Badan Standardisasi Nasional

UNITED NATIONS
ECONOMIC COMMISSION FOR EUROPE

International Electrotechnical Commission System
for Certification to Standards Relating to Equipment
for Use in Explosive Atmospheres (IECEx System)

Overview of Explosion Protection Techniques

IECEx 2018
International Conference
Jakarta, Indonesia
8th and 9th August 2018

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UNITED NATIONS
ECONOMIC COMMISSION FOR EUROPE

INTRODUCING

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- Technical Manager

BARTEC

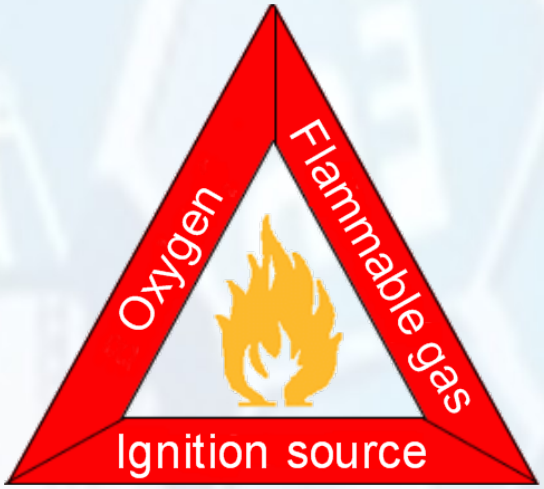
Why am I here...?

Promotion of IEC IECEx to be the one and only accepted certification system!

To achieve total ACCEPTANCE there's a first need for CONFIDENCE.

Each stakeholder needs to understand ISO/IEC based Types of Protection.

Let's start a quick guide:



Ignition sources

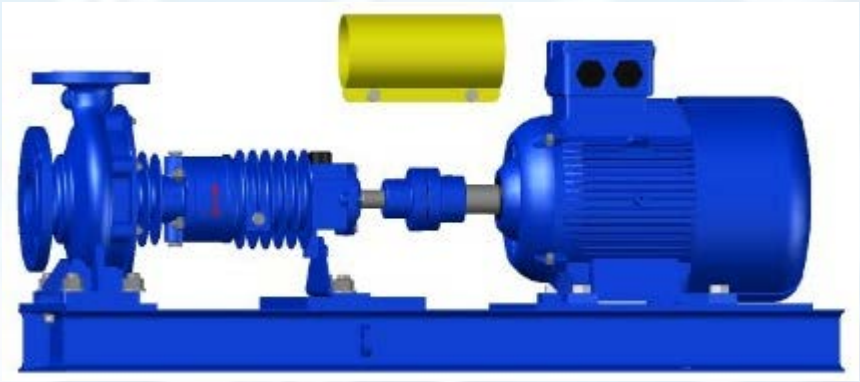
1. Hot surfaces
2. Flames, hot gases, hot particles
3. Mechanically generated sparks
4. Electrical equipment
5. Stray electric currents, cathodic corrosion protection
6. Static Electricity
7. Lightning
8. Radio Frequency (RF) electromagnetic waves ≤ 300 GHz
9. Electromagnetic waves > 300 GHz
10. Ionizing Radiation
11. Ultrasonics
12. Adiabatic compression and shockwaves
13. Exothermic reactions, including self-ignition of dusts

Ignition sources

IEC is commonly known as to deal with just Electrical Equipment.

Be aware that we have today ISO IEC working close together.

Non-electrical equipment shall be assessed in hazardous areas as well.

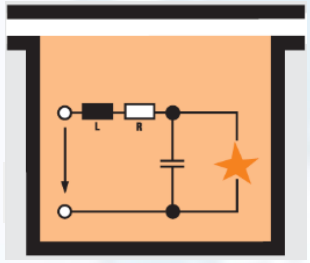


Some basic knowledge is anyhow required.

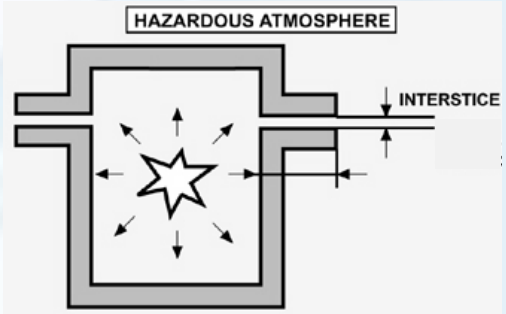
Gas Groups

Gases are divided in sub groups because of:

1. Minimum Ignition Current / Energy
2. Maximum Experimental Safety Gap



Gas group	Representative gas
IIC	Hydrogen, Acetylene, Carbon Disulphide
IIB	Ethene, Dimethylether
IIA	Propane, Petrol, Ethanole, Acetone, Acetaldehyde



Remark:

1st line (IIC) are most dangerous gases.

Dust Groups

Dusts are divided in sub groups because of types of dust:

Dust group	Types of dust	Representative dust
IIIC	Conductive dusts	Graphite Powder, Toner
IIIB	Non-conductive dusts	Milk Powder, Powdered Sugar
IIIA	Fibers and Flyers	Tobacco, Saw Dust

Remark:

1st line (IIIC) are most dangerous dusts (for IP rated electrical equipment)

where IIIB is dangerous when there is possible electrostatic charge

Temperature classes on equipment

are applicable to gases and indicate the max. acceptable surface temperature

T class	Surface Temperature
T1	450°C
T2	300°C
T3	200°C
T4	135°C
T5	100°C
T6	85°C

How to read and use this table?

When a site is classified as Zone 1 / IIA / T4

Hot surfaces become dangerous ≥ 135°C. For that reason all Ex equipment shall be selected having a T class T4, T5 or T6.

Remarks:
The higher the T class, the lower the belonging acceptable temperature.
(T6 classified sites are most dangerous, T6 certified equipment is most safe!)

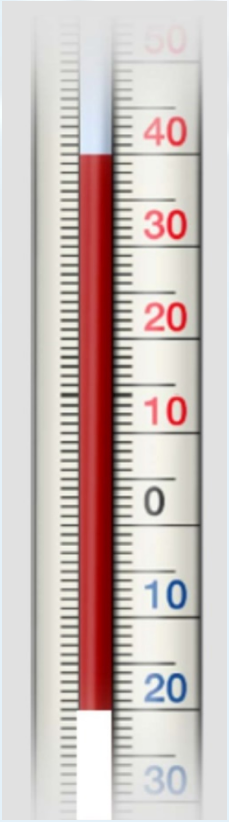
Ambient temperature range

Ex manufacturers and IECEx ExCB's apply -20°C to + 40°C as a default.

When no indication on the Ex type label this default applies.

When an extended range is required because of the application; it shall be indicated and must be followed.

In Indonesia around the Equator you actually might have earlier troubles with the humidity instead of the ambient temperature…



Equipment Protection Level

This is to identify in which Zone an equipment can be used:

EPL	Applicable Zone	Safety level description
Ga	0	Abnormal operation with 2 mal-functions
Gb	1	Normal operation with 1 mal-function
Gc	2	Normal operation
EPL	**Applicable Zone**	**Safety level description**
Da	20	Abnormal operation with 2 mal-functions
Db	21	Normal operation with 1 mal-function
Dc	22	Normal operation
EPL	**Applicable Zone**	**Safety level description**
Ma	Underground Mining	Explosion risk? Operation safely possible
Mb	Underground Mining	Explosion risk? Disconnection required

Capitals?

When identifying markings on equipment be aware!

Level of protection	Safety level
a	Very high
b	High
c	Normal

Grouping	Suitable for Gases (II)	Suitable for Dusts (III)
C	Most easy ignitable	Conductive
B	Easy ignitable	Non-conductive
A	Ignitable	Ignitable Fibers & Flyings

Types of protection (electrical)

Most common applied types according to the IEC 60079 standards, parts:

Part	Code	Description
1	d	Flameproof equipment
2	p	Pressurization
5	q	Quartz encapsulation
7	e	Increased safety
11	i	Intrinsic safety
15	n	Non incendive
18	m	Moulded encapsulation
28	op	Optical radiation
31	t	Protection by enclosure

Flame proof enclosure Ex d

Basic design is: enclosure is strong enough to withstand internal explosion

This design allows internal ignition sources, like sparks and (limited) hot spots.

Critical aspects:

1. Enclosure strength
2. Flame path based on joints
3. Pressure piling
4. Heat-loss of built-in apparatus
5. Entry devices (next speaker will explain)

Increased safety Ex e

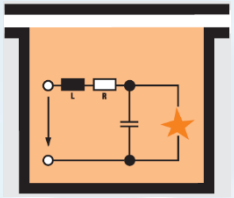
Basic design is: increased safety level for normally non sparking apparatus

This design does not allow any (unprotected) sparking components inside

Critical aspects:

1. Creepages and clearances
2. Enclosure (IP rating, impact strength etc.)
3. Heatloss (wiring and terminations)

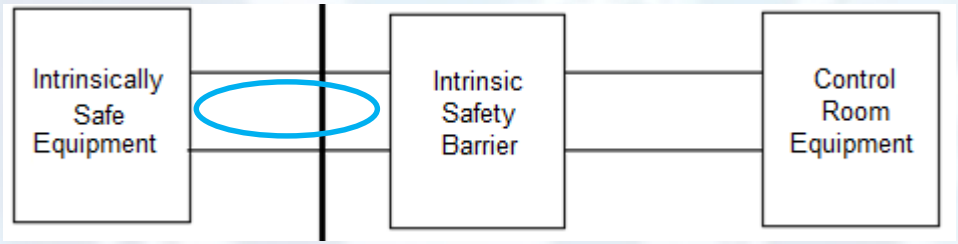
Intrinsic Safety Ex i



Basic design is: limitation of energy in the whole electrical circuit

Energy [µJ] = ½ x C x U^2 = Capacity [µF] x Voltage² [V]
Energy [µJ] = ½ x L x I^2 = Inductivity [mH] x Current² [mA]

Intrinsic safe circuits are normally supplied from safe area and basically limiting the Voltage by Zener diodes and the Current by a Resistor.
Take into account maximum cable length because of increasing C and L.



'Typical' design

The blue circuit shall being verified before commissioning (see IEC 60079-14)

Moulded encapsulation Ex m

Basic design is: moulding of the electrical circuit

Examples of application:
- Solenoid Valves
- Printed Circuit Boards

Ex mb IIC T5 Gb
Solenoid

Critical aspects (for Manufacturer):
1. Thickness of the potting
2. Internal free volumes are limited
3. Ageing of the potting material
4. Potting shall be non-hygroscopic

Ex eb mb
Serial interface

Non Incendive Ex n (for EPL Gc only)

Basic concept: Ex n consists of several sub types of protection.
In most cases being simplified versions of existing types of protection:

IEC 60079-15

Ex nA	non Arcing	→ becomes →	Ex ec	IEC 60079-7
Ex nC	enclosed Construction	→ becomes →	Ex dc	IEC 60079-1
	(or hermetically sealed)	or →	Ex mc	IEC 60079-18
Ex nR	Restricted breathing			

Ex nR
Light fixture

Restricted Breathing
Test tool

Remark: Not easy to guarantee ’nR’ during Life Cycle

Optical radiation Ex op

Basic design is: safety by either limitation of radiation or protection of optical light. This type of protection is divided in:

Ex op is	inherent safe	(limited optical energy in mW/mm²)
Ex op pr	protected	(light source/channel is physical protected)
Ex op sh	with interlock	(fibre optic loop monitoring; no return = stop)

Ex db op is
sensor

Ex db op pr
connector

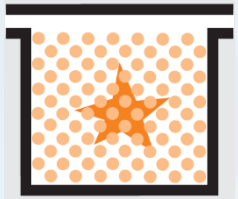
Pressurized enclosures Ex p

Basic design is: keep dangerous atmosphere outside by overpressure

Aspects:
1. First a purging of ≥ 5 times the internal volume
2. For EPL Gb redundant guarding of the flow required
3. Then ’compensation of leak losses’ + power on
4. For EPL Gb mandatory power off when pressure drops

Spark arrestor
in the outlet !

Powder (quartz) filling Ex q



Basic design is: extinguish any ignition source in a quartz filled enclosure

Example: Mobile Computer

Electronics in quartz
Keyboard and Touch screen
intrinsic safe controlled

Remarks:

1. Combination with intrinsic safety [ib]
2. X certificate = specific conditions of use!!

Protection by enclosure Ex t (for dust only)

Basic design is: minimum IP degree for dust tight enclosure

Depending on the dust group a minimum IP rating of either IP5X or IP6X

Remark:
X = ‘don’t care’ (for dust)

because 2nd digit is for ingress protection against water

Critical aspects:
1. IP5X or 6X rating depending on EPL and Dust group
2. Heat dissipation to fulfil the max. surface temperature indicated as T…°C

Marking of equipment

Based on applied type(s) of protection including their level of protection

These levels of protection are:

Level	Safety level description
a	Very high
b	High
c	Normal

for Product … from Manufacturer ……

Remark:
1 product, 10 certificates!
not covering world wide sales

Manufacturers and users prefer one single system!

In previous Conferences we did already do some calls…

Malaysia 2014

Poland 2015

China 2017

Today here in Jakarta shortly again

Let’s do a call…

Overview of types of protection

IEC 60079-14 differentiates these types for each Equipment Protection Level

Level	Ex d	Ex e	Ex i	Ex m	Ex n	Ex op	Ex q	Ex p
Ga	Ex da	-	Ex ia	Ex ma	-	Ex op is	-	-
Gb	Ex db	Ex eb	Ex ib	Ex mb	-	Ex op is/pr/sh	Ex qb	Ex pxb/pyb
Gc	Ex dc	Ex ec	Ex ic	Ex mc	Ex nA/nC/nR	Ex op is/pr/sh	-	Ex pzc

Level	Ex i	Ex m	Ex op	Ex p	Ex t
Da	Ex ia	Ex ma	Ex op is	-	Ex ta
Db	Ex ib	Ex mb	Ex op is/pr/sh	Ex pb	Ex tb
Dc	Ex ic	Ex mc	Ex op is/pr/sh	Ex pc	Ex tc

Remark:

Don’t mix up Db & db !!

How to read the markings?

Let's demonstrate a sample:

CE 0344 BARTEC

BARTEC B-ASSEMBLY — BOELEWERF 25

Ex db eb [ia Gb] IIB+H_2 T5 Gb — NL 2987 VD RIDDERKERK

IECEx DEK 13.0075

Ⓔx II 2(2)G Ex db eb [ia Gb] IIB+H_2 T5 Gb — 2018

DEKRA 13 ATEX 0209 — 115/230VAC

SERIAL Nr.: 3849530-10-12 — -20°C < Ta < +40°C

SEE INSTALLATION INSTRUCTION DOCUMENT

Ex :	Explosion protected.
db :	Flameproof 'd' with level of protection 'b'.
eb :	Increased safe 'e' with level of protection 'b'.
[ia Gb] :	Square brackets [ ] = associated apparatus, intrinsic safety with level of protection 'a', overall application is because of the insert max. for Equipment Protection Level Gb.
IIB+H_2 :	Group IIB additional including Hydrogen.
T5 :	Max. surface temperature classified T5 (100°C).
Gb :	This whole assembly has EPL Gb (zone 1).
DEK :	Responsible Certification Body DEKRA.
13 :	Year (2013) of initial issue 0.
0075 :	Certificate (serial) number from DEKRA.

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How to read the online Certificate of Conformity?

Annexes

Certificate No.:	IECEx DEK 13.0075 issue No.: 2
Status:	Current
Date of Issue:	2018-04-25
Applicant:	BARTEC NEDERLAND B.V. Boelewerf 25 2987 VD Ridderkerk The Netherlands
Equipment: *Optional accessory:*	Control/distribution panels, Series BARTEC B/C/D/E-ASSEMBLY
Type of Protection:	d e i m op q and t
Marking:	BARTEC B (-ASSEMBLY): Ex db ... IIB / IIB + H_2 T6 ... T3 Gb BARTEC C (-ASSEMBLY): Ex db ... IIC T6 ... T3 Gb BARTEC D (-ASSEMBLY): Ex tb ... IIIC T80 °C ... T130 °C Db BARTEC E (-ASSEMBLY): Ex eb ... IIB / IIC T6 ... T3 Gb BARTEC E (-ASSEMBLY): Ex ia / ib ... IIB / IIC T6 ... T4 Gb Additional markings are provided depending on the certified components used in the actual construction.

Certificate history:
Issue No. 2 (2018-4-25)
Issue No. 1 (2015-2-13)
Issue No. 0 (2013-12-20)

Page 1 of 4

Equipment: *Optional accessory:*	Converter
Type of Protection:	Equipment protection by intrinsic safety "i"; Intrinsically safe electrical systems
Marking:	Converter: [Ex ia Gb] IIC/IIB Detector: Ex ia IIC T6/T5 Gb

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Preferable you select equipment to current editions

This certificate is issued as verification that a sample(s), representative of production, was assessed and tested and found to comply with the IEC Standard list below and that the manufacturer's quality system, relating to the Ex products covered by this certificate, was assessed and found to comply with the IECEx Quality system requirements. This certificate is granted subject to the conditions as set out in IECEx Scheme Rules, IECEx 02 and Operational Documents as amended.

STANDARDS:
The apparatus and any acceptable variations to it specified in the schedule of this certificate and the identified documents, was found to comply with the following standards:

IEC 60079-0 : 2007-10 Edition: 5	Explosive atmospheres - Part 0:Equipment - General requirements
IEC 60079-31 : 2008 Edition: 1	Explosive atmospheres – Part 31: Equipment dust ignition protection by enclosure 't'
IEC 60079-7 : 2006-07 Edition: 4	Explosive atmospheres - Part 7: Equipment protection by increased safety "e"

This certificate is issued as verification that a sample(s), rep
found to comply with the IEC Standard list below and that th
covered by this certificate, was assessed and found to com
certificate is granted subject to the conditions as set out in I
as amended.

STANDARDS:
The apparatus and any acceptable variations to it specified in the schedule of this certificate and the identified documents, was found to comply with the following standards:

IEC 60079-0 : 2017 Edition: 7.0	Explosive atmospheres - Part 0: Equipment - General requirements
IEC 60079-1 : 2014-06 Edition: 7.0	Explosive atmospheres - Part 1: Equipment protection by flameproof enclosures "d"
IEC 60079-11 : 2011 Edition: 6.0	Explosive atmospheres - Part 11: Equipment protection by intrinsic safety "i"
IEC 60079-18 : 2017 Edition: 4.1	Explosive atmospheres - Part 18: Protection by encapsulation "m"
IEC 60079-28 : 2015 Edition: 2	Explosive atmospheres - Part 28: Protection of equipment and transmission systems using optical radiation
IEC 60079-31 : 2013 Edition: 2	Explosive atmospheres - Part 31: Equipment dust ignition protection by enclosure "t"
IEC 60079-5 : 2015 Edition: 4.0	Explosive atmospheres –Part 5: Equipment protection by powder filling "q"
IEC 60079-7 : 2017 Edition: 5.1	Explosive atmospheres - Part 7: Equipment protection by increased safety "e"

Non-electrical equipment

Today, there are two parts in ISO/IEC 80079 series of standards available:

Part	Code	Description
36	h	Basic requirements; Hazard assessment
37	c*	Constructional Safety
	b*	Control of Ignition Sources
	k*	Liquid immersion

Marking includes Ex h with info in CoC:

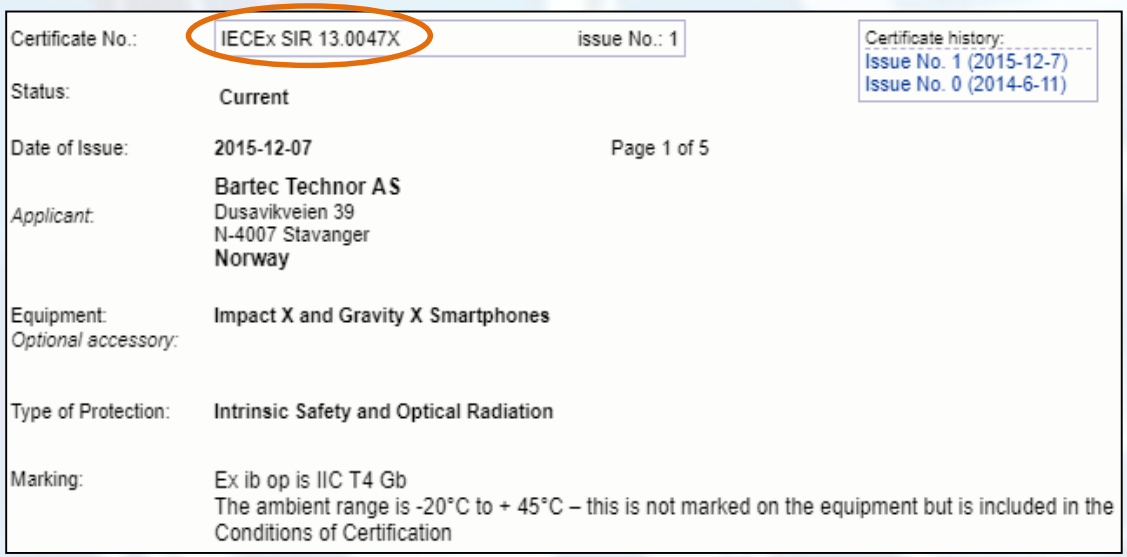
Non-electrical parts:
Assessed against protection type 'c'

* Types of protection 'c, b en k' will not being marked on the product, because of possible user mis-interpretation with levels of protection 'c and b'.

Manufacturers shall indicate Ex h only and have to define the specific used method(s) in the user installation instructions.

Last but not least:

When a Certificate of Conformity has a numbering like SIR 13.0047X



Certificate No.:	IECEx SIR 13.0047X	issue No.: 1	Certificate history: Issue No. 1 (2015-12-7) Issue No. 0 (2014-6-11)
Status:	Current		
Date of Issue:	2015-12-07	Page 1 of 5	
Applicant:	Bartec Technor AS Dusavikveien 39 N-4007 Stavanger Norway		
Equipment: *Optional accessory:*	Impact X and Gravity X Smartphones		
Type of Protection:	Intrinsic Safety and Optical Radiation		
Marking:	Ex ib op is IIC T4 Gb The ambient range is -20°C to + 45°C – this is not marked on the equipment but is included in the Conditions of Certification		

X? Let the alarm bells ring!

That 'X' is for CoC's **always** indicating a 'Specific Condition of Use' !
So; it is neither a placeholder for any future numbering nor a 'don't care' !!!

Thank you

Karel Neleman
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BARTEC
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