
Visokonapetostne varovalke - 1. del: Tokovno omejlne varovalke

High-voltage fuses - Part 1: Current-limiting fuses

Hochspannungssicherungen - Teil 1: Strombegrenzende Sicherungen

Fusibles à haute tension - Partie 1: Fusibles limiteurs de courant

Ta slovenski standard je istoveten z: prEN IEC 60282-1:2018

ICS:

29.120.50	Varovalke in druga medtokovna zaščita	Fuses and other overcurrent protection devices
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Full standard:
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OF INTEREST TO THE FOLLOWING COMMITTEES: SC 17A, SC 17C	PROPOSED HORIZONTAL STANDARD: <input type="checkbox"/> Other TC/SCs are requested to indicate their interest, if any, in this CDV to the secretary.
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TITLE:

High-voltage fuses - Part 1: Current-limiting fuses

PROPOSED STABILITY DATE: 2025

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103 INTERNATIONAL ELECTROTECHNICAL COMMISSION

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HIGH-VOLTAGE FUSES –

Part 1: Current-limiting fuses

FOREWORD

112 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising
113 all national electrotechnical committees (IEC National Committees). The object of IEC is to promote
114 international co-operation on all questions concerning standardization in the electrical and electronic fields. To
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142 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is
143 indispensable for the correct application of this publication.

144 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of
145 patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

146 International Standard IEC 60282-1 has been prepared by subcommittee 32A: High-voltage
147 fuses, of IEC technical committee 32: Fuses.

148 This eighth edition cancels and replaces the seventh edition published in 2009. The content of
149 the amendment (2013) has been considered for this revision.

150 The main changes introduced by this new edition are:

151 Additional information concerning thermally operated strikers, the division of ratings,
152 characteristics and type tests into those applicable to all fuses and those applicable to
153 particular fuse-link types and applications, adjustment of Series II voltages and tests to meet
154 present North American standard system voltages and applications, clarification of
155 requirements for fuse-links used in surrounding temperatures above 40 °C, and clarification of
156 homogeneous requirements for fuse-links containing one element.

157 The text of this standard is based on the following documents:

FDIS	Report on voting
32A/XX/FDIS	32A/XX/RVD

158 Full information on the voting for the approval of this standard can be found in the report on
159 voting indicated in the above table.

160 This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

161 The IEC 60282 series consists of the following parts, under the general title *High-voltage*
162 *fuses*:

163 – Part 1: Current-limiting fuses

164 – Part 2: Expulsion fuses

165 The committee has decided that the contents of this document will remain unchanged until the
166 stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to
167 the specific document. At this date, the document will be

- 168 • reconfirmed,
- 169 • withdrawn,
- 170 • replaced by a revised edition, or
- 171 • amended.

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HIGH-VOLTAGE FUSES –

Part 1: Current-limiting fuses

178 **1 General**

179 **1.1 Scope**

180 This part of IEC 60282 applies to all types of high-voltage current-limiting fuses designed for
181 use outdoors or indoors on alternating current systems of 50 Hz and 60 Hz and of rated
182 voltages exceeding 1 000 V.

183 **1.2 Normative references**

184 The following documents are referred to in the text in such a way that some or all of their
185 content constitutes requirements of this document. For dated references, only the edition
186 cited applies. For undated references, the latest edition of the referenced document (including
187 any amendments) applies.

188 IEC 60050-441:1984 + AMD1:2000, *International Electrotechnical Vocabulary (IEV) – Chapter*
189 *441: Switchgear, controlgear and fuses*

190 IEC 60050-614:2016, *International Electrotechnical Vocabulary (IEV) – Chapter 614: Generation,*
191 *transmission and distribution of electricity – Operation*

192 IEC 60060-1:2010, *High-voltage test techniques – Part 1: General definitions and test*
193 *requirements*

194 IEC 60071-1:1993, *Insulation coordination – Part 1: Definitions, principles and rules*

195 IEC 60085:1984, *Thermal evaluation and classification of electrical insulation*

196 IEC 60549, *High-voltage fuses for the external protection of shunt capacitors*

197 IEC 60644, *Specification for high-voltage fuse-links for motor circuit applications*

198 IEC 62271-100:2008+AMD1:2012+AMD2:2017, *High-voltage switchgear and controlgear –*
199 *Part 100: High-voltage alternating-current circuit-breakers*

200 IEC 62271-105, *High-voltage switchgear and controlgear – Part 105: Alternating current*
201 *switch-fuse combinations for rated voltages above 1 kV up to and including 52 kV*

202 IEC/TR 62655:2013, *Tutorial and application guide for high-voltage fuses*

203 ISO 148-2:1998, *Metallic materials – Charpy pendulum impact test – Part 2: Verification of*
204 *test machines*

205 ISO 179 (all parts), *Plastics – Determination of Charpy impact properties*

206 **2 Normal and special service conditions**

207 **2.1 Normal service conditions**

208 Fuses complying with this standard are designed to be used under the following conditions.

209 a) The maximum ambient air temperature is 40 °C and its mean measured over a period of
210 24 h does not exceed 35 °C.

211 The minimum ambient air temperature is –25 °C.

212 NOTE 1 The time-current characteristics of fuses will be modified at the minimum and maximum
213 temperatures.

214 b) The altitude does not exceed 1 000 m.

215 c) The ambient air is not excessively (or abnormally) polluted by dust, smoke, corrosive or
216 flammable gases, vapour or salt.

- 217 d) For indoor installations, the conditions of humidity are under consideration but, in the
218 meantime, the following figures can be used as a guide:
- 219 – the average value of the relative humidity, measured during a period of 24 h, does not
220 exceed 95 %;
 - 221 – the average value of the vapour pressure, for a period of 24 h, does not exceed
222 22 hPa;
 - 223 – the average value of the relative humidity, for a period of one month, does not exceed
224 90 %;
 - 225 – the average value of the water vapour pressure, for a period of one month, does not
226 exceed 18 hPa.

227 For these conditions, condensation may occasionally occur.

228 NOTE 2 Condensation can be expected where sudden temperature changes occur in periods of high
229 humidity.

230 NOTE 3 To withstand the effects of high humidity and occasional condensation, such as breakdown of in-
231 sulation or corrosion of metallic parts, indoor fuses designed for such conditions and tested accordingly or
232 outdoor fuses are an alternative.

233 NOTE 4 Condensation is prevented by special design of the building or housing, by suitable ventilation and
234 heating of the station or by the use of dehumidifying equipment.

- 235 e) Vibrations due to causes external to fuses or earth tremors are negligible.

236 In addition, for outdoor installations,

- 237 f) account should be taken of the presence of condensation or rain and rapid temperature
238 changes;

- 239 g) the wind pressure does not exceed 700 Pa (corresponding to 34 m/s wind speed);

- 240 h) the solar radiation does not exceed 1,0 kW/m².

241 Applications involving fuse-links in enclosures (fuse enclosure packages) typically satisfy the
242 requirements of “normal service conditions” because the ambient temperature (the
243 temperature outside the enclosure) meets the temperatures in a) of this subclause. However,
244 in an enclosure, surrounding temperatures (see 3.3.11) above 40 °C are to be expected and
245 additional considerations may apply regarding assigning a current carrying capability to the
246 device (see 4.2.4, 4.2.5, 4.2.9.2 and IEC/TR 62655:2013).

247 For certain fuse-links and applications in enclosures additional tests may be required as
248 covered in this standard in Annex E.

249 2.2 Special service conditions

250 2.2.1 General

251 By agreement between the manufacturer and the user, high-voltage fuses may be used under
252 conditions different from the normal service conditions given in 2.1. For any special service
253 condition, the manufacturer shall be consulted.

254 2.2.2 Altitude

255 For installations at an altitude higher than 1 000 m, the required rated insulation withstand
256 level of external insulation shall be determined by multiplying the needed insulation levels at
257 the service location by an altitude correction factor, K_a (> 1) given in column (2) of Table 1.

258 The dielectric withstand voltages of a fuse at a particular altitude may be determined by
259 multiplying its rated insulation withstand levels by $1/K_a$ (< 1), given in column (3) of Table 1.

260 For altitudes between 1 000 m and 1 500 m and between 1 500 m and 3 000 m, the correction
261 factors may be obtained by linear interpolation between the values in Table 1.

262

Table 1 – Altitude correction factors – Dielectric withstand

Maximum altitude m (1)	Correction factor for withstand voltages (K_a) (2)	Correction factor applied to rated withstand voltages ($1/K_a$) (3)
1 000	1,0	1,0
1 500	1,05	0,95
3 000	1,25	0,80

263 Where the dielectric characteristics are identical at any altitude, no special precautions need
264 to be taken.

265 The current-carrying capability of a fuse may be determined for altitudes exceeding 1 000 m
266 by applying the appropriate factors given in Table 2, column (2) to the rated current or
267 allowable continuous current of the fuse.

268 For altitudes between 1 000 m and 1 500 m and between 1 500 m and 3 000 m, the correction
269 factors may be obtained by linear interpolation between the values in Table 2.

270

Table 2 – Altitude correction factors – Current-carrying capability

Maximum altitude m (1)	Correction factor for current-carrying capability (2)
1 000	1,0
1 500	0,99
3 000	0,96

271

272 2.3 Environmental behaviour

273 Fuses complying with this standard are inert devices during normal service. It is also a
274 requirement of 5.1.3 that no significant external emission takes place. Therefore, they are
275 regarded as environmentally safe devices in service and operation.

276 3 Definitions

277 For the purposes of this document, the following terms and definitions apply.

278 ISO and IEC maintain terminological databases for use in standardization at the following
279 addresses:

- 280 • IEC Electropedia: available at <http://www.electropedia.org/>
- 281 • ISO Online browsing platform: available at <http://www.iso.org/obp>

282

283 3.1 Electrical characteristics

284 3.1.1

285 rated value

286 value of a quantity used for specification purposes, established for a specified set of operating
287 conditions of a component, device, equipment, or system

288 NOTE 1 to entry: Examples of rated values usually stated for fuses include, voltage, current and breaking current.

289 [SOURCE: IEC 60050-441:2000, 441-18-35, modified – “used for specification purposes” and
290 “system” added]

291 **3.1.2**
292 **rating**
293 set of rated values and operating conditions

294 [SOURCE: IEC 60050-441:2000, 441-18-36]

295 **3.1.3**
296 **prospective current** (of a circuit and with respect to a fuse)
297 current that would flow in the circuit if the fuse were replaced by a conductor of negligible
298 impedance

299 NOTE 1 to entry: For the method to evaluate and to express the prospective current, see 6.6.2.1 and 6.6.2.2.

300 [SOURCE: IEC 60050-441:2000, 441-17-01, modified – “each pole of the switching device or”
301 has been deleted and “is to be specified in the relevant publications” has been deleted and
302 “see 6.6.2.1 and 6.6.2.2” has been added.]

303 **3.1.4**
304 **prospective peak current**
305 peak value of a prospective current during the transient period following initiation

306 NOTE 1 to entry: The definition assumes that the current is made by an ideal switching device, i.e. with instan-
307 taneous transition from infinite to zero impedance. For circuits where the current can follow several different paths,
308 for example polyphase circuits, it further assumes that the current is made simultaneously in all poles, even if only
309 the current in one pole is considered.

310 [SOURCE: IEC 60050-441:2000, 441-17-02]

311 **3.1.5**
312 **prospective breaking current**
313 the RMS value of the AC component of the prospective current, evaluated at a specified time

314 NOTE 1 to entry: This specified time is given in 6.6.2.3.

315 **3.1.6**
316 **breaking capacity**
317 value of prospective current that a fuse-link is capable of breaking at a stated voltage under
318 prescribed conditions of use and behaviour

319 [SOURCE: IEC 60050-441:2000, 441-17-08, modified – “switching device or a fuse” replaced
320 with “fuse-link” and Notes removed]

321 **3.1.7**
322 **cut-off current;**
323 **let-through current**
324 maximum instantaneous value of current attained during the breaking operation of a fuse

325 NOTE 1 to entry: This concept is of particular importance when the fuse operates in such a manner that the
326 prospective peak current of the circuit is not reached.

327 [SOURCE: IEC 60050-441:2000, 441-17-12, modified – “a switching device or” deleted]

328

329 **3.1.8**
330 **pre-arcing time;**
331 **melting time**
332 interval of time between the beginning of a current large enough to cause a break in the fuse
333 element(s) and the instant when an arc is initiated

334 [SOURCE: IEC 60050-441:2000, 441-18-21]

335 **3.1.9**
336 **arcing time**
337 interval of time between the instant of the initiation of the arc in a fuse and the instant of final
338 arc extinction in that fuse

339 [SOURCE: IEC 60050-441:2000, 441-17-37, modified – references to “poles” removed.]

340 **3.1.10**
 341 **operating time;**
 342 **clearing time**
 343 sum of the pre-arcing time and the arcing time

344 [SOURCE: IEC 60050-441:2000, 441-18-22]

345 **3.1.11**
 346 **I^2t ;**
 347 **Joule integral**
 348 integral of the square of the current over a given time interval $t_0 - t_1$

349
$$I^2t = \int_{t_0}^{t_1} i^2 dt$$

350 NOTE 1 to entry: The pre-arcing I^2t is the I^2t integral extended over the pre-arcing time of the fuse.

351 NOTE 2 to entry: The operating I^2t is the I^2t integral extended over the operating time of the fuse.

352 NOTE 3 to entry: The energy in joules liberated in 1 Ω of resistance in a circuit protected by a fuse is equal to the
 353 value of the operating I^2t expressed in $A^2 \times s$.

354 [SOURCE: IEC 60050-441:2000, 441-18-23]

355 **3.1.12**
 356 **virtual time**
 357 value of Joule integral divided by the square of the value of the prospective current

358 NOTE 1 to entry: The values of virtual times usually stated for a fuse-link are the values of pre-arcing time and of
 359 operating time.

360 [SOURCE: IEC 60050-441:2000, 441-18-37]

361 **3.1.13**
 362 **time-current characteristic**
 363 curve giving the time, for example pre-arcing time or operating time, as a function of the
 364 prospective current under stated conditions of operation

365 [SOURCE: IEC 60050-441:2000, 441-17-13]

366 **3.1.14**
 367 **cut-off (current) characteristic;**
 368 **let-through (current) characteristic**
 369 curve giving the cut-off current as a function of the RMS prospective current, under stated
 370 conditions of operation

371 NOTE 1 to entry: The values of the cut-off currents are the maximum values that can be reached whatever the
 372 degree of asymmetry.

373 [SOURCE: IEC 60050-441:2000, 441-17-14, modified – “RMS” added, and references relating
 374 to direct currents removed from the note to entry]

375 **3.1.15**
 376 **recovery voltage**
 377 voltage which appears across the terminals of a fuse after the breaking of the current

378 NOTE 1 to entry: This voltage may be considered in two successive intervals of time, one during which a
 379 transient voltage exists, followed by a second one during which the power frequency recovery voltage alone exists.

380 [SOURCE: IEC 60050-441:2000, 441-17-25, modified – “a pole of a switching device or”
 381 removed and “or the steady-state” removed from the Note to entry]]