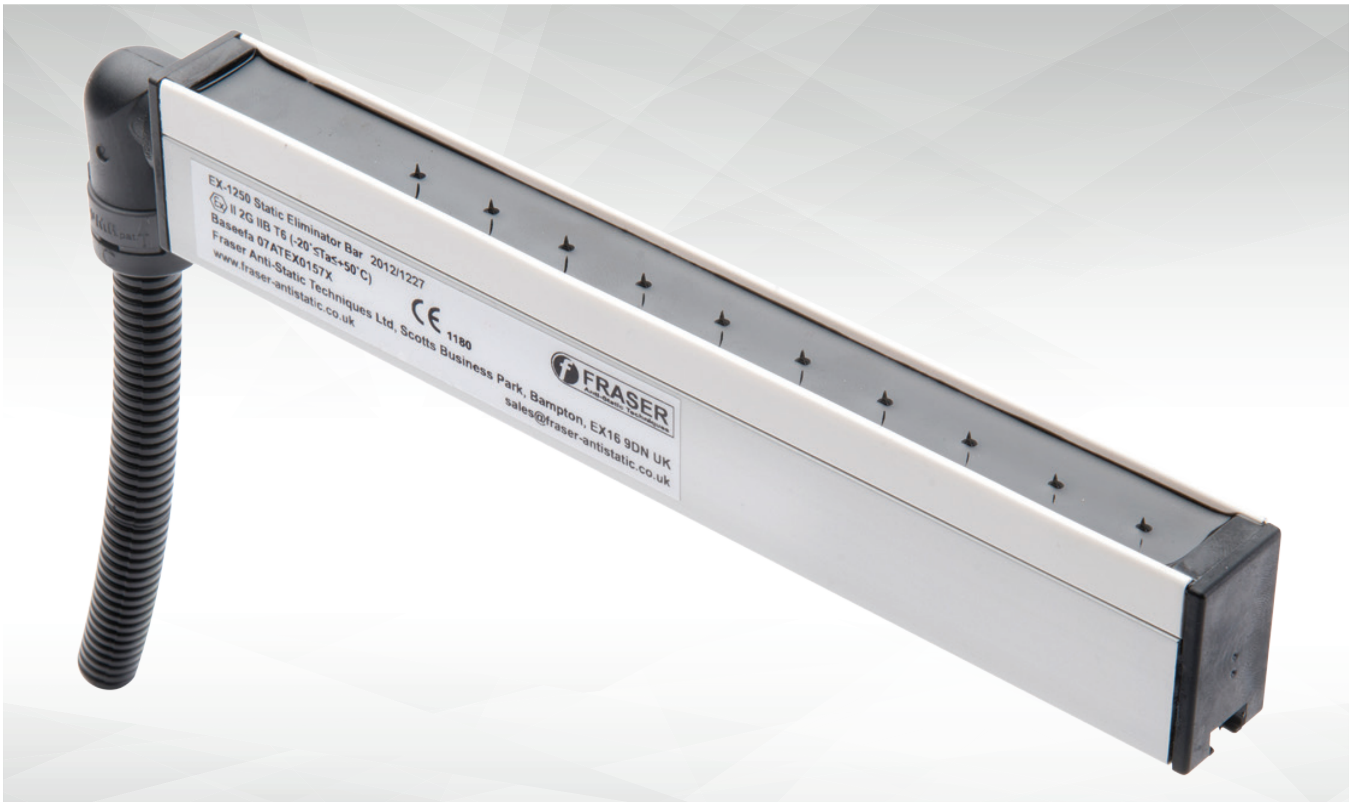
EX STATIC CONTROL

TECHNICAL BULLETIN



CONFIDENTIAL Supplementary Information for Salespeople and Distributors – not for distribution to customers.

This is an important, but difficult, area where we must be careful and offer only the correct information. The following notes are designed to allow salespeople to give useful and correct information to the customer. If in doubt please contact Fraser for advice. The increased scope of the ATEX Certification to include dust applications is covered in section 8.

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1) BASIC STATIC PROBLEM

The inks or coatings in EX applications use combustible solvents which can be ignited by a static discharge. The static discharge can come from two sources:

a) **The static charge in the film or other substrate being printed.**

This is the normal cause of fires. Typically when the substrate separates from the printing cylinder a large static charge is generated which can ignite the solvent vapour. Other sources of charge are from the unwinder, the rapid heat change in the drying ovens and general interaction with any roller.

b) **The charge carried in the body of operators.**

We can only advise on best practice here. If the operators are not wearing conductive shoes, or if the floor is not conductive, then they could carry a static charge in their body which could discharge and ignite the solvent gases. This is especially problematic when they are close to the web when the press is running. The floor should be anti-static and the operators should wear suitable anti-static safety work shoes.

2) DOES THE SOLVENT IN USE MAKE A DIFFERENCE?

Yes. Some solvents have a higher flammability rating than others.

Under the European ATEX classification there are three levels of gas/solvent which correspond to the danger of ignition. IIA is the smallest risk, IIC is most risk. The main gases in each group are:

IIA : Propane, Acetone, Methane, Ethane, Toluene, Methanol, Acetic Acid, Benzene and other gases with a minimum ignition energy (MIE) of >260mJ.

IIB : Ethylene, Methyl Ethyl Ketone (MEK), Propanol 1 and other gases with an MIE of >95mJ, <260mJ.

IIC : Mainly Hydrogen – this is not normally relevant to our customers in printing, coating and c onverting industries.

Our EX1250 Bars have been tested for use with IIA and IIB gases. Many of our competitors are only certified for gas group IIA – not for IIB.

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3) WHAT IS A SAFE STATIC LEVEL?

This is a question which is often asked. Quite reasonably, the customer wants to know how low the static charge should be to avoid a fire risk. The answer is not easy.

There are various considerations:

a) The minimum ignition level (MIE) of the solvent. This was discussed earlier in question 2. The lower the MIE, the lower the voltage needed to avoid fires.

The other considerations depend on the energy in the static discharge. This is practically impossible to predict. The energy in the static discharge is dictated by the formula:

Discharge energy in Joules = ½ C.V2

C = the capacitance of the film. This is very difficult to calculate accurately. It depends on the type and thickness of film. We strongly recommend that you do not try to do this - there are too many variables / unknowns. Thin films can generally hold more charge than thicker films. It also depends on the type of discharge - a normal brush discharge from a non-conductive product will not use all of the charge in the film, while a propagating brush discharge will use more of the charge in a higher energy event. See later.

The voltage V in the equation is squared – showing the importance of the surface voltage as measured by an EX715.

b) The speed of the process. The faster the speed, the more charge is available to turn into current in the discharge. The amount of charge is Q=C.V - but if you do not know the capacitance you cannot calculate it.

c) The nature of the ink – if it is conductive ink (normally gold or silver colour) then it has a big effect on the fire risk. Conductive ink can collect charge from the film and make it mobile so that it easily generates sparks. The larger the area of metallic ink, the more charge can be collected. Conductive ink is dangerous and often results in the printing press having to run more slowly.

d) We can measure the charge in the film entering the printing unit, but we must also measure the charge in the film exiting the unit. Both are important.

The conclusion is that you cannot give the customer an accurate figure for a safe target voltage on the film. The answer is to say that it is impossible to give an exact figure because of the variables mentioned above. As a general guide, based on many years of experience – the voltage should always be reduced below 10kV for every EX application. For applications where the MIE of the solvent is low (group IIB gases) then the target should be under 5kV – the lower the better. The lower the voltage, the safer the operation.

Where metallic inks are used the charge should be even lower, depending on the size of the metallic image.

Where speeds are very high, then these targets should be reduced further.

This is not satisfactory from the customer`s viewpoint, but it is a reasonable recommendation and the best you can make without considerable extra expert investigation.

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4) TYPES OF DISCHARGE

It is useful to learn about the types of static discharges. There are three main types:

a) Sparks

Spark discharges go from an ungrounded conductive object - such as a person or floating metal part - to another conductive object. They can have a high energy and may easily ignite solvent gases and dust clouds. Generally a spark uses all of the charge in the source body.

They are generally avoidable - by correct grounding, apart from metallic inks.

b) Brush discharges

A brush discharge is from a non-conductive charged material, such as film.

They do not have the same energy levels as a spark, but can still ignite solvent gases, but probably not dust clouds.

The normal characteristics of a brush discharge are:

- surface voltage in excess of 20 kV, generally with a negative polarity

For it to have sufficient energy to ignite gas vapour there has to be sufficient voltage (> 20 kV) and the surface area from which the charge is collected needs to have sufficient size (> 400cm2).

A brush discharge will not use all of the energy available in the static charge.

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c) **Propagating brush discharges (PBD)**

A propagating brush discharge has a high energy which can easily ignite solvent gases and give a nasty shock.

The requirements are for a highly resistive thin material to have a polarised charge - positive on one side of the film, negative on the other. Alternatively the sheet could have a conductive coating on one side e.g. metallised, or be in close proximity to a conductor. This creates a capacitive effect which can store a lot of charge.

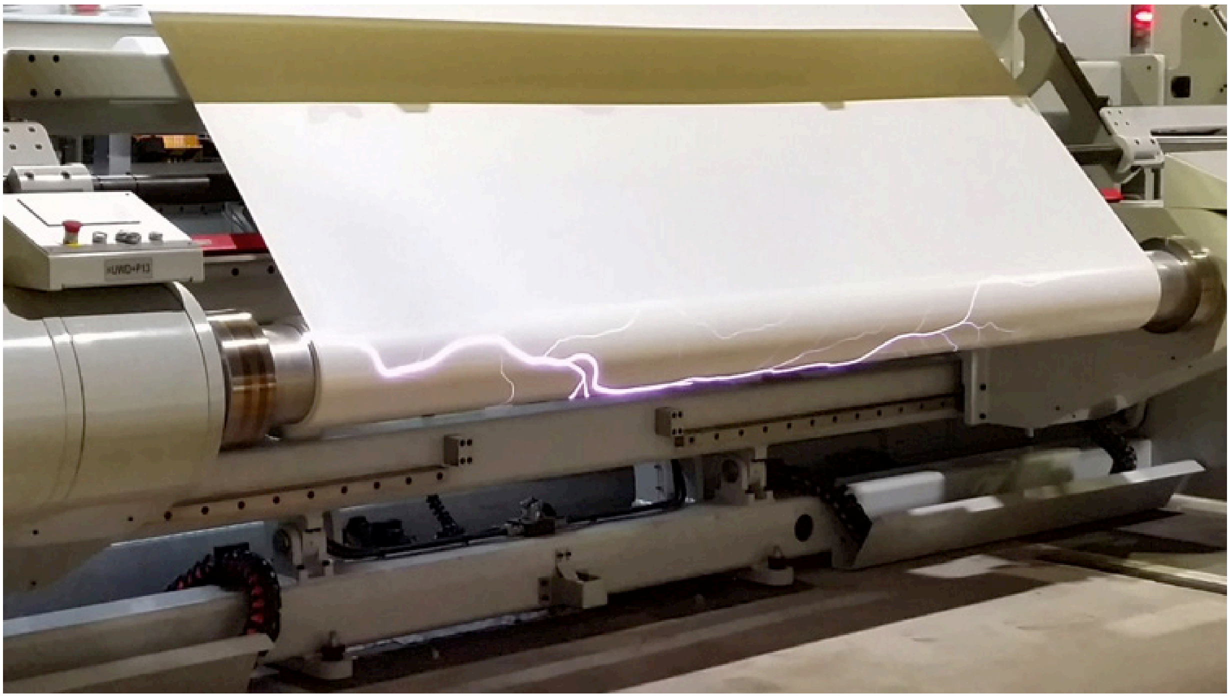
There needs to be a strong charging source.

The voltage may not be very high, but the capacitance and charge density is high. A PBD is often accompanied by a large audible crack. A description of what happens is given by Graham Hearn of Wolfson Electrostatics:

As you know this situation is high capacitance/low voltage with the electric field predominantly through the dielectric web. An initial ESD occurs for example at the edge of the sheet or due to a puncture through the web thickness. This may be a low energy event but it produces ionization of the air close to the web surface. The ionization reduces the breakdown strength of the air in a 'front' allowing charge on surrounding areas to easily migrate towards the initial point of discharge.

The voltage level present will probably be lower than for the less dangerous brush discharges. The lower static voltage leading to a PBD is also more difficult to neutralize because some of the charge will be coupled in "double layer charging".

The best solution is to flood the area with ionized air - so with electrical rather than passive equipment. Care needs to be taken with metallised film - see later.



A PBD

d) **Corona Discharge - for information only.**

Corona discharges are lower in energy and not usually capable of igniting gases and dust. They are created by a sharp conductor in an electric field above 2.7MV/m. This is the process used by anti-static brushes. A blue glow is sometimes visible

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5) WHAT IS THE BEST PRODUCT TO USE?

We have two EX certified products which the customer should consider:

a) EX-HPSD Anti-Static Brush

Advantages:	Lower-cost. Easy to install – just an earth connection. Good for high speeds. Good for Zones 1and 2 and gases IIA and IIB. Solvent resistant construction – can be washed in the solvent to clean ink and dust from fibres. Generally better for metallised film.
Disadvantages:	Cannot reduce charge to zero, typically 85-90%. Must be kept clean. Must be close to the material - within 5mm. Will need replacing every 6 to 12 months depending on conditions in factory.

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b) EX1250 Bars

Advantages:

Can reduce charge to very low level.
IP66 construction.
Up to 4 Bars from One Power unit.
Long life, provided they are kept in good condition.
Can be positioned from 25mm to 150mm from material. Best distance is within 50mm, especially for higher speeds.

The EX Power Unit can power up to 30m of Bar and cable.

Remote monitoring of the operational status of the Bars is possible with the standard Remote Monitor option, or with the more advanced HP-ION Power Unit.

Disadvantages:

Higher cost than EX-HPSD, but lower than most competitors, such as Eltex, Spengler, Haug, Meech, Enulec

The Power Unit must be positioned outside of the area. This also applies to our competitors` power units.

Electrical static eliminators are generally not suitable for metallised films. This applies to EX applications and non-EX application. An electrical static eliminator can make the problem worse.

If the ink is metallic – such as gold and silver colours on packaging films – then both EX1250 and HPSD may be used to reduce the problem. So with small “islands” of conductive inks EX1250 Bars are usable, but not where there is a complete metallised layer.

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6) INSTALLATION – BEFORE OR AFTER THE PRINTING OR COATING UNIT?

Static can always be regenerated by the passage over rollers, or through a process. It is normal to consider Static Eliminators in more than one location in EX applications.

Always install before the printing / coating unit, after the last guide roller. This is to neutralise the charge generated by the drier and passage over rollers between units.

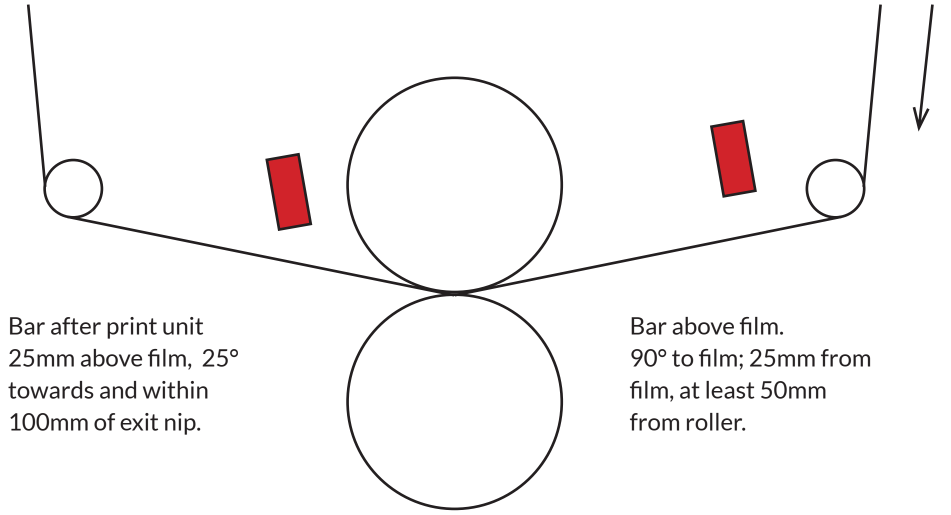
Also always after the print unit if the customer is using ESA. ESA introduces a new static charge into the film which can be a fire risk as the film leaves the printing cylinders. Position this Bar within 100mm and at an angle of about 25° towards the exit nip from the cylinder. If the customer is not using ESA, there may still be a need to fit a Bar after the print unit - measure the charge to see how much charge is regenerated by the printing process.

7) INSTALLATION – ON WHICH SIDE OF THE FILM?

With thin films (< 150μ) before the printing unit it does not usually matter because the film is transparent to the charge. So you can neutralise the charge from either side. An EX1250 Bar is easiest to keep clean if the emitters are pointing downwards – airborne dust cannot fall onto the emitters - so above the film is usually best.

After the printing unit, some customers instinctively think that the antistatic device should be on the wet side with the ink and gas. But this is not usually the best solution. On the wet side there will be the potential for more contamination from the ink or coating and this may result in the need for more frequent cleaning.

SUMMARY



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Regarding the choice of which side to put the static eliminator, it must be stated that the IEC guidelines for static control in hazardous areas differ from the above. An extract from TR 60079-32-1:2015:

6.3.8 Ionisation / Charge Neutralisation

6.3.8.1 General Ionisation of the air is a method of making the air locally ion-rich so that charges on insulating solid materials can be neutralised. It is particularly useful for neutralising charge on insulating plastic sheets or films. Neutralisation cannot succeed if the rate at which charge is generated exceeds the rate at which ions are supplied to the air, or can migrate to the charged surface, or if sufficient ions of the desired polarity are not present. Consequently, correct installation and regular maintenance is essential for those devices, taking into consideration factors that can influence their effectiveness such as environmental conditions (e.g. dust and temperature) and positioning of the device in relation to the material processed, machine parts, and people. The reduction of charge at any one point in the operation does not prevent generation of charge in later steps of the process, so ionisers may be required at a number of locations. Positioning is important, and effectiveness of individual installations should be confirmed by field measurement of residual charge or voltage. In particular, for films and sheets it is necessary to ensure that ions are directed at the correct side to avoid forming a bipolar layer which could give rise to propagating brush discharges.

This can be supported by laboratory experiments, but it is not supported by field evidence. It is also difficult to know on which side of a thin film the charge lies. On problematic double-layer charging, or propagating brush discharge applications, it is worth considering the IEC guideline.

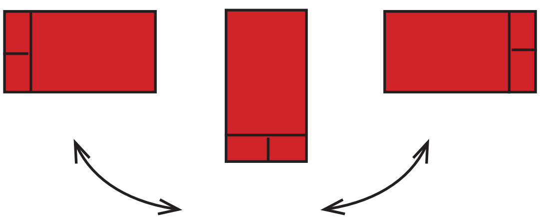
8) DUST APPLICATIONS

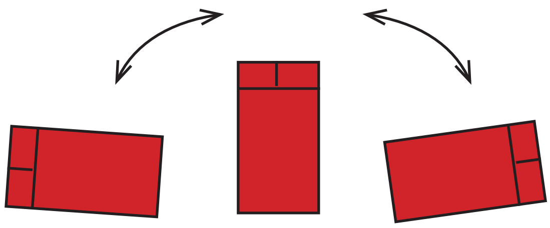
The EX1250 Certification was expanded at the beginning of 2018 to include dust applications in Zone 21 and 22.

The correct installation is an important part of this certification. The EX1250 Bar must be positioned so that dust cannot collect around the emitters. It is an essential part of the certification that the Bar is positioned looking from horizontal to downwards – never looking above this. This is explained in sketch below:

CORRECT – emitters pointing downwards to sideways, so cannot collect dust.

WRONG – emitters pointing upwards so can collect dust. This is not ATEX certified for dust.





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9) MAINTENANCE

Cleaning is important for all static eliminators, especially those in EX applications. The efficiency of the Bar or Brush can be hugely reduced by dust and contamination. The new (2015) EX Guide from IEC TR 60079-32-1 is clear about this:

Corona points remain functional only as long as they are clean and sharp. Accumulation of contaminants (e.g. ink, coating solution, or paper dust) and corrosion products should be controlled by an effective maintenance program.

By "Corona points" the standard means emitter pins on Bars and fibres on brushes.

The EX-HPSD Brush can be cleaned in most common solvents. When the fibres are drying, brush them with your fingers, or similar, so that the fibres do not form "rat tails".

EX1250 Bars can be cleaned with IPA or a similar cleaning agent which is compatible with the materials on the EX1250 Bar - ABS, epoxy and aluminium.

Some coating and printing processes are very dirty and the ink or coating can contaminate the Bar within a few weeks. To overcome the increased frequency of cleaning here, some printers put a layer of electrical tape onto the Bar, pressing the emitters through the tape.

This means that the contamination goes onto the tape rather than the Bar. The operator pulls off the rape when it is dirty and puts a new strip of tape onto the Bar.

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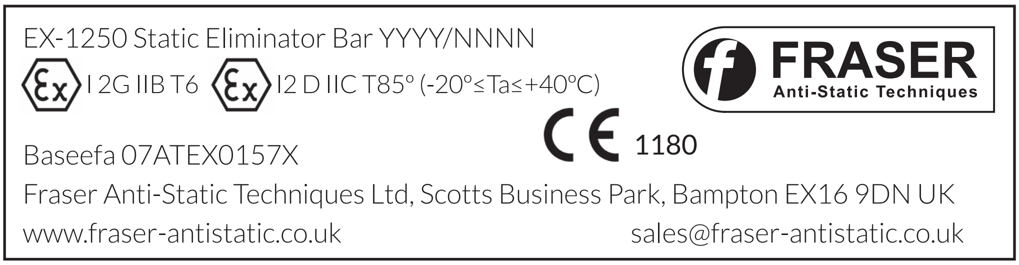
10) SUMMARY OF OUR EX CLASSIFICATIONS

EX715 Meter	ATEX Certification: EX II 2G Ex ia IIB T4/T5
Zones:	1 & 2
Gas Groups:	IIA and IIB (all the usual solvents used in gravure printing and coating – see note 2) above.
Temperature Class:	T4 (with Duracell Procell) max ambient temperature of 59°C.
	T5 (with Panasonic 6F22R) max ambient of 40°C.
	IECEx Certification:
Standards:	IEC 600079-0 and IEC 60079-11

EX1250 Bars

The EX1250 label is:



Gas / Solvents: II 2G IIB T6

II:	Surface Group (not mining).
2:	Equipment category High Protection suitable for Zones 1 and 2.
G:	Equipment used in potentially explosive atmospheres caused by presence of explosive gas, vapour or mist.
Gas Groups:	IIA – which includes propane group gases.
	IIB – Ethylene group gases.
	See section 2) above for more information on gases.
Temperature Class:	T6 with max surface temperature of 85°C.
	- 20° to + 40°C maximum ambient temperature.

EX1250 Bars, continued

Dust: II 2 D IIIC T85

II:	Surface Group (not mining).
2:	Equipment category High Protection suitable for Zones 21 and 22.
D:	Equipment used in potentially explosive atmospheres caused by presence of explosive gas, vapour or mist.
Dust Groups:	IIIA – Combustible flyings.
	IIIB - Non-conductive dust.
	III - Conductive dust.
Temperature Class:	T85° with max surface temperature of 85°C.
	- 20° to + 40°C maximum ambient temperature.

EXHPSD	Certification: EX II 2G
Zones:	1, 2 and 22.
Gas Groups:	IIA, IIB and IIC
Temperature Class:	Does not have a restriction on temperature classification.

11) IEC EX AND ATEX ZONES EQUIVALENTS EXPLAINED:

European and IEC Classification	Definition of zone or division	North American Classification
Zone 0 (gases / Vapors)	An area in which an explosive mixture is continuously present or present for long periods	Class I Division 1 (gases)
Zone 1 (gases / Vapors)	An area in which an explosive mixture is likely to occur in normal operation	Class I Division 1 (gases)
Zone 2 (gases / Vapors)	An area in which an explosive mixture is not likely to occur in normal operation and if it occurs it will exist only for a short time.	Class I Division 2 (gases)
Zone 20 (dusts)	An area in which an explosive mixture is continuously present or present for long periods	Class II Division 1 (dusts)
Zone 21 (dusts)	An area in which an explosive mixture is likely to occur in normal operation	Class II Division 1 (dusts)
Zone 22 (dusts)	An area in which an explosive mixture is not likely to occur in normal operation and if it occurs it will exist only for a short time.	Class II Division 2 (dusts)

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