IEC 60664-1 Edition 3: *Insulation coordination for equipment within low-voltage supply systems - Part 1: Principles, requirements and tests*

A TC 109 horizontal safety standard revision in development

802.3 Isolation Ad Hoc Meeting
Draft IEC 60664-1 ED3 Review Contribution

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Introduction

- IEC TC 109 is creating a replacement (Edition 3) for IEC 60664-1:2007.
- As IEC 60664-1 is a safety document there were attempts to de-emphasise functional insulation in early drafts, resulting in many removal objections.
  - Functional insulation is the Cinderella to basic insulation, supplementary insulation and reinforced insulation
- Only the functional insulation parts of the 2018-03-30 draft document are covered in this presentation.
- Comparisons are made between Edition 2 and draft Edition 3 content
- Forecast Edition 3 publication date is 2019-06.

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Edition 2

Draft Edition 3

Annex F: Tables

- **F.1 – Rated impulse withstand voltage for equipment energized directly from the low-voltage mains**
- **F.2 – Clearances to withstand transient overvoltages**
- **F.3 – Single-phase three or two-wire AC. or DC systems**
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- **F.5 – Creepage distances to avoid failure due to tracking**
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- **F.8a – Dimensioning of clearances to withstand steady-state peak voltages, temporary overvoltages or recurring peak voltages**
- **F.8b – Additional information concerning the dimensioning of clearances to avoid partial discharge**
- **F.9 – Altitude correction factors for clearance correction**

Definitions

- **functional insulation:** insulation between conductive parts which is necessary only for the proper functioning of the equipment.
- **basic insulation:** insulation of hazardous-live-parts which provides basic protection

  Note 1 to entry: This concept does not apply to insulation used exclusively for functional purposes

Basic technical characteristics for insulation coordination

- The technical committee shall make a risk assessment to identify the hazard in case of fault of functional insulation. In case of a failure on insulation (mechanical, ageing behaviour,) could create a hazard, functional insulation shall be designed according to the requirements of this BSP (Basic Safety Practice). See *Dimensioning of clearances*, *Dimensioning of creepage distances* and *Requirements for design of solid insulation*.
- In case a fault of insulation does not create any hazard, the technical committee may choose not to apply the requirements of this BSP.

New in Edition 3

Dimensioning of clearances

- General
  - Clearance dimensions shall be selected, taking into account the following influencing factors:
    - – impulse withstand voltage according to *Selection of rated impulse withstand voltage for equipment* for functional insulation, for basic insulation, supplementary insulation and reinforced insulation;
- Selection of rated impulse withstand voltage for equipment
  - The rated impulse withstand voltage of the equipment shall be selected from Table F.1 corresponding to the overvoltage category specified and to the rated voltage U_n of the equipment.
- Dimensioning of clearance of functional insulation
  - For a clearance of functional insulation, the required withstand voltage is the maximum impulse voltage or steady-state peak voltage (with reference to Table F.8) or recurring peak voltage (with reference to Table F.8) expected to occur across it, under rated conditions of the equipment, and in particular the rated voltage and rated impulse voltage (refer to Table F.2) (Edition 2 used working voltage).

Dimensioning of creepage distances

- General
  - To determine the required creepage distances, the following influencing factors must be taken into account:
    - - voltage (see *Determination of the voltage*)
  - NOTE The values of Table F.5 are based upon existing empirical data and are suitable for the majority of applications. However, for functional insulation, values of creepage distances other than those of Table F.5 can be appropriate.
- Determination of the voltage
  - The voltage to be used for the selection of the minimum creepage distances in Table F.5 shall be in accordance with the rationalized voltages of Table F.3 and Table F.4. They may also be used for the selection of rated insulation voltages. (functional insulation uses the working voltage)

Requirements for design of solid insulation

- General
  - Solid insulation of basic insulation, supplementary insulation and reinforced insulation shall be capable of durably withstanding electrical and mechanical stresses as well as thermal and environmental influences which may occur during the intended life of the equipment. Technical committees shall consider these stresses when specifying conditions for testing.
- Voltage stress
  - Solid insulation shall withstand the voltage stress considering:
    - – Transient overvoltages according to *Transient overvoltages* clause;
- Transient overvoltages
  - Basic insulation and supplementary insulation shall have:
    - – an impulse withstand voltage requirement corresponding to the nominal of the mains voltage (see *Temporary overvoltages* clause), and the relevant overvoltage category according to Table F.1; or
    - – an impulse withstand voltage of an internal circuit of an equipment which has been specified according to the transient overvoltages to be expected in the circuit (see *Recurring peak voltage* clause). (No mention of functional insulation)

Portion of Table F.1 – Rated impulse withstand voltage for equipment energized directly from the low-voltage mains

AC Mains	Rated impulse withstand voltage category			
AC DC	I	II	III	IV
V	V	V	V	V
50	330	500	800	1500
100	500	800	1500	2500
150	800	1500	2500	4000
300	1500	2500	4000	6000
600	2500	4000	6000	8000
1250	4000	6000	8000	12000
1500	6000	8000	10000	15000

Portion of Table F.2 – Clearances to withstand transient overvoltages

Required impulse withstand voltage	Minimum clearances in air
kV	mm
0,33	0,01
0,4	0,02
0,50	0,04
0,60	0,06
0,80	0,10
1,2	0,25
1,5	0,5
2,0	1,0
2,5	1,5
3,0	2,0
4,0	3,0
5,0	4,0
6,0	5,5
8,0	8,0
10	11
12	14
Preferred F1 voltage values	

Comments

- Functional Insulation is the Cinderella of TC 109 insulation types.
- If no hazard is caused by shorting the functional insulation, technical committees can set their own requirements
- Voltage requirements should be set by the expected environment or determined from field experience.
- Alternatively, IEC TR 60664-2-1 Ed. 2.0: *Insulation coordination for equipment within low-voltage systems - Part 2-1: Application guide - Explanation of the application of the IEC 60664 series, dimensioning examples and dielectric testing* has many functional insulation examples to evaluate & learn from.