

IEC 60079
Explosive atmospheres

Type of protections

Peter Thurnherr
thuba Ltd., Switzerland



IEC 60079
Explosive atmospheres – Part 0:

General requirements





IEC 60079-0

Edition 7.0 2017-12

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Explosive atmospheres –
Part 0: Equipment – General requirements**

**Atmosphères explosives –
Partie 0: Matériel – Exigences générales**



Test of enclosures

Test for enclosures shall be performed in the following order:

- **thermal endurance test to heat**
- **thermal endurance test to cold**
- **drop test, if applicable**
- **tests for resistance to impact**
- **tests for degree of protection**
- **any other tests required by this standard**



Thermal endurance test to heat

Service temperature T_s	Test condition	Alternative test condition
$T_s \leq 70\text{ }^{\circ}\text{C}$	672 $^{0}_{+30}$ h at $(90 \pm 5)\%$ RH, at $T_s + 20 \pm 2\text{ K}$ (but not less than $80\text{ }^{\circ}\text{C}$ test temperature)	
$70\text{ }^{\circ}\text{C} < T_s \leq 75\text{ }^{\circ}\text{C}$	672 $^{0}_{+30}$ h at $(90 \pm 5)\%$ RH at $T_s + 20 \pm 2\text{ K}$	504 $^{0}_{+30}$ h at $(90 \pm 5)\%$ RH at $(90 \pm 2)\text{ }^{\circ}\text{C}$ followed by 336 $^{0}_{+30}$ h dry at $T_s + 20 \pm 2\text{ K}$
$T_s > 75\text{ }^{\circ}\text{C}$	336 $^{0}_{+30}$ h at $(90 \pm 5)\%$ RH at $(95 \pm 2)\text{ }^{\circ}\text{C}$, followed by 336 $^{0}_{+30}$ h dry at $T_s + 20 \pm 2\text{ K}$	504 $^{0}_{+30}$ h at $(90 \pm 5)\%$ RH at $(90 \pm 2)\text{ }^{\circ}\text{C}$ followed by 336 $^{0}_{+30}$ h dry at $T_s + 20 \pm 2\text{ K}$
T_s is the temperature defined in 5.2 and shall NOT include the increase stated in 26.7.2.		

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Thermal endurance test to cold

The thermal endurance test to cold shall be determined by submitting the enclosures and parts of enclosures of non-metallic materials, on which the type of protection depends, to storage for 24 h in an ambient temperature corresponding to the minimum service temperature.

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Resistance to impact

	Drop height h $^{0}_{+0,01}$ with 1 $^{0}_{+0,01}$ kg mass m			
Equipment grouping	Group I		Group II or III	
Risk of mechanical danger	High	Low	High	Low
a) Enclosures and external accessible parts of enclosures (other than light-transmitting parts)	2	0,7	0,7	0,4
b) Guards, protective covers, fan hoods, cable glands	2	0,7	0,7	0,4
c) Light-transmitting parts without guard	0,7	0,4	0,4	0,2
d) Light-transmitting parts with guard having individual openings from 625 mm ² to 2 500 mm ² ; see 21.1 (tested without guard)	0,4	0,2	0,2	0,1
NOTE A guard for light-transmitting parts having individual openings from 625 mm ² to 2 500 mm ² reduces the risk of impact, but does not prevent impact.				

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IEC 60079
Explosive atmospheres – Part 1:

Equipment protection by
flameproof «d»





IEC 60079-1

Edition 7.0 2014-06

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Explosive atmospheres –
Part 1: Equipment protection by flameproof enclosures “d”

Atmosphères explosives –
Partie 1: Protection du matériel par enveloppes antidéflagrantes «d»



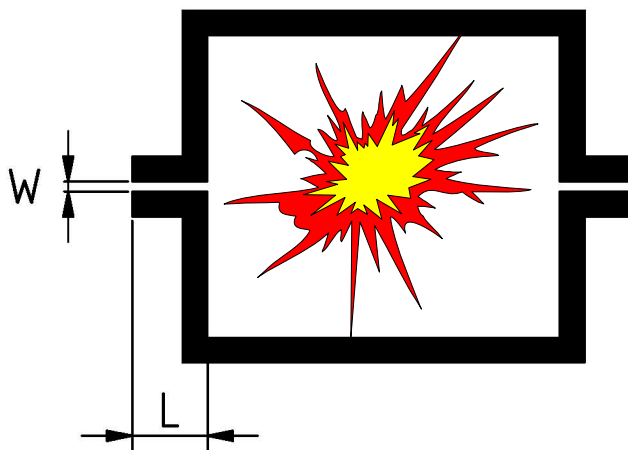
General requirements

- Enclosure must withstand resulting explosion pressure without any deformation
- Transmission of the flame prevented by the tolerated flame paths
- Gas group IIA, IIB or IIC depending on the MESG
- Temperature class dependent on max. surface temperature due to the heat loss of all components T1-T6

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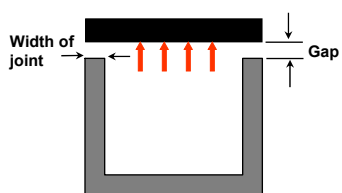
Width of joint and gap



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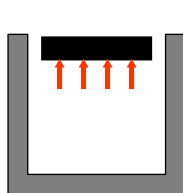
Design of the flameproof gaps



Gas group IIA and IIB

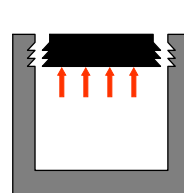
(IIC not possible, since the gap is widened in the event of an explosion.
Ref. to 5.2.7 from IEC 60079-1)

Flat joint



Gas group IIA, IIB and IIC

Cylindrical joint



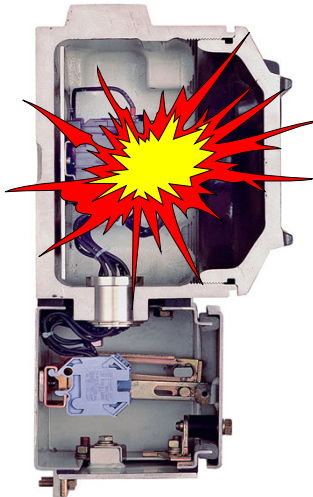
Gas group IIA, IIB and IIC

Threaded joint

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Flameproof enclosure IIC



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Width of joint and gap for IIC

Table 2 – Minimum width of joint and maximum gap for Group IIC enclosures

Type of joint		Minimum width of joint L mm	Maximum gap mm			
			For a volume cm ³ $V \leq 100$	For a volume cm ³ $100 < V \leq 500$	For a volume cm ³ $500 < V \leq 2\,000$	For a volume cm ³ $V > 2\,000$
Flanged joints ^a		6	0,10	–	–	–
		9,5	0,10	0,10	–	–
		15,8	0,10	0,10	0,04	–
		25	0,10	0,10	0,04	0,04
Spigot joints (Figure 2a)	$c \geq 6$ mm	12,5	0,15	0,15	0,15	–
	$d \geq 0,5 L$	25	0,18 ^b	0,18 ^b	0,18 ^b	0,18 ^b
	$L = c + d$ $f \leq 1$ mm	40	0,20 ^c	0,20 ^c	0,20 ^c	0,20 ^c
Cylindrical joints		6	0,10	–	–	–
		9,5	0,10	0,10	–	–
Spigot joints (Figure 2b)		12,5	0,15	0,15	0,15	–
		25	0,15	0,15	0,15	0,15
		40	0,20	0,20	0,20	0,20
Cylindrical joints for shaft glands of rotating electrical machines with rolling element bearings		6	0,15	–	–	–
		9,5	0,15	0,15	–	–
		12,5	0,25	0,25	0,25	–
		25	0,25	0,25	0,25	0,25
		40	0,30	0,30	0,30	0,30

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Cylindrical threaded joints

Table 3 – Cylindrical threaded joints

Pitch	$\geq 0,7 \text{ mm}^a$
Thread form and quality of fit	Medium or fine tolerance quality according to ISO 965-1 and ISO 965-3 ^b
Threads engaged	≥ 5
Depth of engagement	
Volume $< 100 \text{ cm}^3$	$\geq 5 \text{ mm}$
Volume $> 100 \text{ cm}^3$	$\geq 8 \text{ mm}$
^a Where the pitch exceeds 2 mm, special manufacturing precautions may be necessary (for example, more threads engaged) to ensure that the electrical apparatus can pass the test for non-transmission of an internal ignition which is prescribed in 15.2.	
^b Cylindrical threaded joints which do not conform with ISO 965-3 in respect of thread form or quality of fit, are permitted if the test for non-transmission of an internal ignition, prescribed in 15.2, is passed, when the width of the threaded joint specified by the manufacturer is reduced by the amount specified in Table 6.	

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Physikalisch-Technische Bundesanstalt
Braunschweig und Berlin
Nationales Metrologieinstitut



(1) **EU-TYPE EXAMINATION CERTIFICATE**
(Translation)

- (2) Equipment or Protective Systems Intended for Use in
Potentially Explosive Atmospheres - **Directive 2014/34/EU**
- (3) EU-Type Examination Certificate Number:

PTB 19 ATEX 1004 X

Issue: 0

- (4) Product: Power distribution, switch and control gear assembly
Type SAdB 6 AK . .
- (5) Manufacturer: thuba AG
- (6) Address: Blauensteinerstrasse 16, 4002 Basel, Switzerland
- (7) This product and any acceptable variation thereto is specified in the schedule to this certificate and the documents therein referred to.
- (8) The Physikalisch-Technische Bundesanstalt, notified body No. 0102 in accordance with Article 17 of the Directive 2014/34/EU of the European Parliament and of the Council, dated 26 February 2014, certifies that this product has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of products intended for use in potentially explosive atmospheres, given in Annex

- (6) Address: Blauensteinerstrasse 16, 4002 Basel, Switzerland
- (7) This product and any acceptable variation thereto is specified in the schedule to this certificate and the documents therein referred to.
- (8) The Physikalisch-Technische Bundesanstalt, notified body No. 0102 in accordance with Article 17 of the Directive 2014/34/EU of the European Parliament and of the Council, dated 26 February 2014, certifies that this product has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of products intended for use in potentially explosive atmospheres, given in Annex II to the Directive.
- The examination and test results are recorded in the confidential Test Report PTB Ex 19-19027.
- (9) Compliance with the Essential Health and Safety Requirements has been assured by compliance with:
**EN IEC 60079-0:2018, EN 60079-1:2014, EN 60079-7:2015, EN 60079-11:2012,
EN 60079-18:2014, EN 60079-31:2014**
- (10) If the sign "X" is placed after the certificate number, it indicates that the product is subject to the Specific Conditions of Use specified in the schedule to this certificate.
- (11) This EU-Type Examination Certificate relates only to the design and construction of the specified product in accordance to the Directive 2014/34/EU. Further requirements of the Directive apply to the manufacturing process and supply of this product. These are not covered by this certificate.
- (12) The marking of the product shall include the following:

 II 2 G Ex db eb mb ia/ib [ia Ga/ib Gb] IIC T6, T5, T4 Gb
 II 2 D Ex tb ia/ib [ia Da/ib Db] IIIC T80°C, T95°C, T130°C Db

Konformitätsbewertungsstelle, Sektor Explosionsschutz
On behalf of PTB:

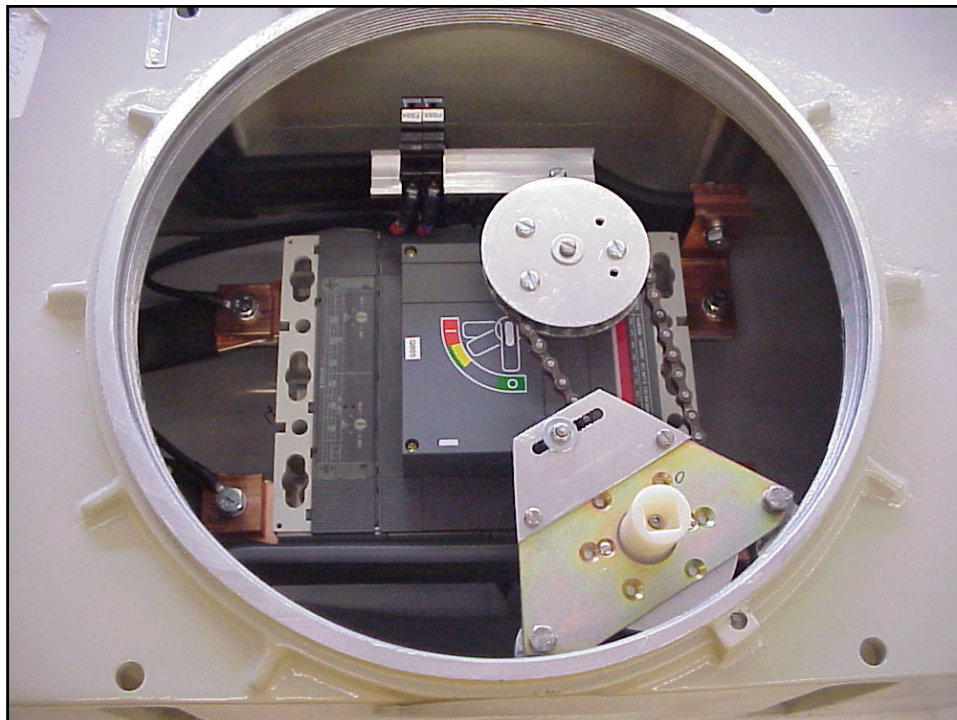
Braunschweig, May 8, 2019

Dr.-Ing. D. Markas
Direktor und Professor:



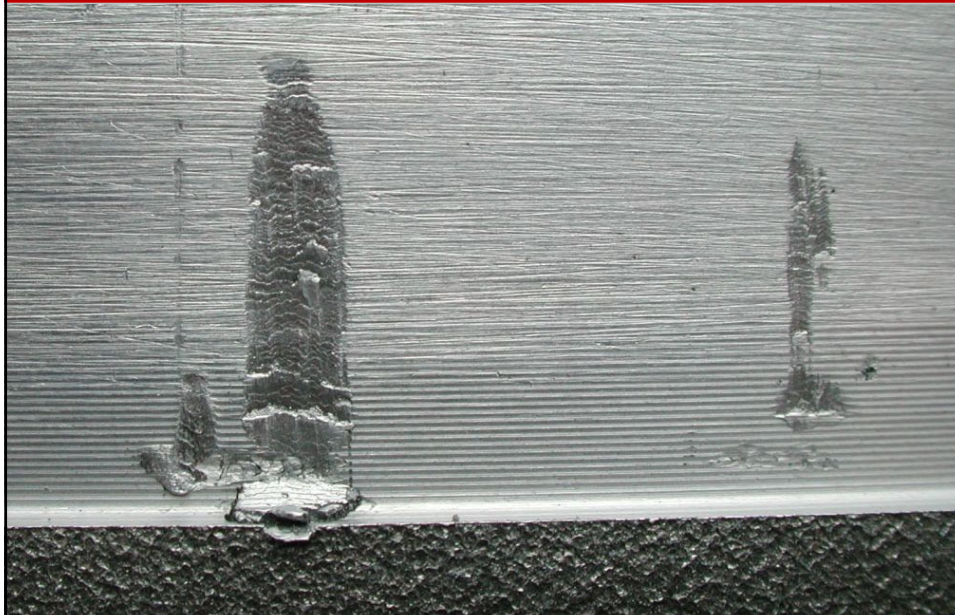
sheet 1/3

EU-Type Examination Certificates without signature and official stamp shall not be valid. The certificates may be circulated





Surface roughness $< 6.3 \mu\text{m}$



**IEC 60079
Explosive atmospheres - Part 2:**

**Equipment protection by
pressurization 'p'**





IEC 60079-2

Edition 6.0 2014-07

INTERNATIONAL STANDARD

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Explosive atmospheres –
Part 2: Equipment protection by pressurized enclosure "p"

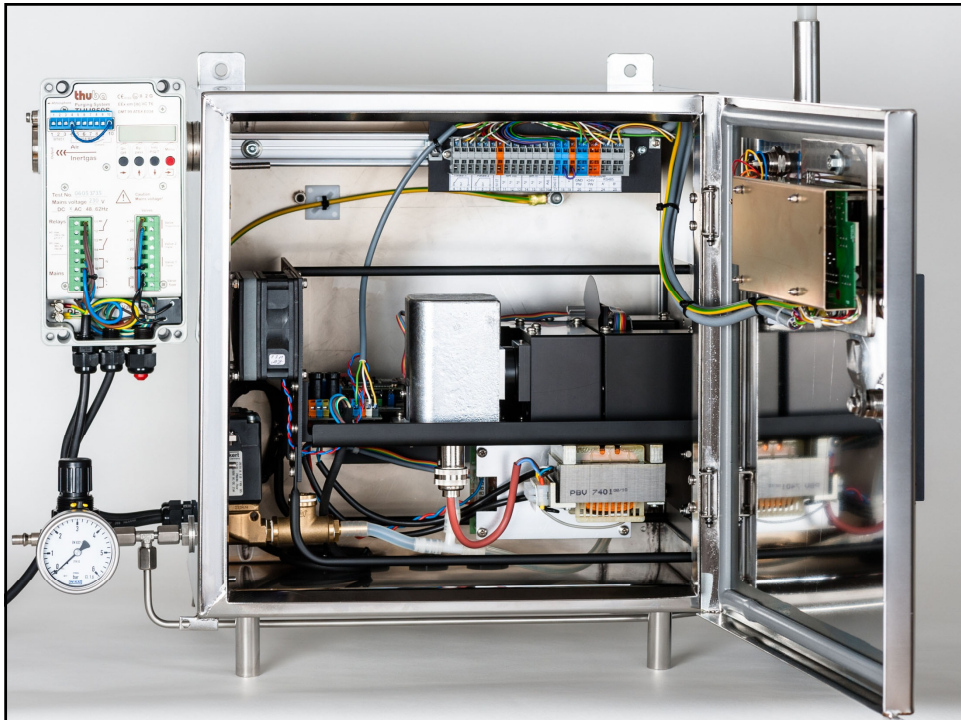
Atmosphères explosives –
Partie 2: Protection du matériel par enveloppe à surpression interne "p"

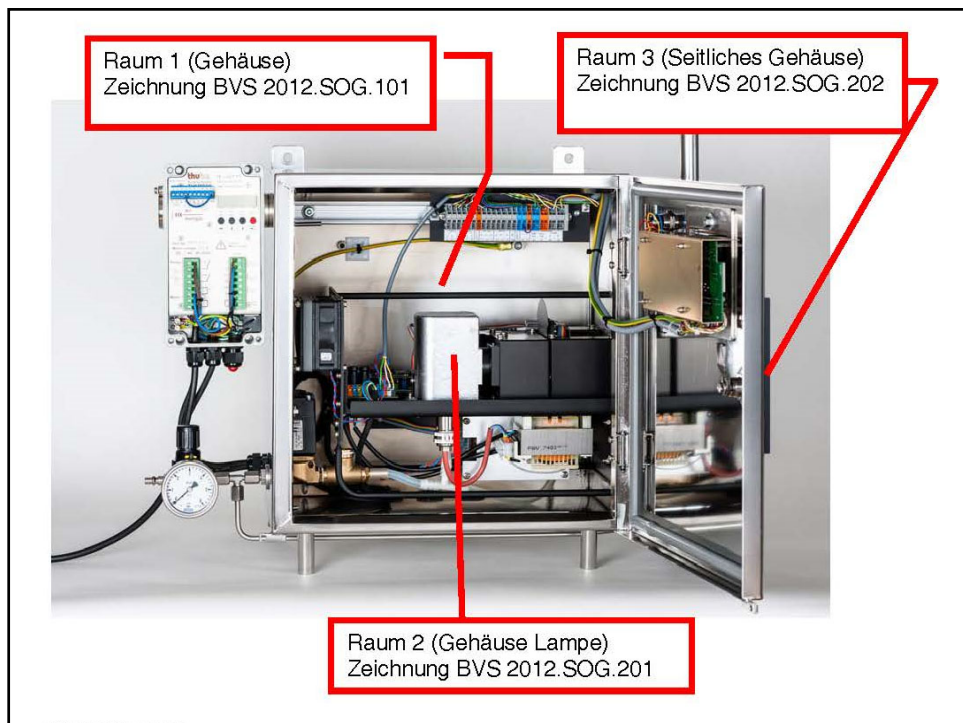
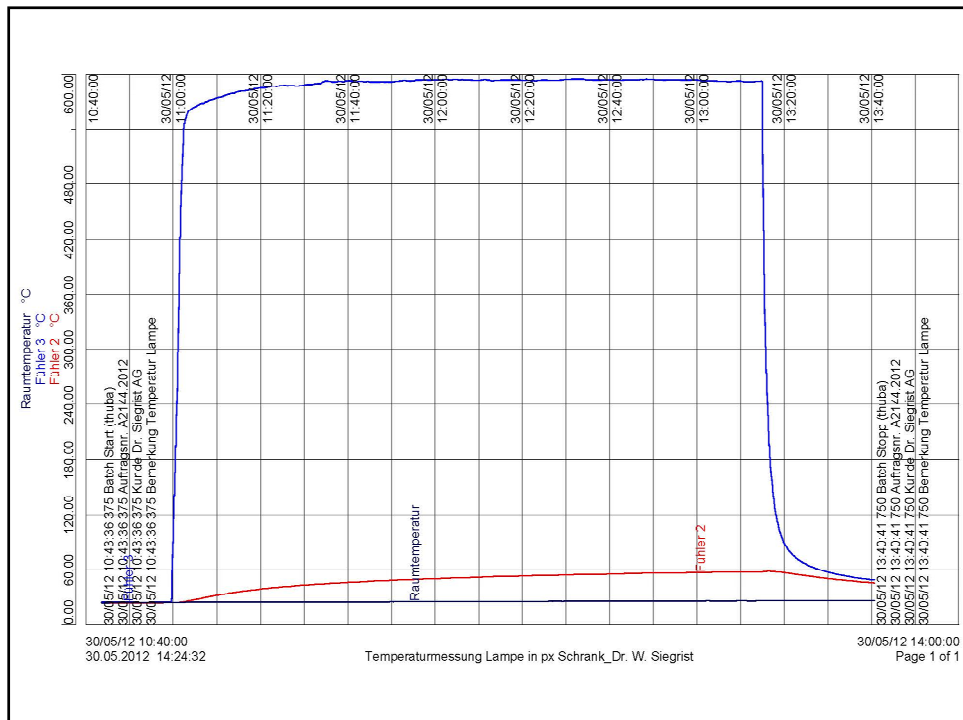


Pressurization "p"

Gas

- Enclosure with industrial components
- Pre-purging according to gas measurement (CO₂ and helium) or 5 times the enclosure volume
- Switch on after pre-purging
- Continuous monitoring of the minimum pressure
- Minimum requirement 0.5 mbar)
- Switch-off corresponds to voltage cut-off (max. values 1.5 Volt, 100 mA, 25 mW)





Test



Test record purge volume

Helium [%]

											Start	999999
Measuring	1	2	3	4	5	6	7	8	9	10	Purge volume [l]	
Cabinet 1	5	13,1	18	20	20,6	20,9	21,1	21,1	21,3		999762	
Lamp 2	4,8	6,7	17	19,5	20,6	20,8	21,1	21,1	21,3			
Ext. Block 3	5	5	17,9	19,6	20,4	20,8	21	21,1	21,3			
4												

Limiting value purge volume [l] 237

surcharge [l] 24

Value to be adjusted [l]
(see test schedule P3.6.29) 261

Carbon dioxide CO₂ [%]

											Start	999999
Measuring	1	2	3	4	5	6	7	8	9	10	Purge volume [l]	
Cabinet 1	83	92	16	2,5	1,2	0,1	0,1	0,1	0,1		999730	
Lamp 2	83	93	23	10	5	1,5	0,1	0,1	0,1			
Ext. Block 3	81	92	6,1	5,3	3,4	1,8	0,6	0,3	0,3			
4												

Limiting value purge volume [l] 269

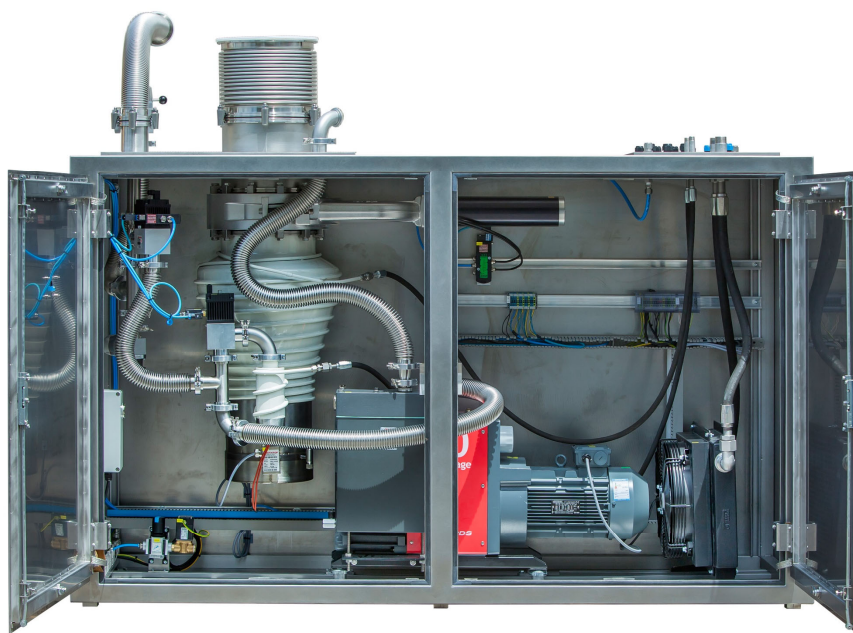
surcharge [l] 27

Value to be adjusted [l]
(see test schedule P3.6.29) 296

Edition May 2012
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Form EP3.6.43

thuba AG, 4015 Basel
Switzerland



IEC 60079
Explosive atmospheres - Part 7:

**Equipment protection by
increased safety “e”**



IEC 60079-7

Edition 5.1 2017-08

**CONSOLIDATED
VERSION**

**VERSION
CONSOLIDÉE**



**Explosive atmospheres –
Part 7: Equipment protection by increased safety “e”**

**Atmosphères explosives –
Partie 7: Protection du matériel par sécurité augmentée «e»**



Increased safety “e”

- No sparks or arcs in normal operation
- Maintenance of clearances and creepage distances
- No hot spots exceeding the temperature class
- Protection min. IP 54 (IP 44)
- Verification of dissipation power
- Requirements to be met by terminals
- Enclosure alloys

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Relationship between equipment protection levels (EPLs) and zones

Zone	Equipment protection levels (EPL)
0	Ga
1	Gb or Ga
2	Gc, Gb or Ga

EPL . . . Equipment Protection Level (EPL)

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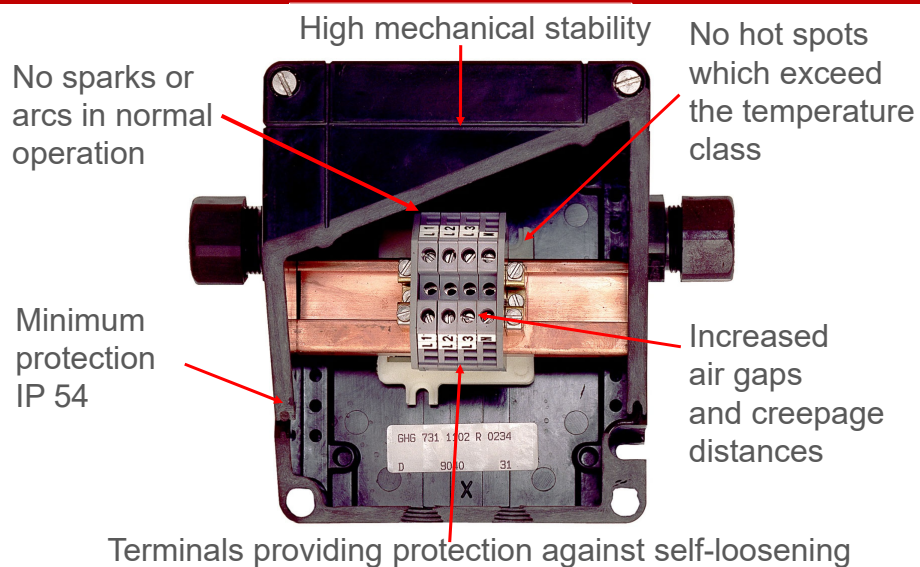
Increased safety “e”



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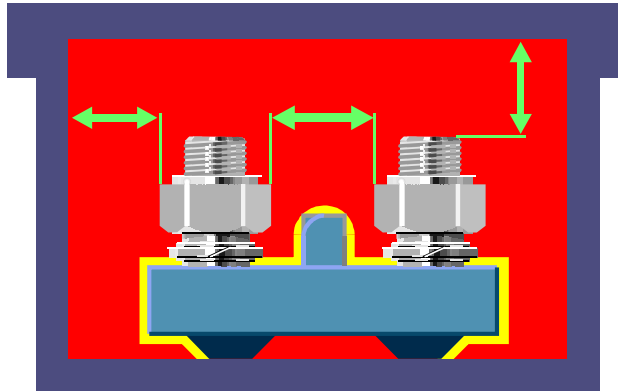
Increased safety “e”



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Clearances and creepage distances



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Clearance and creepage distances

Clearance distance

Shortest distance between conductive parts.

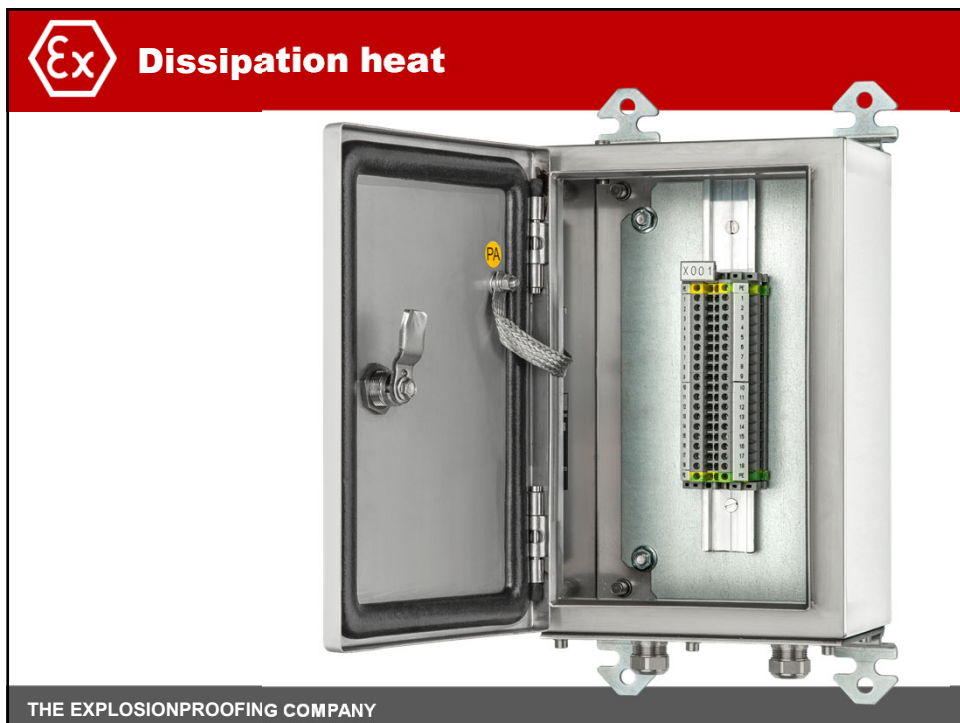
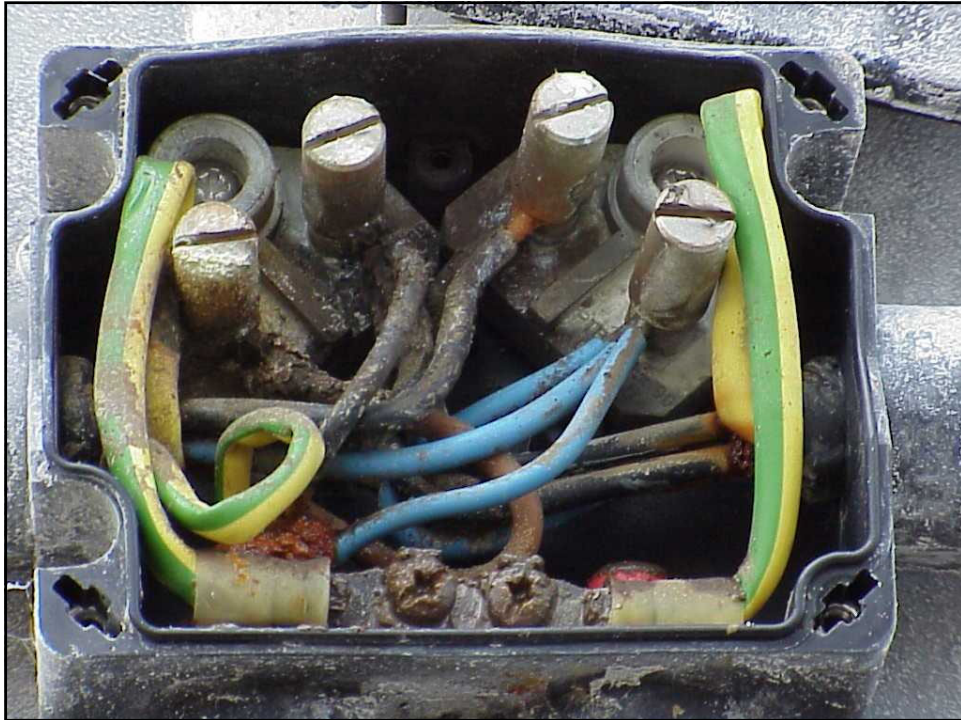
Creepage distance

shortest distance between conductive parts **along an insulating material surface**.

When dimensioning the creepage distance, the CTI value of the material and the surface structure are to be taken into account.

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Dissipation heat

- Nominal currents
- Cross-section
- Capacity utilization of the cross-sections
- Dimension of the terminal boxes
- Number of conductors and terminal connections

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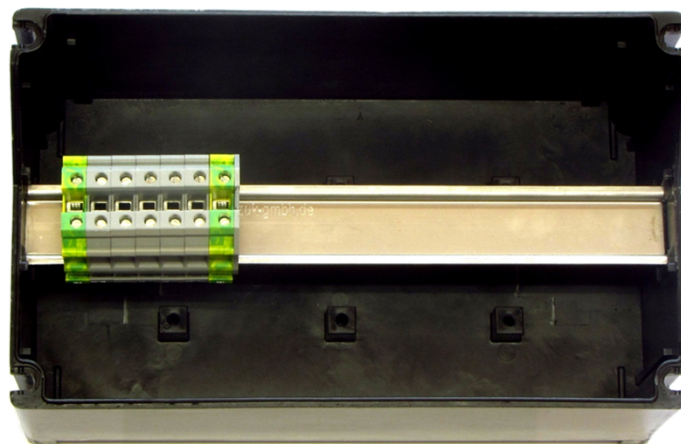
Max. number of conductors in relation to the cross section and continuous current

Current	Cross-section in [mm ²]							
[A]	1,5	2,5	4	6	10	16	25	35
6	102							
10	68	102						
16	23	45	84					
20	9	26	51	64				
25		12	28	24	52			
35			8	5	52	44		
50					10	44		
63						16		
80								
100								
max. number of terminals	51	51	42	32	26	22		

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Max. number of conductors in relation to the cross section and continuous current



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Max. number of conductors in relation to the cross section and continuous current

Cross section mm ²	Current A	Quantity		Utilization
1.5	10	20 (von 68)	=	30.0 %
2.5	16	4 (von 45)	=	9.0 %
4.0	20	4 (von 51)	=	8.0 %
	Total ≤ 100 %		=	47.0 %

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IEC 60079
Explosive Atmospheres – Part 11:

**Equipment protection by
intrinsic safety “i”**



IEC 60079-11

Edition 7.0 2023-01

**INTERNATIONAL
STANDARD**



**Explosive atmospheres –
Part 11: Equipment protection by intrinsic safety “i”**



Standards

Standards regarding intrinsic safety:

- IEC 60079-11:2023 (equipment)
- IEC 60079-14:2013
(design, selection and installation)
- IEC 60079-25:2020 (intrinsically safe systems)

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Power and energy

Prevention of spark ignition by means of:

- **limitation of the provided power by specific barriers**
- **limitation of the stored energy in cables and field devices**
- **prevention of an inadmissible increase of energy**

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Elements of intrinsically safe circuits

Intrinsically safe circuits consist of:

- **an associated apparatus (power supply - source)**
- **an intrinsically safe apparatus (field device - load)**
- **a cable**

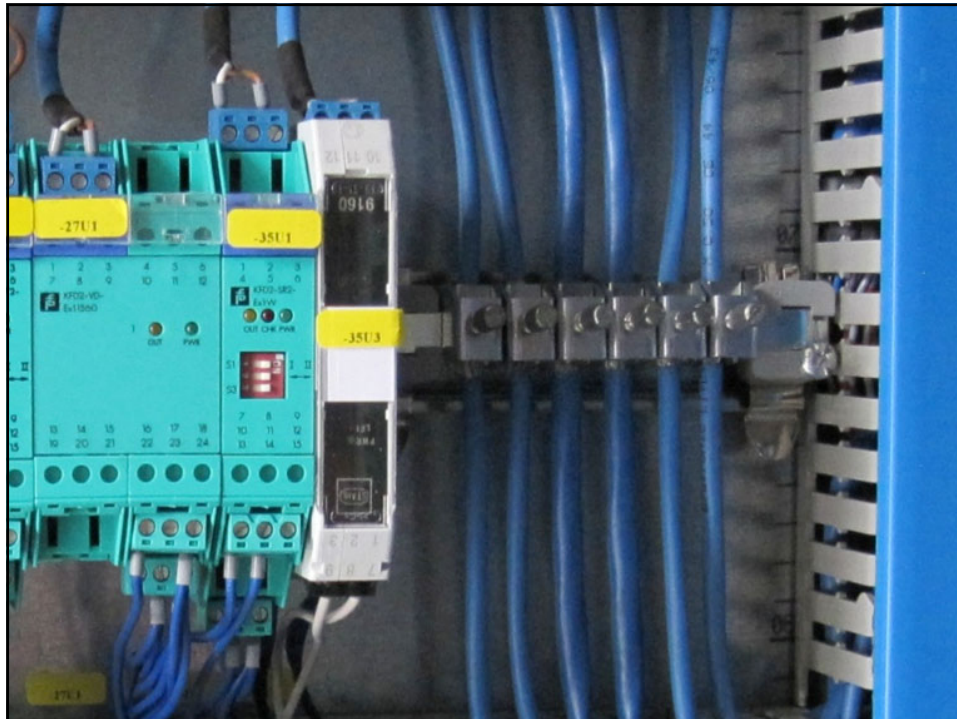
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Associated apparatus

Characteristics of an associated apparatus:

- **comprises both intrinsically safe and non-intrinsically safe circuits**
- **typically the power supply in the cabinet outside the hazardous area**



Installation of associated apparatus

Associated apparatus are usually installed outside the hazardous area:

- non-intrinsically safe circuits (e.g. contacts of relay outputs, 4-20 mA signal etc.) might create ignition capable sparks
- exception: the associated apparatus is protected by an additional, appropriate type of protection (e.g. by mounting in a flameproof enclosure „d“)



Intrinsically safe apparatus

Typical data in the documentation:

- max. input voltage U_i
- max. input current I_i
- max. input power P_i
- effective internal inductance L_i
- effective internal capacitance C_i



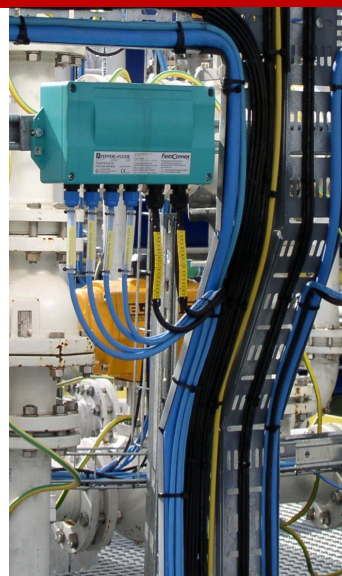
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Cables

Cables appear as energy storages:

- inductance per unit length L' (e.g. in mH/km)
- capacitance per unit length C' (e.g. in nF/km)
- manufacturer information, measurement of the actual cable or reference value from IEC 60079-14



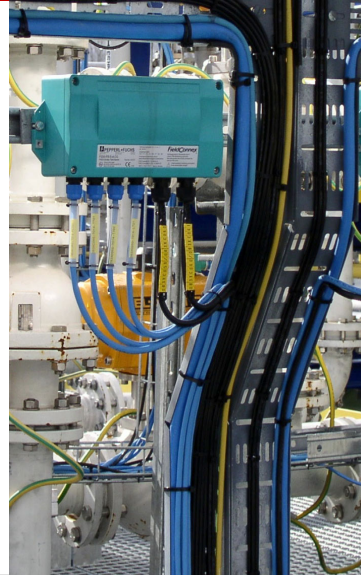
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Cables

Prevention of inadmissible increase of energy:

- Protection against electromagnetic coupling
- Protection against damage



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