

SLOVENSKI STANDARD
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Električne naprave za odkrivanje in merjenje vnetljivih ali strupenih plinov, hlapov ali kisika - Zahteve za funkcionalno varnost vgrajenih sistemov za odkrivanje plina

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

Elektrische Geräte für die Detektion und Messung von brennbaren oder toxischen Gasen und Dämpfen oder Sauerstoff - Anforderungen an die funktionale Sicherheit von ortsfesten Gaswarnsystemen (standards.iteh.ai)

Appareils électriques pour la détection et la mesure des gaz ou vapeurs combustibles ou toxiques ou de l'oxygène - Exigences relatives à la sécurité fonctionnelle des systèmes fixes de détection de gaz

Ta slovenski standard je istoveten z: prEN 50402:2013

ICS:

13.230	Varstvo pred eksplozijo	Explosion protection
13.320	Alarmni in opozorilni sistemi	Alarm and warning systems

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EUROPEAN STANDARD
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prEN 50402

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ICS 13.320

Will supersede EN 50402:2005 + corr. Jan.2009 + A1:2008

English version

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or toxic gases or vapours or of oxygen -
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von ortsfesten Gaswarnsystemen

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This draft European Standard is submitted to CENELEC members for CENELEC enquiry.
Deadline for CENELEC: 2013-10-18.
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It has been drawn up by CLC/SC 31-9.

If this draft becomes a European Standard, CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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CENELEC

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Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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128 **Foreword**

129 This document [prEN 50402:2013] has been prepared by CLC/SC 31-9 "Electrical apparatus for the detection
 130 and measurement of combustible gases to be used in industrial and commercial potentially explosive
 131 atmospheres" of CLC/TC 31 "Electrical apparatus for potentially explosive atmospheres" and by CLC/TC 216
 132 "Gas detectors".

133 This document is currently submitted to the Enquiry.

134 This document will supersede EN 50402:2005 and A1:2008.

135 Technical changes to the first edition:

- 136 – In General the standard is updated to consider the modifications in the second edition of EN 61508 for
 137 hardware and software. Route 2 of the second edition of EN 61508 will not be permitted for gas detection
 138 equipment.
- 139 – The standard is updated for the SIL 1 requirements to be in line with the second edition of EN 50271
 140 specifying the minimum requirements for functional safety for performance approved gas detectors, gas
 141 detection apparatus and complete gas detection systems.
- 142 – The latest revisions of the metrological standards have been considered.
- 143 – SIL 4 has been deleted as being not appropriate to gas detection.
- 144 – The Clauses 4 and 5 have been updated for more detailed specification.
- 145 – Clause 6 for software is new.
- 146 – Clauses 7 to 11 are restructured for clarification of requirements and relation to EN 61508.
- 147 – Clause 10 is specifying more details for the customer information.
- 148 – The former normative Annex D is now Clause 12.
- 149 – The former informative Annex A has been deleted. Relevant text was moved to Clauses 7 to 9.
- 150 – The new informative Annex D is providing information on failure modes of sensing elements
- 151

152 Introduction

153 This European Standard specifies requirements for functional safety of gas detection systems and
154 encompasses criteria for reliability, avoidance of faults and fault tolerance. Functional safety is that part of the
155 overall safety related to the measures within the gas detection system to avoid or to handle failures in such a
156 manner that the safety function will be assured. This includes not only design requirements of the gas
157 detection system but also information requirements for planning, putting into operation, maintenance and
158 repair.

159 This European standard is dedicated to the manufacturer. Information important for the safe use of the device
160 (gas detection system) will be specified in the instruction manual.

161 Gas detection systems will fail to function if dangerous failures occur in the equipment used. Failure to function
162 will also occur if such systems are not installed or maintained in an appropriate manner. In some applications
163 failures of this type will dominate the functional safety achieved. This European Standard is only targeted at
164 reducing equipment failures to levels appropriate to the application. Users of gas detection systems will
165 therefore need to ensure installation and maintenance of such systems is carried out according to
166 requirements. This European Standard does not specify the physical positioning of measuring points /
167 locations.

168 Gas detection systems may differ strongly in structure, complexity and performance. They may not be handled
169 in a uniform manner like low complexity devices. A general specification of requirements is not possible on that
170 basis.

171 Gas detection systems therefore need to be divided into functional modules for validation to ensure that
172 systems which have different structures are handled by appropriate procedures. A gas detection system will
173 not normally include all modules covered by this European Standard. Requirements are specified for each of
174 these modules in terms of hierarchical levels which represent one of the constituents of functional safety
175 performance. The hierarchical levels are termed as SIL-capabilities, with SIL-capability 1 representing the
176 minimum and SIL-capability 3 the maximum levels of performance to comply with this European Standard. The
177 SIL-capability of a module is related to the maximum safety integrity level that may be claimed for a safety
178 function which uses modules of that specified SIL-capability. Modules will be characterised in terms of the SIL-
179 capability. Information is also required on failure rate characteristics of modules or related physical
180 components to enable the overall performance of a gas detection system to be determined. In this way both
181 random failures of hardware components and systematic failures in hardware and software are taken account
182 of. This European standard also specifies the requirements that will enable determination of whether the gas
183 detection system have a low enough failure rate when used in conjunction with other equipment necessary for
184 functional safety.

185 This European Standard will enable the functional safety characteristics of the gas detection system to be
186 determined from the characteristics of its modules and components (see Annex C). This will enable a gas
187 detection system to be used as a part of an overall safety system.

188 The characterisation including the determination of a SIL-capability and failure rate data will only need to be
189 carried out once for a particular design.

190 After characterisation of each module and component the properties of the whole gas detection system will be
191 specified depending on the chosen safety function. The procedure for determining the SIL-capability of the
192 safety function of a gas detection system will only need to be repeated for each new combination of modules
193 and components. Different combination of equivalent modules may lead to gas detection systems which reach
194 different SIL-capabilities.

195 A flexible adoption of the gas detection system to different applications will be possible without repeating all
196 steps of the validation procedure for each new configuration.

197 This European Standard does not include requirements for availability which will need to be considered
198 separately.

prEN 50402:2013 (E)**199 1 Scope**

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

202 NOTE 1 For the purpose of this standard the word 'toxic' covers 'very toxic', 'toxic', 'harmful', 'corrosive', 'irritating', 'sensitising',
203 'carcinogenic', 'mutagenic' and 'teratogenic'.

204 NOTE 2 This European Standard is dedicated to fixed apparatus. For portable gas detectors claiming a SIL higher than 1, this
205 European Standard may be applied.

206 This European Standard supplements the requirements of the European Standards for electrical apparatus for
207 the detection and measurement of flammable gases, vapours (e.g. EN 60079–29–1 or EN 60079–29–4), toxic
208 gases (e.g. EN 45544) or oxygen (e.g. EN 50104).

209 NOTE 3 These European Standards are mentioned in the text as "metrological standards".

210 NOTE 4 The examples above show the state of the standardisation for industrial applications at the time of publishing this European
211 Standard. There may be other metrological standards covering other application fields, for which this European Standard is also
212 applicable.

213 NOTE 5 This European Standard covers all SIL-capabilities (1, 2 and 3) however where SIL 1 capability is the only requirement then
214 EN 50271 may be applied.

215 Applying the above-mentioned metrological standards will ensure the measuring performance is adequate in
216 normal operation of a gas detection system. Additionally the requirements of this European Standard address
217 the functional safety of gas detection systems and encompass criteria for reliability, fault tolerance and
218 avoidance of systematic faults.

219 This European Standard will lead to the characterisation of the gas detection system by a SIL-capability and
220 related hardware failure rate representing a hierarchical order of safety levels. This will allow the user to
221 incorporate the gas detection system into an overall safety system according to the safety integrity levels of
222 EN 61508 (all parts).

223 This European Standard is a product standard which is based on EN 61508 (all parts) and for gas detection
224 systems covers SIL capabilities of 1, 2 or 3 only. It covers part of the phase 10 "realisation" of the overall safety
225 lifecycle defined in Figure 2 of EN 61508-1:2010.

226 NOTE 6 Applications requiring a SIL capability of 4 for a gas detection system are unrealistic.

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

- 229 – gas-sampling;
- 230 – sensor;
- 231 – signal transmission;
- 232 – input to control unit;
- 233 – signal processing in control unit;
- 234 – output from control unit.

235 This European Standard does not specify requirements for the installation and maintenance of gas detection
236 systems. It also does not specify the physical positioning of measuring points / locations.

237 This European Standard does not specify which SIL-capability is sufficient for which application.

238 NOTE 7 The SIL-capability required for an application will be specified by the user (see Clause 9 and Annex A).

239 2 Normative references

240 The following documents, in whole or in part, are normatively referenced in this document and are
 241 indispensable for its application. For dated references, only the edition cited applies. For undated references,
 242 the latest edition of the referenced document (including any amendments) applies.

243 EN 45544-1, *Workplace atmospheres - Electrical apparatus used for the direct detection and direct*
 244 *concentration measurement of toxic gases and vapours*
 245 *Part 1: General requirements and test methods*

246 EN 45544-2, *Part 2: Performance requirements for apparatus used for measuring concentrations in the region*
 247 *of limit values*

248 EN 45544-3, *Part 3: Performance requirements for apparatus used for measuring concentrations well above*
 249 *limit values*

250 EN 45544-4, *Part 4: Guide for selection, installation, use and maintenance*

251 EN 50104, *Electrical apparatus for the detection and measurement of oxygen - Performance requirements and*
 252 *test methods*

253 EN 50270, *Electromagnetic compatibility – Electrical apparatus for the detection and measurement of*
 254 *combustible gases, toxic gases or oxygen*

255 EN 50271:2010, *Electrical apparatus for the detection and measurement of combustible gases, toxic gases or*
 256 *oxygen – Requirements and tests for apparatus using software and/or digital technologies*

257 EN 60079–29–1:2007, *Explosive atmospheres – Part 29-1: Gas detectors – Performance requirements of*
 258 *detectors for flammable gases (IEC 60079-29-1, mod.)*

259 EN 60079–29–2, *Explosive atmospheres – Part 29-2: Gas detectors – Selection, installation, use and*
 260 *maintenance of detectors for flammable gases and oxygen (IEC 60079-29-2)*

261 EN 60079–29–4, *Explosive atmospheres – Part 29-4: Gas detectors – Performance requirements of open path*
 262 *detectors for flammable gases (IEC 60079-29-4, mod.)*

263 EN 61508-1:2010, *Functional safety of electrical / electronic / programmable electronic safety-related systems*
 264 *Part 1: General requirements (IEC 61508-1:2010)*

265 EN 61508-2:2010, *Part 2: Requirements for electrical/electronic/programmable electronic safety-related*
 266 *systems (IEC 61508-2:2010)*

267 EN 61508-3:2010, *Part 3: Software requirements (IEC 61508-3:2010)*

268 EN 61508-4:2010, *Part 4: Definitions and abbreviations (IEC 61508-4:2010)*

269 EN 61508-5:2010, *Part 5: Examples of methods for the determination of safety integrity levels*
 270 *(IEC 61508-5:2010)*

271 EN 61508-6:2010, *Part 6: Guidelines on the application of IEC 61508-2 and IEC 61508-3 (IEC 61508-6:2010)*

272 EN 61508-7:2010, *Part 7: Overview of techniques and measures (IEC 61508-7:2010)*

273 3 Terms and definitions

274 For the purpose of this document, the terms and definitions given in EN 60079–29–1 and EN 61508-4:2010
 275 apply.

276 Some definitions are repeated for convenience. Some definitions from EN 61508-4:2010 are adapted to gas
 277 detection.

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- 278 **3.1**
 279 **functional safety**
 280 part of the overall safety relating to the equipment under control (EUC) and the EUC control system that
 281 depends on the correct functioning of the electrical/electronic/programmable electronic safety-related systems
 282 (E/E/PES) and other risk reduction measures
- 283 Note 1 to entry: The EUC is the equipment under control or the process that the gas detection system is assuring the
 284 safety of (EN 61508-4: 2010, 3.2.1 modified).
- 285 Note 2 to entry: The EUC control system responds to input signals from the process and generates output signals
 286 causing the EUC to operate in the desired manner (EN 61508-4:2010, 3.3.3 modified).
- 287 Note 3 to entry: The gas detection system is part of the E/E/PES.
- 288 [SOURCE: EN 61508-4:2010, 3.1.12]
- 289 **3.2**
 290 **safety function of a gas detection system**
 291 function (inclusive from gas sampling to output of the gas detection system) implemented by the gas detection
 292 system to enable the safety-related system to achieve a safe state of the EUC
- 293 **3.3**
 294 **safety related part**
 295 any part, e. g. module or element, which is necessary to implement the required safety function of a gas
 296 detection system
- 297 **3.4**
 298 **fault**
 299 abnormal condition that may cause a reduction in, or loss of, the capability of a functional unit to perform a
 300 required function
 301 [SOURCE: EN 61508-4:2010, 3.6.1]
- 302 **3.5**
 303 **fault tolerance**
 304 ability of a functional unit to continue to perform a required function in the presence of faults or errors
 305 [SOURCE: EN 61508-4:2010, 3.6.3]
- 306 **3.6**
 307 **SIL-capability**
 308 the SIL-capability is determined by the measures and techniques for avoidance and control of faults in both,
 309 hardware and software. The SIL-capability number is a property of an element, a module, a combination of
 310 modules or of one or several safety function(s) of a gas detection system. There are three different SIL-
 311 capability numbers existing from 1 to 3, with SIL-capability 3 representing the highest level of safety
 312 performance for a gas detection system. Each module or combination of modules will be allocated a SIL-
 313 capability from both class of safe failure fraction and failure rates (λ).
- 314 **3.7**
 315 **engineered for SIL-capability**
 316 The term is a specialised form of the above term SIL-capability. It specifies the classes of SFF without
 317 reference to failure rates.
 318 The term is used for functional modules where the failure modes apply in general but the failure rates will
 319 depend on the applications and therefore cannot be determined in general by the manufacturer.

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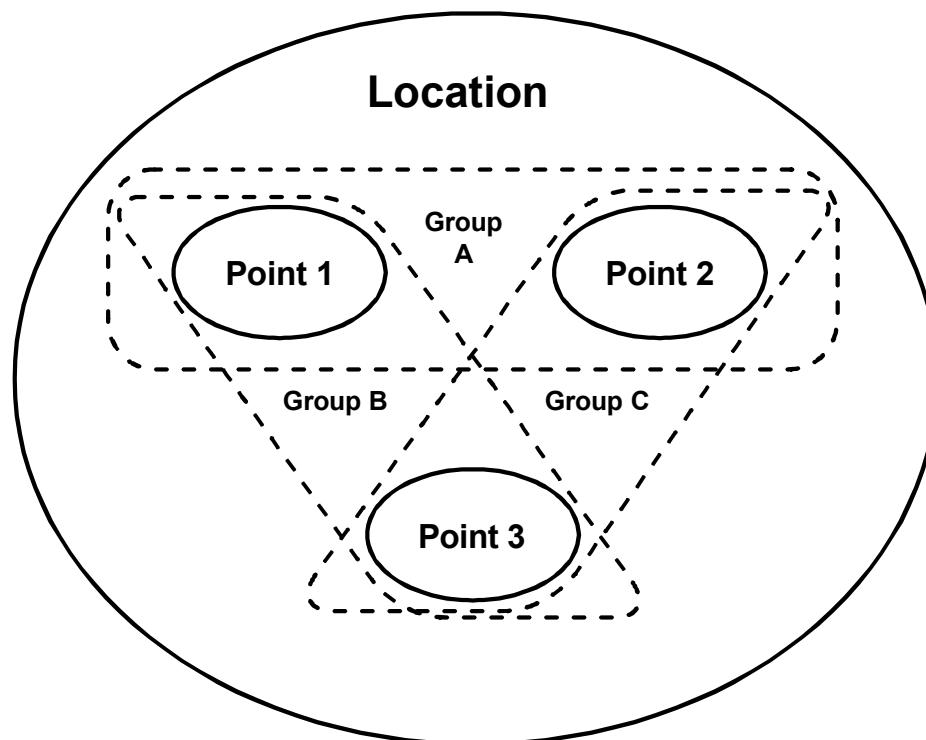
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- 320 **3.8**
 321 **module**
 322 modules form the functional units of a gas detection system. A module executes a defined part of the
 323 functionality within the gas detection system. It consists of one or more elements
- 324 Note 1 to entry: Modules may be simple or complex (see 4.3).
- 325 **3.9**
 326 **element**
 327 functional sub-unit of a module
- 328 Note 1 to entry: The software or a part of it may be considered as an element.
- 329 **3.10**
 330 **component**
 331 the hardware of a gas detection system consists of components which are physically separable subassemblies
- 332 Note 1 to entry: Depending of the specific realisation an element of a functional module may belong to different
 333 hardware components.
- 334 **3.11**
 335 **periphery**
 336 components of the total system which do not belong to the gas detection system but are related with it
- 337 Note 1 to entry: See Figure 3.
- 338 Note 2 to entry: Periphery is not covered by this European Standard.
- 339 **3.12**
 340 **measuring point**
 341 location of a single sensor aspirated by diffusion or by a probe
- 342 Note 1 to entry: See Figure 1.
- 343 **3.13**
 344 **measuring group**
 345 redundant combination of two measuring points belonging to one measuring location
- 346 Note 1 to entry: See Figure 1.
- 347 **3.14**
 348 **measuring location**
 349 area containing one or more measuring points in which similar gas concentrations are expected
- 350 Note 1 to entry: See Figure 1.
- 351 Note 2 to entry: According to 3.12 to 3.14 it is possible that one sensor serves as a redundant partner for several other
 352 sensors.

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353

354 **Figure 1 - Definitions of measuring point, measuring group and measuring location**

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355 **3.15**356 **measured signal**

357 sensor signal in analogue or digital representation which may or may not be pre-amplified

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358 **3.16**359 **measured value**

360 processed measured signal including physical unit (e. g. % LEL). A measured value may be formed from a
 361 single signal or a combination of several measurement signals. The combined measured signals may
 362 represent different physical units, e. g. gas concentration and temperature

363 **3.17**364 **status signal**

365 electrical signal which indicates operational states, switching status of devices, adherence of general
 366 conditions (e. g. allowed temperature range or gas flow) within a module or to another module of the gas
 367 detection system

368 **3.18**369 **alarm signal**

370 electrical signal which indicates the alarm state of one or more measurement points. The alarm signal will be
 371 processed either in the gas detection system (e. g. release of switching) or transmitted to the periphery

372 Note 1 to entry: Alarm signals are handled separately from other signals because they are generally handled with higher
 373 priority.

374 **3.19**375 **special state**

376 every state of a measurement point, module, control unit or the total gas detection system in which the
 377 monitoring of gas concentration does not take place, e. g. put into operation, calibration mode or fault condition

378 **3.20**
 379 **parameter**
 380 setting by the manufacturer or user which affect the operation, e. g. changing of the alarm thresholds or
 381 measuring ranges. Parameter options are included in the software during design of the gas detection system.
 382 Changes of parameter settings are not modifications of the software. In the software several different levels of
 383 permission to read or to change parameters may exist

384 **3.21**
 385 **minimum response time**
 386 value which is determined by the applicable metrological standards. In metrological standards the allowed
 387 response times during type testing are given. If there are different requirements for the response time in
 388 different applicable metrological standards the smallest value is the "minimum response time"

389 **3.22**
 390 **smallest deviation of indication**
 391 value which is determined by the applicable metrological standards. In metrological standards the allowed
 392 tolerances for deviation of indication during type testing are given. If there are different requirements for the
 393 tolerances in different applicable metrological standards the smallest tolerance is the "smallest deviation of
 394 indication".

395 The smallest deviation of indication is basis for the required resolution of measured signals which use digital
 396 transmission and data processing to meet the requirements of the metrological standards when using digital
 397 technologies

398 **3.23**
 399 **Self-testing facilities** iTeh STANDARD PREVIEW
 400 test routines, e. g. memory check, which will be carried out within the gas detection system automatically and
 401 repeated cyclically. These facilities may be carried out within a single module or check the interconnection or
 402 co-operation between modules.
 403 Self-testing facilities are cyclically repeated test routines, which do not interrupt the measuring mode. Test
 404 routines may also be carried out prior to operation during start-up delay of a gas detection system before it
 405 starts the measuring mode, carried out on user request or in calibration mode of single measurement points or
 406 parts of the gas detection system

407 **3.24**
 408 **check**
 409 covers operational procedures, e. g. manual calibration, additional to self-test facilities on user request

410 **3.25**
 411 **verification**
 412 confirmation by examination and provision of objective evidence that the requirements have been fulfilled

413 [SOURCE: EN 61508-4:2010, 3.8.1]

414 **3.26**
 415 **redundancy**
 416 the existence of more than one means for performing a required function or for representing information

417 Note 1 to entry: Redundancy is used primarily to improve reliability (probability of functioning properly over a given
 418 period of time specified as T1) or availability (probability of functioning at given instant).

419 Note 2 to entry: Redundancy may be "hot" or "active" (all redundant item running at the same time), "cold" or "stand-by"
 420 (only one of the redundant item working at the same time), "mixed" (one or several items running and one or several
 421 items in stand-by at the same time).

422 [SOURCE: EN 61508-4:2010, 3.4.6, notes modified]