

# SLOVENSKI STANDARD

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**Tiristorski ventili (elektronke) za visokonapetostni enosmerni prenos (HVDC) električne energije - 1. del: Električno preskušanje**

Thyristor valves for high voltage direct current (HVDC) power transmission - Part 1: Electrical testing

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29.200	Usmerniki. Pretvorniki. Stabilizirano električno napajanje	Rectifiers. Convertors. Stabilized power supply
31.080.20	Tiristorji	Thyristors

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EUROPEAN STANDARD

**EN 60700-1**

NORME EUROPÉENNE

EUROPÄISCHE NORM

September 2015

ICS 29.200

Supersedes EN 60700-1:1998

English Version

## Thyristor valves for high voltage direct current (HVDC) power transmission - Part 1: Electrical testing (IEC 60700-1:2015)

Valves à thyristors pour le transport d'énergie en courant continu à haute tension (CCHT) - Partie 1: Essais électriques  
(IEC 60700-1:2015)

Thyristorventile für Hochspannungsgleichstrom-Energieübertragung (HGÜ) - Teil 1: Elektrische Prüfung  
(IEC 60700-1:2015)

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SIST EN 60700-1:2015

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European Committee for Electrotechnical Standardization  
Comité Européen de Normalisation Electrotechnique  
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

**EN 60700-1:2015****European foreword**

The text of document 22F/341/CDV, future edition 2 of IEC 60700-1, prepared by SC 22F “Power electronics for electrical transmission and distribution systems” of IEC/TC 22 “Power electronic systems and equipment” was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 60700-1:2015.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2016-06-01
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2018-09-01

This document supersedes EN 60700-1:1998.

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## Annex ZA (normative)

### Normative references to international publications with their corresponding European publications

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

NOTE 1 When an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: [www.cenelec.eu](http://www.cenelec.eu)

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60060	Series	High-voltage test techniques	EN 60060	Series
IEC 60060-1	-	High-voltage test techniques - Part 1: General definitions and test requirements	EN 60060-1	-
IEC 60071-1	-	Insulation co-ordination - Part 1: Definitions, principles and rules	EN 60071-1	-
IEC 60099	Series	Surge arresters	EN 60099	Series
IEC 60270	-	High-voltage test techniques - Partial discharge measurements	EN 60270	-
IEC 61803 +A1	1999 2010	Determination of power losses in high- voltage direct current (HVDC) converter stations	EN 61803 +A1	1999 2010
ISO/IEC Guide 25 <sup>1)</sup>	-	General requirements for the competence of calibration and testing laboratories	-	-

<sup>1)</sup> Withdrawn publication.

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Edition 2.0 2015-07

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE

**Thyristor valves for high voltage direct current (HVDC) power transmission –  
Part 1: Electrical testing** (standards.iteh.ai)

**Valves à thyristors pour le transport d'énergie en courant continu à haute  
tension (CCHT) –**  
**Partie 1: Essais électriques**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

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**THYRISTOR VALVES FOR HIGH VOLTAGE DIRECT  
CURRENT (HVDC) POWER TRANSMISSION –**
**Part 1: Electrical testing****FOREWORD**

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60700-1 has been prepared by subcommittee 22F: Power electronics for electrical transmission and distribution systems, of IEC technical committee 22: Power electronic systems and equipment.

This second edition cancels and replaces the first edition published in 1998, its Amendment 1:2003 and its Amendment 2: 2008. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition.

- a) Definitions of terms "redundant thyristor levels", "thyristor level", "valve section" have been changed for clarification.
- b) The notes were added to test requirements of dielectric d.c. voltage tests for valve support, MVU, valve, specifying that before repeating the test with opposite polarity, the tested

object may be short-circuited and earthed for several hours. The same procedure may be followed at the end of the d.c. voltage test.

- c) Table 1 on thyristor level faults permitted during type tests was supplemented.
- d) The alternative MVU dielectric test method was added.
- e) It was specified that production tests may include routine tests as well as sample tests.
- f) It was added into test requirements for periodic firing and extinction tests that a scaling factor for tests shall be applied when testing with valve sections.

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

CDV	Report on voting
22F/341/CDV	22F/351A/RVC

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

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

A list of all parts in the IEC 60700 series, published under the general title *Thyristor valves for high voltage direct current (HVDC) power transmission*, can be found on the IEC website.

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

- reconfirmed,
- withdrawn, [SIST EN 60700-1:2015](https://standards.iteh.ai/catalog/standards/sist/d408cc0b-d273-4ca6-8eb3-0fa0f7e4d74/sist-en-60700-1-2015)
- replaced by a revised edition, <https://standards.iteh.ai/catalog/standards/sist/d408cc0b-d273-4ca6-8eb3-0fa0f7e4d74/sist-en-60700-1-2015>
- amended.

# THYRISTOR VALVES FOR HIGH VOLTAGE DIRECT CURRENT (HVDC) POWER TRANSMISSION –

## Part 1: Electrical testing

### 1 Scope

This part of IEC 60700 applies to thyristor valves with metal oxide surge arresters directly connected between the valve terminals, for use in a line commutated converter for high voltage d.c. power transmission or as part of a back-to-back link. It is restricted to electrical type and production tests.

The tests specified in this standard are based on air insulated valves. For other types of valves, the test requirements and acceptance criteria can be agreed.

### 2 Normative references

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

IEC 60060, *High-voltage test techniques*

[SIST EN 60700-1:2015](http://standards.iteh.ai/catalog/standards/sist/1408cc0b-d273-4ca6-8eb3-b4fa017e4d74/sist-en-60700-1-2015)

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

IEC 60071-1, *Insulation co-ordination – Part 1: Definitions, principles and rules*

IEC 60099 (all parts), *Surge arresters*

IEC 60270, *High-voltage test techniques – Partial discharge measurements*

IEC 61803:1999, *Determination of power losses in high-voltage direct current (HVDC) converter stations*

IEC 61803:1999/AMD 1:2010<sup>1</sup>

ISO/IEC Guide 25, *General requirements for the technical competence of testing laboratories*<sup>2</sup>

### 3 Terms and definitions

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

<sup>1</sup> There exists a consolidated edition 1.1 (2011) that comprises IEC 61803:1999 and its Amendment 1:2010.

<sup>2</sup> Withdrawn.

### 3.1 Insulation co-ordination terms

#### 3.1.1

##### test withstand voltage

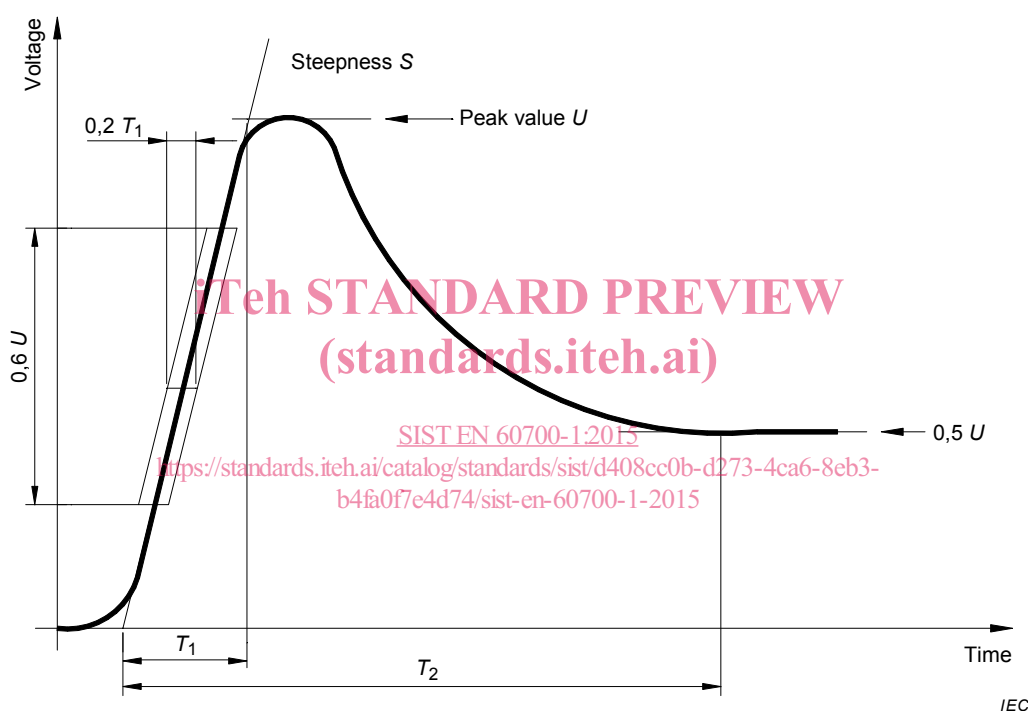
value of a test voltage of standard waveshape at which a new valve, with unimpaired integrity, does not show any disruptive discharge and meets all other acceptance criteria specified for the particular test, when subjected to a specified number of applications or a specified duration of the test voltage, under specified conditions

#### 3.1.2

##### steep front impulse

fast-front voltage impulse whose time to peak is less than that of a standard lightning impulse but not less than that of a very-fast-front voltage as defined in IEC 60071-1

Note 1 to entry: For this standard, the steep front impulse voltage for test purposes is as shown in Figure 1.



#### Key

- $U$  specified peak value of steep front impulse test voltage (kV)  
 $S$  specified steepness of steep front impulse test voltage (kV/ $\mu$ s)

$$T_1 \text{ virtual front time} = \frac{U}{S} \text{ (}\mu\text{s)}$$

The following conditions shall be satisfied:

- The peak value of the recorded test voltage shall be  $U \pm 3\%$ . This tolerance is the same as that in IEC 60060 for standard lightning impulse.
- Over a voltage excursion of not less than  $0,6 U$ , the rising portion of the recorded test voltage shall be entirely contained between two parallel lines of steepness  $S$  and separation  $0,2 T_1$ .
- The value of the test voltage at  $T_2$  shall not be lower than  $0,5 U$ .  $T_2$  is defined as the time interval between the origin and the instant when the voltage has decreased to half the peak value of the waveform which is obtained from system study. However, it shall be assured that an unintentional  $du/dt$  switching of the thyristors can be adequately detected.

Figure 1 – Steep front impulse test voltage

### 3.1.3

#### **internal and external insulation**

air external to the components and insulating materials of the valve, but contained within the profile of the valve or multiple valve unit is considered as part of the internal insulation system of the valve

Note 1 to entry: The external insulation is the air between the external surface of the valve or multiple valve unit and its surroundings.

### 3.1.4

#### **valve protective firing**

means of protecting the thyristors from excessive voltage by firing them at a predetermined voltage

## 3.2 Valve construction terms

### 3.2.1

#### **valve support**

that part of the valve which mechanically supports and electrically insulates from earth the active part of the valve which houses the valve sections

Note 1 to entry: A part of a valve which is clearly identifiable in a discrete form to be a valve support may not exist in all designs of valves.

### 3.2.2

#### **valve structure**

physical structure holding the thyristor levels of a valve which is insulated to the appropriate voltage above earth potential

### 3.2.3

#### **redundant thyristor levels**

maximum number of thyristor levels in a thyristor valve that may be short-circuited externally or internally during service without affecting the safe operation of the thyristor valve as demonstrated by type tests, and which if and when exceeded, would require shutdown of the converter to replace the failed thyristors or acceptance of increased risk of failures

### 3.2.4

#### **valve base electronics**

electronic unit, at earth potential, which is the interface between the control system for the converter and the thyristor valves

### 3.2.5

#### **thyristor level**

part of a thyristor valve comprising a thyristor, or thyristors connected in parallel, together with their immediate auxiliaries, and reactor, if any

### 3.2.6

#### **valve section**

electrical assembly, comprising a number of thyristors and other components, which exhibits pro-rated electrical properties of a complete valve

### 3.2.7

#### **multiple valve unit**

##### **MVU**

single physical structure comprising more than one valve with a common mechanical support structure