**
   a. **Public Inputs.** See attached.
   b. **Task group report(s).**
      i. **Data Archive**. TG Chair: Nathan Egbert. Members: Sam Rodgers, Andy Tworek, Niels Pedersen, Geof Brazier, Monir Ahammad, Regis Bauwens. This task group will review the data used to analyze and revise the venting equations, and provide data in a format that can be released to the public and/or develop a scope of work for the Fire Protection Research Foundation to assist in that effort. The task group will also consider developing a form or requested format for future submittals of new data.
7. **Other Business.**
   a. Reminder to NFPA 67/NFPA 69 Task Group
      i. **Water Hammer**. Members: Bob Leishear, Sam Rodgers, Andy Tworek, Dave Kirby. Consider if water hammer/adiabatic compression should be addressed in NFPA 67 or NFPA 69, and if so, develop language that can be submitted as a TIA or as Public Input for the next edition.
8. **Future meetings.**
9. **Adjournment.**

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MINUTES

NFPA Technical Committee on Explosion Protection Systems (EXL-AAA)
NFPA 67 Second Draft Meeting (F2023)
NFPA 69 Second Draft Meeting (F2023)

May 9, 2023 and May 23, 2023
12:00 p.m. – 4:00 p.m. (EST)

Continuation meeting: June 9, 2023
9:00 a.m. – 12:00 p.m. (EST)

Microsoft Teams Meeting

1. **Call to order.** Tom Scherpa, chair, called the meeting to order at 12:01 p.m. on May 9.
2. **Introductions.** Attendees introduced themselves and identified their affiliation.
3. **Chair report.** Tom Scherpa welcomed attendees and provided an overview of the meeting.
4. **Staff liaison report.** Laura Moreno provided an overview of the standards development process and the revision cycle schedule.
5. **Previous meeting minutes.** The minutes from May and June 2022 (Microsoft Teams Meeting) were approved without revision.
6. **NFPA 67 Second Draft.**
   a. **Review of Public Comments and Committee Inputs.** The Technical Committee reviewed the Public Comments and Committee Inputs and developed Second Revisions as necessary. These will be available in the Second Draft Report at www.nfpa.org/67.
   b. **New task groups.** The following task groups were appointed to work subsequent to the meeting:
      i. **Water Hammer**. Members: Bob Leishear, Sam Rodgers, Andy Tworek, Dave Kirby. Consider if water hammer/adiabatic compression should be addressed in NFPA 67 or NFPA 69, and if so, develop language that can be submitted as a TIA or as Public Input for the next edition.
7. **NFPA 69 Second Draft.**
   a. **Review of Public Comments and Committee Inputs.** The Technical Committee reviewed the Public Comments and Committee Inputs and developed Second Revisions as necessary. These will be available in the Second Draft Report at www.nfpa.org/69.

b. **Task group reports.** The following task groups provided their reports and recommendations.

i. **Battery Backups**. Will Cosey. The task group provided a report, and Second Revisions were made accordingly. The task group has been discharged with thanks.

ii. **Close Clearance Rotary Valves**. Walt Frank. The task group provided a report, and Second Revisions were made accordingly. The task group has been discharged with thanks.

iii. **Orderly Shutdown.** Walt Frank. The task group provided a report, and Second Revisions were made accordingly. The task group has been discharged with thanks.

iv. **Inspections.** Mike Hard. The task group provided a report, and Second Revisions were made accordingly. New inspection forms for passive protection (similar to A.15.7.3) will be reconsidered for the next edition. The task group has been discharged with thanks.

8. **Future meetings.** This was the final meeting of this committee for the revision cycle. Public Inputs for the next editions of NFPA 67 and NFPA 69 are expected to close January 2027. A meeting notification will be posted at www.nfpa.org/67next and www.nfpa.org/69next when the next meeting is scheduled. (Note that this committee is also responsible for NFPA 68, and Public Inputs for NFPA 68 will close sooner, in January 2026.)

9. **Adjournment.** The meeting adjourned at 12:07 p.m. on June 9.

Attendees

Committee Members:

✓	**Scherpa, Thomas**	Chair	DuPont
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✓	**Bauwens, C. Regis**	Principal	FM Global
✓	**Brazier, Geof**	Principal	BS&B Safety Systems, LLC
✓	**Bustamante, Daniel**	Principal	FNX-INNOV
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✓	**Moreno, Laura**	Staff Liaison	National Fire Protection Association

Guests:

Michael Marando NFPA

Total number in attendance: 48

Public Input No. 15-NFPA 68-2026 [Global Input]

New Section 7.6 Deflagration Venting for Battery Energy Storage Systems (BESS)

7.6.1: Determination of Venting Requirements for Enclosed BESS Volumes

7.6.1.1 Vent sizing and placement will take into account the following factors:

(1) Gas explosion characteristics specific to the BESS based on the UL9540a cell test report.

(2) P_{STAT} of the vents

(3) Maximum allowable P_{RED} of the enclosure

(4) Effective gas volume inside the BESS

(5) Characteristic distance between battery modules

(6) Characteristic distance from modules to vent location (ceiling or wall)

Statement of Problem and Substantiation for Public Input

This is a placeholder for the inclusion of guidance for venting on BESS volumes. NFPA 855, which governs the installation and operation of battery energy storage systems, acknowledges the risk of explosion and mandates the implementation of explosion protection systems in BESS containers unless other mitigating factors exist (see Chapter 14 of NFPA 855). However, NFPA 68 does not adequately address the unique geometries and battery module layouts in typical BESS containers. The dense arrangement of battery modules within these containers can exacerbate turbulence and explosion propagation rates, while also obstructing flow through explosion vents. Consequently, there is a risk of explosion over-pressures surpassing the container strength, particularly in near-wall regions, even when explosion vents are installed on the top of a container. There is at least one testing and research program being conducted that will provide clearer guidance on parameters that must be included in the design and implementation of deflagration vents for this unique hazard.

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Submittal Date: Wed Jan 07 13:23:16 EST 2026
Committee: EXL-AAA

Public Input No. 2-NFPA 68-2023 [Global Input]

Replace the remaining “explosion vent” or “explosion venting” terms with deflagration vent or deflagration venting, respectively.

Statement of Problem and Substantiation for Public Input

Explosion vent is the historical usage, circa 1970-1990. The NFPA 68 committee has been moving towards deflagration vent for a while. I did a search on “explosion vent” and “deflagration vent” in NFPA 68. Both are used, however, deflagration vent is used much more often. It is confusing to the user to use two terms for the same item.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 1-NFPA 68-2023 [Section No. 8.10.1]	single example

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Submittal Date: Thu Mar 16 15:40:31 EDT 2023
Committee: EXL-AAA

Public Input No. 6-NFPA 68-2025 [Global Input]

Section(s): General requirements for deflagration venting design and application.

Proposed Change:
Add new Annex language to recognize autonomous multidisciplinary safety architectures (e.g., AIMSAFEGURD™) as a supplemental practice for monitoring and mitigating explosion risks before vent activation.

Proposed Annex Language (New):

> *A.x.x Autonomous Multidomain Safety Systems.*
> Explosion protection by deflagration venting can be supported by autonomous multidisciplinary safety systems such as AIMSAFEGURD™, which integrate sensors for pressure, oxygen concentration, temperature, gas leakage, and vibration, combined with autonomous isolation capabilities. These systems can detect abnormal conditions that may precede a deflagration, such as micro-leaks, unstable flow regimes, or equipment fatigue.
>
> Upon detection of such anomalies, autonomous architectures may activate early-stage mechanical or electrical isolation, trigger supplemental venting sequences, or initiate shutdown procedures. While not required, these systems may be considered as additional protective measures to improve reliability and reduce the likelihood of catastrophic vent activation.

Statement of Problem and Substantiation:
NFPA 68 addresses deflagration venting as a reactive protective measure but does not account for modern technologies that provide **early anomaly detection and autonomous mitigation**. AIMSAFEGURD™ adds:

- **Pre-Ignition Detection:** identification of precursor conditions (gas accumulation, pressure rise, corrosion weakening).
- **Sub-Cycle Autonomous Response:** rapid mechanical/electrical isolation to minimize deflagration energy release.
- **Cross-Domain Monitoring:** combining civil, structural, mechanical, electrical, and biological safety inputs into one architecture.
- **Fiber-Optic Communication:** eliminating ignition risks from copper control lines in hazardous zones.
- **Cross-Standard Integration:** complements NFPA 67 (piping explosion protection), NFPA 69 (explosion prevention), NFPA 59A (LNG), and NFPA 70 (electrical hazards).

By including reference to autonomous architectures in Annex A, NFPA 68 can transition from purely reactive venting strategies to proactive explosion prevention and advanced resilience in industrial facilities.

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Statement of Problem and Substantiation for Public Input

NFPA 68 addresses deflagration venting as a reactive protective measure but does not account for modern technologies that provide early anomaly detection and autonomous mitigation. AIMSAFEGURD™ adds:

Pre-Ignition Detection: identification of precursor conditions (gas accumulation, pressure rise, corrosion weakening).

Sub-Cycle Autonomous Response: rapid mechanical/electrical isolation to minimize deflagration energy release.

Cross-Domain Monitoring: combining civil, structural, mechanical, electrical, and biological safety inputs into one architecture.

Fiber-Optic Communication: eliminating ignition risks from copper control lines in hazardous zones.

Cross-Standard Integration: complements NFPA 67 (piping explosion protection), NFPA 69 (explosion prevention), NFPA 59A (LNG), and NFPA 70 (electrical hazards).

By including reference to autonomous architectures in Annex A, NFPA 68 can transition from purely reactive venting strategies to proactive explosion prevention and advanced resilience in industrial facilities.

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Submittal Date: Fri Sep 26 14:39:44 EDT 2025
Committee: EXL-AAA

Public Input No. 7-NFPA 68-2025 [Global Input]

Section A.3.3.19 indicates that the term "Hydraulic Diameter" and related equation [A.3.3.19a] have been, "…determined to be more appropriate…" than the term "Equivalent Diameter" and related equation [A.3.3.19b] used in previous editions. Therefore, the term Hydraulic Diameter, "…has been introduced into this edition of the standard." The standard reinforces the intent to use hydraulic diameter in the example calculations 1, 2, and 3 of A.6.4.3, and annex I, I.1, fifth paragraph.

However, the term "Equivalent diameter" or variations are still used in the body of the standard:

6.6.2.4(4) , in which case the term "equivalent diameter" is used

Equation [7.2.6.1b], in which case the term "hydraulic equivalent diameter" is used

Annex I, I.1, fifth paragraph, in which case the term "equivalent hydraulic diameter" is used

I suggest that the language in section A.3.3.19, with the examples of use in the body of the standard, may imply that the use of Equivalent Diameter is acceptable. I suggest the term Hydraulic Diameter replace the standard's body text as cited above; and the following be added to A.3.3.19: "Do not use equivalent diameter in calculations per this edition."

As a less important optional issue, I also suggest a comment be added to A.3.3.19 regarding the continuing acceptability of installed designs which used equivalent diameter in the past (i.e., sensitivity analysis comments).

Additional Proposed Changes

File Name	Description	Approved
68_PC1.pdf	68_PC1	

Statement of Problem and Substantiation for Public Input

NOTE: This Public Input appeared as "Reject but Hold" in Public Comment No. 1 of the (F2022) Second Draft Report for NFPA 68 and per the Regs. at 4.4.8.3.1 and needs to be reconsidered by the TC for the next edition of the document.

Terminology confusion which could lead to inconsistent calculations.

Submitter Information Verification

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Submittal Date: Wed Dec 17 16:27:05 EST 2025
Committee: EXL-AAA

Public Comment No. 1-NFPA 68-2021 [Global Input]

Section A.3.3.19 indicates that the term "Hydraulic Diameter" and related equation [A.3.3.19a] have been, "…determined to be more appropriate…" than the term "Equivalent Diameter" and related equation [A.3.3.19b] used in previous editions. Therefore, the term Hydraulic Diameter, "…has been introduced into this edition of the standard." The standard reinforces the intent to use hydraulic diameter in the example calculations 1, 2, and 3 of A.6.4.3, and annex I, I.1, fifth paragraph.

However, the term "Equivalent diameter" or variations are still used in the body of the standard:

- **6.6.2.4(4) , in which case the term "equivalent diameter" is used**
- **Equation [7.2.6.1b], in which case the term "hydraulic equivalent diameter" is used**
- **Annex I, I.1, fifth paragraph, in which case the term "equivalent hydraulic diameter" is used**

I suggest that the language in section A.3.3.19, with the examples of use in the body of the standard, may imply that the use of Equivalent Diameter is acceptable. I suggest the term Hydraulic Diameter replace the standard's body text as cited above; and the following be added to A.3.3.19: "Do not use equivalent diameter in calculations per this edition."

As a less important optional issue, I also suggest a comment be added to A.3.3.19 regarding the continuing acceptability of installed designs which used equivalent diameter in the past (i.e., sensitivity analysis comments).

Statement of Problem and Substantiation for Public Comment

Terminology confusion which could lead to inconsistent calculations.

Related Item

• A.3.3.19

Submitter Information Verification

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Submittal Date: Thu Dec 23 07:38:08 EST 2021
Committee: EXL-AAA

Committee Statement

Committee Action: Rejected but held

Resolution: This topic was not addressed at the First Draft stage, so to create a revision at this point would be introducing new material at the Second Draft.

Public Input No. 8-NFPA 68-2026 [Section No. 6.1.2.3]

6.1.2.3*

For aluminum, hafnium, magnesium, tantalum, titanium, zirconium, and similar alloys or mixtures with adiabatic flame temperature higher than 3300°C, unless K_{St} and P_{max} are determined in nominal 1 m^3 or larger calibrated test vessels, the K_{St} value shall be multiplied by a factor of 2 for application of the design methods [Add References here] .

Proposal: add proper references for this paragraph.

This paragraph was added following a presentation entitled "Scaling-up metal dusts explosion severity" that was given to the Explosion Protection Systems committee at the NFPA Headquarters in Quincy (September 9th, 2015).

This work has been published since then, and can be referenced as follows:

Taveau , J., Lemkowitz , S., Hochgreb , S., Roekaerts , D. (2018). Scaling up the severity of metal dusts deflagrations . Proceedings of the Twelfth International Symposium on Hazards, Prevention, and Mitigation of Industrial Explosions (XII ISHPMIE), Kansas City, USA, pp. 99-122, ISBN 978-1-5323-8443-1 .

Taveau, J., Lemkowitz, S., Hochgreb, S., Roekaerts, D. (2019). Metal dusts explosion hazards and protection. Chemical Engineering Transactions, Volume 77, 7-12.

Statement of Problem and Substantiation for Public Input

The requirement in 6.1.2.3 lacks proper reference/evidence.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 9-NFPA 68-2026 [Section No. A.6.1.2.3]	

Submitter Information Verification

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Submittal Date: Sun Jan 04 22:57:19 EST 2026
Committee: EXL-AAA

Public Input No. 11-NFPA 68-2026 [Section No. 6.6.2.4]

6.6.2.4*

A deflector design shall meet all of the following criteria in order to maintain the full area of the explosion vent device :

(1) The deflector for a rectangular vent shall be geometrically similar to the vent and sized with a linear scale factor of at least 1.75. For a round vent, the deflector shall be square shaped and at least 1.75 times the vent's hydraulic diameter.

(2) The deflector shall be inclined 45 degrees to 60 degrees from the vent axis, as shown in Figure 6.6.2.4.

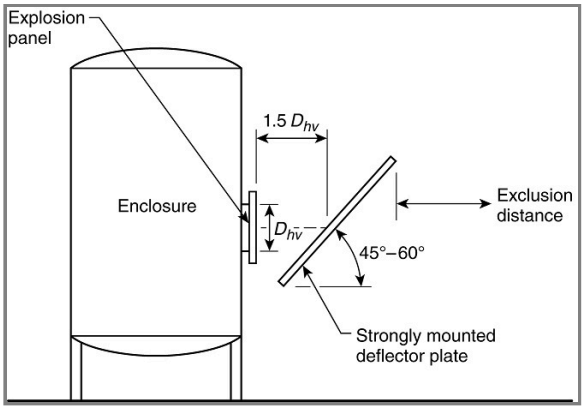
(3) The centerline of the deflector shall be coincident with the vent axis.

(4) The distance from the vent opening to the deflector on the vent axis shall be $1.5D_{hv}$, where D_{hv} is the vent's hydraulic diameter.

(5) The deflector plate shall be mounted so as to withstand the force exerted by the vented explosion, calculated as P_{red} times the deflector area.

(6) The deflector location shall not interfere with the operation of hinged vent closures.

Figure 6.6.2.4 Design for an Installation of a Blast Deflector Plate.



Statement of Problem and Substantiation for Public Input

The revised language clarifies that this deflector design may be credited with its full vent area.

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Committee: EXL-AAA

Public Input No. 12-NFPA 68-2026 [New Section after 6.6.2.5]

Integrated Explosion Vent Deflector

6.6.2.6 A deflector design which has a deflecting mechanism integrated to the explosion vent downstream side shall meet all of the following criteria:

(1) An integrated explosion vent deflector shall be performance tested to establish its reduced effective vent area arising from the restraint of full explosion vent opening.

(2) An integrated deflecting mechanism shall be installed according to the manufacturers installation instructions to achieve the intended modification in both flame and pressure wave discharge path.

(3) The integrated deflector mechanism shall be designed for the Pred of the application.

Statement of Problem and Substantiation for Public Input

Explosion vent deflection devices that are integrated to the downstream side of an explosion vent rely upon interference between the explosion vent and the deflector, something that is not permitted under current 6.6.2.4(6). Integrated vent deflectors provide the owner / operator with a convenient alternative to the arrangement shown in Figure 6.6.2.4. The addition of paragraph 6.6.2.6 provides guidance on the use of this technology.

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Public Input No. 3-NFPA 68-2023 [Section No. 8.2.1.3]

8.2.1.3

The following limitations shall be applicable to 8.2.1:

(1) 5 bar-g ≤ P_{max} ≤ 12 bar-g

(2) 10 bar-m/s ≤ K_{St} ≤ 800 bar-m/s

(3) 0.1 m^3 ≤ V ≤ 10,000 m^3

(4) P_{stat} ≤ $P_{initial}$ + 0.75(1 + $P_{effective}$) bar-g when $P_{initial}$ is >0.2 bar-g

(5) P_{stat} < 0.75 bar-g when $P_{initial}$ is ~~<0~~ <=0 .2 bar-g

Statement of Problem and Substantiation for Public Input

I wanted to point out that there is an issue in paragraph 8.2.1.3 in NFPA 68 (2023) with respect to the limits on Pstat. The limits are given if Pinitial is either greater than or less than 0.2 barg, but it isn't stated what limit should be used on Pstat if Pinitial is equal to 0.2 barg. This is a minor point, but should be at least fixed in the next update. This issue was also in the 2018 version of 68. I edited the limit to be <= to 0.2 barg, but I'm not sure if that is the proper fix to the problem.

Submitter Information Verification

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Submittal Date: Tue Mar 28 10:20:07 EDT 2023
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Public Input No. 5-NFPA 68-2025 [New Section after 8.8.4]

8.8.5 Bucket Elevators Handling Agricultural Products

8.8.5.1 This subsection shall apply to bucket elevators handling agricultural products with a specific K_{st}.

8.8.5.1.1 Agricultural products shall have a $K_{st} \leq 100$ barm/s

8.8.5.1.2 Agricultural products with $K_{st} > 100$ barm/s shall use the venting methodology in sections 8.8.2 through 8.8.4.

8.8.5.2 The casing(s), head, and boot shall all be designed for a minimum P_{red} of 0.19 bar-g.

8.8.5.3 Head Vents

8.8.5.3.1 The vent area shall be a minimum of 0.46 m^2 per 2.83 m^3 of head section volume.

8.8.5.3.2 The vents shall be located directly in the head section.

8.8.5.4 Additional Casing Vents

8.8.5.4.1 Additional vents shall be installed in each casing at a center-to-center spacing distance along the elevator axis at a maximum of 6 meters along the casing of the leg.

8.8.5.4.2 Vent area shall be a minimum of 4/3 the cross-sectional area of each leg.

8.8.5.4.3 Vent area shall be permitted to be distributed across two vents at each location on the leg.

8.8.5.4.4 Casing vent(s) shall be fitted as close as practicable to the boot.

8.8.5.4.5 Casing vent(s) shall be installed at a distance of no less than 6 meters from the boot.

8.8.5.5 Vent closures shall have P_{stat} less than or equal to 0.07 bar-g.

Type your content here ...

Statement of Problem and Substantiation for Public Input

Venting methodologies exist in NFPA 660 that should be implemented in NFPA 68 where they belong. The methodology shown in the new proposed 8.8.5 is based on the NFPA 660 21.9.4.14.2 and 21.9.4.14.3 with inclusions of missing critical design criteria from the original research effort that the design basis was based upon.

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Public Input No. 1-NFPA 68-2023 [Section No. 8.10.1]

8.10.1

Where bin vents (air material separators) are installed in common with a silo or any other storage vessel, they shall be protected as follows:

(1) The protected volume shall be calculated as the sum of the volume of the silo and the volume of the collector in accordance with Section 8.7.

(2) The *L/D* of the combination shall be calculated based on the dimensions of the silo alone in accordance with Section 6.4.

(3) Vent panels shall be located on the silo top surface or on the side walls above the maximum level of the contents of the silo.

(4) It shall be permitted to locate a portion of the venting on the bin vent surface in accordance with the following proportions:

$$A_{v,bin\ vent} = A_{v,\ total} - A_{v,silo\ min} \qquad \textbf{[8.10.1a]}$$

$$A_{v,silo\ min} = \left(\frac{V_{silo}}{V_{total}} \right)^{2/3} A_{v,\ total} \qquad \textbf{[8.10.1b]}$$

where:

$A_{v,bin\ vent}$ = vent area of the bin vent/collector

$A_{v,\ total}$ = total vent area calculated for the bin vent–silo combination

$A_{v,\ silo\ min}$ = minimum ~~explosion~~ deflagration venting area required to be on the silo

$A_{v,\ silo}$ = actual ~~explosion~~ deflagration venting area installed on the silo

Statement of Problem and Substantiation for Public Input

Explosion vent is the historical usage, circa 1970-1990. The NFPA 68 committee has been moving towards deflagration vent for a while. The NFPA 68 committee should consider a global change to replace the remaining “explosion vent” or “explosion venting” terms with deflagration vent or deflagration venting, respectively.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 2-NFPA 68-2023 [Global Input]	

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Public Input No. 14-NFPA 68-2026 [New Section after 11.4.5]

11.4.6

In the absence of explosion relief device information according to 11.4.4, the owner / operator shall remove the unidentified device from service and replace it with an appropriately sized, constructed, and identified item.

Statement of Problem and Substantiation for Public Input

Explosion vent devices can have their identification obscured or removed in service leading to uncertainty regarding the integrity of the safety system. The new section gives clear remedial instruction to the owner / operator in the case of loss of safety device traceability.

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Submittal Date: Tue Jan 06 17:47:24 EST 2026
Committee: EXL-AAA

Public Input No. 10-NFPA 68-2026 [Section No. 11.9.3]

11.9.3

The management of change procedures shall ensure that the following issues are addressed prior to any change:

(1) The technical basis for the proposed change

(2) Safety and health implications

(3) Review of fire and explosion prevention systems

(4) Whether the change is permanent or temporary

(5) Personnel exposure changes

(6) Modifications to operating maintenance procedures

(7) Employee training requirements

(8) Authorization requirements for the proposed change

(9) In the case of a vented explosion, verification that the flame and pressure wave path is safe & without obstruction

Statement of Problem and Substantiation for Public Input

The additional application consideration of vent trajectory prompts the owner / operator to consider that a safe and effective relief path is present. The discharge environment of an explosion vent is easily neglected - often installation activity is conducted by parties not involved in the original vent sizing & vent placement. Including this additional requirement in the Management Of Change section gives an additional opportunity for the owner / operator to make the right overall design decisions.

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Submittal Date: Tue Jan 06 16:47:39 EST 2026

Committee: EXL-AAA

Public Input No. 9-NFPA 68-2026 [Section No. A.6.1.2.3]

A.6.1.2.3

Recent testing [Add References here] has shown that certain metal dusts exhibit K_{St} values that are significantly larger in 1 m^3 tests than in 20 L tests. There is evidence of nonconservative vent area predictions for aluminum, when based on 20 L tests, while silicon vent area is overpredicted. It is currently hypothesized that flame temperature is a significant related parameter and it is therefore considered appropriate to require either testing in the larger 1 m^3 vessel or application of a safety factor to 20 L results for aluminum, hafnium, magnesium, tantalum, titanium, zirconium, and similar alloys or mixtures. These metals all have maximum adiabatic flame temperatures higher than 3300°C, whereas the calculated adiabatic flame temperature for silicon is 2970°C (NFPA 484 Table A.1.3(a)). The factor of 2 adjustment is based on the comparison of optimum K_{St} values for aluminum in 1 m^3 and 20 L tests. Until more information is available, K_{St} results for aluminum, hafnium, magnesium, tantalum, titanium, zirconium, and similar alloys or mixtures in smaller test vessels are adjusted to provide additional confidence in application of the design methods. It is possible that the adjusted 20 L value will exceed the actual K_{St} when measured in the 1 m^3 vessel and, where available, the measured K_{St} should be used. If the adjusted K_{St} value exceeds 800 bar-m/s, testing in a 1 m^3 vessel is recommended because this exceeds the limitations of the dust venting equations. Representative samples should be collected before the metals undergo significant surface oxidation, and the sample should be preserved in suitable inert gas or vacuum packaging until tested. *(See Table A.6.1.2.3.)*

Table A.6.1.2.3 Determining K_{St} and P_{max} for Aluminum, Hafnium, Magnesium, Tantalum, Titanium, Zirconium, and Similar Alloys or Mixtures

Multiply K_{St} from 20 L sphere tests by a factor of 2 AND use P_{max} from 20 L sphere tests
Or use K_{St}/P_{max} from 1 m^3 vessel tests

Proposal: add proper references for this paragraph.

This paragraph was added following a presentation entitled "Scaling-up metal dusts explosion severity" that was given to the Explosion Protection Systems committee at the NFPA Headquarters in Quincy (September 9th, 2015).

This work has been published since then, and can be referenced as follows:

Taveau, J., Lemkowitz, S., Hochgreb, S., Roekaerts, D. (2018). Scaling up the severity of metal dusts deflagrations. Proceedings of the Twelfth International Symposium on Hazards, Prevention, and Mitigation of Industrial Explosions (XII ISHPMIE), Kansas City, USA, pp. 99-122, ISBN 978-1-5323-8443-1 .

Taveau, J., Lemkowitz, S., Hochgreb, S., Roekaerts, D. (2019). Metal dusts explosion hazards and protection. Chemical Engineering Transactions, Volume 77, 7-12.

Statement of Problem and Substantiation for Public Input

Statements in A.6.1.2.3 lack proper reference/evidence.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 8-NFPA 68-2026 [Section No. 6.1.2.3]	

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Committee: EXL-AAA

Public Input No. 4-NFPA 68-2025 [Section No. A.6.6.2.4]

A.6.6.2.4

Using this design, deflectors are not permitted to be installed at the exit of a vent duct (i.e., indoor vessel vented to the outdoors through duct).

Other deflector designs are possible, but design information is not available at this time. An alternative could be to use a vent duct consisting of a long radius elbow, accounting for the effect of vent area according to Chapter 8 for dusts. A vertical barrier wall could result in higher P_{red} or larger radial hazard distance than an angled deflector, and no design guidance can be given.

Statement of Problem and Substantiation for Public Input

Additional annex language here would help to clarify the intent of the design. It has been observed during dust hazard analyses (DHAs) the misapplication of deflector plates such that the deflector is installed at the outlet of a vent duct which allows for indoor vessels to be vented outdoors. The new language in the annex would aid in clearly communicating that such an installation is not permitted under the current design basis language.

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Submittal Date: Thu Aug 21 16:03:22 EDT 2025
Committee: EXL-AAA

Public Input No. 18-NFPA 68-2026 [New Section after A.7.2.6.1]

A 7.3.1

Mechanical ventilation systems used to control or limit the combustible gas concentrations within the enclosure volume should comply with the Deflagration Prevention by Combustible Concentration Reduction system requirements of NFPA 69, except for the combustible concentration limits of NFPA 69 Section 8.3.1.

Statement of Problem and Substantiation for Public Input

Section 7.3.1 appears to allow justification for using standard HVAC systems serving a room to reduce combustible gas concentration within the enclosure. However, such systems do not provide the same operational reliability and performance assurances as a NFPA 69 compliant design. Furthermore, NFPA 69-compliant systems are subject to mandatory inspection and maintenance requirements prescribed by code, whereas standard HVAC systems are not held to these same obligations.

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Submittal Date: Wed Jan 07 15:36:01 EST 2026
Committee: EXL-AAA

Public Input No. 17-NFPA 68-2026 [Section No. A.8.5]

A.8.5

The flow resistance coefficient K for the vent duct correlation is defined on the static pressure drop, ΔP, from the enclosure to the duct exit at a given average duct flow velocity, U:

$$K \equiv \frac{\Delta P}{\frac{1}{2} \cdot \rho \cdot U^2} \qquad \textbf{[A.8.5a]}$$

Another convention used by some reference books is to define K on the total pressure drop or on another velocity scale. The user should ensure that the loss coefficients used in the calculations are consistent with the definition of K adopted for the vent duct calculations. See Ural [114] for additional information.

The user should note that inlet loss can vary depending on the shape of the vent closure attachment to the vessel; however, most typically a flush inlet would be appropriate. Figure A.8.5(a) shows the loss coefficient for two different inlet designs as well as a plain duct outlet. Rain hats or other outlet covers provide additional resistance as in Figure A.8.5(d). In regard to using a rain hat, a designated safety zone surrounding the rain hat should be defined. In utilizing a stationary rain hat, the device may redirect the flame and pressure wave back towards the protected enclosure or structure, thus requiring consideration of a safe zone that accounds for this deflection of the vented relief stream.

Figure A.8.5(a) Loss Coefficients for Inlets and Plain Duct Outlet.

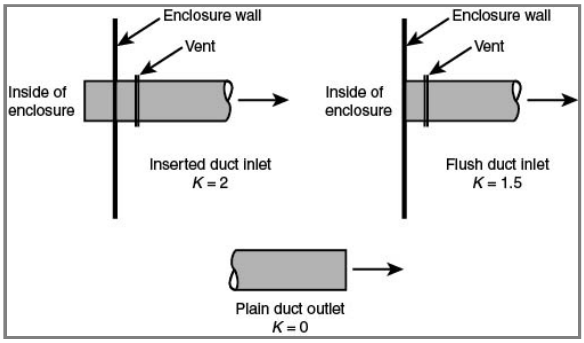
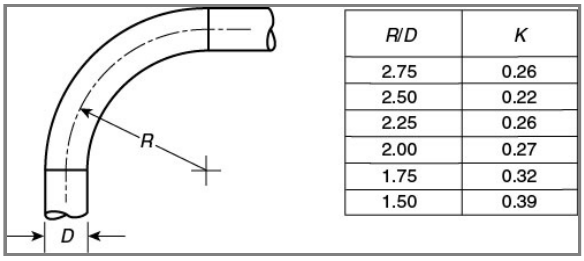


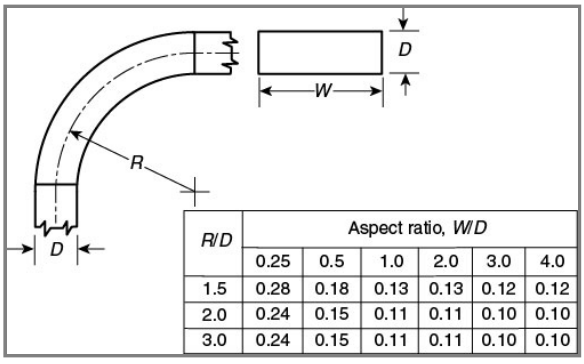
Figure A.8.5(b) shows a round elbow and loss coefficients for various radii of curvature. Figure A.8.5(c) shows a rectangular elbow and loss coefficients for various duct aspect ratios and radii of curvature. Loss coefficients for 45 degree bends and 30 degree bends are proportionally less than the tabulated 90 degree bends. Figure A.8.5(d) provides loss coefficients for a typical rain hat design. [123]

Figure A.8.5(b) Loss Coefficients for Round Elbows.



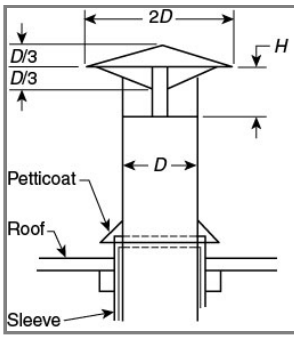
R/D	K
2.75	0.26
2.50	0.22
2.25	0.26
2.00	0.27
1.75	0.32
1.50	0.39

Figure A.8.5(c) Loss Coefficients for Square and Rectangular Elbows.



R/D	Aspect ratio, W/D					
	0.25	0.5	1.0	2.0	3.0	4.0
1.5	0.28	0.18	0.13	0.13	0.12	0.12
2.0	0.24	0.15	0.11	0.11	0.10	0.10
3.0	0.24	0.15	0.11	0.11	0.10	0.10

Figure A.8.5(d) Loss Coefficients for Rain Hats.



H No. of Diameters	K
1.0 D	0.10
0.75 D	0.18
0.70 D	0.22
0.65 D	0.30
0.60 D	0.41
0.55 D	0.56
0.50 D	0.73
0.45 D	1.0

The equations are nonlinear and, under certain combinations of input values, result in two possible solutions for vent area for a given P_{red}. The lower value of vent area is the meaningful solution, and the upper value is an artifact of the form of the equation set. There are certain combinations of P_{red} and vent duct length where no vent area is large enough and no solution is obtainable. When that occurs, it could be possible to vary P_{red} or vent duct length to converge to a solution. If that solution is not satisfactory, NFPA 69 can provide alternatives.

There is a minimum value for P_{red} as vent area increases, beyond which solutions are not meaningful. That value occurs approximately when the volume of the duct exceeds a fraction of the volume of the vessel. When solving the equations, constraining A_{vf} as follows will typically isolate the smaller root:

$$\frac{A_{vf} \cdot L_{duct}}{V} \leq 1 \qquad \textbf{[A.8.5b]}$$

For the following input values, Figure A.8.5(e) illustrates the potential solutions:

V = 500 m^3

P_{max} = 8.5 bar-g

K_{St} = 150 bar-m/s

P_{stat} = 0.05 bar-g

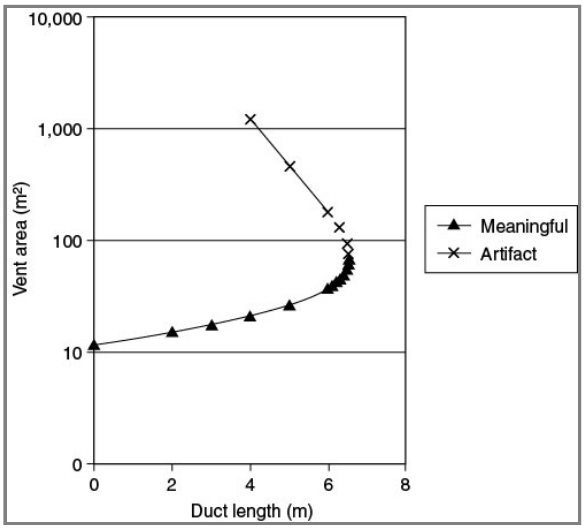
P_{red} = 0.5 bar-g

Vessel L/D = 4

ε = 0.26 mm

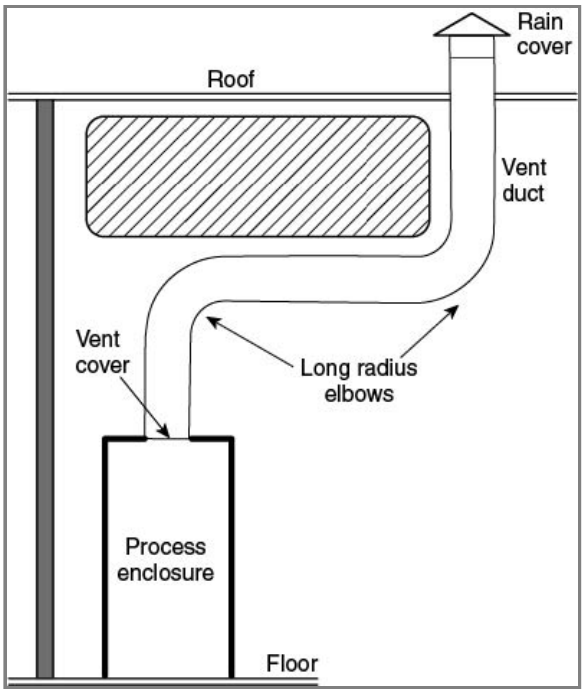
Straight duct, no elbows, fittings, or rain hats.

Figure A.8.5(e) A_v vs. Duct Length.



Example problem. Given Figure A.8.5(f) and the following conditions, calculate P_{red}:

Figure A.8.5(f) Example Vent Duct Installation.



Enclosure volume, V = 25 (m^3)

Enclosure L/D = 4

Vent diameter, D_V = 1.5 (m)

Duct diameter, D_h = 1.5 (m)

A_V = 1.77 (m^2)

P_{stat} = 0.25 (bar-g)

K_{St} = 200 (bar-m/s)

P_{max} = 8 (bar-g)

L_{duct} = 12 (m)

Duct effective roughness, ε = 0.26 (mm)

Elbows = 2 × 90 degrees, long radius (R/D = 1.5)

Elbow flow resistance = 2 × 0.39 = 0.78 [see Figure A.8.5(b)]

Rain hat flow resistance = 0.73 [H = 0.5D, see Figure A.8.5(d)]

While Section 8.5 provides the equations in a form to calculate the vent area based on an allowable P_{red}, this example shows how to determine the resulting P_{red} for a given vent area. In general, such calculations will be iterative. These input parameters are provided for demonstration purposes. Ural [114] can be referenced for additional discussion on how they were selected.

Solution:

(1) Compute the friction factor for the problem. For practically all vent ducts, the Reynolds number is so large that a fully turbulent flow regime will be applicable. In this regime, the friction factor is only a function of the ratio of the internal duct surface effective roughness (ε) to duct diameter. The duct friction factor can thus be calculated using a simplified form of the Colebrook equation:

$$f_D = \left\{ \frac{1}{\left[1.14 - 2 \log_{10} \left(\frac{\varepsilon}{D_h} \right) \right]} \right\}^2 \qquad \text{[A.8.5c]}$$

The effective roughness for smooth pipes and clean steel pipes is typically 0.0015 mm and 0.046 mm, respectively. Recognizing that the pipes used repeatedly in combustion events could be corroded, a value of ε = 0.26 mm is assumed.

From Equation A.8.5c, f_D = 0.013:

$$\text{then } \frac{f_D \cdot L_{duct}}{D_h} = \frac{0.013 \cdot 12}{1.5} = 0.107, \text{ and}$$
$$K = K_{inlet} + \frac{f_D \cdot L_{duct}}{D_h} + K_{elbows} + K_{outlet} \quad \text{[A.8.5d]}$$
$$K = 1.5 + 0.107 + 0.78 + 0.73 = 3.117$$

where:

K = 3.117

K_{inlet} = 1.5 [static pressure loss for flush duct entry, see Figure A.8.5(a)]

K_{elbows} = 0.78

K_{outlet} = 0.73

(2) Assume a P_{red} value of 1 bar-g. The solution is iterative, where the assumed value of P_{red} is replaced with the calculated value of P_{red} until the two values substantially match. A 1 percent difference between iterations is typically considered acceptable convergence.

(3) From Equation 8.2.1.1:

$$A_{v0} = 1 \cdot 10^{-4} \cdot \left[1 + 1.54 \cdot (0.25)^{4/3}\right] \cdot 200 \cdot (25)^{3/4} \cdot \sqrt{\frac{8}{P_{red}} - 1} \quad \text{[A.8.5e]}$$
$$A_{v0} = 0.735 \text{ m}^2$$

(4) From Equation 8.2.2.3:

$$A_{v1} = 0.735 \cdot \left[1 + 0.6 \cdot (4-2)^{0.75} \cdot \exp(-0.95 \cdot P_{red}^2)\right] \quad \text{[A.8.5f]}$$
$$A_{v1} = 1.02 \text{ m}^2$$

(5) From Equation 8.5.1b, and using the intended vent area of 1.77 m^2:

$$E_1 = \frac{1.77 \cdot 12}{25} \quad \text{[A.8.5g]}$$
$$E_1 = 0.85$$

(6) From Equation 8.5.1c, and using the installed vent area of 1.77 m^2:

$$E_2 = \frac{10^4 \cdot 1.77}{\left[1 + 1.54 \cdot (0.25)^{4/3}\right] \cdot 200 \cdot (25)^{3/4}} \quad \text{[A.8.5h]}$$
$$E_2 = 6.37$$

(7) From Equation 8.5.1a, with A_{V4} equal to A_{V1}, assuming no increase for turbulence, inertia, or partial volume:

$$A_{vf} = (1.02) \cdot \left[1 + 1.18 \cdot (0.85)^{0.8} \cdot (6.37)^{0.4}\right] \cdot \sqrt{\frac{3.117}{1.5}}$$
$$A_{vf} = 4.67 \text{ m}^2$$ [A.8.5i]

(8) Because the calculated value of A_{vf} is not equal to the installed vent area, go back to Step 2, and change P_{red} until the A_{vf} calculated in Step 7 is equal to the specified vent area of 1.77 m^2. A trial-and-error process (or the goal seek button in Excel) satisfies the requirement in Step 8 when P_{red} = 2.72 bar-g.

(9) From 8.5.9, Equation A.8.5j and Equation A.8.5k show that there is no deflagration-to-detonation-transition (DDT) propensity for this particular application:

$$L_{eff} \le \min\left[\frac{10{,}000 \cdot 1.5}{200}, \frac{11{,}000}{200}\right]$$
$$L_{eff} \le \min\ [75, 55]$$
$$\le 55$$ [A.8.5j]

$$L_{dusty} = (8 - 2.723) \cdot \frac{25}{1.77}$$
$$= 74.5 \text{ m}$$ [A.8.5k]

Because L_{duct} = 12 m, L_{eff} = min [12, 75] = 12 m ≤ 55 m. Therefore, DDT is not expected.

Statement of Problem and Substantiation for Public Input

The stationary rain hat example in the current Annex material would deflect the combustion event back towards the protected container or structure. The added language reminds the safety system designer and owner / operator to account for the deflection of the expected flame and pressure wave by defining a safety zone.

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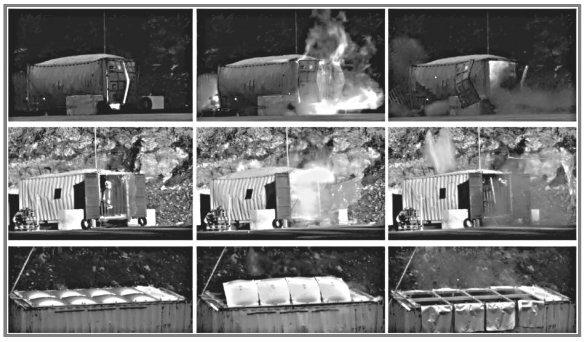
K.4 Vented Container Tests.

Figure K.4 shows video frames from three vented container tests.

The top series of frames is from the 24 vol % hydrogen test. The middle series of frames is from a 21 vol % hydrogen test, which produced a peak pressure of 0.94 bar-g (13.6 psig). The bottom series of frames is from a test with 21 vol % hydrogen and venting through the container roof via the installed vent panes. The peak pressure in the last test was 0.234 bar-g (3.39 psig).

NFPA 855 - 2026 provides direction with respect to the explosion venting of Containers used for Stationary Energy Storage Systems, so called BESS units (Battery Energy Storage Systems).

Figure K.4 Vented Container Tests. ***(Courtesy of T. Skjold et al., "Influence of Congestion on Vented Hydrogen Deflagrations in 20-foot ISO Containers: Homogeneous Fuel-Air Mixtures," 26th ICDERS, 2017.)***



Statement of Problem and Substantiation for Public Input

While NFPA 68 provides specific vent sizing direction for both dusts and gases, NFPA 855 has additional requirements and exceptions with respect to the use of explosion venting of Stationary Energy Storage Systems. The safety system designer and owner / operator of such equipment should be guided to the appropriate use of both NFPA Standards.

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