

BUCKET ELEVATORS

TYPICAL INDUSTRIES SERVED

- Agricultural
- Chemical
- Wood Processing
- Power
- Food

INTRODUCTION

Bucket elevators are among the most common conveyors used for making vertical lifts of bulk materials. The materials being conveyed can vary over a wide range of sizes, from powders to pellets. Most of these bulk materials inherently produce dusty conditions within the bucket elevators, creating explosion hazards.

In the grain storage and handling industry, the bucket elevator is ranked among the most likely to experience a deflagration. Good housekeeping and explosion prevention strategies have reduced the average number of explosions per year, but do not mitigate the destructive effects of explosions that do occur.

The purpose of this Application Profile is to provide a better understanding of the possible explosion hazards and protection solutions for bucket elevators when handling combustible materials. This document is intended to be a guideline and is not applicable to all situations. If you have any questions, please contact Fike Explosion Protection Technical Support or the Fike sales outlet in your area.

THE PROBLEM: DEFLAGRATION (EXPLOSION)

Dust suspension is generated due to the conveyance mechanics and material characteristics, creating explosive concentrations during product feed and discharge. All that is needed for an explosion to occur is an ignition source such as a hot surface, fire, sparks or embers. Upon ignition, the deflagration can propagate throughout the elevator enclosure to other connected process equipment and, in some instances, into the immediate surrounding area of the elevator enclosure, leading to secondary explosions within the facility.

THE SOLUTION: EXPLOSION VENTING/SUPPRESSION/ISOLATION

Preventative strategies such as bearing temperature and belt alignment monitoring, metal detectors, or spark extinguishing systems, are often employed. These methods, while affective at reducing the frequency of explosions, are not intended to reduce the consequences of an explosion. Explosion protection methods that follow NFPA Standards, eliminate or reduce the destruction consequences to the facility and equipment. Protecting the facility structure and the integrity of the equipment also significantly improves safety to personnel. The correct explosion protection strategy for any application depends on the explosion protection objectives of the owner, regulatory guidance for design, acceptance by authorities having jurisdiction, economic impact of an event and the corrective action project expense. The most widely accepted and recognized options include deflagration venting or suppression to protect the bucket elevator, coupled with isolation to prevent propagation to connected equipment.



Figure 1:
Bucket Elevator with Explosion Vents

Form No. EAP 1008

Explosion (Deflagration) Venting

Venting is the most widely accepted and utilized explosion protection strategy. A comprehensive guidance for venting of bucket elevators is outlined in NFPA 61, Standard for the Prevention of Fires and Dust Explosions in Agricultural and Food Products Facilities. This standard specifies vents to be located at intervals no greater than 20 ft. along the casing. Vents are to be installed on each side of the casing with a minimum area per vent equal to $\frac{2}{3}$ the casing cross section. The head must also be vented with an area of 5 ft² (square feet) for every 100 ft³ (cubic feet) of head volume. Refer to NFPA 61, Factory Mutual 7-76, NFPA 68 and NFPA 654 for further design guidance. It is extremely important to evaluate the safe application of the explosion venting solution. Explosion venting can be expected to release a flame discharge and pressure path during a deflagration event. This event must be evaluated against the plant site's location of driveways/sidewalks, as well as exposure to other combustible materials. Personnel access to vent release areas must be considered and restricted within the operation procedures and general daily duties.

Features and Benefits of Fike Explosion Vents:

- Tested under actual large scale explosion tests to verify performance as designed and manufactured
- Engineered to include the most desirable performance characteristics for best industry practices:
 - Low mass
 - Cyclic pressure capable
 - Vacuum resistant
 - Certified burst pressures (P_{stat})
 - Full opening
 - Non-fragmenting (with restraints not necessary)
- No moving parts and fail safe design for greater reliability
- Low product cost, simple installation requirements, and long service life
- High mechanical integrity for longer service life
- Weather covers, burst indicators, thermal insulation and vacuum bar options available

Flameless Explosion Venting

Explosion vents are one of the most economic, practical and convenient solutions to prevent explosions from reaching their potential maximum pressures. However, it is often necessary to locate process equipment indoors, making venting difficult, if not impossible - free venting is not permitted and the flame must be ducted outdoors or passed through a flame arresting device. These devices relieve pressure, retain particulates and prevent the release of flame.

Fike's EleQuench is a flameless venting device specifically developed for elevator casings and does not require proximity to walls or the roof.

Features and Benefits of EleQuench include:

- Flame is prevented from entering the work area
- Particulates are retained within the unit
- Integral frame and gasket provide easy, no-weld, 6-bolt installation
- Tested under full-scale explosion conditions
- Additional venting area is not required
- Easy installation by plant personnel, reducing

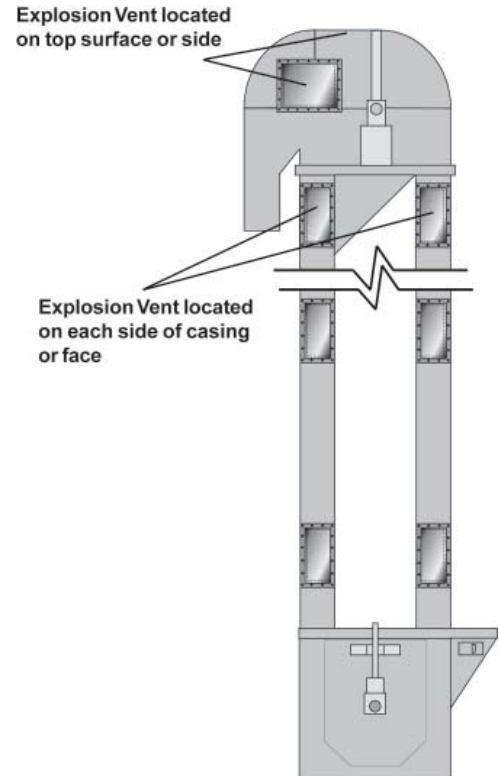


Figure 2:
Bucket Elevator with Explosion Venting

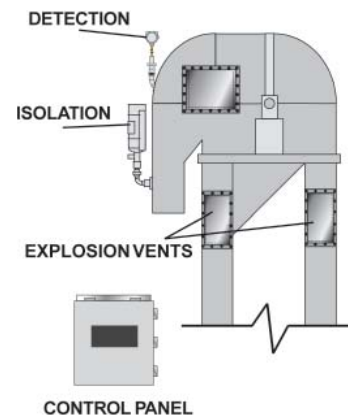


Figure 3:
Bucket Elevator with Explosion Venting
and Chemical Isolation

Explosion Suppression

Explosion suppression is most widely used for bucket elevators located indoors. It provides additional protection benefits when compared to venting or flameless venting. For specific explosion suppression hardware requirements refer to NFPA 69.

Features and Benefits of Fike explosion suppression systems:

- Reduces the pressure of deflagration to protect enclosure integrity
- Extinguishes the flame within the bucket elevator, reducing fire damage potential
- Eliminates the flame release and greatly reduces the pressure path associated with explosion venting
- Provides compliance with NFPA explosion protection regulations
- Can be used in combination with explosion venting for the indoor section of the elevator enclosure
- Eliminates the discharge of toxic or hazardous materials outside of the elevator enclosure

Explosion Isolation

Explosion protection measures such as venting, flameless venting or explosion suppression of the primary enclosure must include the addition of Explosion Isolation. Isolation, placed on the feed, discharge spouts or aspirating ducts prevents flame from propagating to interconnected equipment. NFPA 654 states that isolation devices shall be provided to prevent deflagration propagation between pieces of equipment connected by ductwork. The design of the isolation shall be in accordance with NFPA 69. Factory Mutual 7-76 requires explosion isolation where the elevator head or boot feeds into equipment or areas which have an explosion hazard.

Chemical Explosion Isolation is achieved through a rapid discharge of a chemical explosion suppressant which prevents the flame from continuing through to other areas of a process system. An explosion detector initiates the release of the extinguishing agent when it detects a deflagration pressure or flame front -- preventing the propagation of flame and burning materials.

Features and Benefits of Fike's Chemical Isolation:

- Rapidly delivers suppressant agent, reducing overall pressure and damage to vessel
- Designed for easy maintenance
- Variety of suppressant agents protects against a wide range of hazards
- Easily recharged, minimizing downtime
- Low pressure monitoring and continuous system integrity supervision

CONCLUSION

Safety is no accident. With over 60 years of field experience and a team of in-house engineers, application specialists, and combustion researchers, Fike understands plant processes, relevant code compliance, and the critical nature of continued plant operation. Fike provides design assistance to determine the correct size, selection, and placement of all explosion protection systems and equipment.

Fike is the leader in bringing patented, innovative technologies to the explosion protection market. When considering explosion protection for your process, Fike is uniquely qualified as the total solutions provider.

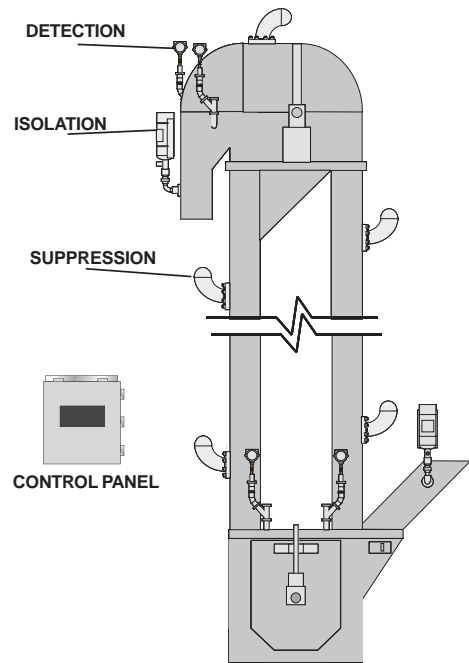


Figure 4:
Bucket Elevator with Explosion Suppression
and Chemical Isolation



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