Explosion Protection

Principle Concepts & Implementation on Infrared Thermometers

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Breaking News

Plant Explosion

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Explosion Protection

IECEx – International Standard

- IEC – **I**nternational **E**lectro-technical **C**ommission
- International cooperation on standardization and conformity assessment
- IECEx - international standard for Ex certifications for equipment in explosive atmospheres
- "Explosive Atmosphere" is synonymous with:
  - "Hazardous Location"
  - "Hazardous Area"
  - "Ex Area"

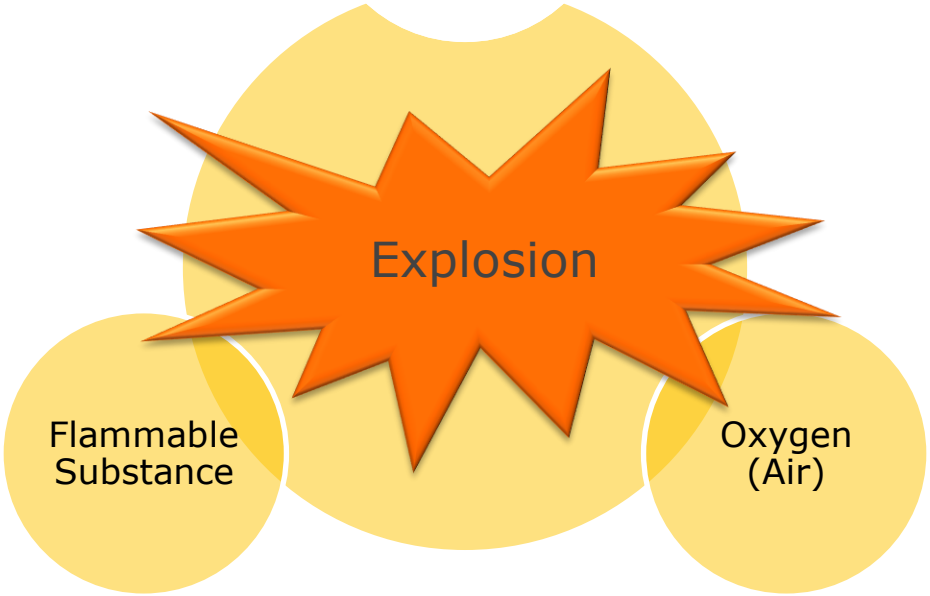
Explosion Protection

ATEX – European Standard

- ATEX – **AT**mospheres **EX**plosives
- Guideline for use of equipment in potentially explosive areas
- ATEX directive 94/9/EC – essential health and safety requirements
- ATEX directive 1999/92/EC – detailed assessment of explosive risks (zone classification, documentation for protection measures)

Explosion

Principle

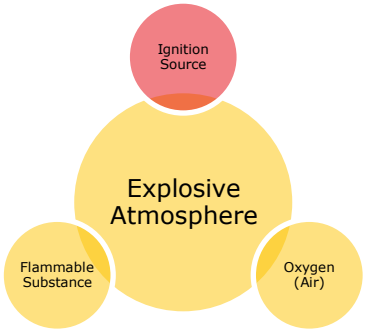


Ignition Sources

Potential Triggers for an Explosion

Hot Surfaces

- Surface temperature increase due to malfunctions
- Overheating of bearings/breaks, short-circuited resistors/coils



Flames or hot gases

- E.g. exhausts from combustion engines

Sparks

- Mechanically generated sparks (rusty hammer in contact with light alloys)
- Electrically generated sparks (switches, relays)

Static Electricity

- Releasing of stored energy in the form of sparks (friction between different materials)

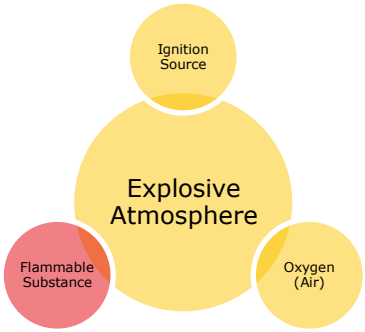
Lightning

Flammable Substances

Groups

Gas

- Gases – often compounds of carbon and hydrogen
- Vapor – evaporated from the liquid surface into the air



Dust

- … from coal, wood, flour, sugar etc.
- Dust clouds: explosions
- Dust layers: smoldering on hot surfaces

Flammable Gases

Classification

Substance	Lower Explosion Limit [vol. %]	Upper Explosion Limit [vol. %]
Hydrogen	4	77
Propane	1.7	10.9
Heating oil	0.6	6.5

Flammable Gases

Temperature Classes

- Highest equipment surface temperature must be lower than ignition temperature of the surrounding atmosphere
- **Equipment** is assigned to the respective temperature class based on its maximum **surface temperature**
- **Flammable substance** is assigned to the respective temperature class according to its **ignition temperature**

Flammable Gases

Temperature Classes

Temperature Class	Max. Surface Temperature	Ignition Temperatures for flammable substances
T1	450°C (842°F)	> 450°C (842°F)
T2	300°C (572°F)	> 300°C (572°F)
T3	200°C (392°F)	> 200°C (392°F)
T4	135°C (275°F)	> 135°C (275°F)
T5	100°C (212°F)	> 100°C (212°F)
T6	85°C (185°F)	> 85°C (185°F)

Temperature class is the maximum temperature of a surface that may be.

Flammable Dust

Temperatures

	Ignition Temperature Dust as Cloud	Glow Temperature Dust as Layer
Cotton	560°C (1040°F)	350°C (662°F)
Paper	540°C (1004°F)	300°C (572°F)
Aluminum	530°C (986°F)	280°C (536°F)
Iron	310°C (590°F)	300°C (572°F)

Zone Classes

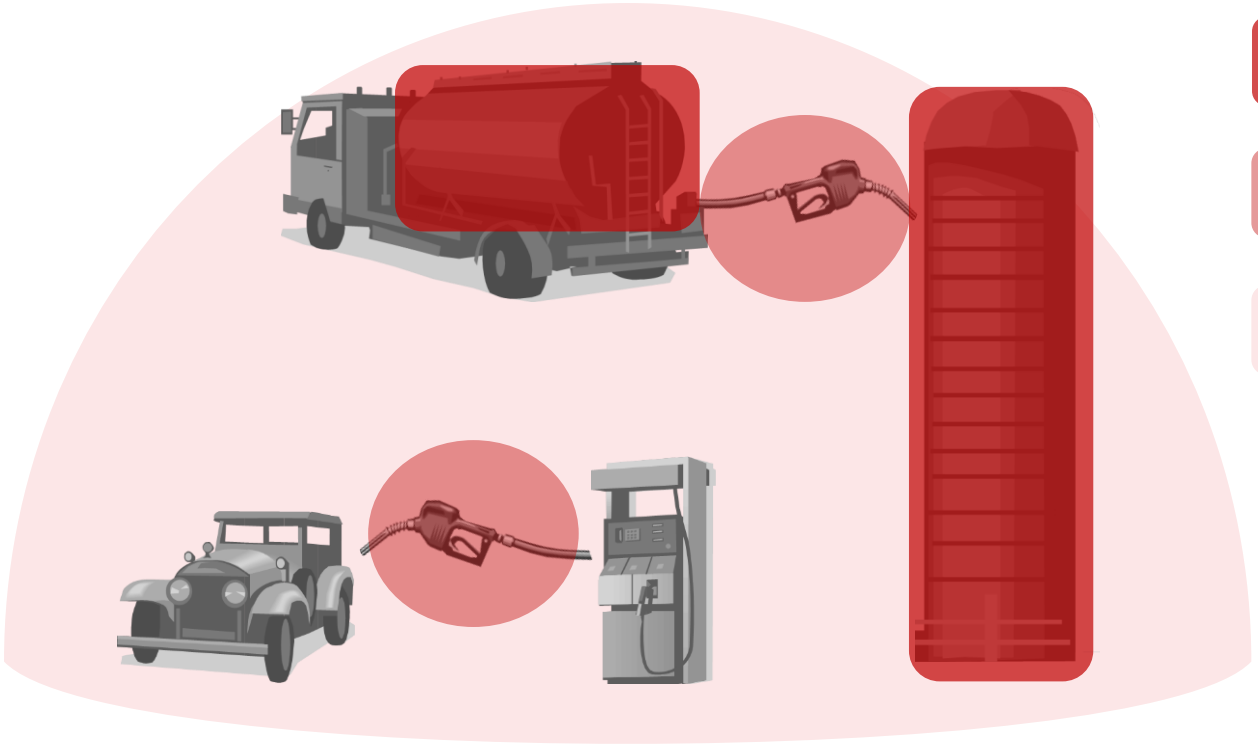
Classification

Gases	Dusts	Explosive Atmosphere
Zone 0	Zone 20	ALWAYS present
Zone 1	Zone 21	WILL be present
Zone 2	Zone 22	COULD be present

- Dividing potentially explosive atmospheres into zones
- Zones classified on the risk, the frequency and the duration of an explosive atmosphere

Zone Classes

Filling Station



Zone 0

Zone 1

Zone 2

Type of Protection

Safeguards

For explosive gas atmospheres	For dust explosion protection
Flameproof encapsulation	Protection by enclosure
Powder filling	Pressurized
Oil-immersion	Encapsulation
Intrinsic safety	Intrinsic safety
…	…

Type of Protection

Flameproof Encapsulation

- Explosive atmosphere can penetrate the equipment and can be ignited
- The explosion cannot spread to the surrounding atmosphere due to a sealed casing resistant

Explosive Atmosphere

Flameproof housing

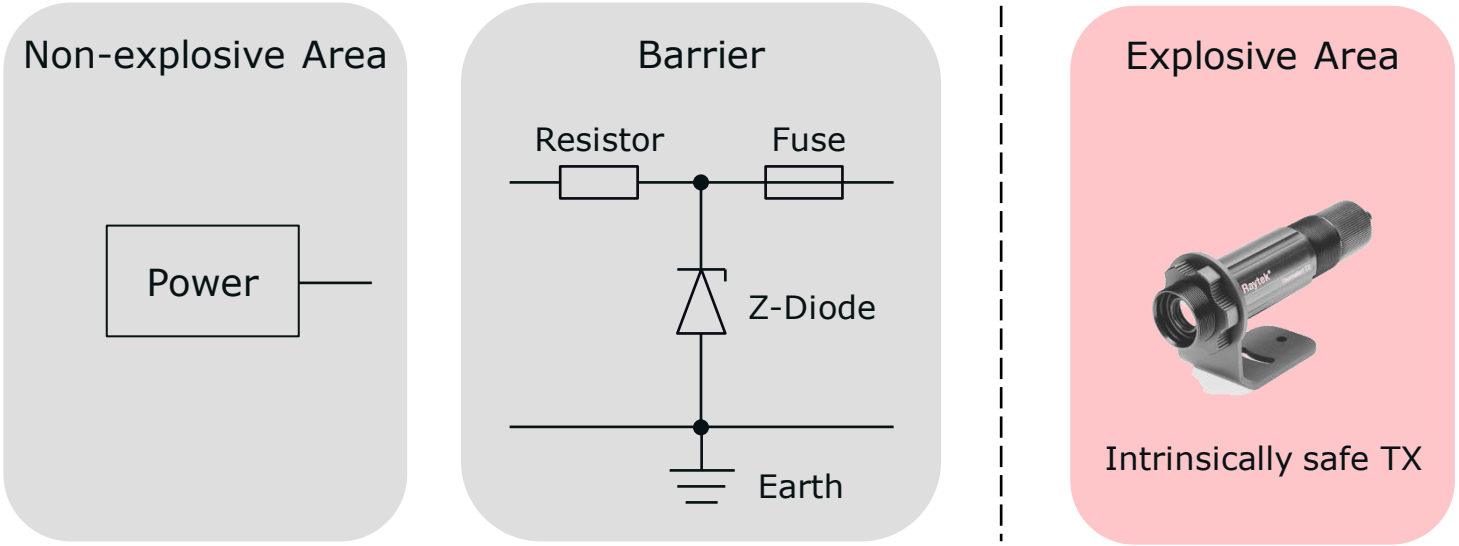
Ircon Modline 5
in a flameproof housing

Type of Protection

Intrinsic Safety - TX

- Explosive atmosphere penetrates the equipment but cannot be ignited
- No impermissible temperatures and sparks even in case of short circuits

  → limiting the energy in the equipment



Type of Protection

Equipment Group

Category	Equipment	Sub Category	Description
I	for mines	M1	
		M2	
II	for potentially explosive gas atmospheres	IIA	typical gas is propane
		IIB	typical gas is ethylene
		IIC	typical gas is hydrogen
III	for potentially explosive dust atmospheres	IIIA	combustible flying's
		IIIB	non-conductive dust
		IIIC	conductive dust

Type of Protection

Equipment Group

Rising requirement for electrical equipment

Explosion Group	Safe Gap	Max. permitted ignition energy	Typical Gas
IIA	> 0.9 mm (0.03 in)	160 µJ	Propane
IIB	0.5 to 0.9 mm (0.02 to 0.035 in)	80 µJ	Ethylene
IIC	< 0.5 mm (0.02 in)	20 µJ	Hydrogen

Explosion Groups classify equipment by electrostatic discharge.

MI3 - Intrinsically Safe

Introduction

- Type of protection: **intrinsically safe**
- Certified for use in explosive atmospheres due to **gases** and **dusts**

MI3 - Intrinsically Safe

ATEX Ratings

- MI3 / MI3100

  II 2G Ex ib IIC T4 Gb (Gas)
  II 2D Ex ib IIIC T135°C Db (Dust)
  Support for all spectral heads and specials
  MI3100 certified including the standard laser

- MI3LTH

  II 2G Ex ib IIC T4/T3 Gb (Gas)
  II 2D Ex ib IIIC T135°C/185°C Db (Dust)
  Higher temperature class for the sensing head; lower one for the separated electronics

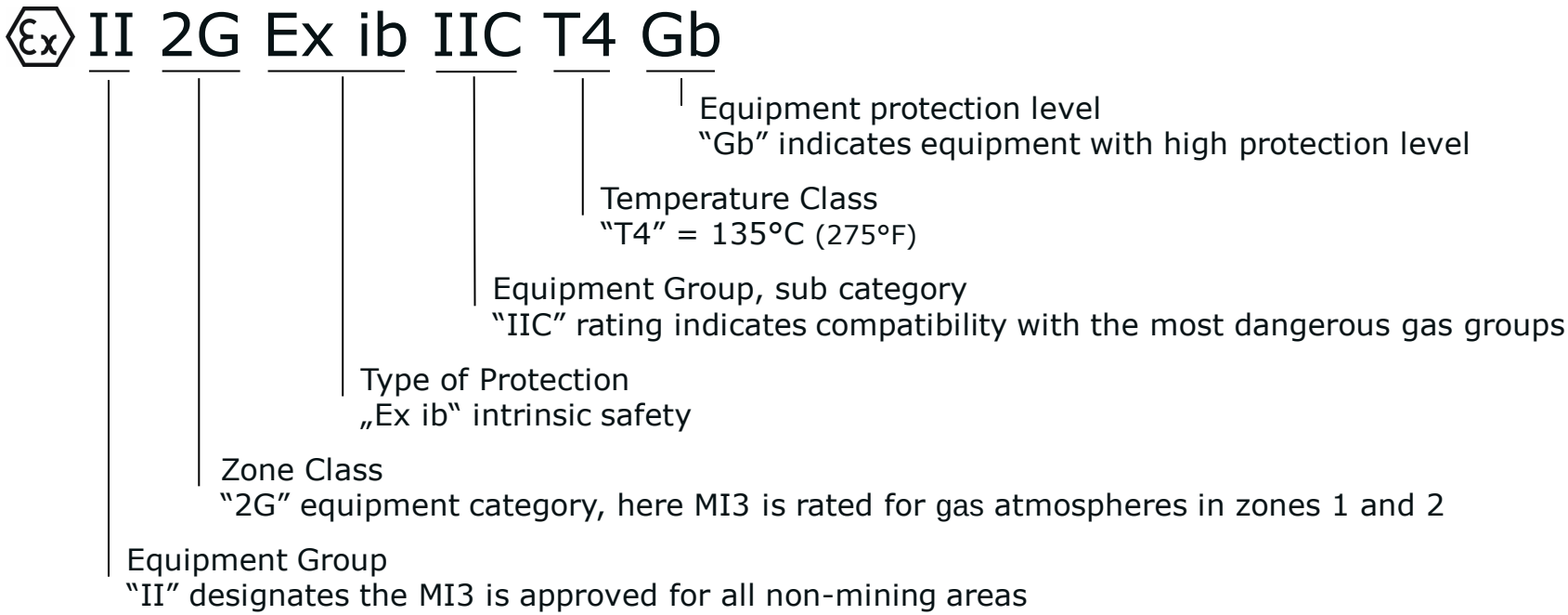
- Ex-Power Supply

  II (2)G [Ex ib Gb] IIB (Gas)
  II (2)D [Ex ib Db] IIIC (Dust)
  For associated equipment, the marking is placed inside square brackets.

MI3 - Intrinsically Safe

How to read the ATEX Rating?

MI3 Sensing Head



MI3 - Intrinsically Safe

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- Ex-Power Supply

  [Ex ib Gb] IIB (Gas)
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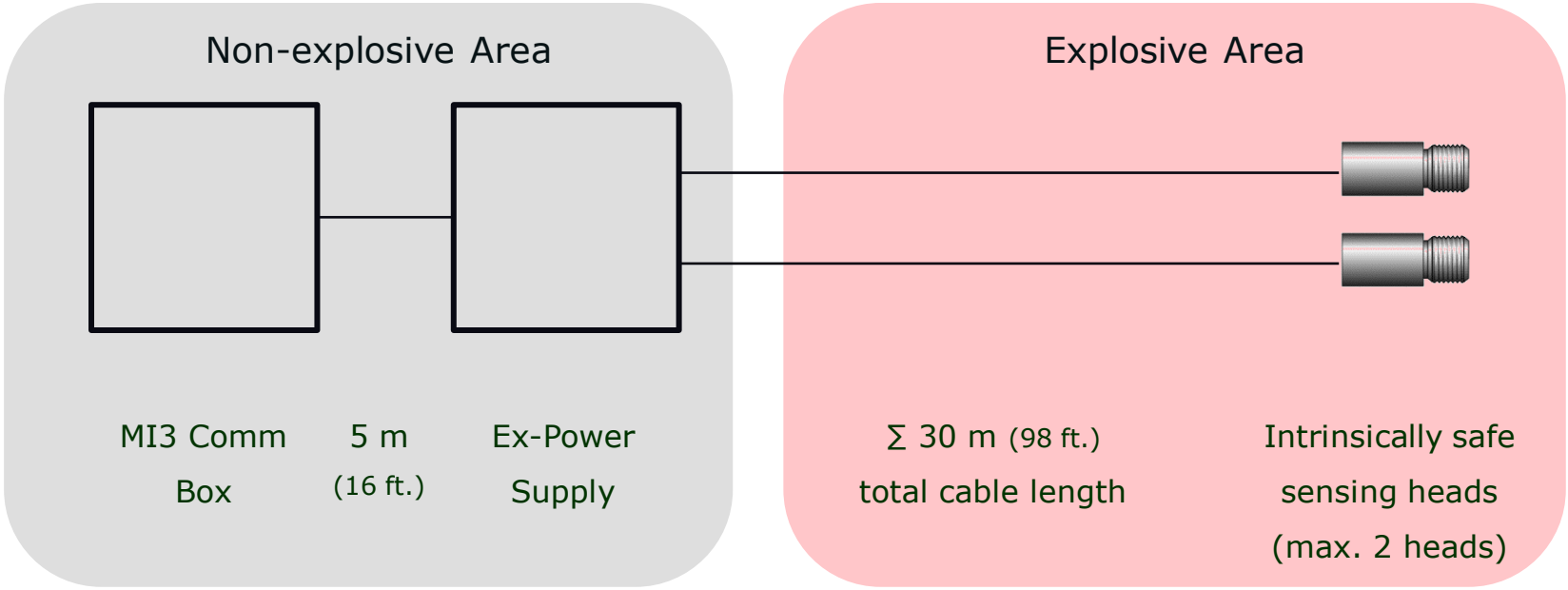
MI3 - Intrinsically Safe

Implementation



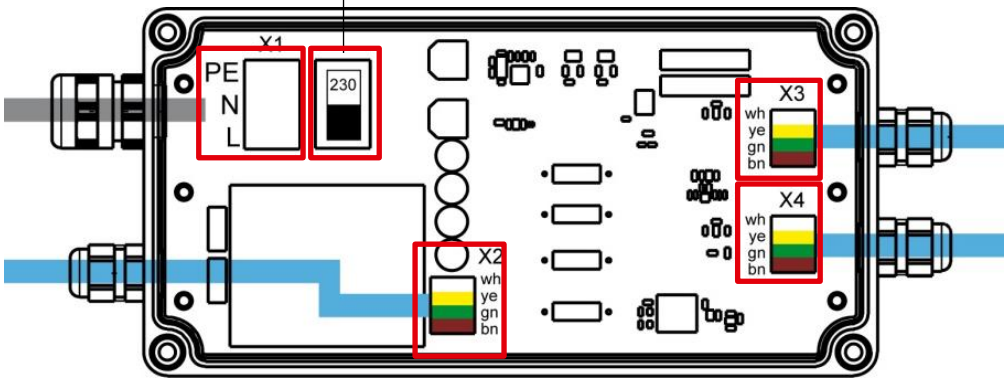
MI3 - Intrinsically Safe

Ex-Power Supply Implementation

Before Installation –
select local mains voltage!

115 / 230 VAC

MI3 Comm Box



Sensing Head 1

Sensing Head 2

Make sure to implement a 360° shield contact with the contact socket!

MI3 - Intrinsically Safe

What should you know?

- MI3 Comm Box, Ex-Power Supply, and intrinsically safe MI3 sensing heads are field exchangeable!
- Do not exchange intrinsically safe MI3 sensing heads with standard MI3 sensing heads!
- All MI3 components – Comm Box, Ex-Power Supply, Sensing Head – are IP65 rated!
- Intrinsically safe MI3100 sensing heads are available with water cooled housing!

MI3 - Intrinsically Safe

Markets

Branch	Application	Type
Steel	Galvanizing, annealing, plating & coating with hydrogen atmosphere	Gas
Solar	Hydrogen reduction	Gas
Petrochemical	Sulfur recovery, boilers, crackers, reactors, pipes, flare control	Gas
Chemical	Fertilizer, starch, alcohols, flower, vinyl	Gas
Open cast mining (above ground)	Monitoring of conveyors & equipment	Dust
Fire detection	Off shore, storage areas, indoor coke handling, dust extraction	Dust
Storage terminals	Storage of coal, wood pellets, sulfur, petroleum coke, starch, flour	Dust

Explosion Protection

MI3 – Intrinsically Safe

Thank you for your attention!

For more information, visit

www.raytek.com