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GROUP SAFETY PUBLICATION

PUBLICATION GROUPÉE DE SÉCURITÉ

AMENDMENT 1 AMENDEMENT 1 (standards.iteh.ai)

Safety of transformers, reactors, power supply units and similar products for supply voltages up to 1 100^{11/2} <u>61558-2-16:2009/AMD1:2013</u> Part 2-16: Particular requirements and tests for switch mode power supply units and transformers for switch mode power supply units

Sécurité des transformateurs, bobines d'inductance, blocs d'alimentation et produits analogues pour des tensions d'alimentation jusqu'à 1 100 V – Partie 2-16: Règles particulières et essais pour les blocs d'alimentation à découpage et les transformateurs pour blocs d'alimentation à découpage





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FOREWORD

This amendment has been prepared by IEC technical committee 96: Transformers, reactors, power supply units, and combinations thereof.

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

FDIS	Report on voting
96/401/FDIS	96/405/RVD

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

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

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which <u>lare2-considered</u> 20to be useful for the correct understanding of hits://contents.h.Usersg/should/stherefore-print2-thise.document using a colour printer. ac9a2299583friec-61558-2-16-2009-amd1-2013

INTRODUCTION to the Amendement

This amendment has been prepared to allow the use of **FIW** wires in SMPS.

The manufacturer should be careful, that during production and transport no damage of the ${\bf FIW}$ wire will be possible.

2 Normative references

Add, to the existing list of references, the following new references:

IEC 60317-0-7:2012, Specifications for particular types of winding wires – Part 0-7: General requirements – Fully insulated (FIW) zero-defect enamelled round copper wire with nominal conductor diameter of 0,040 mm to 1,600 mm

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IEC 60317-43, Specifications for particular types of winding wires – Part 43: Aromatic polyimide tape wrapped round copper wire, class 240

IEC 60317-56, Specifications for particular types of winding wires – Part 56: Solderable fully insulated (FIW) zero-defect polyurethane enamelled round copper wire with nominal conductor diameter 0,040 mm to 1,600 mm, class 180

IEC 60851-3:2009, Winding wires – Test methods – Part 3: Mechanical properties

IEC 60851-5:2008, Winding wires – Test methods – Part 5: Electrical properties

3 Terms and definitions

Add, at the end of the existing text, the following new instruction and new terms and definitions as follows:

Addition:

3.101 FIW fully insulated winding wire wire according to IEC 60317-0-7, IEC 60317-56 and IEC 60851-5:2008 which is a zero-defect wire construction iTeh STANDARD PREVIEW

3.102

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 zero-defect wire
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 winding wire that exhibits no electrical discontinuities when tested under specific conditions

 IEC 61558-2-16:2009/AMD1:2013

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grade of FIW ac9a2299583f/iec-61558-2-16-2009-amd1-2013

range of overall diameter of a wire (FIW3 - FIW9)

18 Insulation resistance, dielectric strength and leakage current

18.3

Add, after the existing Table 8a, the following new instruction:

Replacement of the text in footnote a of Table 8a:

^a For construction according to 26.2.4.1, test B the voltage is multiplied by the factor 1,25. For the construction according to 26.2.4.2 the voltage is multiplied by the factor 1,35.

Add, after the existing subclause 18.101, the following new subclause and new figure:

18.102 A partial discharge test according to IEC 60664-1, (test description see below) shall be performed, if **FIW** wires are used and if the recurring peak working voltage U_t across the insulation is greater than 750 V. The relevant recurring peak voltage is the maximum measured voltage between the input and the output circuit of the SMPS, if the secondary side is earthed. The measuring shall be done at 1,0 of the maximum rated input voltage.

A partial discharge test shall be done at the transformer for the SMPS with the measured recurring peak voltage U_{t} , greater than 750 V peak.

 $U_{\rm t}$ is the maximum peak working voltage;

*t*₁ is 5 s;

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t₂ is 15 s.

Partial discharge shall be less than or equal to 10 pC at time t_2 .

The test shall be done according to the following Figure 104.

For other applications higher values may be required (e.g. IEC 61800-5-1).



19 Construction

Add, at the end of the existing text of this clause, the following new text:

19.12.3 Replacement:

Insulated winding wires, in an insulation system providing **basic**, **supplementary** or **reinforced insulation**, shall meet the following requirements.

Wire that has multi-layer extruded or spirally wrapped insulation (where only the finished wire can be tested) and passes the tests of Annex K.

The minimum number of constructional layers applied to the conductor shall be as follows:

- BASIC INSULATION: two wrapped layers or one extruded layer;
- SUPPLEMENTARY INSULATION: two layers, wrapped or extruded;
- REINFORCED INSULATION: three layers wrapped or extruded.

For spirally wrapped insulation where the CREEPAGE DISTANCES between layers, as wrapped, are less than those given in Clause 26. for pollution degree 1, the path between layers shall be sealed as for a cemented joint in 26.2.3, Test A and the test voltages of the TYPE TESTS in Clause K.2 are increased to 1,35 times their normal values.

NOTE 1 One layer of material wound with more than 50 % overlap is considered to constitute two layers.

The finished component shall pass ROUTINE TEST for electric strength using the appropriate value of test voltages in 18.3.

Compliance is checked by inspection and measurement and, if applicable, as specified in Annex K.

- a) Where the insulation on the winding wire is used to provide **basic- or supplementary insulation** in a wound part:
 - the insulated wire (for example polyimide or insulation of equivalent quality) shall comply with Annex K;
 - the insulation of one insulated winding wire shall consist of at least two layers for supplementary insulation;
 - the insulation of one insulated winding wire shall consist of at least one layer for basic insulation;
 - an insulation for mechanical separation which fulfil the electric strength test for basic insulation shall be provided between the insulated wires and the enamelled wires.

NOTE 2 If for basic or supplementary insulation a triple insulated wire is used in combination with enamelled wire, an additional interleaved insulation (mechanical separation) is not required.

- b) Where the insulation on the winding wire is used to provide **reinforced insulation** in a wound part:
 - the insulated wire (for example polyimide or insulation of equivalent quality) shall comply with Annex K;
 - the insulation of one insulated winding wire shall consist of at least three layers;
 - the insulation is subjected to the relevant dielectric strength test of 18.3.

Where the insulated winding wire is wound:

- upon metal or ferrite cores or a solution of the second second
- https://standards.iteh.ai/catalog/standards/sist/27cc3470-a1fc-42e1-aaec-
- upon enamelled wire a05 12299583 friec-61558-2-16-2009-amd1-2013
- under enamelled wire;

an insulation for mechanical separation which fulfil the electric strength test for **basic insulation** shall be provided between the insulated wires and the core or between the insulated wires and the enamelled wires. The both windings shall not touch each other and both wires shall not touch the core.

NOTE 3 This requirement takes into consideration the mechanical production stress applied to the **insulated winding wires**.

The manufacturer of the **transformer** shall demonstrate that the winding wire has been subjected to 100 % routine dielectric strength test as in Clause K.3.

No requirements for **creepage distances** and **clearances** are applicable for the **insulated winding wires**.

For windings providing **reinforced insulation**, no value is required in box 2) c) of Table 13, Table C.1 and Table D.1 of Part 1 and no values are required of 26.106.

Compliance is checked by inspection of the part and the declaration of the wire manufacturer

19.12.101 The transformer which use fully insulated winding wires (**FIW**), shall only be used up and including insulation class F.

19.12.102 Fully insulated winding wires (**FIW**) shall comply with IEC 60851-5:2008, IEC 60317-0-7 and IEC 60317-56. If the wire has other nominal diameter than in Table 111 defined, so the minimum high voltage strength value can be calculated according to formula below Table 111:

• **FIW** wires used for basic or supplementary isolation for transformers according to 19.1.2:

- 6 -

- the test voltage required in Table 8a for basic/supplementary insulation according to the working voltage of the transformer, shall comply with the minimum voltage strength of basic insulation for the **FIW**-wire according to Table 111;
- between an basic insulated FIW wire and an enamelled wire an insulation for mechanical separation shall be used. The both windings shall not touch each other. The insulation for mechanical separation shall fulfil the high voltage test of basic insulation. Creepage distances and clearances to the FIW wire are not required.
- **FIW** wires used for double or reinforced insulation according to 19.1.3:
 - the test voltage required in Table 8a for basic-/supplementary insulation according to the working voltage of the transformer, shall comply with the minimum voltage strength of basic insulation for the FIW-wires according to Table 111. For the primary and the secondary winding a basic insulated FIW wire shall be used;
 - between the two basic insulated FIW wires an insulation for mechanical separation shall be used. The both windings shall not touch each other. The insulation for mechanical separation shall fulfil the high voltage test of basic insulation. Creepage distances and clearances between the FIW wires are not required.
- Alternative construction with **FIW**-wires reinforced insulated:
 - the test voltage required in Table 8a for reinforced insulation according to the working voltage of the transformer, shall comply with the minimum voltage strength for the **FIW** wire according to Table 111;
 - between a reinforced insulated FIW wire and an enamelled wire an insulation for mechanical separation shall be used. The both windings shall not touch each other. The insulation for mechanical separation shall fulfil the high voltage test of basic insulation. Creepage distances and clearances to the FIW wire are not required.
- Alternative construction with FIW wires, basic or supplementary insulated for transformers with double or reinforced insulation according to 191.3.
 - the test voltage required in Table 8a for basic /supplementary insulation according to the working voltage of the transformer, shall comply with the minimum voltage strength of basic insulation for the FIW-wire according to Table 111. For the primary or the secondary winding a basic insulated FIW wire shall be used. For the other winding enamelled wire can be used;
 - between the basic insulated FIW wire and the enamelled wire an supplementary insulation according to the working voltage is required. Creepage distances and clearances between the FIW wire and the enamelled wire are required for supplementary insulation.
- Where the **FIW wire** is wound:
 - upon metal or ferrite cores, an insulation for mechanical separation which fulfil the electric strength test for **basic insulation** shall be provided between the **FIW** wires and the core. The **FIW** wire and enamelled wire (if used) shall not touch the metal or ferrite core.

26 Creepage distances, clearances and distances through insulation

Add, at the end of the existing clause, the following new subclause:

26.107 For transformers with FIW wires the following test is required:

To test the **FIW**-winding at the final **transformer**, three specimens shall be used.

The specimens shall be subjected 10 times to the following sequence of temperature cycles:

68 h at the highest winding temperature ± 2 °C measured in normal use plus 10 K with a minimum of 85 °C;

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1 h at 25 °C \pm 2 °C;

2 h at 0 °C \pm 2 °C;

1 h at 25 °C \pm 2 °C.

During each thermal cycling test, a voltage of twice the value of the working voltage at 50 Hz or 60 Hz shall be applied to the specimens between the windings where the reduced values apply.

Two of the three specimens are then subjected to the humidity treatment of 17.2 (48 h treatment) and the relevant dielectric strength test of 18.3.

One of the three specimens shall be subjected to the relevant dielectric strength test of 18.3 immediately at the end of the last period at highest temperature during the thermal cycling test.

The partial discharge test shall be done at the end of the cycling test at normal room temperature as performed in 18.101.

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<u>IEC 61558-2-16:2009/AMD1:2013</u> https://standards.iteh.ai/catalog/standards/sist/27cc3470-a1fc-42e1-aaecac9a2299583f/iec-61558-2-16-2009-amd1-2013

(Overall dia - copper dia) / 2 = Insulation thickness (µm)	Insulation thickness (um) * Voltage strength per um = minimun voltage strength for FW design
Calculation of test voltage for further FIV dlameters :	Insulation thickness (um) * Voltage strength

Controlling Insultation Voltage strength for basic, supplementary or reinforced Insultation F. M. T. V. M.		Insulation thickness (µm) * Voltage strength per µm	Ickness (µ	m) • Voltag	le strength	-	= minimun voltage strength for FIW design	oltage stre	vngth for F	W design					_	sheet	
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53 0.206 0.227 0.244 0.271 0.235 0.331 0.116 2355 0.326 0.336 0.306 0.325 0.317 0.307 0.3	0,14	8	0,181	0,201	0,221	0,241	0,261	0,281	0,301	1087	1617	2147	2677	3207	37.37	4267	
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63 0,262 0,277 0,302 0,324 0,366 0,324 0,366 0,324 0,366 0,208 0,416 0,417 0,420 2346 5406 5406 5602	0,18	8	0,229	0,253	0,277	0,301	0,325	0,349	0,373	1299	1935	2571	3207	3843	4479	5115	
53 0,280 0,307 0,334 0,361 0,388 0,415 0,442 0,442 0,442 0,442 0,442 0,442 0,442 0,443 0,446 0,433 6183 4323 4346 5003 5618 53 0,345 0,375 0,407 0,430 0,430 0,432 0,432 0,433 5003 4073 5503 5618 5630 5618 5630 5618 5630 5618 5630 5618 5630 5618 5630 5618 5618 5619 5619 5610 5618 5610 5618 5709 5618 5709 5618 5709 5618 5709 5618 5709 5618 5709 5618 5709	0,2	8	0,252	0,277	0,302	0,327	0,352	0,377	0,402	1378	2041	2703	3366	4028	4691	5353	
53 0,312 0,342 0,372 0,432 0,432 0,469 0,500 0,531 1723 2438 4028 4823 5618 63 0,345 0,345 0,446 0,477 0,508 0,531 1723 2544 3366 4187 5009 5830 64 0,438 0,446 0,571 0,552 0,563 0,514 2438 5115 5036 5336 49 0,438 0,560 0,571 0,562 0,587 0,519 4407 7487 5009 5830 49 0,587 0,586 0,571 0,603 0,511 2,123 2132 4131 5143 5716 5336 37 0,587 0,586 0,571 0,602 0,537 0,817 2132 4141 5145 6150 5570 37 0,516 0,586 0,810 0,810 0,817 0,813 2141 5141 5142 5156 5156	0,224	8	0,280	0,307	0,334	0,361	0,388	0,415	0,442	1484	2200	2915	3631	4346	5062	5777	
53 0.345 0.345 0.407 0.438 0.460 0.501 0.531 1723 2544 3366 4187 5009 5830 49 0.428 0.4415 0.4415 0.4415 0.4415 0.471 0.508 0.539 0.517 1081 2648 3370 4807 5686 49 0.4373 0.564 0.5450 0.541 0.651 0.633 0.4191 2648 5906 5716 5936 49 0.5373 0.564 0.566 0.710 0.751 0.683 2041 2730 4191 5145 5150 5708 37 0.587 0.564 0.760 0.710 0.751 2132 3136 4141 5145 6150 5709 37 0.581 0.690 0.857 0.892 0.776 5873 3411 5142 5696 475 5696 475 5696 475 5696 475 5696 475 570 3301 <th>0,25</th> <th>ß</th> <th>0,312</th> <th>0,342</th> <th>0,372</th> <th>0,402</th> <th>0,432</th> <th>0,462</th> <th>0,492</th> <th>1643</th> <th>2438</th> <th>3233</th> <th>4028</th> <th>4823</th> <th>5618</th> <th>6413</th> <th></th>	0,25	ß	0,312	0,342	0,372	0,402	0,432	0,462	0,492	1643	2438	3233	4028	4823	5618	6413	
63 0,384 0,415 0,446 0,477 0,508 0,570 1829 2650 3472 4293 5115 5936 49 0,428 0,450 0,521 0,552 0,583 0,614 1907 4927 2493 5115 5936 49 0,478 0,509 0,540 0,511 0,602 0,633 0,614 4190 4949 5709 37 0,681 0,566 0,700 0,710 0,711 0,071 2034 2132 3136 4141 5145 6150 5709 37 0,611 0,851 0,880 0,817 0,882 0,814 7709 4877 5175 5175 5175 5175 5175 5175 5175 5175 5176	0,28	8	0,345	0,376	0,407	0,438	0,469	0,500	0,531	1723	2544	3366	4187	5009	5830	6652	
49 0.428 0.450 0.430 0.521 0.562 0.583 0.614 1789 2548 3308 4067 4827 5596 49 0.478 0.500 0.540 0.571 0.602 0.633 1911 2671 3430 4190 449 5700 49 0.587 0.564 0.566 0.657 0.688 2034 2793 3553 4312 5709 5709 7 0.587 0.564 0.506 0.710 0.711 0.7121 1711 2034 2793 3553 4312 5709 7709 7 0.587 0.686 0.710 0.751 0.789 4755 6150 7709 7 0.728 0.561 0.7637 0.992 1721 2173 3571 3996 4755 6150 7709 7 0.728 0.810 0.937 0.992 1721 2173 3411 4244 775 7 0.71	0,315	83	0,384	0,415	0,446	0,477	0,508	0,539	0,570	1829	2650	3472	4293	5115	5936	6758	
49 $0,478$ $0,509$ $0,540$ $0,571$ $0,602$ $0,633$ 1911 2671 3430 4190 4949 49 $0,533$ $0,564$ $0,596$ $0,626$ $0,657$ $0,689$ 2793 3553 4312 5072 5072 37 $0,587$ $0,628$ $0,670$ $0,776$ $0,710$ $0,771$ 2732 31741 5145 6150 4756 37 $0,614$ $0,753$ $0,710$ $0,776$ $0,817$ $0,817$ 3996 4756 6150 37 $0,728$ $0,710$ $0,776$ $0,817$ $0,817$ 3930 4089 4847 37 $0,714$ $0,826$ $0,892$ $0,917$ $0,892$ 3127 4070 5072 5072 37 $0,911$ $0,962$ $1,171$ $1,226$ $1,171$ $1,226$ $1,217$ 4070 5014 4164 1266 1266 1266 <t< th=""><th>0,355</th><th>49</th><th>0,428</th><th>0,459</th><th>0,490</th><th>0,521</th><th>0,552</th><th>0,583</th><th>0,614</th><th>1789</th><th>2548</th><th>3308</th><th>4067</th><th>4827</th><th>5586</th><th>6346</th><th></th></t<>	0,355	49	0,428	0,459	0,490	0,521	0,552	0,583	0,614	1789	2548	3308	4067	4827	5586	6346	
49 0,533 0,564 0,505 0,626 0,657 0,688 2034 2793 3553 4312 1 49 0,587 0,564 0,505 0,651 0,613 0,751 2132 3136 4141 5145 1 37 0,587 0,628 0,694 0,753 0,710 0,711 2132 3136 4141 5145 1 3996 1 3091 4089 3571 3996 1 3041 4000 3041 4084 1 3041 4084 1 306 3041 4014 5126 3127<	0,4	49	0,478	0,509	0,540	0,571	0,602	0,633		1911	2671	3430	4190	4949	5709		
49 0,587 0,628 0,669 0,710 0,751 2132 3136 4141 5145 37 0,653 0,694 0,753 0,716 0,817 1721 2479 3571 3906 37 0,653 0,694 0,753 0,716 0,817 1721 2479 3571 3906 37 0,728 0,769 0,810 0,851 0,892 1813 2572 3330 4089 37 0,814 0,855 0,896 0,337 0,978 1924 2683 3441 4200 37 1,018 1,064 2054 2997 3941 4884 37 1,126 1,171 2126 1,277 2183 3127 4070 5014 33 1,124 1,176 1,277 2294 3238 4181 5126 33 1,248 1,309 1,370 2162 3119 4126 2126 2126 2126 2126	0,45	49	0,533	0,564	0,595	0,626	0,657	0,688		2034	2793	3553	4312	5072			
37 $0,663$ $0,694$ $0,753$ $0,716$ $0,817$ $1,721$ 2479 3571 3906 37 $0,728$ $0,769$ $0,810$ $0,851$ $0,802$ 1813 2572 3330 4089 37 $0,711$ $0,855$ $0,896$ $0,937$ $0,978$ 1924 2863 3441 4200 37 $0,911$ $0,962$ $1,013$ $1,064$ 2054 2997 3941 4884 37 $1,126$ $1,171$ $1,064$ 2054 2397 4070 5014 37 $1,126$ $1,171$ 2126 $1,277$ 2294 3277 4070 5014 33 $1,248$ $1,300$ $1,277$ 2294 3236 4181 5126 33 $1,248$ $1,300$ $1,277$ 2294 2334 4175 7126 33 $1,248$ $1,300$ $1,370$ 2162 3119 <td< th=""><th>0,5</th><th>49</th><th>0,587</th><th>0,628</th><th>0,669</th><th>0,710</th><th>0,751</th><th></th><th></th><th>2132</th><th>3136</th><th>4141</th><th>5145</th><th>6150</th><th></th><th></th><th></th></td<>	0,5	49	0,587	0,628	0,669	0,710	0,751			2132	3136	4141	5145	6150			
37 0.728 0.769 0.810 0.851 0.802 1813 2572 3330 4089 37 0.814 0.855 0.896 0.337 0.978 1924 2683 3441 4200 37 0.911 0.962 1.013 1.064 2054 2997 3941 4884 37 1.018 1.069 1.171 1.071 2183 3127 4070 5014 37 1.124 1.175 1.226 1.277 2294 2293 4181 5125 33 1.248 1.309 1.370 2112 3119 4125 5126	0,56	37	0,653	0,694	0,753	0,776	0,817			1721	2479	3571	3996	4755			
37 $0,814$ $0,855$ $0,806$ $0,937$ $0,978$ 1924 2683 3441 4200 37 $0,911$ $0,962$ $1,013$ $1,064$ 2054 2997 3941 4884 37 $1,018$ $1,069$ $1,120$ $1,171$ 2164 2397 4070 5014 37 $1,124$ $1,175$ $1,226$ $1,277$ 2294 3238 4181 5125 33 $1,248$ $1,309$ $1,370$ 2112 3119 4125 5126 5176 5126 5	0,63	37	0,728	0,769	0,810	0,851	0,892			1813	2572	3330	4089	4847			
37 $0,911$ $0,962$ $1,013$ $1,064$ 2064 2997 3941 37 $1,018$ $1,069$ $1,120$ $1,171$ 2183 3127 4070 3041 37 $1,124$ $1,175$ $1,226$ $1,277$ 2294 3238 4181 33 $1,248$ $1,309$ $1,370$ 2112 3119 4125 33 $1,248$ $1,309$ $1,370$ 2162 3168 4176 33 $1,536$ $1,657$ 2228 3234 4241 33 $1,740$ $1,801$ $1,862$ 2310 2317 4231	0,71	37	0,814	0,855	0,896	0,937	0,978			1924	2683	3441	4200	4958			
37 1,018 1,069 1,120 1,171 2183 3127 4070 37 1,124 1,175 1,226 1,277 2294 3238 4181 33 1,248 1,309 1,370 2112 3119 4125 33 1,248 1,309 1,370 2162 3168 4175 33 1,535 1,596 1,657 2228 3234 4241 33 1,536 1,596 1,657 2218 3234 4241 33 1,740 1,801 1,862 3317 4323 4323	0,8	37	0,911	0,962	1,013	1,064				2054	2997	3941	4884				
37 1,124 1,175 1,226 1,277 2294 3238 4181 33 1,248 1,300 1,370 1,370 4126 4126 33 1,248 1,300 1,370 2162 3119 4126 33 1,535 1,506 1,657 2228 3234 4241 33 1,535 1,506 1,657 2228 3234 4241 33 1,740 1,801 1,862 3317 4323	0'0	37	1,018	1,069	1,120	1,171				2183	3127	4070	5014				
33 1,248 1,309 1,370 2112 3119 33 1,381 1,442 1,503 2162 3168 33 1,535 1,596 1,657 2228 3234 33 1,540 1,801 1,862 2310 3317	Ŧ	37	1,124	1,175	1,226	1,277				2294	3238	4181	5125				
33 1,381 1,442 1,503 2162 3168 33 1,535 1,596 1,657 2228 3234 33 1,740 1,801 1,862 2317 2317	1,12	g	1,248	1,309	1,370					2112	3119	4125					
33 1,535 1,596 1,657 2228 3234 33 1,740 1,801 1,862 2310 3317	1,25	8	1,381	1,442	1,503					2162	3168	4175					
33 1,740 1,801 1,862 2310 3317	1,4	g	1,535	1,596	1,657					2228	3234	4241					
	1,6	R	1,740	1,801	1,862					2310	3317	4323					

The values of allowed voltage strength for other **FIW** dimensions than defined in Table 111 are calculated according following formula:

$$V = \frac{d_{\rm a} - d_{\rm cu}}{2} \times U \times 10^3$$

where

 d_a is the maximum overall diameter in (mm);

 d_{cu} is the nominal copper diameter in (mm);

U is the voltage value according to Table 7 of IEC 60317-0-7 (see column 2) in $(V/\mu m)$;

V is the allowed voltage strength for **FIW** wire in (V).

Higher voltage values, based on the "enamel increase" of Table 7 of IEC 60317-0-7:2012, are under consideration.

Annexes

Add, before the existing word "Addition", the following new text and new annex as follows:

Replacement of Annex K:

iTeh STANDARD PREVIEW (standards.iteh.ai)

IEC 61558-2-16:2009/AMD1:2013 https://standards.iteh.ai/catalog/standards/sist/27cc3470-a1fc-42e1-aaecac9a2299583f/iec-61558-2-16-2009-amd1-2013

Annex K

(normative)

Insulated winding wires

K.1 General

This annex specifies the winding wires of the insulation that may be used to provide **basic insulation**, **supplementary insulation**, **double insulation** or **reinforced insulation** in wound components. For details of the construction, see 19.12.3.

This annex applies to solid circular winding wires and stranded winding wires having diameters between 0,05 mm and 5,0 mm and solid square and solid rectangular (flatwise bending) winding wires with equivalent cross-sectional areas (0,002 to 19,6 mm²).

If the wire is insulated with two or more spirally wrapped layers of tape, the overlap of layers shall be adequate to ensure continued overlap during manufacture of the wound component. The layers of spirally wrapped wire insulation shall be sufficiently secured to maintain the amount of overlap.

K.2 Type tests iTeh STANDARD PREVIEW

K.2.1 General

(standards.iteh.ai)

The winding wire shall pass the following **type tests**, carried out at a temperature between 15 °C and 35 °C and a relative humidity between 25 % and 175 %, unless otherwise specified. https://standards.iteh.ai/catalog/standards/sist/27cc3470-a1fc-42e1-aaec-

K.2.2 Electric strength ac9a2299583fiec-61558-2-16-2009-amd1-2013

K.2.2.1 Solid circular winding wires and stranded winding wires

The test sample is prepared according to 4.4.1 of IEC 60851-5:2008 (twisted pair). The sample is then subjected to the electric strength test of 18.3 in this standard with a test voltage standard, with a minimum of:

- 6 kV r.ms. for **reinforced insulation**, or
- 3 kV r.m.s. for **basic insulation** or **supplementary insulation**.

K.2.2.2 Square or rectangular wires

The test sample is prepared according to 4.7.1 of IEC 60851-5:2008 (single conductor surrounded by metal shots). The sample is then subjected to the electric strength test of 18.3 of this standard, with a minimum test voltage of:

- 5,5 kV r.m.s. for **reinforced insulation**, or
- 2,75 kV r.m.s. for **basic insulation** or **supplementary insulation**.

K.2.3 Flexibility and adherence

5.1 (in Test 8) of IEC 60851-3:2009 shall be used, using the mandrel diameters of Table K.1. The test voltage is applied between the wire and the mandrel.

The test sample is then examined in accordance with 5.1.1.4 of IEC 60851-3:2009, followed by the electric strength test of 18.3 in this standard, with minimum test voltage of:

- 5,5 kV r.m.s. for reinforced insulation, or