



Italy
Section



L'Ordine degli ingegneri della Provincia di Milano in collaborazione con AIS co-organizza il seminario

LUOGHI CON PERICOLO DI ESPLOSIONE: DIRETTIVA ATEX

Milano, 31 MAGGIO 2017

AUDITORIUM TECNIMONT | Via G. De Castillia, 6/A - 20124 Milano

 **PEPPERL+FUCHS**



ATEX: safety devices in Ex zone

Gas, vapori, nebbie infiammabili e polveri combustibili: safety devices in Ex zone

Direttiva ATEX 99/92/CE - Ing Paolo Corbo – paolo.corbo@silexsr.com

ATEX: safety devices in Ex zone

Gas, vapori, nebbie infiammabili e polveri combustibili: safety devices in Ex zone

Ing Paolo CORBO

ATEX, MACHINE, SIL Specialist



SILEx Engineering Srl

Tel: (+39) 039 9163902

Fax: (+39) 039 9163902

Mob: (+39) 3482396407

e-mail: paolo.corbo@silexsrl.com

www.silexsrl.com

Direttiva ATEX 99/92/CE - Ing Paolo Corbo – paolo.corbo@silexsrl.com

EPL: Equipment Protection Level



N O R M A I T A L I A N A C E I

Norma Italiana

CEI EN 50495

La seguente Norma è identica a: EN 50495:2010-02.

Data Pubblicazione

2011-06

Titolo

Dispositivi di sicurezza richiesti per il funzionamento sicuro degli apparecchi in relazione al rischio di esplosione

Direttiva ATEX 99/92/CE - Ing Paolo Corbo – paolo.corbo@silexsr.com

EN 50495:2010 - Dispositivi di sicurezza

Project	
Reference	EN 50495:2010
Title	Safety devices required for the safe functioning of equipment with respect to explosion risks
Project Number	20481
Abstract/Scope	
Status	Published

EN 50495:2010 - Dispositivi di sicurezza

Implementation Dates	
date of Ratification (DOR) (1)	2009-12-01
date of Availability (DAV) (2)	2010-02-26
date of Announcement (DOA) (3)	2010-06-01
date of Publication (DOP) (4)	2010-12-01
date of Withdrawal (DOW) (5)	2012-12-01

EN 50495:2010 - Dispositivi di sicurezza



Relations	
Supersedes	
Superseded by	
Normative reference (6)	

EN 50495:2010 - Dispositivi di sicurezza



Dispositivi di sicurezza, la cui funzione di sicurezza non possa adeguatamente essere specificata nelle Norme esistenti della serie EN 60079 oppure EN 61241 devono in aggiunta essere progettate in accordo a questa norma.

ATTENZIONE: Alcune sorgenti potenziali di innesco potrebbero essere non controllabili da dispositivi di sicurezza, ad. es. energie rilasciate da cariche elettrostatiche, scintille di origine meccanica a seguito di impatti. Inoltre alcune misure di protezione potrebbero non essere controllabili da dispositivi di sicurezza, ad es. custodie a prova di esplosione.

EN 50495: 2010-Dispositivi di sicurezza

- I metodi possibili per determinare le performance in termini di sicurezza funzionale sono quelli indicati nel testo della EN50495:

5.4 Requirements for achieving functional safety

5.4.1 General

The safety integrity of a safety device shall be derived:

- either according to EN 61508 series/EN 61511 series or EN 62061;

Hard- and software requirements shall be considered in the design process to minimize the probability of statistical and systematic faults. Additionally, management of functional safety shall be applied during the overall safety life-cycle of the equipment (EN 61508-1, Clause 6). This refers to the design, modification and production by the manufacturer as well as to the installation, operation, maintenance and repair by the user.

- or according to EN 61511 series based on proven-in-use experience.

The safety integrity is assessed by a statistical failure analysis of an appropriate number of devices used in an appropriate number of typical applications. Modification and production by the manufacturer as well as the installation, operation, maintenance and repair by the user shall comply with EN 61511 series.

EN 50495: 2010-Dispositivi di sicurezza



Alcuni esempi di metodi strumentati di sicurezza valutabili in termini di conformità agli EPL sono i seguenti:

- Una pompa un sistema di regolazione della pressione, che assicuri sufficiente pressione e portata ad un sistema di sicurezza idraulico;
- Dispositivi di protezione da sovraccarichi per motori elettrici con modo di protezione Ex e;
- Unità di controllo in area sicura, per il controllo dell'ambiente consistente in rilevatori di gas distribuiti;
- Unità di controllo di sensori che misurano temperature, pressioni, portate ecc. fuori dall'area pericolosa usati per il controllo di apparecchi in area pericolosa;
- Dispositivi di controllo per la ricarica degli accumulatori e batterie;
- Dispositivi di protezione termica (bimetalli);
- Sistemi di pressurizzazione Ex-p;
- Sistemi di rilevamento concentrazione gas (EN 50402, EN 50271, EN 50104);
- Livelli per il controllo di pompe sommerse;
- Rilevatori di fiamma;
- Apparecchiature associate [Ex ia];

EN 50495: 2010-Dispositivi di sicurezza



Valgono alcune eccezioni per i dispositivi di sicurezza già coperti dagli standard serie 60079 e 61241 e che non sono 'dispositivi complessi' nell'accezione che a questi attribuisce la 50495 al punto 3.1.6, definizioni:

3.1.6

complex safety device

safety devices where the safety function depends on complex technology, which is not defined in the series of standards of EN 60079 or EN 61241 and which can only be assessed adequately in accordance with EN 61508 series / EN 61511 series or EN 62061

e per i quali la 50495 non si applica:

Examples:

Integrated current and voltage limitation in IS apparatus (barriers and galvanic isolators), fuses, intrinsically safe associated apparatus, electromechanical overload protection, thermal protection device

Sensori gas: un'eccezione



Valgono alcune eccezioni per i dispositivi di rivelazione gas infiammabili ai quali si applicano, in alternativa alla EN50495, le seguenti norme:

	Infiammabili	
Tolleranze Condizioni ambientali Performance	EN60079-29-1	Explosive atmospheres -- Part 29-1: Gas detectors - Performance requirements of detectors for flammable gases
	EN60079-29-4	Explosive atmospheres -- Part 29-4: Gas detectors - Performance requirements of open path detectors for flammable gases

	Infiammabili	
Sicurezza funzionale delle apparecchiature usate stand-alone. Elaborazione del segnale. Hardware e software.	EN60079-29-1	Explosive atmospheres -- Part 29-1: Gas detectors - Performance requirements of detectors for flammable gases
	EN60079-29-4	Explosive atmospheres -- Part 29-4: Gas detectors - Performance requirements of open path detectors for flammable gases
	EN50271	Electrical apparatus for the detection and measurement of combustible gases, toxic gases or oxygen - Requirements and tests for apparatus using software and/or digital technologies

	Infiammabili	
Sistemi complessi costituiti da sensori combinati. Centrali.	EN60079-29-1	Explosive atmospheres -- Part 29-1: Gas detectors - Performance requirements of detectors for flammable gases
	EN60079-29-4	Explosive atmospheres -- Part 29-4: Gas detectors - Performance requirements of open path detectors for flammable gases
	EN50402	Electrical apparatus for the detection and measurement of combustible or toxic gases or vapours or of oxygen. Requirements on the functional safety of fixed gas detection systems
	EN61508-1,2,3,4,5,6,7	Functional safety of electrical/electronic/programmable electronic safety related systems

EN 60079-29-1: 2007 Costruzioni elettriche per atmosfere esplosive per la presenza di gas - Parte 29-1: Apparecchiatura per la rilevazione e misura di gas infiammabili - Requisiti generali e di prestazione

This part of IEC 60079-29 specifies general requirements for construction, testing and performance, and describes the test methods that apply to portable, transportable and fixed apparatus for the detection and measurement of flammable gas or vapour concentrations with air. The apparatus, or parts thereof, are intended for use in potentially explosive atmospheres (see 3.1.8) and in mines susceptible to firedamp.

This standard is applicable to flammable gas detection apparatus intended to provide an indication, alarm or other output function; the purpose of which is to give a warning of a potential explosion hazard and in some cases, to initiate automatic or manual protective action(s).

This standard does not apply to external sampling systems, or to apparatus of laboratory or scientific type, or to apparatus used only for process control purposes. It also does not apply to open path (line of sight) area monitors. For apparatus used for sensing the presence of multiple gases, this standard applies only to the detection of flammable gas or vapour.

EN 60079-29-1: 2007

Performance requirements

Table A.1 – Performance requirements

Sub-clause	Test	Group I apparatus limits (whichever value is greater)		Group II apparatus limits (whichever value is greater)	
		Volume fraction up to 5 % methane in air indication	Volume fraction up to 100 % methane in air indication	Volume fraction up to 100 % lower flammable limit indication	Volume fraction up to 100 % gas indication
5.4.2	Unpowered storage	None	None	None	None
5.4.3.2	Calibration curve	±0,1 % methane or ±5 % of indication	±3 % methane or ±5 % of indication	±5 % measuring range or ±10 % of indication	±5 % measuring range or ±10 % of indication
5.4.3.3	Response to other gases	Not applicable	Not applicable	±7 % measuring range or ±15 % of indication	±7 % measuring range or ±15 % of indication
5.4.4 (a)	Stability, short term	±0,1 % methane or ±5 % of indication	±3 % methane or ±5 % of indication	±3 % measuring range or ±10 % of indication	±3 % measuring range or ±10 % of indication
5.4.4 (b)	Stability, long term (fixed/transportable)	±0,1 % methane or ±5 % of indication	±3 % methane or ±5 % of indication	±7 % measuring range or ±20 % of indication	±7 % measuring range or ±20 % of indication
5.4.4 (c)	Stability, long term (portable)	±0,1 % methane or ±5 % of indication	±3 % methane or ±5 % of indication	±5 % measuring range or ±10 % of indication	±5 % measuring range or ±10 % of indication
5.4.5	Stability (spot-reading apparatus only)	±0,1 % methane or ±5 % of indication	±3 % methane or ±5 % of indication	±5 % measuring range or ±10 % of indication	±3 % measuring range or ±10 % of indication
5.4.6	Alarm set point(s)	Check alarm/manual reset operation	Check alarm/manual reset operation	Check alarm/manual reset operation	Check alarm/manual reset operation
5.4.7 (a)	Temperature (portable/transportable)	±0,2 % methane or ±10 % of indication from 20 °C (test: -10 °C, 20 °C, 40 °C)	±5 % methane or ±10 % of indication from 20 °C (test: -10 °C, 20 °C, 40 °C)	±5 % measuring range or ±10 % of indication from 20 °C (test: -10 °C, 20 °C, 40 °C)	±5 % measuring range or ±10 % of indication from 20 °C (test: -10 °C, 20 °C, 40 °C)

Table A.1 (continued)

Sub-clause	Test	Group I apparatus limits (whichever value is greater)		Group II apparatus limits (whichever value is greater)	
		Volume fraction up to 5 % methane in air indication	Volume fraction up to 100 % methane in air indication	Volume fraction up to 100 % lower flammable limit indication	Volume fraction up to 100 % gas indication
5.4.7 (b)	Temperature (fixed with remote sensor)	±0,2 % methane or ±10 % of indication from 20 °C (test: -10 °C, 20 °C, 40 °C)	±5 % methane or ±10 % of indication from 20 °C (test: -10 °C, 20 °C, 40 °C)	Sensor: ±10 % measuring range or ±20 % of indication from 20 °C (test: -25 °C, 20 °C, 55 °C) Control unit: ±3 % measuring range or ±10 % of indication from 20 °C (test: 5 °C, 20 °C, 55 °C)	Sensor: ±10 % measuring range or ±20 % of indication from 20 °C (test: -25 °C, 20 °C, 55 °C) Control unit: ±3 % measuring range or ±10 % of indication from 20 °C (test: 5 °C, 20 °C, 55 °C)
5.4.7(c)	Temperature (fixed with sensor)	±0,2 % methane or ±10 % of indication from 20 °C (test: -10 °C, 20 °C, 40 °C)	±5 % methane or ±10 % of indication from 20 °C (test: -10 °C, 20 °C, 40 °C)	±5 % measuring range or ±15 % of indication from 20 °C (test: -10 °C, 20 °C, 55 °C)	±5 % measuring range or ±15 % of indication from 20 °C (test: -10 °C, 20 °C, 55 °C)
5.4.8	Pressure	±0,2 % methane or ±30 % of indication from 100 kPa (test: 80 kPa, 100 kPa, 120 kPa)	±5 % methane or ±30 % of indication from 100 kPa (test: 80 kPa, 100 kPa, 120 kPa)	±5 % measuring range or ±30 % of indication from 100 kPa (test: 80 kPa, 100 kPa, 120 kPa)	±5 % measuring range or ±30 % of indication from 100 kPa (test: 80 kPa, 100 kPa, 120 kPa)
5.4.9	Humidity	±0,2 % methane or ±15 % of indication from the indication at adjustment at 40 °C (test: 20 %RH, 50 %RH, 90 %RH)	±5 % methane or ±15 % of indication from the indication at adjustment at 40 °C (test: 20 %RH, 50 %RH, 90 %RH)	±10 % measuring range or ±30 % of indication from the indication at adjustment at 40 °C (test: 20 %RH, 50 %RH, 90 %RH)	±10 % measuring range or ±30 % of indication from the indication at adjustment at 40 °C (test: 20 %RH, 50 %RH, 90 %RH)
5.4.10	Air velocity	±0,1 % methane or ±5 % of indication	±3 % methane or ±5 % of indication	±5 % measuring range or ±10 % of indication	±5 % measuring range or ±10 % of indication
5.4.11	Flow rate	±0,1 % methane or ±5 % of indication	±3 % methane or ±5 % of indication	±5 % measuring range or ±10 % of indication	±5 % measuring range or ±10 % of indication
5.4.12	Orientation	±0,1 % methane or ±5 % of indication	Portable: ±5 % methane or ±10 % of indication Fixed/transportable: ±3 % methane or ±5 % of indication	±5 % measuring range or ±10 % of indication	±5 % measuring range or ±10 % of indication

EN 60079-29-1: 2007

Table A.1 (continued)

Sub-clause	Test	Group I apparatus limits (whichever value is greater)		Group II apparatus limits (whichever value is greater)	
		Volume fraction up to 5 % methane in air indication	Volume fraction up to 100 % methane in air indication	Volume fraction up to 100 % lower flammable limit indication	Volume fraction up to 100 % gas indication
5.4.13	Vibration	±0,1 % methane or ±5 % of indication, and no loss of function, no fault signal, no damage resulting in a hazard and no false alarms	±3 % methane or ±5 % of indication, and no loss of function, no fault signal, no damage resulting in a hazard and no false alarms	±5 % measuring range or ±10 % of indication, and no loss of function, no fault signal, no damage resulting in a hazard and no false alarms	±5 % measuring range or ±10 % of indication, and no loss of function, no fault signal, no damage resulting in a hazard and no false alarms
5.4.14	Drop test	±0,1 % methane or ±5 % of indication	±3 % methane or ±5 % of indication	±5 % measuring range or ±10 % of indication	±5 % measuring range or ±10 % of indication
5.4.15	Warm-up time	Fixed/transportable: ±0,1 % methane within 5 min, and no false alarm Continuous duty portable: ±0,1 % methane within 2 min, and no false alarm	Fixed/transportable: ±3 % methane within 5 min, and no false alarm Continuous duty portable: ±3 % methane within 2 min, and no false alarm	Fixed/transportable: ±5 % measuring range within manual spec., and no false alarm Continuous duty portable: ±5 % measuring range within 2 min, and no false alarm	Fixed/transportable: ±5 % measuring range within manual spec., and no false alarm Continuous duty portable: ±5 % measuring range within 2 min, and no false alarm
5.4.16	Time of response (increasing concentration)	t(50) in less than 10 s t(90) in less than 30 s	t(50) in less than 10 s t(90) in less than 30 s	t(50) in less than 20 s t(90) in less than 60 s	t(50) in less than 20 s t(90) in less than 60 s
5.4.16	Time of response (decreasing concentration)	t(50) in less than 30 s t(10) in less than 90 s	t(50) in less than 10 s t(10) in less than 30 s	Not applicable	t(50) in less than 20 s t(10) in less than 60 s
5.4.17	Minimum time to operate	Indication at 90 % final value in less than 30 s in either gas	Indication at 90 % final value in less than 30 s in either gas	Indication at 90 % final value in less than 30 s in either gas	Indication at 90 % final value in less than 30 s in either gas
5.4.18	High gas concentration operation above the measuring range	±0,2 % methane or +20 % / -10 % of indication	±5 % methane or ±10 % of indication	±7 % measuring range or +20 % / -10 % of indication	±7 % measuring range or ±15 % of indication

EN 60079-29-1: 2007

Table A.1 (continued)

Sub-clause	Test	Group I apparatus limits (whichever value is greater)		Group II apparatus limits (whichever value is greater)	
		Volume fraction up to 5 % methane in air indication	Volume fraction up to 100 % methane in air indication	Volume fraction up to 100 % lower flammable limit indication	Volume fraction up to 100 % gas indication
5.4.19	Battery capacity	Portable continuous duty: $\pm 0,1$ % methane or ± 5 % of indication (test: 8 h or 10 h, respectively) $\pm 0,2$ % methane or ± 10 % of indication (test: 10 min after "low battery" condition) Spot-reading apparatus: $\pm 0,1$ % methane or ± 5 % of indication (test: 200 operations) $\pm 0,2$ % methane or ± 10 % of indication (test: 10 operations after "low battery" condition)	Portable continuous duty: ± 3 % methane or ± 5 % of indication (test: 8 h or 10 h, respectively) ± 6 % methane or ± 10 % of indication (test: 10 min after "low battery" condition) Spot-reading apparatus: ± 3 % methane or ± 5 % of indication (test: 200 operations) ± 6 % methane or ± 10 % of indication (test: 10 operations after "low battery" condition)	Portable continuous duty: ± 5 % measuring range or ± 10 % of indication (test: 8 h or 10 h, respectively) ± 7 % measuring range or ± 15 % of indication (test: 10 min after "low battery" condition) Spot-reading apparatus: ± 5 % measuring range or ± 10 % of indication (test: 200 operations) ± 7 % measuring range or ± 15 % of indication (test: 10 operations after "low battery" condition)	Portable continuous duty: ± 3 % measuring range or ± 10 % of indication (test: 8 h or 10 h, respectively) ± 6 % measuring range or ± 20 % of indication (test: 10 min after "low battery" condition) Spot-reading apparatus: ± 3 % measuring range or ± 10 % of indication (test: 200 operations) ± 6 % measuring range or ± 20 % of indication (test: 10 operations after "low battery" condition)
5.4.20	Power supply variation	$\pm 0,1$ % methane or ± 5 % of indication	± 3 % methane or ± 5 % of indication	± 5 % measuring range or ± 10 % of indication	± 3 % measuring range or ± 10 % of indication
5.4.21	Power supply interruptions, voltage transients and step changes of voltage	No spurious alarms	No spurious alarms	No spurious alarms	No spurious alarms
5.4.22	Addition of sampling probe	$\pm 0,1$ % methane or ± 5 % of indication	± 3 % methane or ± 5 % of indication	± 5 % measuring range or ± 10 % of indication	± 5 % measuring range or ± 10 % of indication
5.4.23	Dust	$\pm 0,1$ % methane or ± 5 % of indication, $t(90)$ increase less than 10 s	± 5 % methane or ± 10 % of indication, $t(90)$ increase less than 10 s	Not applicable	Not applicable
5.4.24.1	Poisons	$\pm 0,2$ % methane or ± 10 % of indication	± 3 % methane or ± 10 % of indication	Not applicable	Not applicable



Table A.1 (continued)

Sub-clause	Test	Group I apparatus limits (whichever value is greater)		Group II apparatus limits (whichever value is greater)	
		Volume fraction up to 5 % methane in air indication	Volume fraction up to 100 % methane in air indication	Volume fraction up to 100 % lower flammable limit indication	Volume fraction up to 100 % gas indication
5.4.24.2	Other gases	±10 % of the actual methane volume fraction applied.	±10 % of the actual methane volume fraction applied.	Not applicable	Not applicable
5.4.25	Electromagnetic immunity	Variation less than ±0,1 % methane and no spurious alarms	Variation less than ±3 % methane and no spurious alarms	Variation less than ±5 % measuring range and no spurious alarms	Variation less than ±3 % measuring range and no spurious alarms
5.4.26	Field calibration kit	±0,1 % methane or ±5 % of indication	±3 % methane or ±5 % of indication	±5 % measuring range or ±10 % of indication	±5 % measuring range or ±10 % of indication

EN 60079-29-2: 2007 - Explosive Atmospheres – Part 29-2 – Gas detectors – Selection, Installation, use and maintenance of detectors for flammable gases and oxygen

This part of IEC 60079-29 gives guidance on, and recommended practice for, the selection, installation, safe use and maintenance of electrically operated group II apparatus intended for use in industrial and commercial safety applications for the detection and measurement of flammable gases complying with the requirements of IEC 60079-29-1.

This standard is applicable for oxygen measurement for the purpose of inertisation where explosion protection is provided by the exclusion of oxygen instead of measuring the combustible gases or vapours present.

For the purposes of this standard, apparatus includes

- a) fixed apparatus;
- b) transportable apparatus; and
- c) portable apparatus.

EN 60079-29-2: 2007 - Explosive Atmospheres – Part 29-2 – Gas detectors – Selection, Installation, use and maintenance of detectors for flammable gases and oxygen

This standard is not intended to cover, but may provide useful information, for the following:

- a) apparatus intended only for the detection of non-flammable toxic gases;
- b) apparatus of laboratory or scientific type intended only for analysis or measurement purposes;
- c) apparatus intended for underground mining applications (group I apparatus);
- d) apparatus intended only for process control applications;
- e) apparatus intended for applications in explosives processing and manufacture;
- f) apparatus intended for the detection of a potentially flammable atmosphere resulting from dust or mist in air;
- g) open path apparatus not used for point measurement.

	Definitions	Basic information properties of gas and vapours	Measuring principles	Selection of apparatus	Behaviour of gas releases	Design and installation of fixed gas detection systems	Use of portable and transportable flammable gas detection apparatus	Training of operational personnel	Maintenance, routines procedures General administrative control	Measuring principles (full detail) (normative)	Environmental parameters (informative)
Function (Clause)	3	4	5	6	7	8	9	10	11	Annex A	Annex B
Authorities	+	+++	+++	+	+	-	-	-	+	-	-
General management	+	+++	+++	+	+	-	-	+	+	-	+
Selection	+++	+++	+	+++	+++	+	++	-	+	+++	+++
Design engineering / management	+++	+++	+	+++	+++	+++	-	-	-	+++	+++
Installation engineering / management	+++	+++	+	++	+++	+++	-	-	-	+++	+++
Installation, technical	++	+++	++	++	++	++	-	-	-	+	++
Commissioning	+++	+++	++	+	++	+++	-	++	+	-	-
Operations management	++	+++	++	+	+	++	++	+++	+++	+	+++
Operation training	+++	+++	+	+	+	+++	+++	+++	+++	+++	+++
Servicing / Calibration	+++	+++	-	-	-	++	++	+	+++	++	++
Repair	++	+++	++	-	-	+	+	+	+++	++	-
"+++"	Essential										
"++"	Advisable										
"+"	Useful										
"-"	Not applicable										
NOTE	It should be noted that Clause 5 is a simplified version of Annex A.										

EN 60079-29-2: 2007

EN 60079-29-2: 2007

Table 1 – Overview of gas detection apparatus with different measuring principles

	Catalytic sensor	Thermal conductivity sensor	Infrared sensor	Semi-conductor sensor	Electro-chemical sensor	Flame ionisation detector	Flame temperature analyser	Photo ionisation detector	Para-magnetic oxygen detector
Details in subclause	5.1	5.2	5.3	5.4	5.5	5.6	5.7	5.8	5.9
O ₂ required in gas sample	Yes	No	No	(No)	(No)	(No)	Yes	No	Not applicable
Typical measuring ranges Combustible gases	≤ LFL	(0)–100 %	0–(100) %	≤ LFL	≤ LFL	≤ LFL	< LFL	< LFL	Not applicable
Typical measuring ranges for oxygen	Not applicable	Not applicable	0–(100) %	Not applicable	0-25 % (0-100 %)	Not applicable	Not applicable	Not applicable	0-100 %
Combustible gases not measurable	Large molecules	See 5.2	H ₂	(See 5.4)	Alkanes	H ₂ ; CO	(see 5.7)	H ₂ ; CO; CH ₄ IP>X ⁵	Combustible gases
Relative response time ¹	Depends on substance	Medium	(Low)	Depends on substance	Medium	Low	Low	Low	Low to medium
Interference of non-combustible gases ²	No	CO ₂ ; Freons	(Yes)	SO ₂ ; NO _x H ₂ O	SO ₂ ; NO _x	ClHCs ³ ; Halon	(Halon)	Substance IP < X ⁵	NO; NO ₂
Poisoning ²	Si; (Hal ⁴); (H ₂ S); Pb	No	No	Si; Hal ⁴ ; SO ₂	(No)	(Si)	No	No	No
External gases required	No	No	No	No	No	Yes	Yes	No	(Yes/No)

NOTE 1 Qualitative comparison between principles. The values do not take into account time for aspirated sampling lines.

NOTE 2 Table gives common examples.

NOTE 3 Chlorinated hydrocarbons.

NOTE 4 Organic halogenated or inorganic halogen compounds.

NOTE 5 IP is the ionisation potential of the substance; X is the detector UV-lamp energy.

(No),(Yes) For information on the statements in brackets, refer to the corresponding subclause.

EN 60079-29-2: 2007

Table A.1 – Overview of gas detection apparatus with different measuring principles

	Catalytic sensor	Thermal conductivity sensor	Infrared sensor	Semi-conductor sensor	Electro-chemical sensor	Flame ionisation detector	Flame temperature analyser	Photo ionisation detector	Para-magnetic oxygen detector
Details in clause	A.1	A.2	A.3	A.4	A.5	A.6	A.7	A.8	A.9
O ₂ required in gas sample	Yes	No	No	(No)	(No)	(No)	Yes	No	Not applicable
Typical measuring ranges Combustible gases	≤ LFL	(0)-100 %	0-(100) %	≤ LFL	≤ LFL	≤ LFL	< LFL	< LFL	Not applicable
Typical measuring ranges for oxygen	Not applicable	Not applicable	0-(100) %	Not applicable	0-25 % (0-100 %)	Not applicable	Not applicable	Not applicable	0-100 %
Combustible gases not measurable	Large molecules	See A.2	H ₂	(See A.4)	Alkanes	H ₂ ; CO	(See A.7)	H ₂ ; CO; CH ₄ IP>X ⁵	Combustible gases
Relative response time ¹	Depends on substance	Medium	(Low)	Depends on substance	Medium	Low	Low	Low	Low to medium
Interference of non-combustible gases ²	No	CO ₂ ; Freons	(Yes)	SO ₂ ; NO _x H ₂ O	SO ₂ ; NO _x	ClHCs ³ ; Halon	(Halon)	Substance IP < X ⁵	NO; NO ₂
Poisoning ²	Si; (Hal ⁴); (H ₂ S); Pb	No	No	Si; Hal ⁴ ; SO ₂	(No)	(Si)	No	No	No
External gases required	No	No	No	No	No	Yes	Yes	No	(Yes/No)

Directive ATEX 99/92/EC - 11th Edition - info@shexa.com

EN50402:2005+A1:2008 Electrical apparatus for the detection and measurement of combustible or toxic gases or vapours or of oxygen. Requirements on the functional safety of fixed gas detection systems

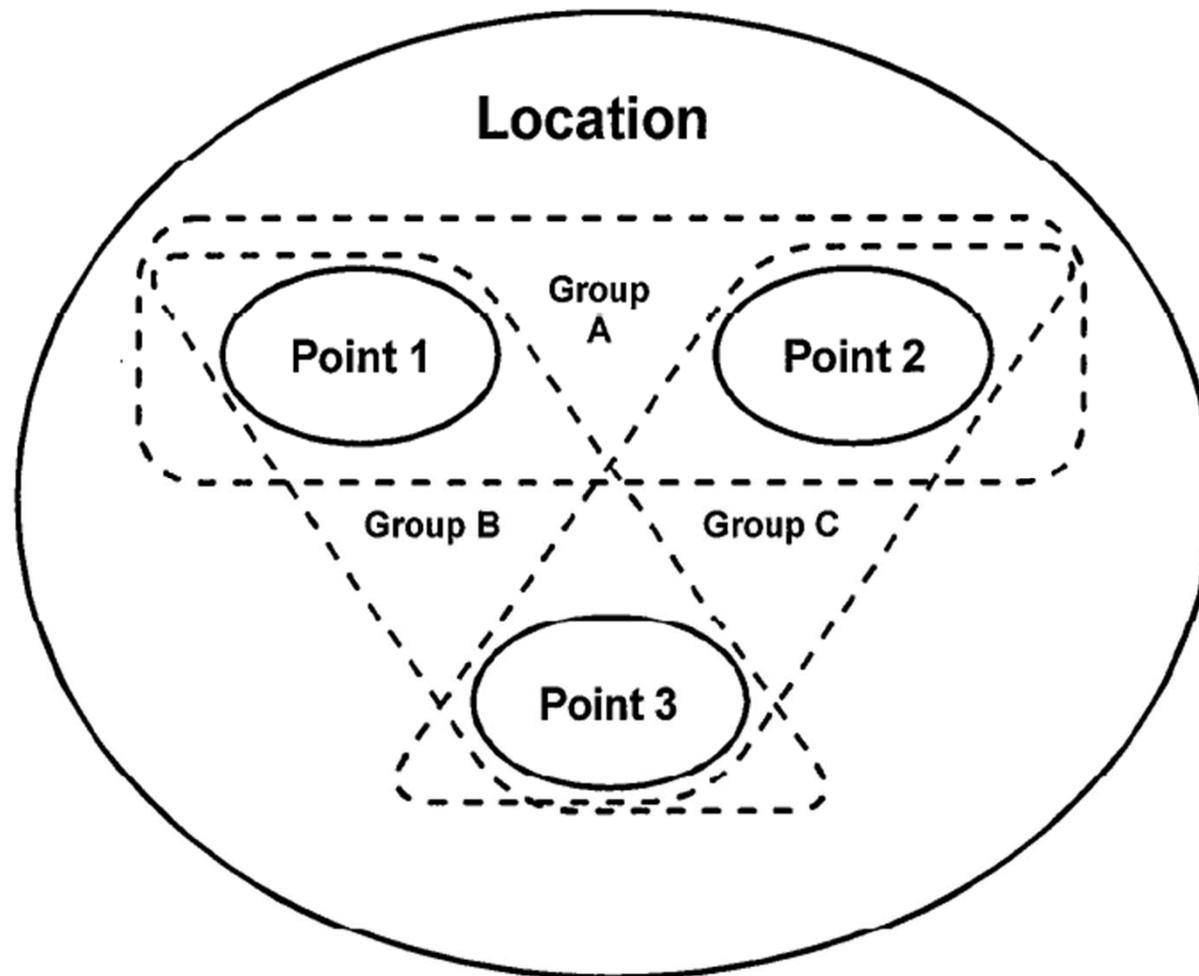
This European Standard is applicable to fixed gas detection systems for the detection and measurement of flammable or toxic¹⁾ gases or vapours or oxygen.

This European Standard supplements the requirements of the European Standards for electrical apparatus for the detection and measurement of flammable gases, vapours (e.g. EN 61779 or EN 50241), toxic gases (e.g. EN 45544) or oxygen (e.g. EN 50104).

This European Standard is applicable for gas detection systems, which may consist of the following functional units:

- gas-sampling;
- sensor;
- signal transmission;
- input to control unit;
- signal processing in control unit;
- output from control unit.

EN50402:2005+A1:2008 Electrical apparatus for the detection and measurement of combustible or toxic gases or vapours or of oxygen. Requirements on the functional safety of fixed gas detection systems



EN50402:2005+A1:2008

Table 1 - Fault tolerance for complex modules according EN 61511-1, Table 5

SIL-capability	Minimum hardware fault tolerance (see EN 61511-1, 11.4.2)		
	Safe failure fraction < 60 %	Safe failure fraction 60 % to 90 %	Safe failure fraction > 90 %
1	1	0	0
2	2	1	0
3	3	2	1
4	Special requirements apply - See EN 61508		

Table 2 - Fault tolerance for complex modules according EN 61508-2, Table 3

SIL-capability	Minimum hardware fault tolerance (see EN 61508-2, 7.4.3.1)			
	Safe failure fraction < 60 %	Safe failure fraction 60 % to < 90 %	Safe failure fraction 90 % to < 99 %	Safe failure fraction ≥ 99 %
1	1	0	0	0
2	2	1	0	0
3	Not mentioned in EN 61508-2	2	1	0
4	Not applicable	Special requirements apply - See EN 61508	2	1

EN50402:2005+A1:2008

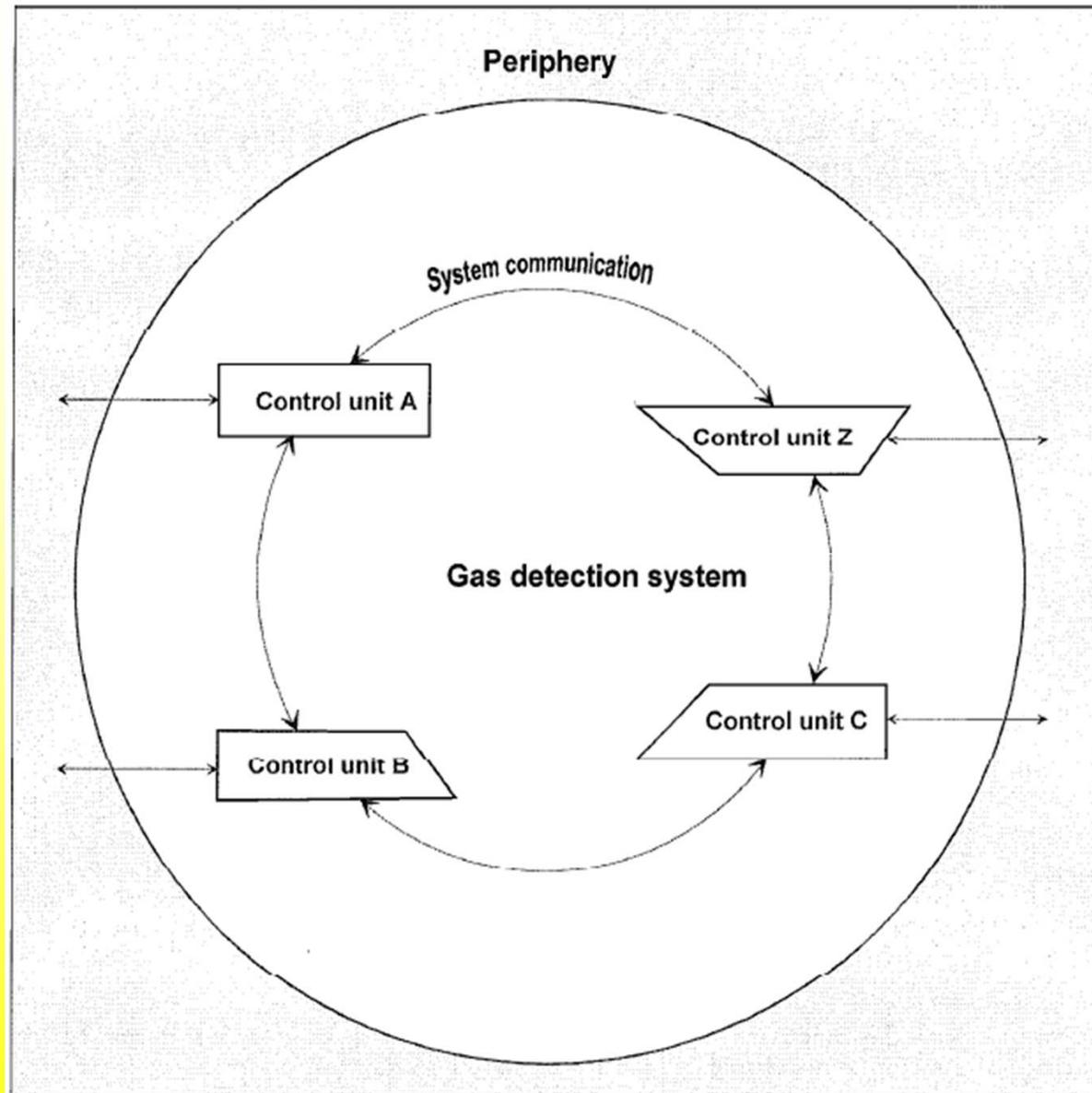
Table 3 - Minimum hardware fault tolerance for simple modules according EN 61511-1, Table 6

SIL-capability	Minimum hardware fault tolerance (see EN 61511-1, 11.4.3 and 11.4.4)	Minimum hardware fault tolerance reduced by one (see text above)
1	0	0
2	1	0
3	2	1
4	Special requirements apply - See EN 61508	<u>Not applicable</u>

Table 4 - Fault tolerance for simple modules according EN 61508-2, Table 2

SIL-capability	Minimum hardware fault tolerance (see EN 61508-2, 7.4.3.1)			
	Safe failure fraction < 60 %	Safe failure fraction 60 % to < 90 %	Safe failure fraction 90 % to < 99 %	Safe failure fraction ≥ 99 %
1	0	0	0	0
2	1	0	0	0
3	2	1	0	0
4	Not mentioned in EN 61508-2	2	1	1

EN50402:2005+A1:2008



EN50402:2005+A1:2008

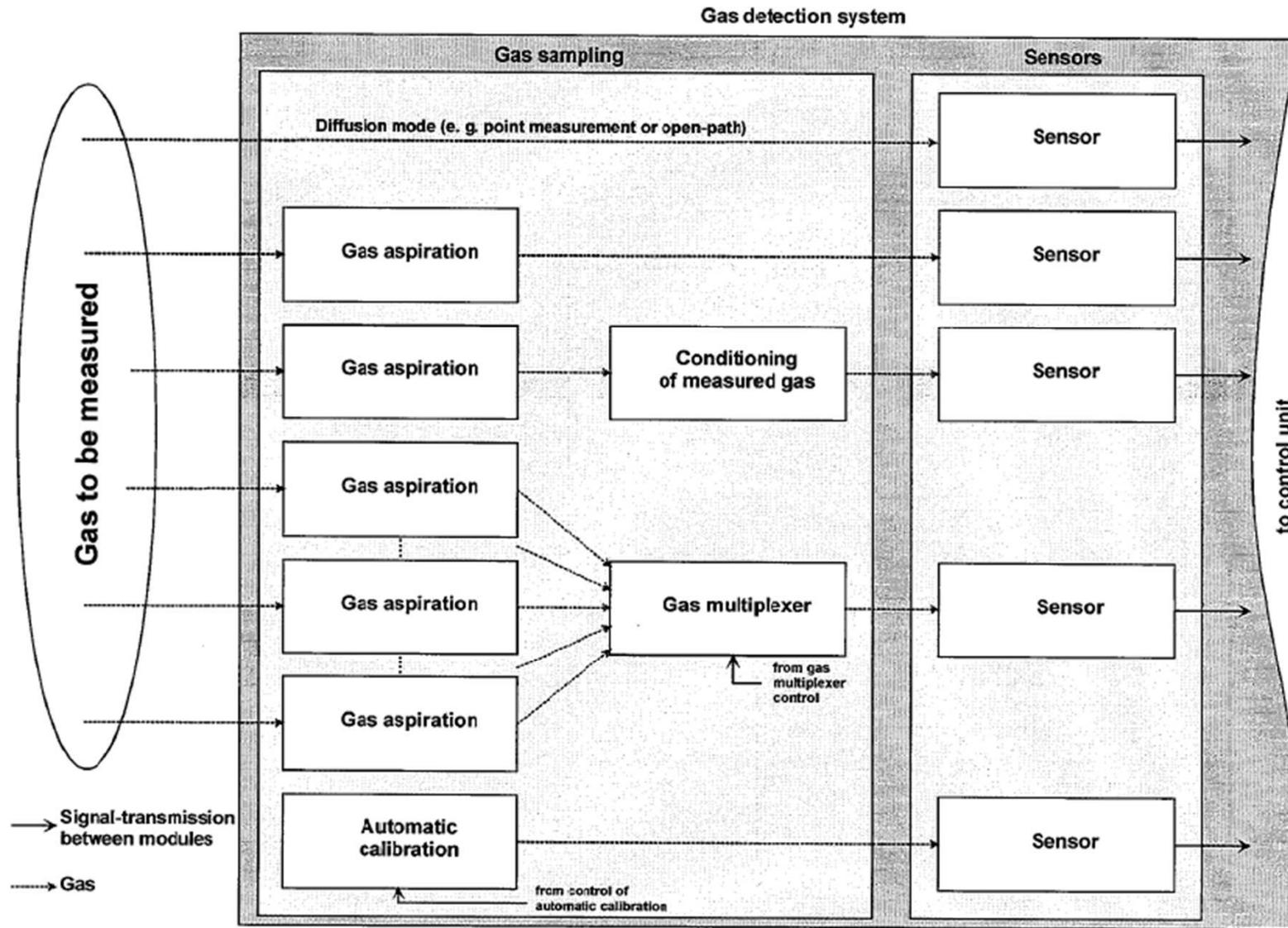


Figure 3a - Modules of a gas detection system (Gas sampling, sensors)

EN50402:2005+A1:2008

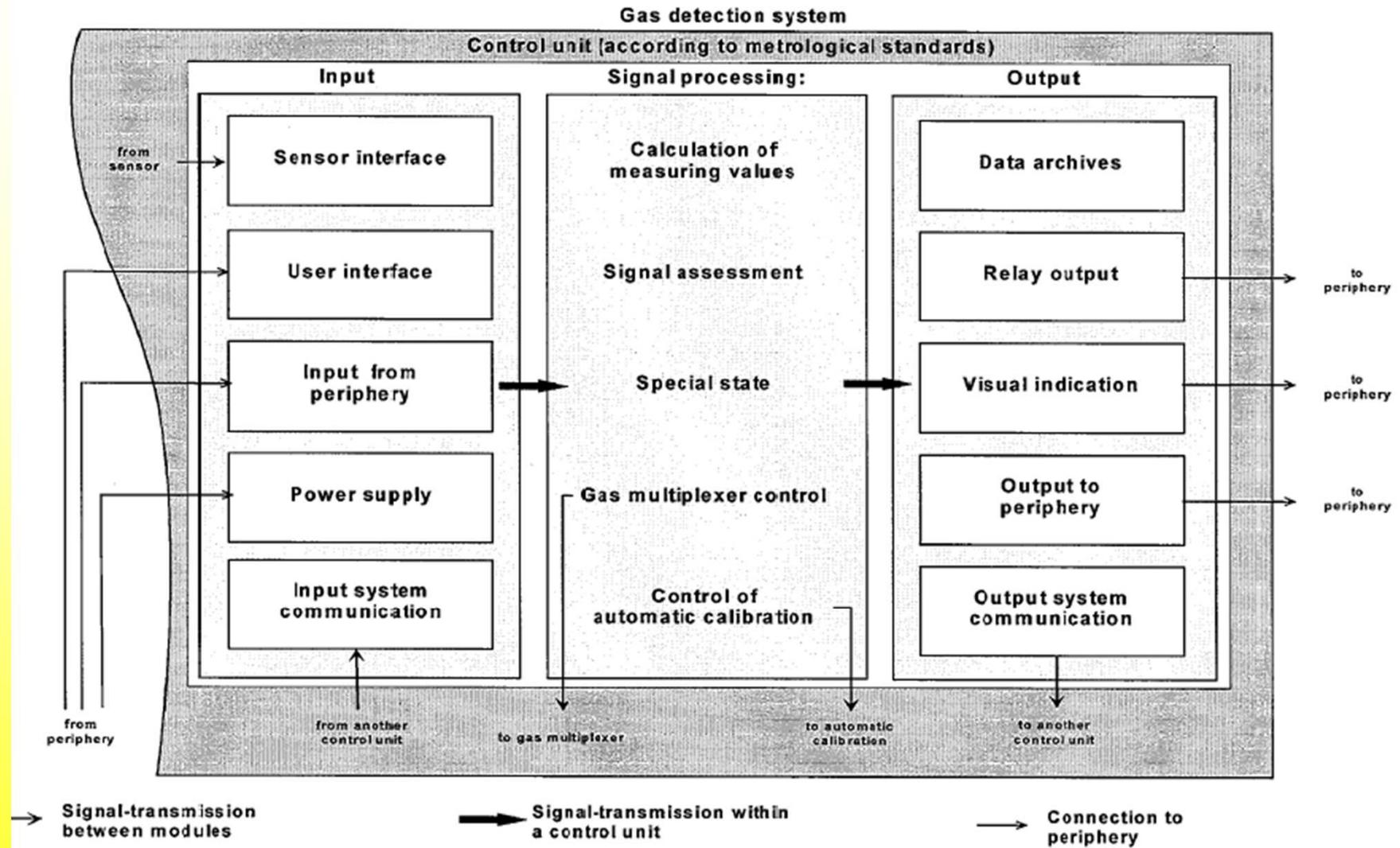


Figure 3b - Modules of a gas detection system (Control unit)



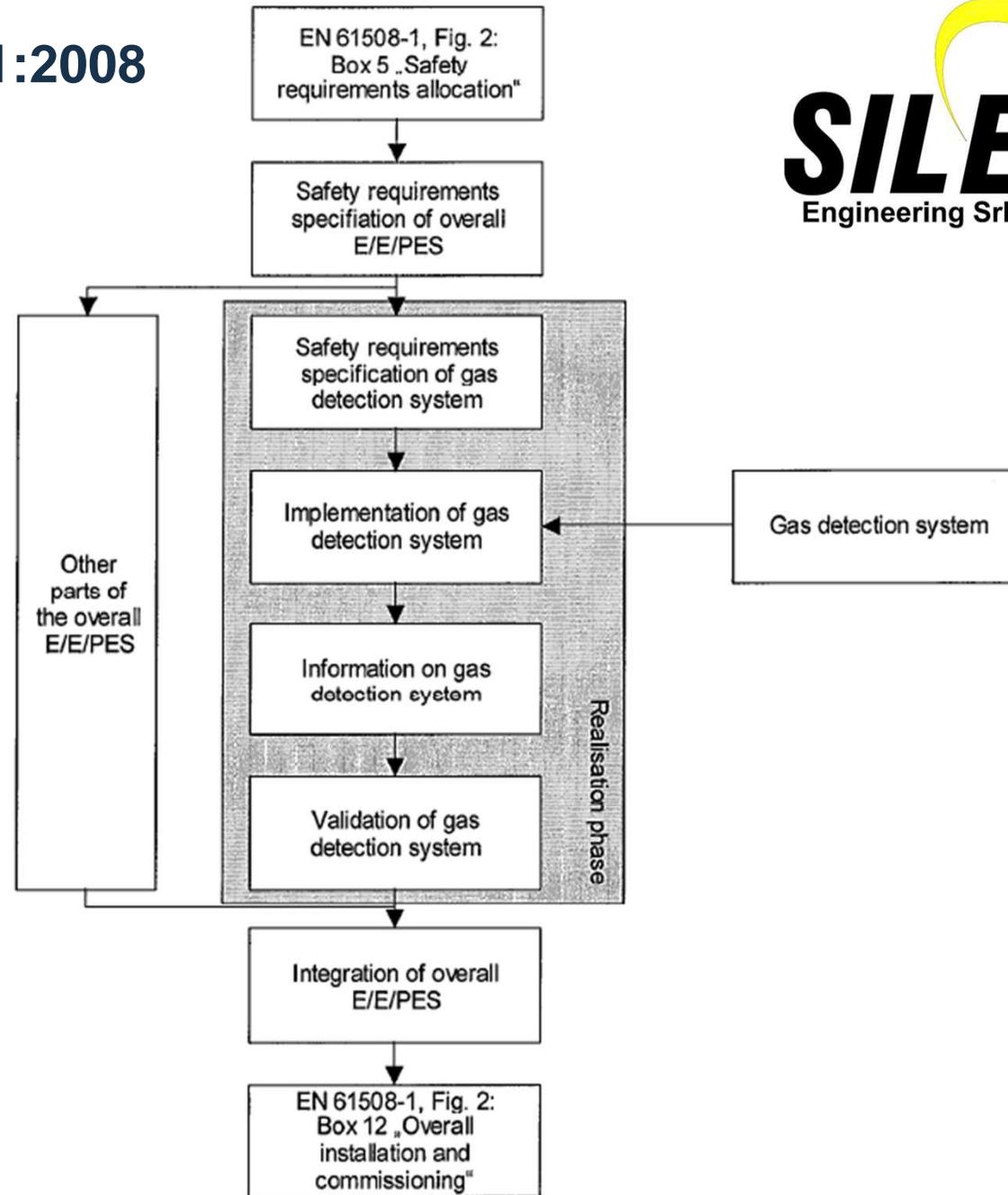
Table 5 - Diagnostic measures for program sequence monitoring from EN 61508-2

EIL-capability	Program sequence monitoring
1	Watchdog with separate time base without time window.
2	Watchdog with separate time base without time window plus redundant hardware - or - Logical monitoring of program sequence or temporal monitoring with online check - or - Watchdog with separate time base and time window
3	Logical monitoring of program sequence or temporal monitoring with online check plus redundant hardware - or - Temporal and logical monitoring - or - Watchdog with separate time base and time window plus redundant hardware
4	Temporal and logical monitoring plus redundant hardware

Table 6 - Diagnostic measures for memory from EN 61508-2

SIL-capability	Invariable memory (Program/Parameter)	Variable memory
1	Modified checksum	Parity-bit for RAM - or - RAM test "checkerboard" or "march"
2	Word-saving multi-bit redundancy - or - Signature of one word (8-bit)	RAM test "walk-path"
3	Test from SIL-capability 2 plus redundant hardware - or - Test from SIL-capability 4 without redundant hardware	Test from SIL-capability 2 plus redundant hardware - or - Test from SIL-capability 4 without redundant hardware
4	Signature of a double word (16 bit) plus redundant hardware - or - Block replication plus redundant hardware	RAM test "galpat" or "transparent galpat" plus redundant hardware - or - RAM test "Abraham" plus redundant hardware - or - RAM monitoring with a modified Hamming code, or detection of data failures with error-detection-correction codes (EDC) plus redundant hardware - or - Double RAM with hardware or software comparison and read/write test

EN50402:2005+A1:2008



Dire

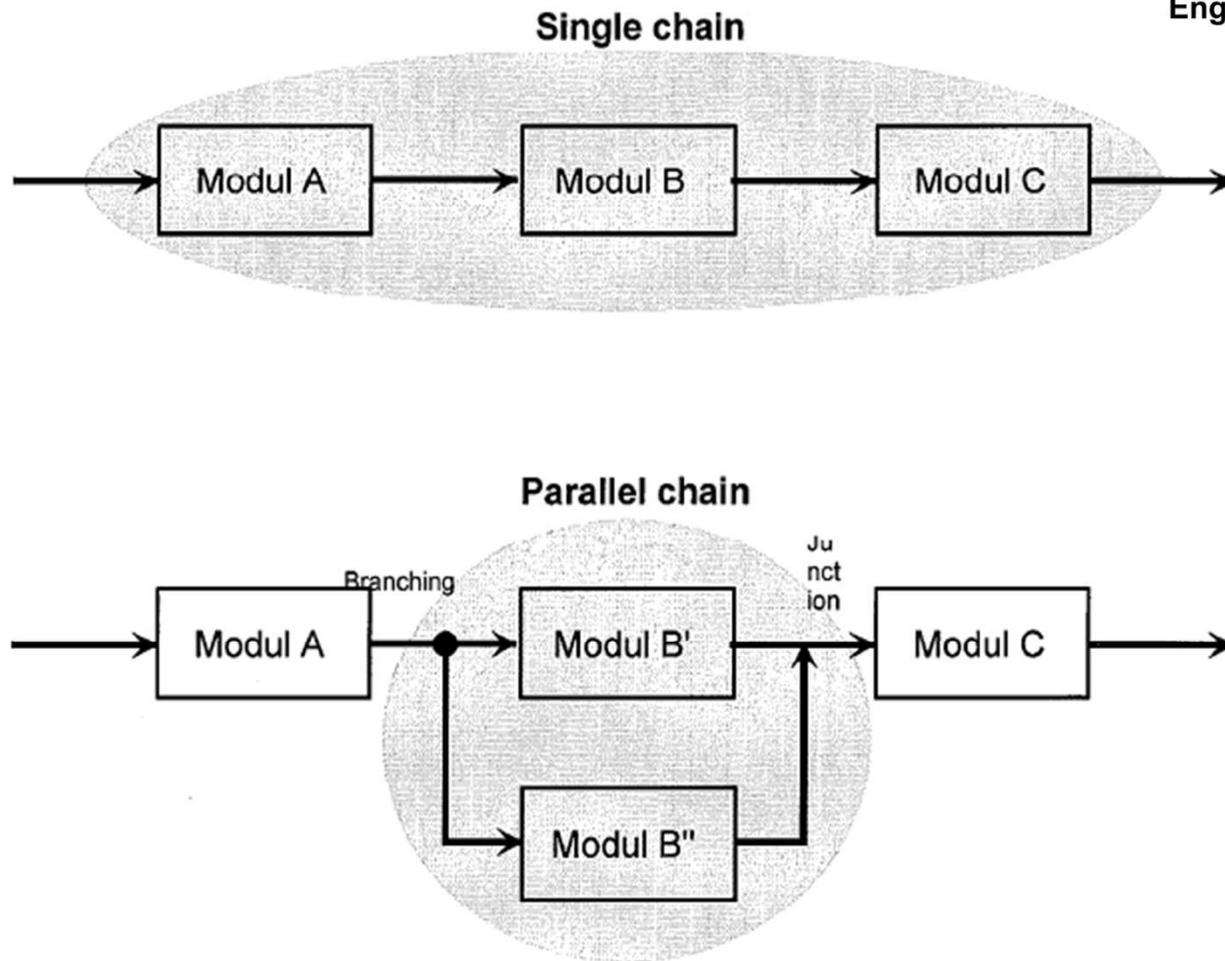
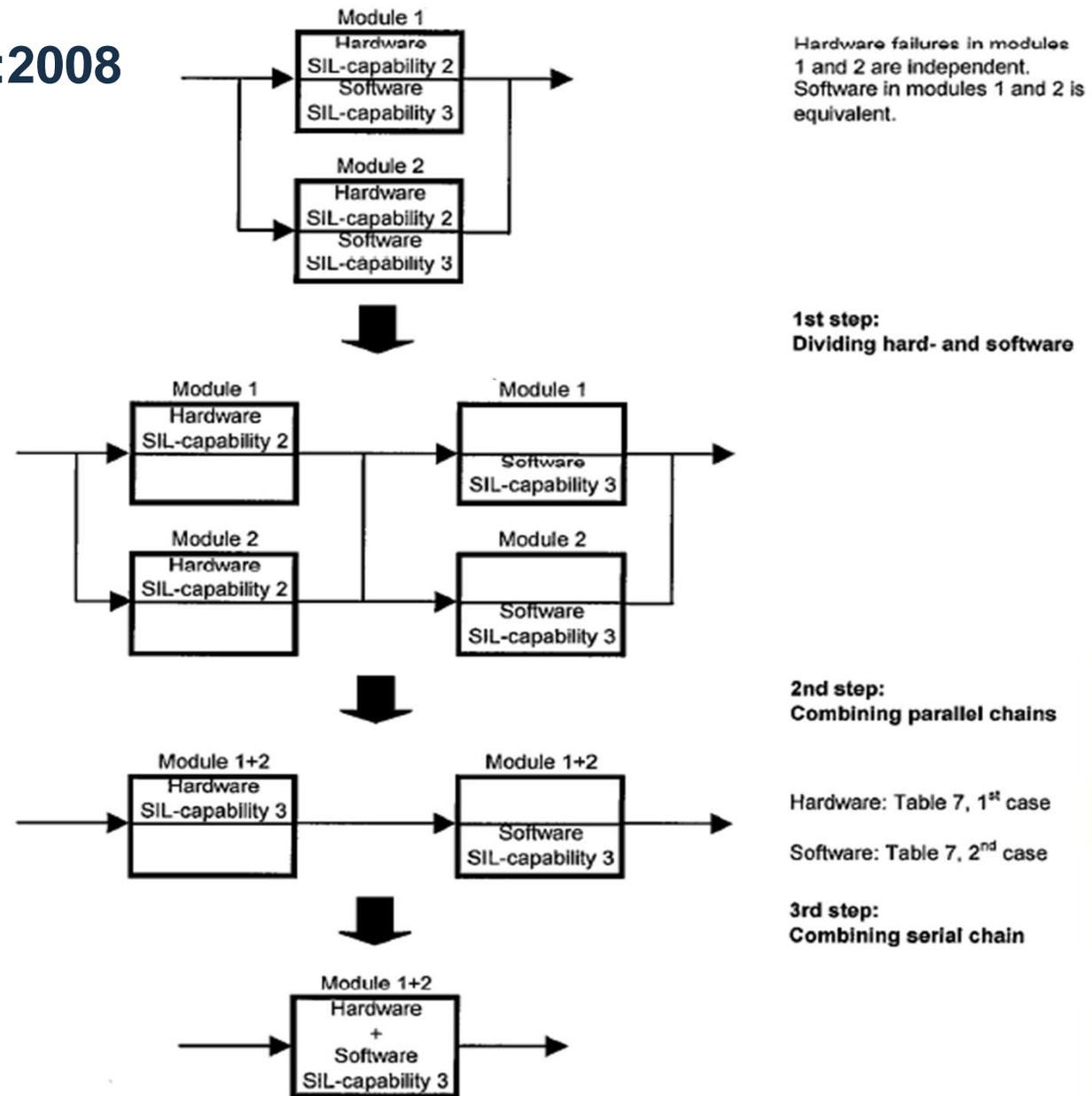


Figure 5 - Single and parallel chains

Table 7 - Determination of SIL-capability for a parallel chain block

		SIL-capability Module I			
		1	2	3	4
SIL-capability Module II	1	2 (1)	3 (2)	4 (3)	4
	2	3 (2)	3 (2)	4 (3)	4
	3	4 (3)	4 (3)	4 (3)	4
	4	4	4	4	4

EN50402:2005+A1:2008



Hardware failures in modules 1 and 2 are independent. Software in modules 1 and 2 is equivalent.

1st step:
Dividing hard- and software

2nd step:
Combining parallel chains

Hardware: Table 7, 1st case

Software: Table 7, 2nd case

3rd step:
Combining serial chain

Figure 6 – Handling of complex modules in a redundant structure

EN50402:2005+A1:2008

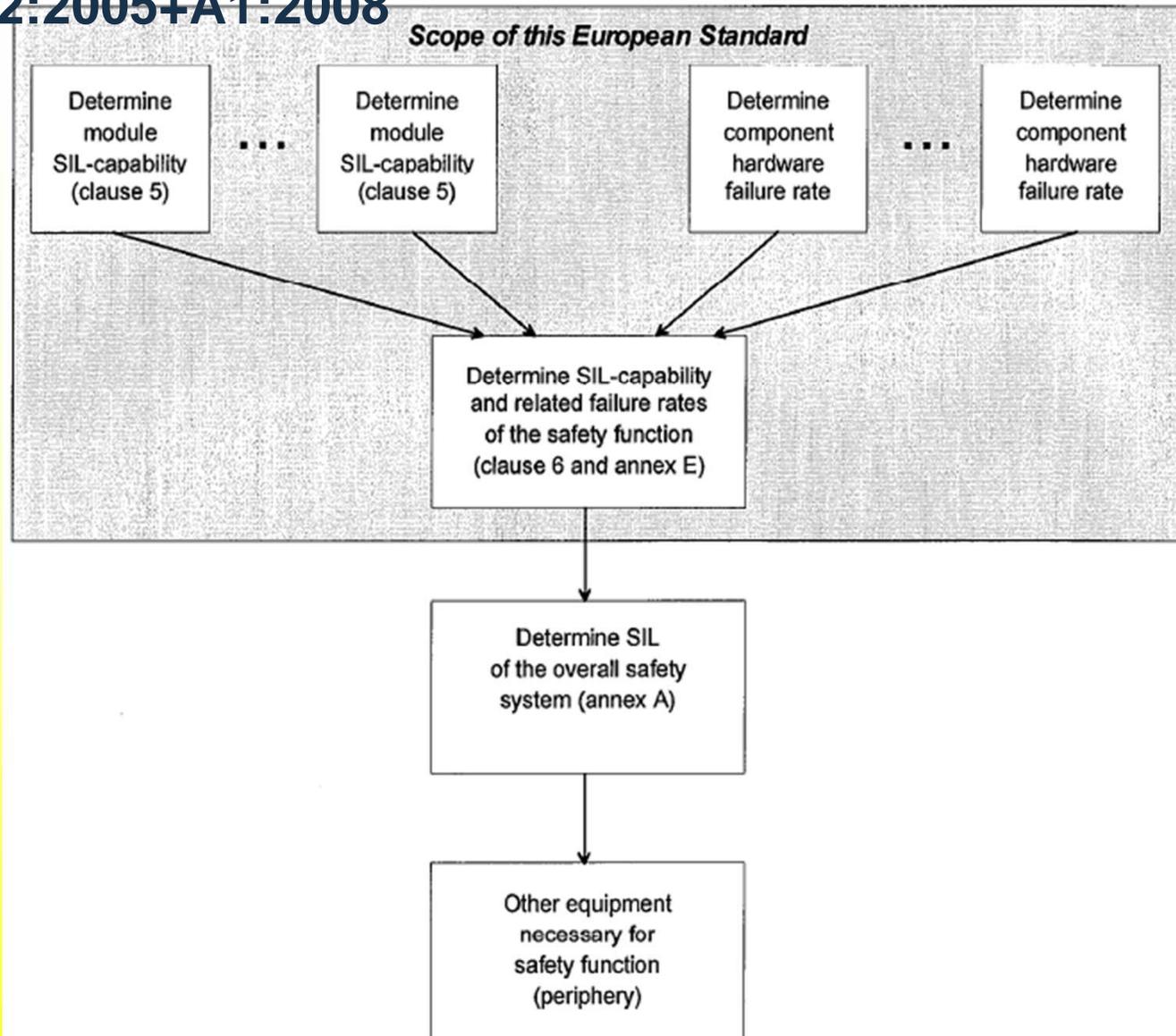


Figure A.1 - Functional safety of modules and systems (Proof test interval and mean time to repair (MTTR) are not shown in the figure although they have to be included into the considerations)

EN 50495: 2010-Dispositivi di sicurezza

La 50495 mette a disposizione le tabelle di cross-reference tra il livello di protezione atteso e l'indice di performance di sicurezza: in questo caso il SIL (Safety Integrity Level). Si noti che la 50495 afferma testualmente che il livello di affidabilità atteso “può essere” classificato in termini di SIL level come definito nella 61508:

4 Ignition prevention by safety devices

The equipment category of explosion protected equipment depends on its fault tolerance with respect to its potential ignition source(s). To increase the equipment category the fault tolerance of this equipment can be enhanced by a safety device, which *controls or monitors the potential ignition source(s)*. The combined equipment shall comply with the relevant standards EN 60079-0 and EN 61241-0.

A safety device shall meet a level of reliability depending on the level by which the fault tolerance of the Equipment Under Control (EUC) shall be enhanced. The required degree of reliability can be classified in Safety Integrity Levels (SIL) as defined by EN 61508 series. A predetermined Safety Integrity Level can be achieved by different combinations of fault tolerance and Safe Failure Fraction (SFF). Tables 1 and 2 show the requirements for the fault tolerance of a safety device when used in combination with equipment of Group I or II.

EN 50495: 2010-Dispositivi di sicurezza



Detto quanto sopra, è possibile associare le prestazioni espresse in termini di SIL alla categoria del prodotto attraverso le tabelle che seguono (Gruppi I, II e III):

Tabella 1 – Requisiti minimi per Livello di Integrità della Sicurezza e Tolleranza al Guasto per un dispositivo di sicurezza

EUC Tolleranza al Guasto Hardware	2	1	0	1	0	0
Dispositivo di sicurezza						
Tolleranza al Guasto Hardware	-	0	1	-	0	-
Livello di Integrità della Sicurezza	-	SIL 1	SIL 2	-	SIL 1	-
Apparecchio combinato						
Gruppo I Categoria		M1		M2		-
Gruppo II, III Categoria		1		2		3

NOTA 1 Tolleranza al guasto:

“0” indica che l'EUC è sicuro in operatività normale. Un guasto singolo può causare una avaria dell'apparecchio.

“1” indica che l'apparecchio è sicuro con un singolo guasto. Due guasti indipendenti possono causare una avaria dell'apparecchio.

“2” indica che l'apparecchio è sicuro con due guasti indipendenti. Tre guasti possono causare una avaria dell'apparecchio.

NOTA 2 SIL1 o SIL2 indica il Livello di Integrità della Sicurezza del dispositivo di sicurezza in accordo alle Norme della serie EN 61508.

NOTA 3 Categoria 1 o 2 o 3: le categorie pertinenti sono definite nella EN 13237, [1]

NOTA 4 “-” significa, che non servono dispositivi di sicurezza

NOTA 5 Apparecchi che contengono una potenziale sorgente di innesco in funzionamento normale non sono inclusi nella Tabella 1, poiché tali apparecchi sono già coperti dalle Norme dei modi di protezione.

EN 60079-0:2012 - Dispositivi di sicurezza

Il livello di protezione così appurabile è confrontabile con quanto indicato nella 60079-0 dove si esprime la cross reference tra il livello di protezione garantito e il livello di rischio:



Protection afforded	Equipment protection level	Performance of protection	Conditions of operation
	Group		
Very high	Ma	Two independent means of protection or safe even when two malfunctions occur independently of each other	Equipment remains functioning when explosive atmosphere present
	Group I		
Very high	Ga	Two independent means of protection or safe even when two malfunctions occur independently of each other	Equipment remains functioning in zones 0, 1 and 2
	Group II		
Very high	Da	Two independent means of protection or safe even when two malfunctions occur independently of each other	Equipment remains functioning in zones 20, 21 and 22
	Group III		
High	Mb	Suitable for normal operation and severe operating conditions	Equipment de-energized when explosive atmosphere present
	Group I		
High	Gb	Suitable for normal operation and frequently occurring disturbances or equipment where malfunctions are normally taken into account	Equipment remains functioning in zones 1 and 2
	Group II		
High	Db	Suitable for normal operation and frequently occurring disturbances or equipment where malfunctions are normally taken into account	Equipment remains functioning in zones 21 and 22
	Group III		
Enhanced	Gc	Suitable for normal operation	Equipment remains functioning in zone 2
	Group II		
Enhanced	Dc	Suitable for normal operation	Equipment remains functioning in zone 22
	Group III		

EN 60079-0:2012- Dispositivi di sicurezza



Accanto a quanto sopra, la 60079-0 richiama anche la tabella D.1 di associazione tra gli EPL e zona di installazione.

Table D.1 – Traditional relationship of EPLs to zones
(no additional risk assessment)

Equipment protection level	Zone
Ga	0
Gb	1
Gc	2
Da	20
Db	21
Dc	22

EN 60079-0:2012- Dispositivi di sicurezza



Accanto a quanto sopra, la 60079-0 richiama anche la tabella D.1 di associazione tra gli EPL, categorie della Direttiva 94/9/CE e zona di installazione.

Equipment groups

In all cases Equipment Protection Levels (EPL) as defined by EN 60079-0 are related to the corresponding Equipment Groups and Equipment Categories according to the following table. The same applies if a standard makes reference to the intended use of equipment in Zones according to the definitions in EN 60079-10.

EN 60079-0		Directive 94/9/EC		EN 60079-10-X
31 EPL	31.1 Group	Equipment Group	Equipment Category	31.2 Zones
<i>Ma</i>	31.3 I	I	31.4 M1	NA
<i>Mb</i>			M2	
<i>Ga</i>	31.5 II	31.6 II	1G	0
<i>Gb</i>			2G	1
<i>Gc</i>			3G	2
<i>Da</i>	31.7 III		1D	20
<i>Db</i>			2D	21
<i>Dc</i>			3D	22

EN 60079-0:2012- Dispositivi di sicurezza



L'integrità della sicurezza di un dispositivo di sicurezza complesso deve essere derivata

- sia seguendo la serie **EN 61508** o Norme correlate (ad esempio **EN 62061, EN ISO 13849-1**);
- sia sulla base di esperienza "di uso-comprovato" in accordo alle Norme della serie **EN 61508/EN 61511**. L'integrità della sicurezza è valutata da un'analisi statistica dei guasti di un numero appropriato di dispositivi usati in un appropriato numero di applicazioni tipiche.

EN 60079-0:2012 - Marcatura



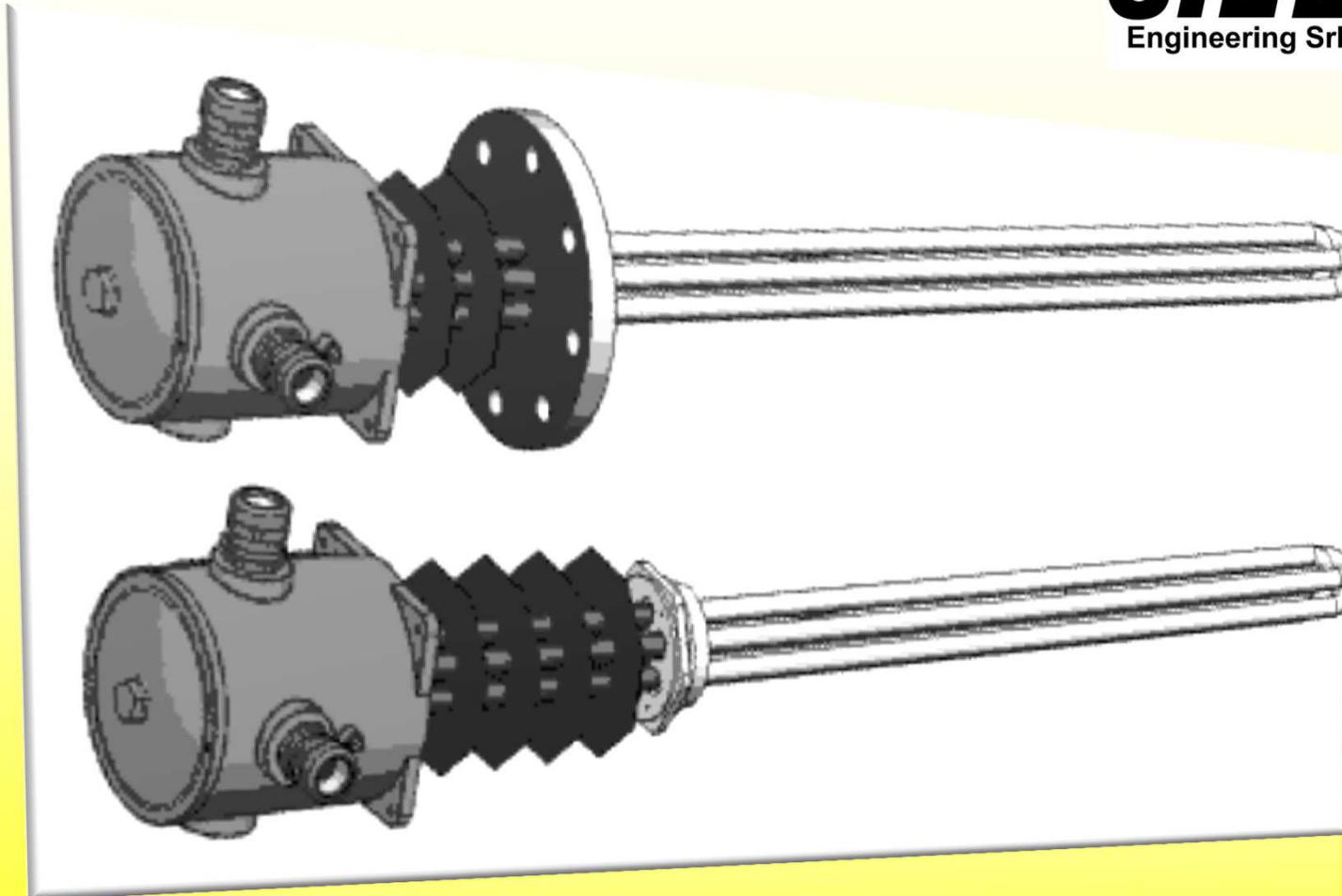
- Marcature
- La norma introduce una doppia simbologia relativa ai metodi di protezione per atmosfere potenzialmente esplosive per presenza di gas: una per la quale è prevista l'indicazione esplicita dello EPL e una (chiamata 'alternativa') che ingloba un'indicazione sintetica del grado EPL.

29.12 Alternate marking of equipment protection levels (EPLs)

The marking of the equipment protection levels is shown by the use of an upper case letter for the specific explosive atmosphere for which the equipment is suitable and a lower case letter indicating the level. As an alternate to the marking given in 29.3 and 29.4 the 'M', 'G' and 'D' are not used as the specific explosive atmosphere is recognised by the marking of the Equipment Groups 'I' (mining), 'II' (gases and vapours) and 'III' (combustible dusts) and the lower case letter for the level is added to the type of protection where it does not already exist.

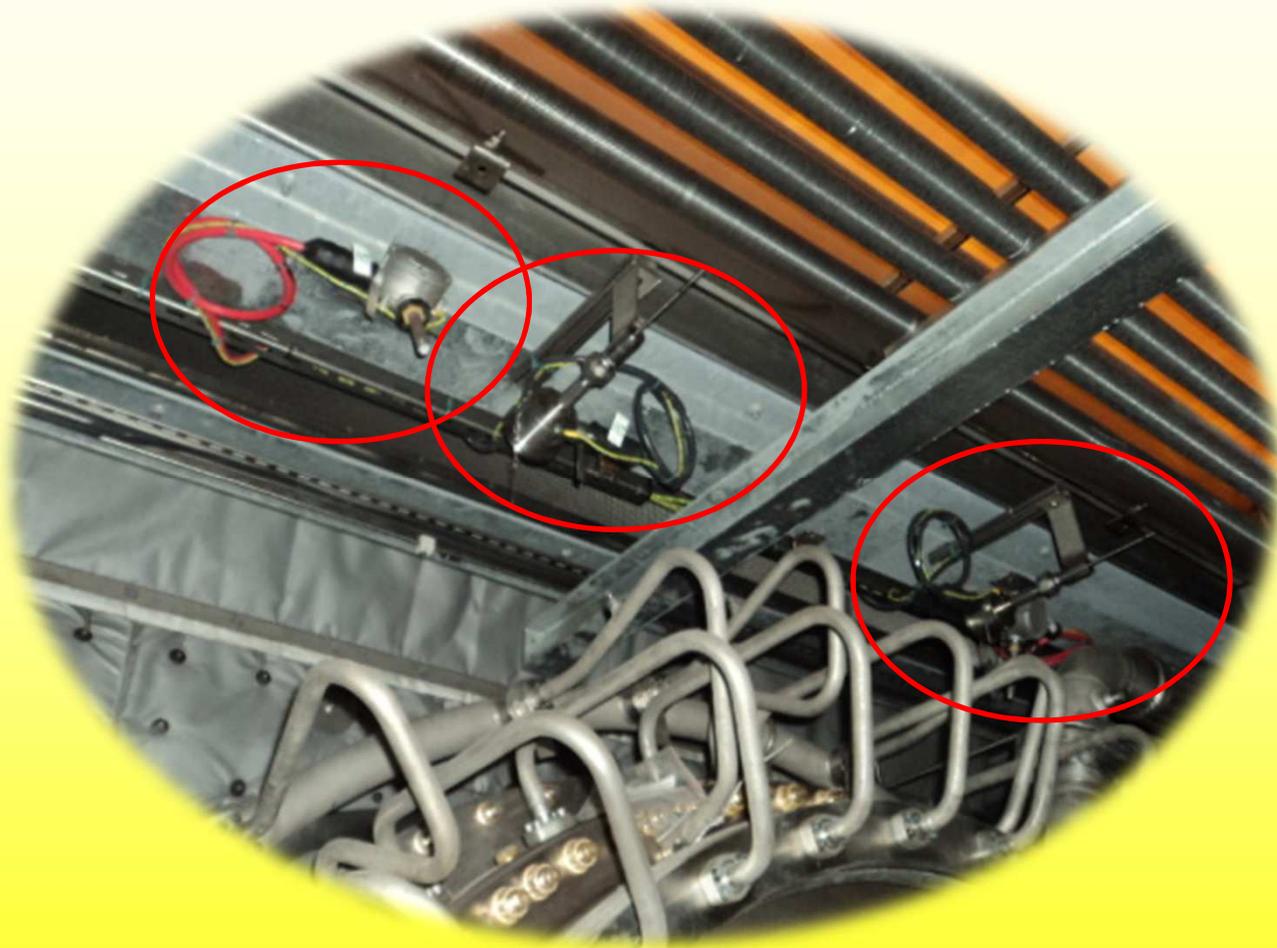
The alternate marking of equipment Protection Levels (EPLs) is not permitted when IEC 60079-26 is applied for equipment intended for installation in the boundary wall between an area requiring EPL Ga and a less hazardous area. See the "Marking" clause of IEC 60079-26.

EN 60079-0:2012- Dispositivi di sicurezza



Direttiva ATEX 99/92/CE - Ing Paolo Corbo – paolo.corbo@silexsr.com

EN 60079-0:2012- Dispositivi di sicurezza



Direttiva ATEX 99/92/CE - Ing Paolo Corbo – paolo.corbo@silexsr.com

Ing Paolo CORBO

ATEX, MACHINERY, SIL Specialist
SILEx Engineering Srl



Paolo CORBO
ATEX, MACHINERY, SIL Specialist



PRODUCT CONFORMITY•SAFETY• SYSTEMS

SILEx Engineering Srl
Via Volta, 26
20852 Villasanta (MB), ITALY
www.silexsr.com

Tel (+39) 039 9163902
Fax (+39) 039 9163902
Mob (+39) 3482396407
paolo.corbo@silexsr.com

Loss Prevention



UN SALUTO A TUTTI

www.silexsr.com

Direttiva ATEX 99/92/CE - Ing Paolo Corbo – paolo.corbo@silexsr.com