

DUROVAC

HOW DUROVAC® HANDLES

Combustible Dust



3-6175 Tomken Rd Mississauga, ON L5T 1X5, Canada Toll Free 1-888-330-3365 Tel 905-624-4003 Fax 905-696-7359

www.durovac.com

COMBUSTIBLE DUST

Types of Material

If a company or a firm processes any of these products or materials, there is a potential for a combustible dust explosion.



NOTE: This list is not exhaustive. It is the owner's responsibility to test the dust in their processes.

Agricultural Products

Egg white
Milk, powdered
Milk, nonfat, dry
Soy flour
Starch, corn
Starch, rice
Starch, wheat
Sugar
Sugar, milk
Sugar, beet
Tapioca
Whey
Wood flour

Agricultural Dusts

Alfalfa
Apple
Beet root
Carrageen
Carrot
Cocoa bean dust
Cocoa powder
Coconut shell dust
Coffee dust
Corn meal
Cornstarch
Cotton
Cottonseed
Garlic powder
Gluten
Grass dust
Green coffee
Hops (malted)
Lemon peel dust
Lemon pulp

Linseed
Locust bean gum
Malt
Oat flour
Oat grain dust
Olive pellets
Onion powder
Parsley (dehydrated)
Peach
Peanut meal and skins
Peat
Potato
Potato flour
Potato starch
Raw yucca seed dust
Rice dust
Rice flour
Rice starch
Rye flour
Semolina
Soybean dust
Spice dust
Spice powder
Sugar (10x)
Sunflower
Sunflower seed dust
Tea
Tobacco blend
Tomato
Walnut dust
Wheat flour
Wheat grain dust
Wheat starch
Xanthan gum

Carbonaceous Dusts

Charcoal, activated
Charcoal, wood
Coal, bituminous
Coke, petroleum
Lampblack
Lignite
Peat, 22%H₂O
Soot, pine
Cellulose
Cellulose pulp
Cork
Corn

Chemical Dusts

Adipic acid
Anthraquinone
Ascorbic acid
Calcium acetate
Calcium stearate
Carboxy-methylcellulose
Dextrin
Lactose
Lead stearate
Methyl-cellulose
Paraformaldehyde
Sodium ascorbate
Sodium stearate
Sulfur

Metal Dusts

Aluminum
Bronze
Iron carbonyl
Magnesium
Zinc

Plastic Dusts

(poly) Acrylamide
(poly) Acrylonitrile
(poly) Ethylene
(low-pressure process)
Epoxy resin
Melamine resin
Melamine, molded
(phenol-cellulose)
Melamine, molded
(wood flour
and mineral filled
phenolformaldehyde)
(poly) Methyl acrylate
(poly) Methyl acrylate,
emulsion polymer
Phenolic resin
(poly) Propylene
Terpene-phenol resin
Urea-formaldehyde/
cellulose, molded
(poly) Vinyl acetate/
ethylene copolymer
(poly) Vinyl alcohol
(poly) Vinyl butyral
(poly) Vinyl chloride/
ethylene/vinyl
acetylene suspension
copolymer
(poly) Vinyl chloride/
vinyl acetylene
emulsion
copolymer

Source: OSHA, *Osha Combustible Dust Poster*, <http://www.osha.gov/>

NFPA – Brief History

The NFPA mission:

“To help save lives and reduce loss...”

Founded in 1896, NFPA is a global **nonprofit organization** devoted to eliminating death, injury, and property and economic loss due to **fire, electrical and related hazards**.¹

NFPA's **300 codes and standards** are designed to minimize the risk and effects of fire by establishing criteria for **building, processing, design, service, and installation** around the world.²



NATIONAL FIRE PROTECTION ASSOCIATION

The leading information and knowledge resource on fire, electrical and related hazards

1. <http://www.nfpa.org/about-nfpa>

2. <http://www.nfpa.org/about-nfpa/nfpa-overview>



Clarifications

**"Explosion Proof" and
"8 Cubic Feet Rule" explained.**

CLARIFICATIONS

Explosion Proof

Be aware that a **system protected against internal explosion** is different from an "explosion proof" vacuum!

"Explosion proof" vacuum system

- Hazard is OUTSIDE the machine
- Designed NOT TO BECOME the ignition source in an environment



Vacuum system protected against internal explosion

- Hazard is INSIDE the machine
- Will vent/suppress/contain and isolate the explosion inside the vessel



CLARIFICATIONS

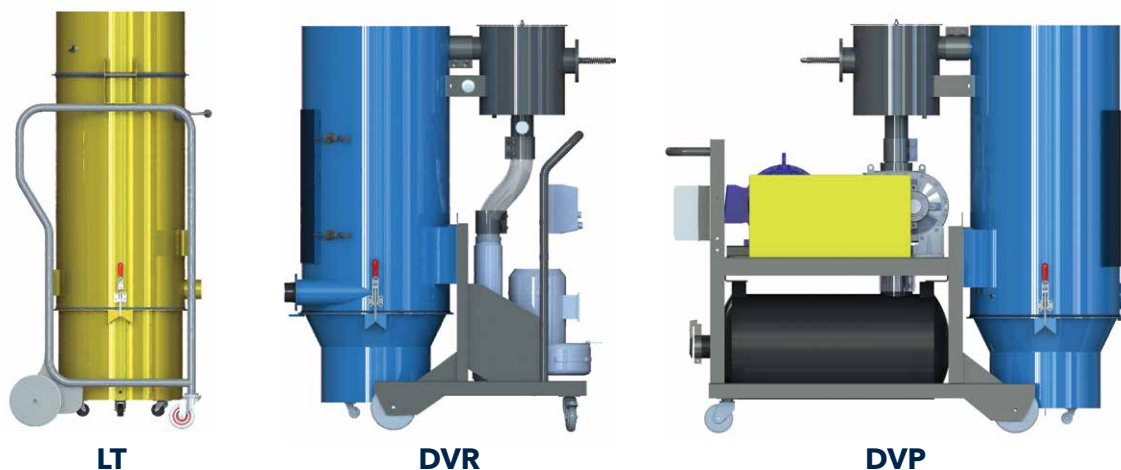
8 Cubic Feet Rule – Indoors or Outdoors?

NFPA 654¹

Section 9.3.13.1.1.1 & 9.3.13.1.1.2

"Where an explosion hazard exists, air-material separators...shall be located outside of buildings [unless they] have a dirty-side volume of less than 8 ft³ (0.2 m³)... [or] are protected in accordance with 9.7.1."

DIRTY-SIDE VOLUME < 8 FT³

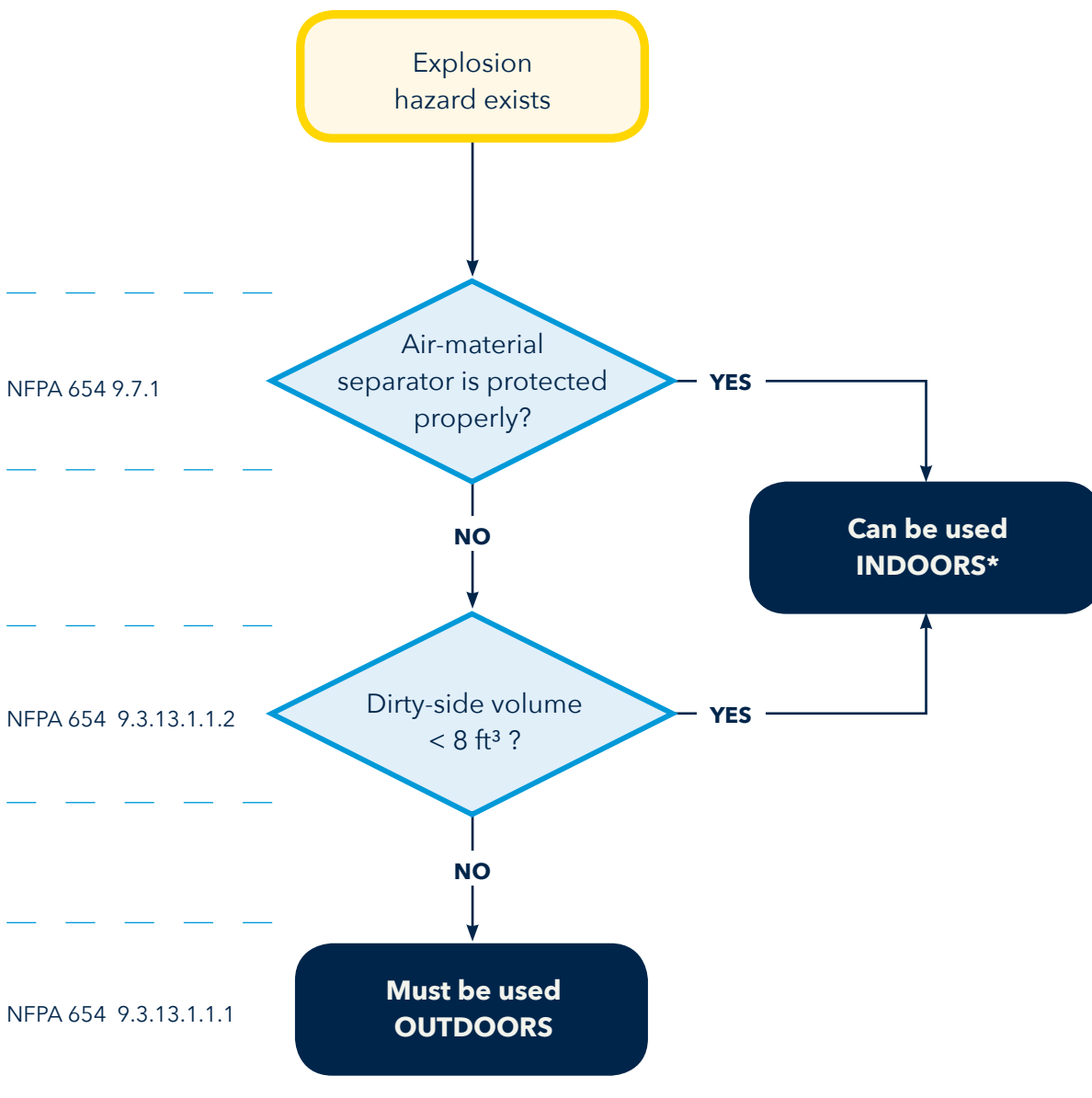


These systems can be used indoors.

1. Refer to NFPA 654 Edition 2020

CLARIFICATION

In other words...



*Certain explosion protection method require the system to be used outdoors (ex: deflagration vent). Read carefully NFPA Codes.

CLARIFICATIONS

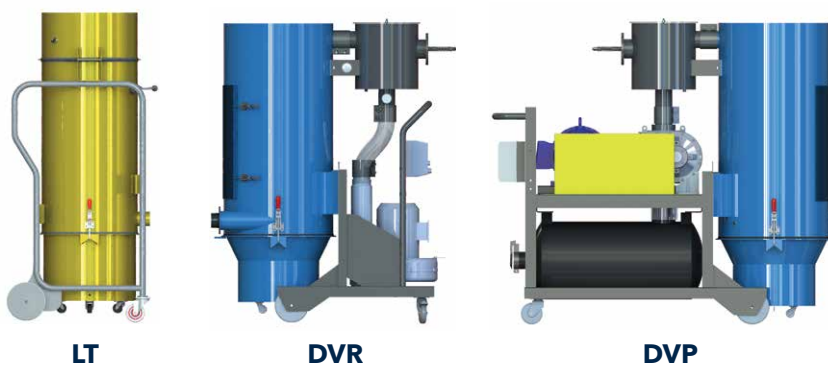
8 Cubic Feet Rule – Protection Needed?

NFPA 654¹

Section 9.3.13.1.2.2

"Where an explosion hazard exists, air-material separators with a dirty-side volume of 8 ft³ (0.2 m³) or greater shall be protected in accordance with 9.7.1."

DIRTY-SIDE VOLUME < 8 FT³



Protection not practical for these small systems.

DIRTY-SIDE VOLUME > 8 FT³



These systems **MUST BE PROTECTED** properly (9.7.1).

1. Refer to NFPA 654 Edition 2020



Things You Should Know

Explosion Protection Methods

Active vs Passive Isolation Techniques

Dust Hazard Analysis Due Date

THINGS TO KNOW

Explosion Protection

NFPA 654¹

Section 9.7.1

The five common methods of explosion protection:

1. **Containment** (NFPA 654/69)
2. **Inerting** (NFPA 654/69)
3. **Deflagration venting** (NFPA 68)
4. **Deflagration suppression** (NFPA 69)
5. **Deflagration isolation** (NFPA 69)
 - Active
 - Passive

DuroVac®
frequently uses
methods
1, 3, 4 & 5.

Active vs. Passive Isolation Techniques

Active

Requires detection, control, and a pneumatic or electrical response that creates an isolating barrier.

- Chemical barrier
- Fast-acting mechanical valve
- Externally actuated float valve
- Actuated pinch valve

Passive

Responds to the deflagration pressure to create the isolating barrier.

- Passive float valve
- Passive flap valve
- Rotary valve
- Dual butterfly valves

1. Refer to NFPA 654 Edition 2020

THINGS TO KNOW

Dust Hazard Analysis

NFPA 652¹

Section 7.1.1.1

"A DHA (Dust Hazard Analysis) shall be completed for all new processes and facility compartments."

Section 7.1.1.2

"For **existing processes and facility compartments**, a DHA (Dust Hazard Analysis) shall be completed by **September 7, 2020.** "



DHA Due Date:
September 7, 2020

**Dust Hazard Analysis shall be reviewed
and updated at least every 5 years.**

1. Refer to NFPA 652 Edition 2020



Four Examples

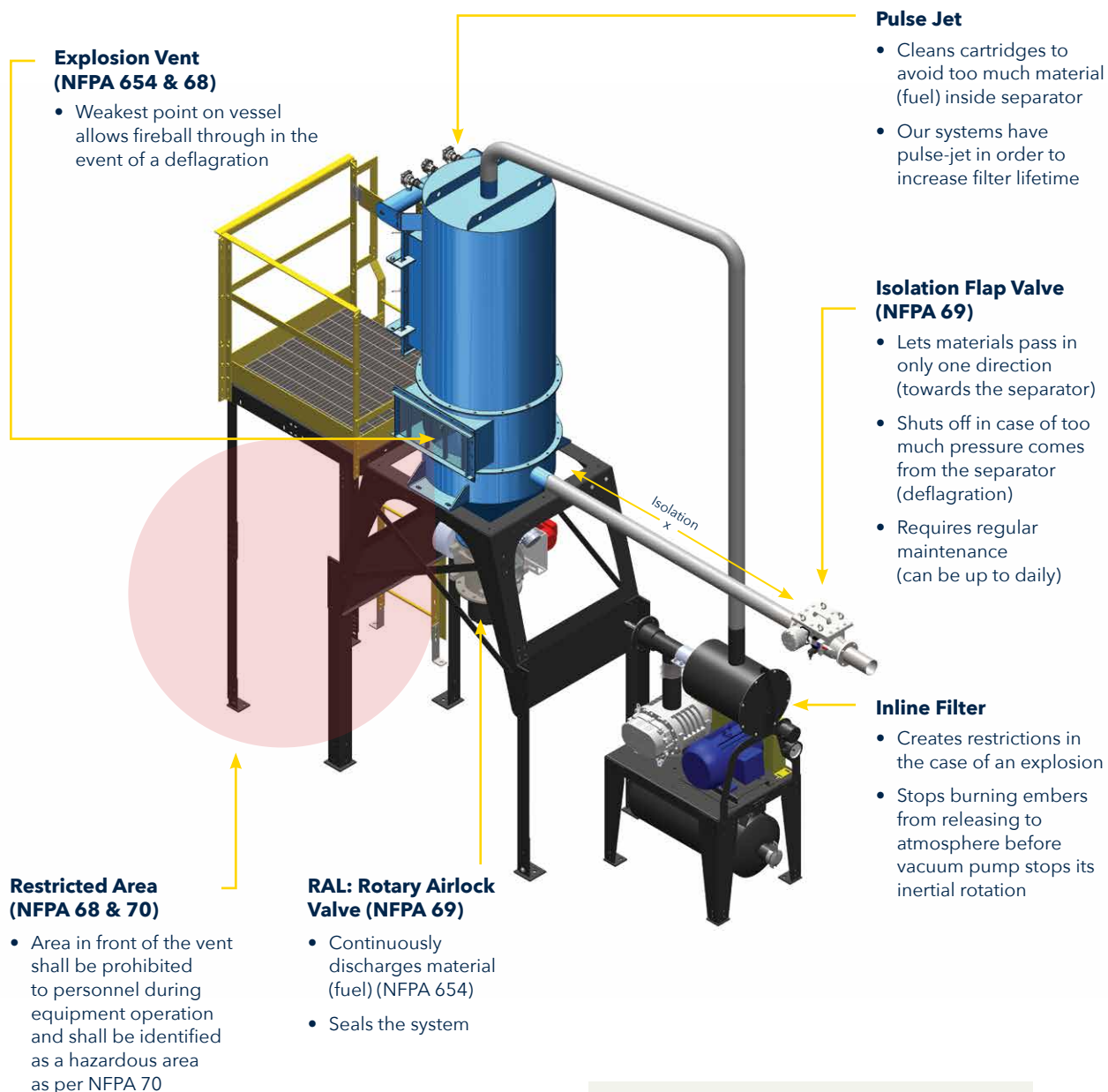
How DuroVac® systems can be equipped with specific devices in order to handle combustible dusts and how they comply with NFPA Codes.

EXAMPLE ONE

NFPA/ATEX-Compliant DuroVac® Central Vacuum System with *Passive* Devices



This type of system must be used **OUTDOORS**



Both NFPA-compliant continuous discharge valves AND an inline filter must be used for combustible dust.

EXAMPLE TWO

NFPA/ATEX-Compliant DuroVac® Central Vacuum System with **Active** Devices



This type of system may be used **INDOORS**

Suppression Bottle (NFPA 69 & 654)

- Inlet isolation
- Standard Rate Discharger (SRD)

RAL: Rotary Airlock Valve (NFPA 69)

- Continuously discharges material (fuel) (NFPA 654)
- Seals the system

Suppression Bottle (NFPA 69 and 654)

- Safety shut off gate
- High Rate Discharger (HRD)
- Receives signal from control panel to initiate the opening of the rupture disc
- Releases chemical agents into the separator

Pulse Jet

- Cleans cartridges to avoid too much material (fuel) inside separator
- Our systems have pulse-jet in order to increase filter lifetime

Inline Filter

- Creates restriction in the case of high pressure
- Stops burning embers from releasing to atmosphere before vacuum pump stops its inertial rotation

Pressure Detector (NFPA 69)

- Senses pressure wave
- Sends signal to control panel (in LESS than 1 millisecond)

Both NFPA-compliant continuous discharge valves AND an inline filters must be used for combustible dust.

EXAMPLE THREE

NFPA/ATEX-Compliant DuroVac® PowerLift *Portable* Vacuum System with a Flameless Vent



This type of system may
be used **INDOORS**

Pulse Jet

- Cleans cartridges to avoid too much material (fuel) inside separator
- Our systems have pulse-jet in order to increase filter lifetime

Flameless Vent (NFPA 68 & 654)

- Weakest point
- Releases pressure, without releasing flame
- If explosion, stops the machine

If the system is to be used as a **Portable, a flameless vent** must be used to counter the reaction force of an explosive "release". Only with a **bolted-down**, central vacuum frame may a system without a flameless vent be used.

Inline Filter

- Creates restriction in the case of explosion
- Stops burning embers from releasing to atmosphere before vacuum pump stops its inertial rotation

Restricted Area (NFPA 68 & 70)

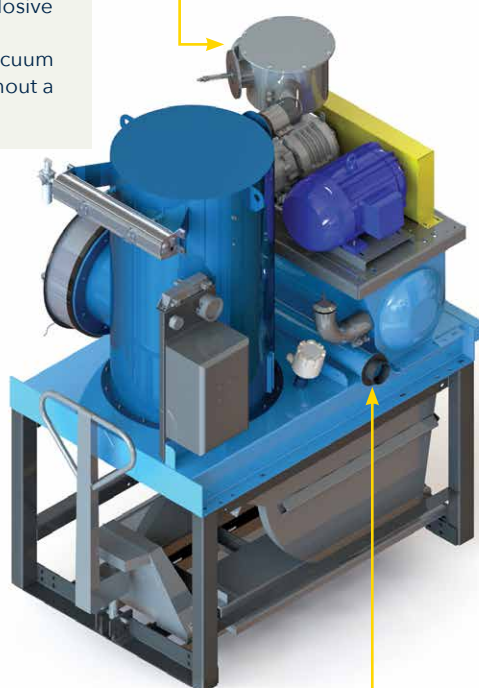
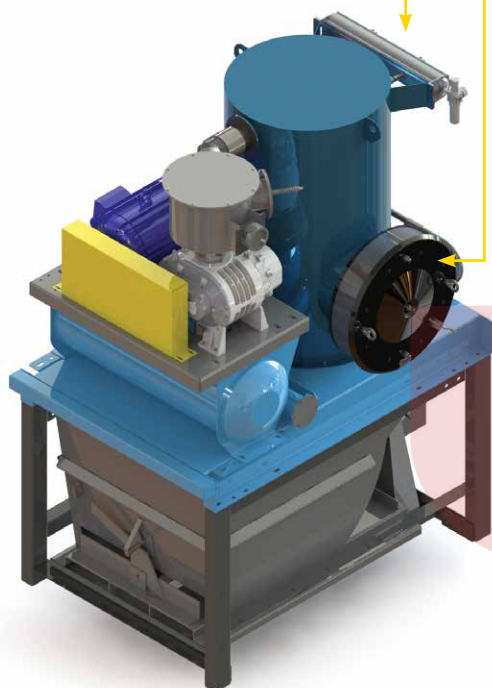
- Area in front of the vent shall be prohibited to personnel during equipment operation and shall be identified as a hazardous area as per NFPA 70



**Material K_{St}
must be < 160**

Inlet (NFPA 69)

- If inlet $\geq 4.0''$ OD, NFPA requires inlet isolation
- If inlet $< 4.0''$ OD, it is far less likely to provide a conduit for flame spread or to propagate a deflagration than larger diameters



EXAMPLE FOUR

NFPA/ATEX-Compliant DuroVac® Elevator™ *Portable* Vacuum System with a Flameless Vent



This type of system may
be used **INDOORS**

Pulse Jet

- Cleans cartridges to avoid too much material (fuel) inside separator
- Our systems have pulse-jet in order to increase filter lifetime

Restricted Area (NFPA 68 & 70)

- Area in front of the vent shall be prohibited to personnel during equipment operation and shall be identified as an hazardous area as per NFPA 70

The EL Series system is **suitable for ST1¹ dusts** as standard, and up to **ST3 dusts** with specific options.

Flameless Vent (NFPA 68 & 654)

- Weakest point
- Releases pressure, without releasing flame
- If explosion, stops the machine

RAL: Rotary Airlock Valve (NFPA 69)

- Continuously discharges material (fuel) (NFPA 654)
- Seals the system



Material K_{St}
may be > 300

Inline Filter

- Creates restriction in the case of an explosion
- Stops burning embers from releasing to atmosphere before vacuum pump stops its inertial rotation

1. Refer to Appendices III of this document for Dust Explosion Class

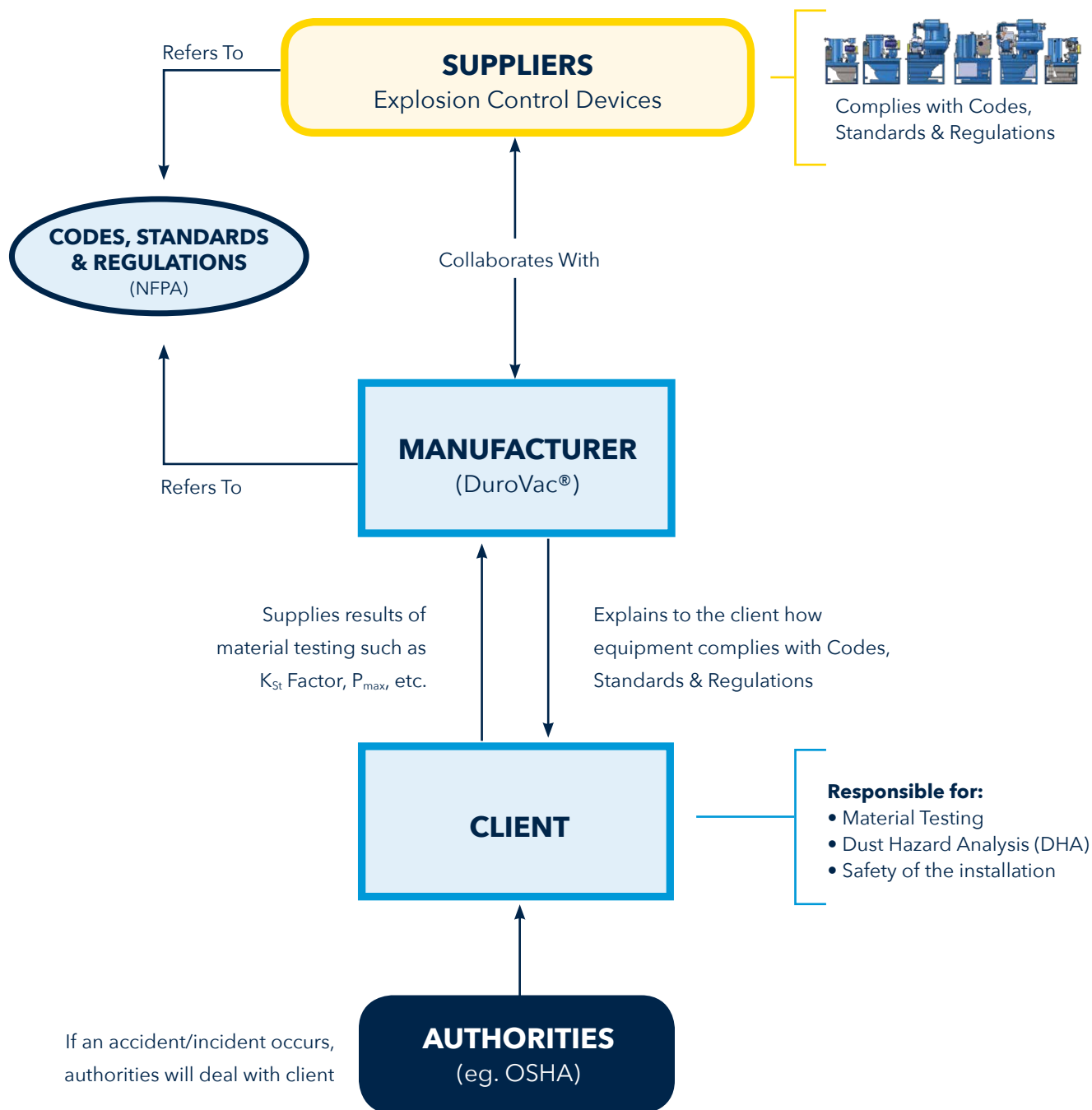


Remember

We have the duty to explain what we know about combustible dust and how DuroVac® systems are designed to comply with Codes & Regulations.

**BUT, in the end,
the client is always responsible
for the safety of his plant.**

Client Responsibility





Appendices

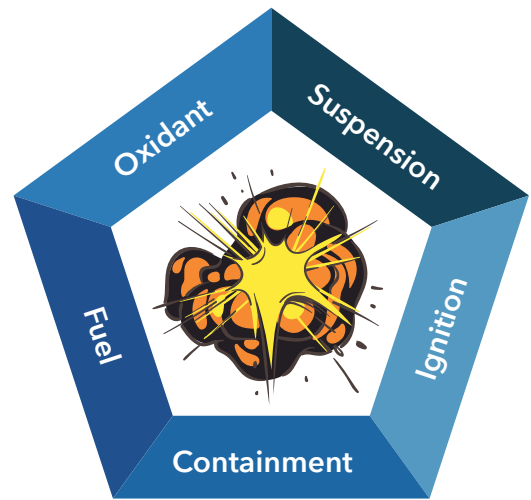
Definitions

Explosion¹

"Rupture of an enclosure due to the development of internal pressure from a deflagration."

The requirements² for an explosion are:

1. Fuel (Combustible Dust)
2. Oxygen (Typically Air)
3. Suspension (Dust Cloud)
4. Ignition Source
5. Containment (Enclosure)



Dust Explosion Pentagon

Deflagration¹

"Propagation of a combustion zone at a velocity that is LESS than the speed of sound."

Detonation¹

"Propagation of a combustion zone at a velocity that is GREATER than the speed of sound."

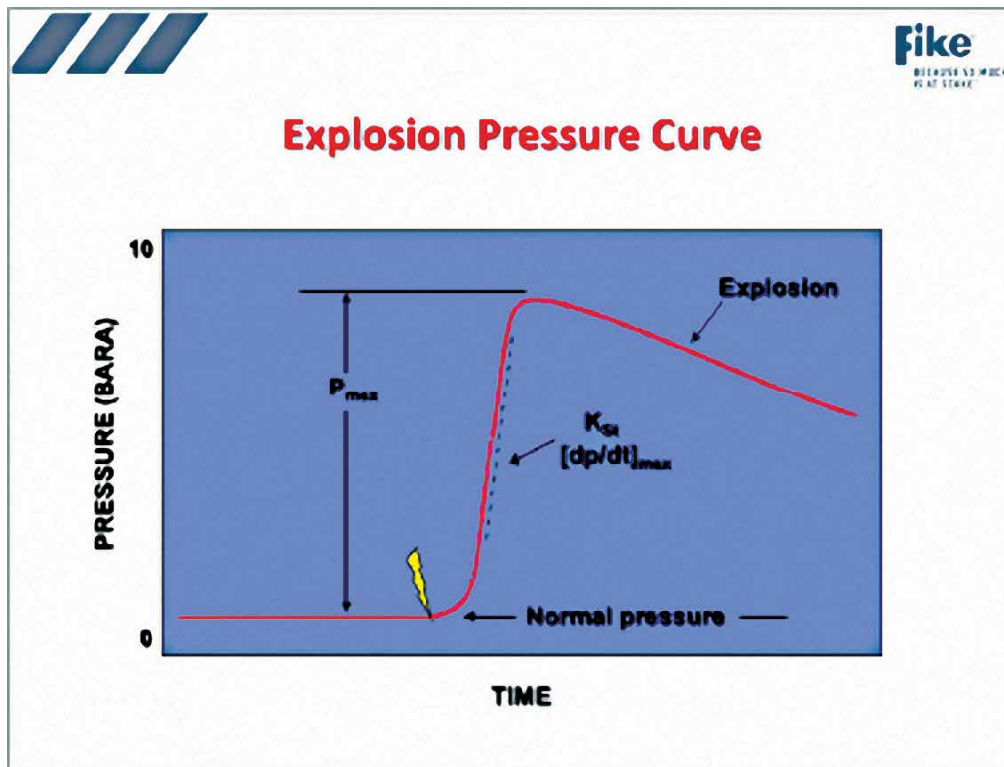
¹ NFPA 68, Standard on Explosion Protection by Deflagration Venting, Chapter 3, Edition 2018.

² NFPA, Guide to Combustible Dust, Chapter 3, Edition 2012.

APPENDICES II

K_{St} and P_{max} Explained

K_{St} and P_{max} are the **explosive properties** measured in the laboratory to quantify the **severity of a dust explosion**. Basically, the tests tell you **how much pressure** an explosion will generate and **how fast** the explosion will develop.¹



The "Explosion Severity Test" is a standard dust test used to quantify the maximum pressure of a dust cloud explosion (P_{max}) and the speed of the pressure rise (K_{St}).¹

¹ FAUSKE, K_{St} and P_{max} Tests For Combustible Dust: Who or What Are They, <http://blog.fauske.com>

² FIKE, January 2016. Fike Explosion Protection Seminar, Explosion Pressure Curve

APPENDICES III

Dust Explosion Class

OSHA lists **Class One (ST 1)** dusts as “**weak explosion**” **BUT** that does not mean it is not a hazard. Historically, Class One (ST 1) dusts have caused the most **damage**, the most **injuries** and the most **loss of lives** than any other class dust, as a result of the frequency and severity. The **weakest K_{St}** can produce an explosion that would **destroy a vessel** and **kill or injure a person**.

Dust Explosion Class*	K_{St} (bar·m/s)*	Characteristic*	Typical Material**
St 0	0	No explosion	Silica
St 1	> 0 and = 200	Explosion	Powdered milk, charcoal, sulfur, sugar and zinc
St 2	> 200 and = 300	Strong explosion	Cellulose, wood flour, and poly methyl acrylate
St 3	> 300	Very strong explosion	Anthraquinone, aluminium, and magnesium

The actual class is sample specific and will depend on varying characteristics of the material such as particle size or moisture.

* OSHA CPL 03-00-008 - Combustible Dust National Emphasis Program.

** NFPA 68, Standard on Explosion Prevention by Deflagration Venting.

(OSHA, Hazard Communication Guidance for Combustible Dust,
<https://www.osha.gov/Publications/3371combustible-dust.html>)

APPENDICES IV

International Guidelines that DuroVac® Complies With

Country or Continent	Association/Organization Determining Codes & Standards	Government Bodies that Administer Codes and Regulations
CANADA	CCBFC (Canadian Commission on Building and Fire Codes) NFPA (National Fire Protection Association)	Alberta: WCB British-Columbia: WorkSafe BC Manitoba: WCB New Brunswick: WorkSafe NB Newfoundland: WHSCC Nova Scotia: WCB Ontario: WSIB Prince Edward Island: WCB of PEI Québec: CNESST Saskatchewan: WCB Northwest and Nunavut Territories: WSCC Yukon: WCB Office of the Fire Marshall Building Inspectors
USA	NFPA (National Fire Protection Association)	OSHA (Occupational Safety and Health Administration)
AUSTRALIA	IECEX	SWA (Safe Work Australia)
EUROPE	ATEX (ATmospheres EXplosibles)	DSEAR Dangerous Substances and Explosive Atmospheres Regulations)

APPENDICES V

NFPA Codes Applying to DuroVac® Systems



NOTE: It is the owner's responsibility to adhere to and keep up to date on NFPA requirements as they are constantly evolving.

NFPA Codes	Edition	Description
61	2020	Standard for the Prevention of Fires and Dust Explosions in Agricultural and Food Processing Facilities
68	2018	Standard on Explosion Protection by Deflagration Venting
69	2019	Standard on Explosion Prevention Systems
484	2019	Standard for Combustible Metals
652	2019	Standard on the Fundamentals of Combustible Dust
654	2020	Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids
664	2020	Standard for the Prevention of Fires and Explosions in Wood Processing and Woodworking Facilities



**Thank you
for choosing
DuroVac® to tackle
your mess.**

Famously tough.
www.durovac.com