



EX COURSE



EX PHILOSOPHY

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- **An explosive atmosphere results from a mixture of flammable gases, vapours, mist or dust with air in such proportions that high temperature or an electrical energy ignition source will cause an explosion.**

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To create this explosion three elements are required, these are:

- **Oxygen (air)**
- **An inflammable substance, gas, liquid, solid.**
- **An energy ignition source**

Based on this it is possible to prevent an explosion by just removing one of the elements.

EXPLOSION TRIANGLE



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- **Areas where there is a risk of explosion are divided into four areas, below are the two most common.**
- **Area category A –risk of air mixed with flammable gases, vapours or suspended liquid drops.**
- **Area category B –risk of air mixed with flammable dust.**

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- The above areas are classified into zones based on how long and how often the risk will occur.

Group/ Zone	Division US	Category according to Dir. 94/9/EC (Atex)	Text
II / Zone 0	Division 1	1	Continuous / long period release. More than 1000 hours a year or more than 10% of the processing time.
II / Zone 1	Division 1	2	Primary source of release. Release expected every now and then.
II / Zone 2	Division 2	3	Secondary source of release. Release not expected to occur and if so only for a short period of time. Release less than 2 hours each time and less than 10 hours a year total.

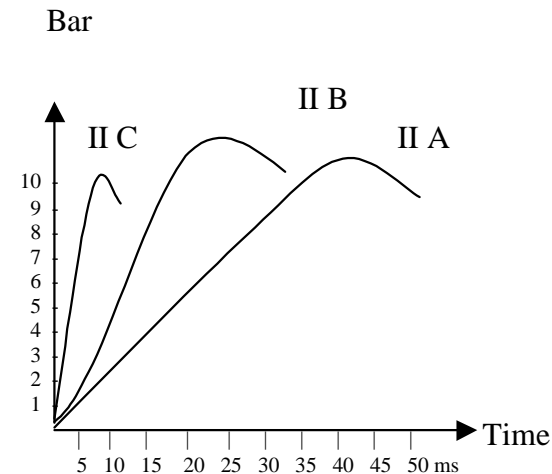
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- **Flammable liquid are divided into classes based on their flash-points**
- **Class A – Lower then 23 Degree. C**
- **Class B – Between 23 to 55 Degree. C**
- **Class C – Higher then 55 Degree. C**

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- Gases, are divided into two groups, group I is methane and applies only to coal mines.
- Group II is divided into three categories, A, B and C.
The categorisation is based on speed of pressure build up and minimum energy needed to ignite the gas.

I – gas	: 280 μ J
IIA – gases	: 200 μ J
IIB – gases	: 60 μ J
IIC – gases	: 20 μ J

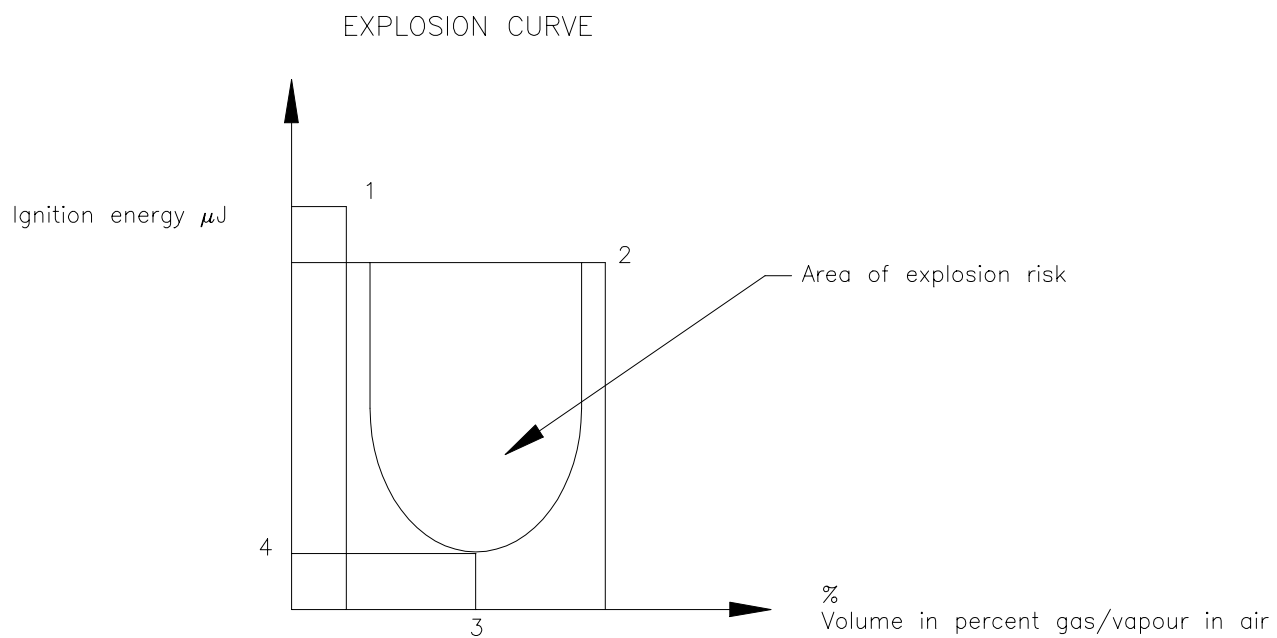


- The pressure build up is done more rapidly and needs less energy in an IIC gas then in a IIB gas.

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- **To cause an explosion the mixture of gas and air must be within certain limits. All gases have a explosion curve with an LEL (Lower explosion limit) and UEL (Upper explosion limit).**
- **By having a mixture between the two values an explosion may occur. See below for a typical curve and a table for gasses split into categories with values for LEL and UEL.**
- **The table also has the ignition temperature for each gas.**

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1=Lower explosion limit, 2=Upper explosion limit, 3=Optimum mixture, 4=Minimum ignition energy

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Gas grouping table in %

Group	Gas or vapour	Temp. class	Ignition temp. ° C	Lower expl. limit	Upper expl. limit
I	Methane		595	5,0	15,0
	Acetaldehyde	T 4	140	4,0	57,0
II A	Acetone	T 1	535	2,5	13,0
	Ammoniac	T 1	630	15,0	28,0
	Amylacetat	T 2	375	1,0	
	i-Amylacetate	T 2	380	1,0	10,0
	Amyl alcohol	T 3	300	1,3	10,5
	Butane	T 2	365	1,5	8,5
	Benzene	T 1	560	1,2	8,0
	Butanol	T 2	340	0,8	5,8
	Butylacetat	T 2	370	1,2	75,0
	i-Butyl alcohol	T 2	408	1,7	
	Cyclohexan	T 3	259	1,2	8,3
	Cyclohexanon	T 2	419	1,3	9,4
	Decane	T 3	205	0,7	5,1
	Acetic acid	T 1	485	4,0	17,0
	Acetic acid anhydride	T 2	330	2,0	10,2
	Ethane	T 1	515	3,0	15,5
	Ethanol	T 2	425	3,5	18,0
Ethyl acetate	T 1	460	2,1	11,5	
Ethylbenzene	T 2	431	1,0		
Ethyl chloride	T 2	510	3,6	14,8	
Ethylene chloride	T 2	440	6,2	16,0	
Ethyl nitrite	-		3,0	50,0	
Heptane	T 3	215	1,1	6,7	
Hexane	T 3	233	1,2	7,4	
Hydrogen sulphide	T 3	270	4,7	46,0	
Carbon monoxide	T 1	605	12,5	74,0	
Chlorobenzene	T 1	638	1,3	11,0	
Chloroethylene	-		4,0	22,0	
Methane	T 1	595	5,0	15,0	
Methanol	T 1	455	5,5	26,5	
Methyl acetate	T 1	475	3,1	16,0	
Methyl ethylketone	T 1	505	1,8	11,5	
Methyl chloride	T 1	625	7,1	18,5	
Naphthalene	T 1	528	0,9	5,9	
Nonane	T 3	205	0,7	5,6	
i-Octane	T 2	411	1,0	6,0	
Pentane	T 3	285	1,4	7,8	
Propane	T 1	470	2,1	9,5	
Propanol	T 2	405	2,1	13,5	
Propyl acetate	T 2	430	1,7	8,0	
Toluene	T 1	535	1,2	7,0	
Vinyl acetate	T 2	385	2,6	13,4	
p-Xylene	T 1	528	1,1	7,0	
II B	1,3-Butadiene	T 2	430	1,1	12,5
	1,4-Dioxane	T 2	379	1,9	22,5
	Ethylene	T 2	425	2,7	34,0
	Ethylene oxide	T 2	440	3,0	100,0
	Ethylether	T 4	170	3,0	50,0
	Tetrahydrofuran	T 3	224	1,5	12,0
II C	Acetylene	T 2	305	1,5	82,0
	Ethyl nitrate	-		3,8	
	Hydrogen	T 1	560	4,0	75,6
	Carbon disulfide	T 5	102	1,0	50,0

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- According to EN 60529/IEC529 – below the degree of protection for enclosures.

FIRST NUMBER		SECOND NUMBER	
0	No protection	0	No protection
1	Protected against a solid object 50 m/m or greater	1	Protected against vertically dripping water
2	Protected against a solid object 12 m/m or greater	2	Protected against vertically dripping water, when tilted 15 degree.
3	Protected against a solid object 2,5 m/m or greater	3	Protected against water spraying at an angle up to 60 degree.
4	Protected against a solid object 1 m/m or greater	4	Protected against water splashing from any direction
5	Dust protected	5	Protected against jets of water from any direction
6	Dust tight	6	Protected against powerful jets of water from any directions
		7	Protected against immersion between a depth of 150m/m and 1000 m/m
		8	Protected against submersion

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Approximately correlation between IP (IEC) and NEMA 250 standards	
IP 10	NEMA 1
IP 11	NEMA 2
IP 14	NEMA 3 R
IP 52	NEMA 5-12-12K
IP 54	NEMA 3-3S
IP 56	NEMA 4-4X
IP 67	NEMA 6-6P

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- **Some technical parameters from EN 50014.**
- **Ignition temperature is the lowest temperature on the surface at which an explosive atmosphere may be ignited.**
- **Ignition energy is the minimum energy required to ignite an explosive atmosphere.**
- **Flash point is the minimum temperature where a flammable liquid emits enough vapour to be ignited by a spark, high temperatures, etc.**

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- **Temperature classes for equipment in group II**

Temperature class	Maximum surface temperature in degree. C
T 1	450
T 2	300
T 3	200
T 4	135
T 5	100
T 6	85

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- **Electrical apparatus are normally designed for use between ambient temperature of -20 to $+40$ degr. C.**
- **It is possible to lower the t.amb. or to increase the t.amb. but this requires additional marking on the apparatus. The temperature range must be stated in the certificate.**

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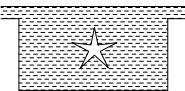
Marking

In addition to the marking described earlier, the following applies:


- The name of the manufacturer or his registered trade mark. According to the Atex, the name and address of manufacturer.
- The manufacturer's type identification, not applicable according to Atex, but required by CENELEC standards
- Marking as described on the introduction, "old" approach or according to new directive 94/9/EC (Atex).
- Serial number except on plugs, glands, sockets and very small apparatus where there is limited space, batch number may in some cases be accepted. According to Atex also production year.
- If special conditions are needed for safe use an X follows the certificate number, this may be replaced by a warning label.
- For components not intended to be used alone, the certificate number is followed by a U, the letter X is not used.

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Methods of protection

Ex code	EN-stdr.	IEC-norm	Min. IP-rating	Text	Drawing
EEx o	EN 50015	IEC 60079-6	IP-66	Ignition source is immersed in oil to a dept sufficient to prevent ignition of a potential hazardous gas mixture above the surface of the oil. For use in Zone 1 and 2.	

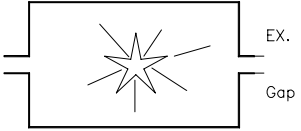
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Ex code	EN-stdr.	IEC-norm	Min. IP-rating	Text	Drawing
EEx p	EN 50016	IEC 60079-2	IP-40	Potential hazardous gas mixture is prevented from entering the enclosure by the use of overpressure of air inside or other protective gas inside the enclosure. For use in Zone 1 and 2	

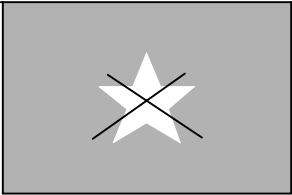
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Ex code	EN-stdr.	IEC-norm	Min. IP-rating	Text	Drawing
EEx q	EN 50017	IEC 60079-5	IP-54	Ignition source is embedded with granular or powder material to prevent ignition of a potential hazardous gas mixture above the surface of the embedded material. For use in Zone 1 and 2	

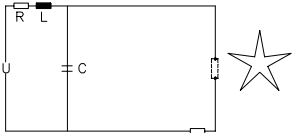
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Ex code	EN-stdr.	IEC-norm	Min. IP-rating	Text	Drawing
EEx d	EN 50018	IEC 60079-1	NA	<p>Ignition source is mounted inside an enclosure that will withstand an internal explosion if a hazardous gas mixture were to enter the enclosure. At the same time preventing the explosion to ignite the surrounding atmosphere.</p> <p>For use in Zone 1 and 2</p>	 <p>The diagram shows a rectangular enclosure with a starburst symbol inside representing an explosion source. To the right of the enclosure, there is a gap in the wall, labeled 'EX.' and 'Gap'.</p>

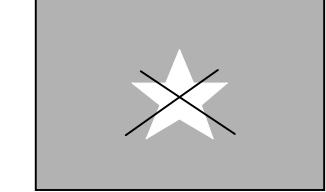
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Ex code	EN-stdr.	IEC-norm	Min. IP-rating	Text	Drawing
EEx e	EN 50019	IEC 60079-7	IP-54	Prevention of an ignition source to occur, e.g. sparks, arcs or excessive heat in the enclosure. For use in Zone 1 and 2	

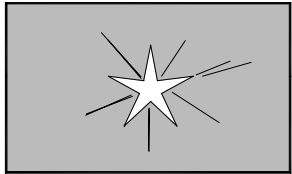
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Ex code	EN-stdr.	IEC-norm	Min. IP-rating	Text	Drawing
EEx i	EN 50020	IEC 60079-11	IP-20	<p>The electrical circuits are incapable to produce enough energy to act as an ignition source, also under specified failure conditions.</p> <p>For use in Zone 0, 1 and 2 (ia) and for use in zone 1 and 2 (ib)</p>	

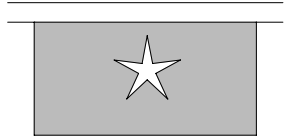
EX PHILOSOPHY

Ex code	EN-stdr.	IEC-norm	Min. IP-rating	Text	Drawing
EEx n V	EN 50021	IEC 60079-15	NOTE1	Prevention of an ignition source to occur, e.g. sparks, arcs or excessive heat in the enclosure. For use in Zone 2	


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Ex code	EN-stdr.	IEC-norm	Min. IP-rating	Text	Drawing
EEx nW	EN 50021	IEC 60079-15	NOTE1	<p>Ignition source is protected to prevent ignition of a potential hazardous gas mixture above the surface of the encapsulated material, by other means than by restricted breathing enclosure, energy limitation and simplified pressurization.</p> <p>For use in Zone 2</p>	


EX PHILOSOPHY

Ex code	EN-stdr.	IEC-norm	Min. IP-rating	Text	Drawing
EEx nR	EN 50021	IEC 60079-15	NOTE1	Ignition source is encapsulated in an enclosure that is designed to restrict the entry of gases. For use in Zone 2	

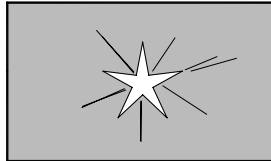
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Ex code	EN-stdr.	IEC-norm	Min. IP-rating	Text	Drawing
EEx nL	EN 50021	IEC 60079-15	NOTE1	<p>Electrical apparatus in which the electrical circuits are incapable of producing enough energy or thermal effect to act as an ignition source.</p> <p>For use in Zone 2</p>	

EX PHILOSOPHY

Ex code	EN-stdr.	IEC-norm	Min. IP-rating	Text	Drawing
EEx nP	EN 50021	IEC 60079-15	NOTE1	<p>Potential hazardous gas mixture is prevented from entering the enclosure by the use of overpressure of air inside or other protective gas inside the enclosure.</p> <p>For use in Zone 2</p>	

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Ex code	EN-stdr.	IEC-norm	Min. IP-rating	Text	Drawing
EEx m	EN 50028	IEC 60079-18	NA	Ignition source is embedded with compound material to prevent ignition of a potential hazardous gas mixture above the surface of the embedded material. For use in Zone 1 and 2	

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Note 1

- **IP54 where there are bare live parts or IP44 where there are insulated live parts.**
- **IP4X where there are bare live parts or IP2X where there are insulated live parts and the apparatus is intended for installation only in locations providing adequate protection against solid foreign objects or water capable of impairing safety, and the apparatus is marked with the symbol X**