TEST REPORT

IEC/EN 61558-2-16
Information technology equipment – Safety –
Part 1: General requirements

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Applicant's name.....:	FERMION INSTRUMENTS (SHANGHAI) CO., LTD.
Address .....:	No. 558 Fulian Er Road, Shanghai, 201906, China
Manufacturer's name .....:	FERMION INSTRUMENTS (SHANGHAI) CO., LTD.
Address .....:	No. 558 Fulian Er Road, Shanghai, 201906, China
Test specification:	
Standard .....:	IEC/EN 61558-1: 2019 IEC/EN 61558-2-1: 2007
Test procedure.....:	Compliance with IEC/EN 61558-1: 2019 IEC/EN 61558-2-1: 2007
Non-standard test method.....:	N/A
Test item description .....:	Mini Electron-beam Power Supply
Trade Mark .....:	FERMI
Model/Type reference .....:	XRS-2kV-300W-F5A-3U-S, XRS series power supply
Ratings .....:	Input: 180-264V~, 50/60Hz, 300W PF: 0.92 Output: Main high voltage: 2kV, 150mA Max Filament: 15V, 5A

General disclaimer:

This report is only for applicant use. Any copying this report to/for any other person or entity, and use our name or trademark, is permitted only with our prior written permission. This report sets forth our findings solely with respect to the test samples identified herein. The results set forth in this report are not indicative or representative of the quality or characteristics of the lot from which a test sample was taken or any similar or identical product unless specifically and expressly noted. Our report includes all of the tests requested by you and the results thereof based upon the information that you provided to us. Unless specific mention, the uncertainty of measurement has been explicitly taken into account to declare the compliance or non-compliance to the specification.

List of Attachments (including a total number of pages in each attachment):

Attachment 1: Photos (3 pages)

Summary of testing:

Tests performed (name of test and test clause):

1.Following tests performed during evaluation

Clause(s)	Test(s)
8.15	Durability of Marking Test
9.1	Protection Against Electric Shock
11	Output voltage and output current under load
12	No-load output voltage
14.1	Heating Test
15	Short Circuit and Overload Protection
16.2	Impact Test
16.4	Tumbling Barrel Test
17.1.1	IP20 test
17.2	Humidity Treatment
18.2	Insulation Resistance
18.3	Electric Strength Test
18.5	Touch Current Test
19.15	Torque test
22.9.5	Cord anchorage test
26	Working Voltage Measurement
26	Creepage Distance, Clearance and Distance Through Insulation
26.3	Mandrel test
27.1	Ball Pressure Test
27.3	Glow Wire Test
Annex H	Electronic circuit fault test

Note:

If not otherwise specified, tests were performed on model XRS-2kV-300W-F5A-3U-S to represent other similar models.

All models are same except their model name and physical color.

Testing location:

Shenzhen AOCE Electronic Technology Service Co., Ltd

Room 202, 2nd Floor, No.12th Building of Xinhe Tongfuyu Industrial Park, Fuhai Street, Baoan District, Shenzhen, Guangdong, China

Summary of compliance with National Differences:

☒ **The product fulfils the requirements of EN 61558-1:2009 and EN 61558-2-16:2009+A1:2013.**

Copy of marking plate:
The artwork below may be only a draft.

Mini Electron-beam Power Supply
XRS-2kV-300W-F5A-3U-S
Input: 180-264V~, 50/60Hz, 300W PF: 0.92
Output: Main high voltage: 2kV, 150mA Max
Filament: 15V, 5A

Manufacturer: FERMION INSTRUMENTS (SHANGHAI) CO., LTD.
Made in China

Note:
- The above markings are the minimum requirements required by the safety standard. For the final production samples, the additional markings which do not give rise to misunderstanding may be added.
- The model can be replaced by others model in this report.

Test item particulars .....:	
Classification of installation and use .....:	N/A
Supply Connection.....:	N/A
Type of transformer .....:	Safety isolating
Protection against electric shock.....:	Not classified
Short-circuit protection .....:	Yes
Inherently short-circuit proof .....:	No
Non-inherently short-circuit proof .....:	Yes
Non short-circuit proof .....:	No
Fail safe .....:	No
Protection index.....:	IPX0
Other characteristics .....:	Short time / Intermittent duty
Rated ambient temperature ta (°C) .....:	45°C
Short-circuit voltage (V) .....:	N/A
The length of the output cord.....:	--
Mass of equipment (kg) .....:	13.5 kg
Possible test case verdicts:	
- test case does not apply to the test object.....:	N (Not Applicable)
- test object does meet the requirement.....:	P (Pass)
- test object does not meet the requirement.....:	F (Fail)
Testing.....:	
Date of receipt of test item .....:	2025-05-19
Date (s) of performance of tests.....:	2025-05-19 to 2025-06-30
General remarks:	
"(See Enclosure #)" refers to additional information appended to the report. "(See appended table)" refers to a table appended to the report. **Throughout this report a ☐ comma / ☒ point is used as the decimal separator.**	
Name and address of factory (ies) .....:	FERMION INSTRUMENTS (SHANGHAI) CO., LTD. No. 558 Fulian Er Road, Shanghai, 201906, China
General product information:	
1. Instructions and equipment marking related to safety is applied in the language that is acceptable in the country in which the equipment is to be sold.	

EN 61558-2-16			
Clause	Requirement + Test	Result - Remark	Verdict
8	**MARKING AND OTHER INFORMATION**		P
8.1	Transformer marked with:		P
	a) rated supply voltage or voltage range (V) ..... :	See rating label	P
	b) rated output voltage (V) ..... :	See rating label	P
	c) rated output (VA, kVA or W) ..... :	See rating label	P
	d) rated output current (A) ..... :	See rating label	P
	e) rated frequency (Hz) ..... :	See rating label	P
	f) rated power factor (if not 1) ..... :	See rating label	P
	g) symbol AC for alternating current, or DC for direct current-output	See rating label	P
	h) symbol for electrical function (according to one or more part's 2) in addition with the symbol for SMPS (IEC 61558-2-16:2009+A1:2013)		N
	i) manufacturer's name or trademark or name of the responsible vendor		P
	j) model or type reference	See rating label	P
	k) vector group according to IEC 60076 for three-phase transformer		N
	l) symbol for Class II		N
	m) symbol for Class III		N
	n) index IPXX if other than IP00	IPX0	P
	o) rated max. ambient temperature ta (if not 25°C) ..... :	45°C	P
	p) rated minimum ambient temperature ta min, if <10° C and if a temperature sensitive device is used		N
	q) short-time duty cycle: operating time Intermittent duty cycle: operating and resting time (e.g. 5min/30min)		N
	r) for tw-marked transformers marked with the rated max. operating temperature, increased by multiples of 5 (e.g. tw 120; tw 125)		N
	s) transformers used with forced air cooling shall be marked with "AF" in m/s		N
	t) Information from the manufacturer to the purchaser (data sheet) :		P
	– short-circuit voltage (% rated supply voltage) for stationary transformers > 1000 VA		N
	– electrical function of the transformer		P

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Clause	Requirement + Test	Result - Remark	Verdict
8.2	Marking for transformers IP00 or for associated transformers: type and trademark, instruction sheets		N
8.3	Adjusted voltage easily and clearly discernible		N
8.4	For each tapping or winding: rated output voltage and rated output		N
	necessary connections clearly indicated		N
8.5	For short-circuit proof transformers or non-inherently short-circuit proof transformers:	Install in terminal consideration	N
	Rated current (A or mA) and symbol for time current characteristics of the fuses for non-inherently short-circuit proof transformer with incorporated fuses and non-short-circuit proof transformer ..... :		N
	Manufacturer's model or type reference and rating of the device for non-inherently short-circuit proof transformers with incorporated replaceable protective device (other than fuses)		N
	Construction sheet for transformers with replaceable protective device (other than fuses) information with information about the replacement.		N
8.6	Terminals for neutral: "N"		N
	Terminal for protective earth marked with earthing symbol		N
	Identification of input terminals: "PRI"		N
	Identification of output terminals: "SEC"		N
	Symbol for any point/terminal in connection with frame or core		N
8.7	Indication for correct connection	Evident from the design of the transformer	N
8.8	Instruction sheet for type X, Y, Z attachments	Attachment Z for output cord	P
8.9	Transformer for indoor use shall be marked with the relevant symbol.		P
8.10	Symbol for Class II construction not confused with maker's name or trademark.		P
	Class II transformer with parts to be mounted – delivered with all parts for class II after mounting.		N
	Symbol for class II transformer placed on the part which provides class II.		N
8.11	Correct symbols:		P
	Volts	V	P
	Amperes	A	P
	Volt amperes (or volt-amperes reactive for reactors)		N

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Clause	Requirement + Test	Result - Remark	Verdict
	Watts		N
	Hertz	Hz	P
	Input		P
	Output		P
	Direct current	⎓	N
	Neutral		N
	Single-phase a.c.	~	P
	Three-phase a.c.		N
	Three-phase and neutral a.c.		N
	Power factor		N
	Class II construction		N
	Class III construction		N
	Fuse-link		N
	Rated max. ambient temperature	45	N
	Frame or core terminal		N
	Protective earth		N
	IP number	IPX0	P
	Earth (ground for functional earth)		N
	For indoor use only		P
	tw5 YYY		N
	tw10 YYY		N
	twx YYY		N
	Additional Symbols (IEC 61558-2-16:2009+A1:2013)		P
	SMPS incorporating a **Fail-safe separating transformer**		N
	SMPS incorporating a **Non-short-circuit-proof separating transformer**		N
	SMPS incorporating a **Short-circuit-proof separating transformer** (inherently or non-inherently)		N
	SMPS incorporating a **Fail-safe isolating transformer**		N
	SMPS incorporating a **Non-short-circuit-proof isolating transformer**		N

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Clause	Requirement + Test	Result - Remark	Verdict
	SMPS incorporating a **Short-circuit-proof isolating transformer** (inherently or non-inherently)		N
	SMPS incorporating a **Fail-safe safety isolating transformer**		N
	SMPS incorporating a **Non-short-circuit-proof safety isolating transformer**		N
	SMPS incorporating a **Short-circuit-proof safety isolating transformer** (inherently or non-inherently)		N
	SMPS incorporating a Fail-safe **auto-transformer**		N
	SMPS incorporating a **Non-short-circuit proof auto-transformer**		N
	SMPS incorporating a **Short-circuit proof auto-transformer** (inherently or non-inherently)		N
	SMPS (Switch mode power supply unit)		N
8.12	Figures, letters or other visual means for different positions of regulating devices and switches		N
	OFF position indicated by figure 0		N
	Greater output, input etc. indicated by higher figure		N
8.13	Marking not on screws or other easily removable parts		P
	Marking clearly discernible (transformer ready for use)		P
	Marking for terminals clearly discernible if necessary after removal of the cover		N
	Marking for terminals: no confusion between input and output		N
	Marking for interchangeable protective devices positioned adjacent to the base		N
	Marking for interchangeable protective devices clearly discernible after removal of cover and protective device		N
8.14	Special information for installation (in the catalogue, data sheet, or instruction sheet) if necessary:		P
	For non-inherently short-circuit proof transformers with non-self-resetting or non-replaceable devices (weak-point, thermal link): The device cannot be reset or replaced		N

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Clause	Requirement + Test	Result - Remark	Verdict
	For transformers generating a protective earth conductor current of 10 mA (see also cl. 18.5.2): The installation shall be made according to the wiring rules.		N
	For associated- and IP00-transformers: At 10% over or under voltage in the supply voltage, the rated output of the transformer shall be selected accordingly.		N
	For stationary transformers exceeding 1000 VA: The short circuit voltage in % of the rated voltage		N
	For all transformers the electrical function: An information about the electrical function of the transformer (e.g. inherently short circuit proof safety isolating transformer)		P
	For associated- and IP00-transformers: The max. abnormal winding temperature		N
	For tw-transformers: The specific constant S is (e.g. S6 says S = 6000)		N
	For transformers with more than one output winding, not for series or parallel connection		N
	– an information in the instruction sheet: the transformer is not intended for series/parallel connection		N
	For IP00-transformers the test of 27.2 is not performed. The result may be affected by the enclosure in the final application.		N
8.15	Marking durable and easily legible		P

9	**PROTECTION AGAINST ELECTRIC SHOCK**		P
9.1	Protection against contact with hazardous live parts		P
9.1.1	A live part is not a hazardous live part if:		P
	– it is separated from the supply by double or reinforced insulation		P
	– the requirements of 9.1.1.1 or 9.1.1.2 are fulfilled		P
9.1.1.1	The touch voltage is ≤ 35 V(peak) a.c. or ≤ 60 Vd.c.	Max.15.11Vdc (output terminals)	P
9.1.1.2	If the touch voltage is > 35 V (peak)a.c. or > 60 V d.c., the following requirements shall be fulfilled:	Install in terminal consideration	N
	The touch current shall not exceed:		N
	– for a.c. 0,7 mA (peak)	Install in terminal consideration	N
	– for d.c. 2,0 mA (see Annex J)		N

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Clause	Requirement + Test	Result - Remark	Verdict
	In addition, when a capacitor is connected to live parts:		—
9.1.1.2.1	discharge: < 45 µC (between 60 V and 15 kV)		N
9.1.1.2.2	energy: ≤ 350 mJ (voltage >15 kV)		N
9.1.2	Transformers shall have an adequate protection against accessibility to hazardous live parts:		P
	The enclosure of class I and class II transformers gives an adequate protection against accentual contact with hazardous live parts.		P
	Class I transformers: accessible parts are separated from hazardous live parts by at least basic insulation.		N
	Class II transformers: no accessibility to basic insulation, or conductive parts separated from hazardous live parts by basic insulation.		P
	Hazardous live parts are not accessible after removal of detachable parts.		P
	Hazardous live parts are not accessible after removal of detachable parts except for:		N
	– lamps having caps larger B9 and E10		N
	– type D fuse holder		N
	Lacquers, enamel, paper, cotton, oxide film on metal parts not used for protection against accidental contact with hazardous live parts:		P
	Shafts, handles, operating levers, knops are not hazardous life parts.		N
	Compliance is checked by inspection and by relevant tests according to IEC 60 529		P
	Class II transformers and Class II parts of Class I construction are tested with the test pin (fig. 3)		P
	Hazardous live parts shall not be touchable by test finger (fig. 2)		P
	for Class II transformers: metal parts separated by basic insulation from hazardous live parts not touchable by test finger		N
	hazardous live parts shall not be touchable with the test pin		P
9.1.3	Accessibility of non-hazardous live parts		P
	Non-hazardous live parts of the output circuit may be accessible if they are isolated from the input circuit by double or reinforced insulation and if the following conditions are fulfilled:		P
	– The no load output voltage is ≤ 35 V peak a.c. or ≤ 60 V ripple free d.c., both poles are accessible	Max.15.11Vdc (output terminals)	P

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Clause	Requirement + Test	Result - Remark	Verdict
	– The no load output voltage is > 35 V peak a.c. or > 60 V ripple free d.c. and ≤ 250 V a.c., only one pole may be accessible		N
9.2	Transformers with primary supply plug: 1 s after the interruption of the supply the voltage between the pins do not exceed 35 V(peak) a.c. or 60 V ripple free d.c.		N
	Transformers without a primary supply plug: 5 s after the interruption of the supply the voltage between the input terminals do not exceed 35 V (peak) a.c. or 60 V ripple free d.c.		N
	The following tests are required :		N
	If the nominal capacitance is ≤ 0.1 µF – no test is conducted.		N
	– 10 times switch the supply source on and off, or use a special equipment for to switch off at the most unfavourable electrical angle		N
	If the measured voltage is > 60 V ripple free d.c., the discharge must be < 45 µC.		N
10	**CHANGE OF INPUT VOLTAGE SETTING**		P
	Voltage setting not possible to change without a tool		N
	Different rated supply voltages:		N
	– indication of voltage for which the transformer is set, is discernible on the transformer.		N
10.101	A wide range of the input (120 V a. c, to 240 V a.c voltage is allowed (IEC 61558-2-16:2009+A1:2013):		P
	– if the output voltages does not exceed the rated output voltage		P
	– if the no-load voltage does not exceed the limits of output voltage deviation		P
11	**OUTPUT VOLTAGE AND OUTPUT CURRENT UNDER LOAD**		P
11.1	Difference from rated value (without rectifier; with rectifier):		P
	a) inherently short-circuit proof transformers with one rated output voltage for output voltage: a.c. ≤ 10% ; d.c. ≤ 15%		N
	b) inherently short-circuit proof transformers with one more than 1 rated output voltage for highest output voltage: a.c. ≤ 10%; d.c. ≤ 15%		N
	c) idem for other output voltages: a.c. ≤ 15%; d.c. ≤ 20%		N

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Clause	Requirement + Test	Result - Remark	Verdict
	d) other transformers for output voltages: a.c. ≤ 5%; d.c. ≤ 10%	(see appended table)	P
12	**NO-LOAD OUTPUT VOLTAGE (see supplementary requirements in Part 2)**		P
	Remark: with rectifier measuring on both sides of the rectifier		N
12.101	The no load output voltage shall not exceed (IEC 61558-2-16:2009+A1:2013):		P
	– For SMPS incorporating separating or auto-transformers: 1000V a.c. or 1415 V ripple free d.c.		N
	– For SMPS including isolating transformers: 500 V a.c. or 708 V ripple-free d.c.		N
	– For SMPS including safety isolating transformers: 50 V a.c. or 120 V ripple-free d.c.		P
	For **independent transformers,** this output voltage limitation applies even when output windings, not for interconnection, are connected in series		N
12.202	The difference between output voltage at no load and the output voltage measured in clause 11 does not exceed the values of table 101 (IEC 61558-2-16:2009+A1:2013), Rated output (VA) Rated value %	(see appended table)	P
13	**SHORT-CIRCUIT VOLTAGE**		N
	Difference from marking for short-circuit voltage ≤ 20%		N
14	**HEATING**		P
14.1	General requirements		P
	No excessive temperature in normal use		P
	Room temperature: rated ambient temperature ta + 5°C	45°C	—
	Type X, Y, Z attachments: 1 pull (5 N) to the connection windings		P
	Upri (V): 1,1 times rated supply voltage loaded with rated impedance – for independent transformers		—
	Upri (V): 1,1 times rated supply voltage: with I sec (A), measured with rated impedance and 1,0 times of the rated supply voltage for others than independent transformers		—
	Type X, Y, Z attachments: 1 pull (5 N) to the connection windings		P

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Clause	Requirement + Test	Result - Remark	Verdict
	Max. temperature windings..... :	(see appended table)	P
	– Class A: ≤ 100°C		N
	– Class E: ≤ 115°C		N
	– Class B: ≤ 120°C		P
	– Class F: ≤ 140°C		N
	– Class H: ≤ 165°C		N
	– other classes		N
	Temperature of external enclosures of stationary transformers:		N
	– metal: ≤ 70°C		N
	– other material: ≤ 80°C		N
	Temperature of external enclosure of stationary transformer ≤ 85°C (not touchable with the IEC test finger)		N
	Temperature of external enclosures, handles, etc. of portable transformers:		P
	– continuously held parts of metal: ≤ 55°C		N
	– continuously held parts of other material: ≤ 75°C		N
	– not continuously held parts of metal: ≤ 60°C		N
	– not continuously held parts of other material: ≤ 80°C		P
	Temperature of terminals for external conductors ≤ 70°C		N
	Temperature of terminals of switches ≤ 70°C		N
	Temperature of internal and external wiring:		P
	– rubber: ≤ 65°C		N
	– PVC: ≤ 70°C		P
	Temperature of parts where safety can be affected:		N
	– rubber: ≤ 75°C		N
	– phenol-formaldehyde: ≤ 105°C		N
	– urea-formaldehyde: ≤ 85°C		N
	– impregnated paper and fabric: ≤ 85°C		N
	– impregnated wood: ≤ 85°C		N
	– PVC, polystyrene and similar thermoplastic material: ≤ 65°C		N
	– varnished cambric: ≤ 75°C		N
	Temperature rise of supports ≤ 85°C		P

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Clause	Requirement + Test	Result - Remark	Verdict
	Temperature of printed boards:		P
	– bonded with phenol-formaldehyde: ≤ 105°C		P
	– melamine-formaldehyde: ≤ 105°C		N
	– phenol-furfural: ≤ 105°C		N
	– polyester: ≤ 105°C		N
	– bonded with epoxy: ≤ 140°C		N
	Electric strength between input and output windings (18.3, 1 min); test voltage (V) ..... :	4200VAC, 1 min	P
14.101	Winding temperature measured by thermocouples at the surface of the winding(IEC 61558-2-16:2009+A1:2013)		P
	– if the internal frequencies is > 1kHz		P
	– the values of Table 1 for windings temperatures are reduced by 10°C		P
14.2	Application of 14.1 or 14.3 according to the insulation system		P
14.2.1	Class of isolating system (classified materials according to IEC 60 085 and IEC 60 216)	Class B	P
14.2.2	No classified material, or system but the measured temperature does not exceed the value of Class A		N
14.2.3	No classified material or system but the measured temperature exceeds the value for Class A, the live parts of the transformers are submitted to the test of 14.3		N
14.3	Accelerated ageing test for undeclared class of isolating system		N
	Cycling test (10 cycles):		N
	– measuring of the no-load input current (mA)		N
14.3.1	– heat run (temperature in table 2)		N
14.3.2	– vibration test: 30 min; amplitude 0,35 mm; frequency range: 10 Hz, 55 Hz, 10 Hz		N
14.3.3	– moisture treatment (48 h, 17.2)		N
14.3.4	Measurements and tests at the beginning and after each test:		N
	– deviation of the no-load input current, measured at the beginning of the test is ≤ 30%		N
	– insulation resistance acc. cl.18.1 and 18.2		N
	– electric strength, no breakdown (18.3); 2 min; test voltage 35% of specified value (table VI)		N

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Clause	Requirement + Test	Result - Remark	Verdict
	– Transformers (50 or 60 Hz version) are tested after the dielectric strength test as follows: under no load; duration: 5 min; Upri(V):1,2 times rated supply voltage; frequency (Hz): 2 times rated frequency		N

15	**SHORT-CIRCUIT AND OVERLOAD PROTECTION**		N
15.1	General		N
	Tests direct after 14.1 at the same ta and without changing position.		N
	Supply voltage between 0,9 times and 1,1 times of the rated supply voltage		—
	Transformer with rectifier tests of 15.2 and 15.3 at the input and the output terminals of the rectifier.		N
	Transformers with more than one output winding or tapping, all windings tested with normal load, the winding with the highest temperature is short circuited.		N
	Wining protected inherently (15.2)		N
	– Max. temperature of winding protected inherently (insulation class): ≤ 150 °C (A); ≤ 165 °C (E); ≤ 175 °C (B); ≤ 190 °C (F); ≤ 210 °C (H)		N
	Winding protected by protective device:		N
	– Test according 15.3.2 - 15.3.3 – 15.3.4: max. temperature of winding during the time required or the time T given in table 4 (a) (insulation class): ≤ 200 °C (A); ≤ 215 °C (E); ≤ 225 °C (B); ≤ 240 °C (F); ≤ 260 °C (H)		N
	– Test according 15.3.1: max. temperature of winding **during the first hour, peak value** (insulation class): ≤ 200 °C (A); ≤ 215 °C (E); ≤ 225 °C (B); ≤ 240 °C (F); ≤ 260 °C (H)		N
	– Test according 15.3.1: max. temperature of winding **after first hour, peak value** (insulation class): ≤ 175 °C (A); ≤ 190 °C (E); ≤ 200 °C (B); ≤ 215 °C (F); ≤ 235 °C (H)		N
	– Test according 15.3.1: max. temperature of winding **after first hour, arithmetic mean value** (insulation class): ≤ 150 °C (A); ≤ 165 °C (E); ≤ 175 °C (B); ≤ 190 °C (F); ≤ 210 °C (H)		N
	Max. temperature of external enclosures (accessible by test finger) ≤ 105°C		N
	Max. temperature of insulation of wiring (rubber and PVC) ≤ 85°C		N

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Clause	Requirement + Test	Result - Remark	Verdict
	Temperature rise of supports ≤105°C		N
15.2	For inherently short-circuit proof transformers and for transformers with rectifiers test by short circuit of the output winding at rated supply voltage x 1,1: temperature rises ≤ values in table 3		N
15.3	For non-inherently short-circuit proof transformers and for transformers with rectifiers: temperature rises ≤ values in table 3		N
15.3.1	Output terminals short-circuited: protection device operates, test at 0,9 … 1,1 of the rated supply voltage	1) short-circuit after 14.2 at hot condition, electronic circuit protected immediately 2) short-circuit at cold condition, electronic circuit protected immediately	N
15.3.2	If protected by a fuse accordance with either IEC 60 269-2 or IEC 60 269-3, or a technical equivalent fuse, the transformer is loaded as in table 4.		N
15.3.3	If protected by a fuse accordance with either IEC 60 127 or ISO 8820, or a technical equivalent fuse, the transformer is loaded with the current as specified for the longest pre arcing time. If protected by a miniature fuses in accordance to IEC 60127, 1,5 times of the rated fuse, until steady state condition (in addition)		N
15.3.4	If protected by a circuit-breaker according to IEC 60 898 the transformer is loaded with a current equal to 1,45 times the value of the circuit-breaker rated current		N
15.3.5	If other overload protection than a fuse (IEC 60 127) or a circuit-breaker (IEC 60 898) test with 0,95 times of operating current		N
	If an internal week point is used, the test must be repeated with two new samples. The two additional samples works similar to the first sample. Temperatures in the limit of table 3		N
15.4	For non-short-circuit proof transformers: temperature rises values in table 3, tests as indicated in 15.3		N
15.5	For fail-safe transformers:		N
15.5.1	Three additional new specimens are used		—
	– Upri (V): 1,1 times rated supply voltage ..... :		—
	– Isec (A): 1,5 times rated output current ..... :		—
	– time until steady-state conditions t1 (h) ..... :		—
	– time until failure t2 (h): ≤ t1; ≤ 5 h ..... :		N
15.5.2	During the test:		N

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Clause	Requirement + Test	Result - Remark	Verdict
	– no flames, molten material, etc.		N
	– temperature of enclosure ≤ 175°C		N
	– temperature of plywood support ≤125°C		N
	After the test:		N
	– electric strength (Cl. 18, 1 min, test voltage: 35% of specified value); no flashover or break down for primary-to-secondary only for safety isolating, isolating and separating transformer and for primary-to-body for all kinds of transformer		N
	– bare hazardous live parts not accessible by test finger through holes of enclosure		N
15.101	Electronic circuits of the SMPS fulfil the requirements of **Annex H of part 1**. After a fault: no electric shock, no fire hazard and no unintentional operation.	(Details see Annex H)	N
16	**MECHANICAL STRENGTH**		N
16.1	General	Install in terminal consideration	N
	After tests of 16.2, 16.3 and 16.4		N
	– no damage		N
	– hazardous live parts not accessible by test pin according to 9.2		N
	– no damage for insulating barriers		N
	– handles, levers, etc. have not moved on shafts		N
16.2	Transformers (stationary and portable s. 16.1)		N
	For stationary and portable transformers: 3 blows, impact energy 0,5 Nm		N
16.3	Portable transformers (except of plug in transformers)		N
	For portable transformers: 100 falls, 25 mm		N
16.4	Transformers with integrated pins (plug in transformers), the following tests are carried out:		N
	a) plug-in transformers: tumbling barrel test: 50 x ≤ 250 g; 25 x ≥ 250 g		N
	b) torque test of the plug pins with 0,4 Nm		N
	c) pull force according to table 5 for each pin		N
17	**PROTECTION AGAINST HARMFUL INGRESS OF WATER AND MOISTURE**		N

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Clause	Requirement + Test	Result - Remark	Verdict
17.1	Degree of protection (IP code marked on the transformer)		N
	Test according to 17.1.1 and for other IP ratings test according to IEC 60 529:		N
	– stable operating temperature before starting the test for < IPX8		N
	– transformer mounted and wired as in normal use		N
	– fixed transformer mounted as in normal use by the tests according to 17.1.1 A to L		N
	– portable transformers placed in the most unfavourable position and wired as in normal use		N
	– glands tightened with a torque equal to two-thirds of 25.6		N
	After the tests:		N
	– dielectric strength test according to 18.3		N
	Inspection:		N
	a) in dust-proof transformers no deposit of talcum powder		N
	b) no deposit of talcum powder inside dust-tight transformers		N
	c) no trace of water on live parts except SELV parts below 15 V ac or 25 V dc or insulation if hazard for the user or surroundings no reduction of creepage distances		N
	d) no accumulation of water in transformers ≥ IPX1 so as to impair safety		N
	e) no trace of water entered in any part of water-tight transformer		N
	f) no entry into the transformer by the relevant test probe		N
17.1.1	Tests on transformers with enclosure:		N
	A) Solid-object-proof transformers:		N
	– 2 IP2X test finger (IEC 60 529) and test pin (fig. 3)		N
	B) Solid-object-proof transformers:		N
	– wire 2,5 mm; force 3 N		N
	– IP4X, wire 1 mm; force 1 N		N
	C) Dust-proof transformers, IP5X; dust chamber according to IEC 60 529, fig. 2:		N
	a) transformer has operating temperature		N

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Clause	Requirement + Test	Result - Remark	Verdict
	b) transformer, still operating, is placed in the dust chamber		N
	c) the door of the dust chamber is closed		N
	d) fan/blower is switched on		N
	e) after 1 min transformer is switched off for cooling time of 3 h		N
	D) Dust-tight transformers (IP6X) test according to C)		N
	E) Drip-proof transformers (IPX1) test according to fig. 3 of IEC 60 529 for 10 min		N
	F) Rain-proof transformers (IPX2) test according to fig. 3 of IEC 60 529 for 10 min in operation, any angle up to 15°		N
	G) Spray proofed transformers (IPX3) test according to fig. 4 of IEC 60 529 for 10 min in operation and 10 min switched off , time for complete oscillation (2 x 120°) is 4 sec.		N
	H) Splash-proof transformers (IPX4) test according to fig. 4 of IEC 60 529 (see F) for 10 min in operation and 10 min switched off (the tube shall oscillate 2 x 360°)		N
	I) Jet-proof transformer (IPX5) test according to fig. 6 of IEC 60 529 (nozzle 6,3mm)		N
	J) Powerful Jet-proof transformer (IPX6) test according to fig. 6 of IEC 60 529 (nozzle 12 mm)		N
	K) Watertight transformers (IPX7)		N
	L) Pressure watertight transformers (IPX8)		N
17.2	After moisture test (48 h for ≤ IP20, 168 h for other transformers):		N
	– insulation resistance and electric strength (Cl. 18)		N

18	INSULATION RESISTANCE AND ELECTRIC STRENGTH		P
18.2	Insulation resistance between:		N
	– live parts and body for basic insulation ≥ 2 MΩ		N
	– live parts and body for reinforced insulation ≥ 7 MΩ		N
	– input circuits and output circuits for basic insulation ≥ 2 MΩ		N
	– input circuits and output circuits for double or reinforced insulation ≥ 5 MΩ		N
	– each input circuit and all other input circuits connected together ≥ 2 MΩ		N

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Clause	Requirement + Test	Result - Remark	Verdict
	– each output circuit and all other output circuits connected together ≥ 2 MΩ		N
	– hazardous live parts and metal parts with basic insulation (Class II transformers) ≥ 2 MΩ		N
	– body and metal parts with basic insulation (Class II transformers) ≥ 5 MΩ		N
	– metal foil in contact with inner and outer surfaces of enclosures ≥ 2 MΩ		P
18.3	Electric strength test (1 min): no flashover or breakdown:		P
	1) basic insulation between input circuits and output circuits; working voltage (V); test voltage (V) ……:		N
	2) double or reinforced insulation between input circuits and output circuits; working voltage (V); test voltage (V) .....:	(See appended table for details) Test voltage: 4200Va.c. (between pri. circuit and sec. circuit)	P
	3) basic or supplementary insulation between:		P
	a) live parts of different polarity; working voltage (V); test voltage (V) .....:	(See appended table for details)	P
	b) live parts and the body if intended to be connected to protective earth .....:		N
	c) inlet bushings and cord guards and anchorages .....:		N
	d) live parts and an intermediate conductive part .....:		N
	e) intermediate conductive parts and body .....:		N
	4) Reinforced insulation between the body and live parts; working voltage (V); test voltage (V) .....:	(See appended table for details) Test voltage: 4200Va.c. (between pri. circuit and enclosure)	P
	5) Functional insulation for windings intended to be connected in series or parallel (test voltage = working voltage + 500 V) (IEC 61558-2-16:2009+A1:2013)		N
18.4	Does not apply (IEC 61558-2-16:2009+A1:2013)		--
18.101	Impulse test according Table F5 of IEC 60664-1 with 1,2/50 µs (IEC 61558-2-16:2009+A1:2013)		P
	– After the test of 18.3, 10 impulses of each polarity between input and output terminals		P

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Clause	Requirement + Test	Result - Remark	Verdict
	– During the tests no breakdown of the insulation between turns of a winding, between input and output circuits, or between windings and any conductive core		P
18.102 (A1)	Partial discharge tests according to IEC 60664-1, if the working voltage is > 750 V peak		N
	Partial discharge is < 10 pC at time P2 See Fig. 19.101		N
18.5	Touch current and protective earth current		N
18.5.1	Touch current		N
	Touch current measured after the clause 14 test (hot) for class I and class II transformers (class II transformers with metal foil at the plastic surface). The test circuit according figure 8. Measuring network according Figure J1 (Annex J). If the frequency is >30kHz, measuring across the 500 Ohm resistor of J1 (burn effects).		N
	Measurement of the touch current with switch p of picture 8 in both positions and in combination with switches e and n. The measured values are less than the required values of table 8b.		N
	– switches n and e in on position		N
	– switch n: off and switch e: on		N
	– switch n: on and switch e: off		N
18.5.2	Protective earth conductor current		N
	The transformer is connected as in clause 14 Impedance of the ammeter < 0,5 Ohm, connected between earth terminal of the transformer and protective earth conductor		N
	The measured values are less than the required values of table 8b.		N

19	**CONSTRUCTION**		P
19.1	Separation of input and output circuits		P
19.1.1	SMPS incorporating auto-transformers (IEC 61558-2-16:2009+A1:2013)		N
19.1.1.1	For plug connected auto-transformers with rated input voltage > rated output voltage the potential to earth shall not exceed the rated output voltage. (IEC 61558-2-16:2009+A1:2013)		N

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Clause	Requirement + Test	Result - Remark	Verdict
19.1.1.2	SMPS with polarised input and output plug and socket-outlet system: an instruction is given with the information, that the transformer shall not be used with non-polarised plug and socket outlet system. (IEC 61558-2-16:2009+A1:2013)		N
19.1.1.3	A polarity detecting device only energises the output in the case: output potential to earth < rated output voltage, also with reversed input plug. (IEC 61558-2-16:2009+A1:2013)		N
	– The contact separation of the device is > 3mm		N
	– A current to earth does not exceed 0.75 mA.		N
	– All tests are repeated under fault conditions of H.2.3 of annex H of part 1. The potential to earth does not exceed the max output voltage for more than 5 s.		N
19.1.2	SMPS incorporating separating transformers (IEC 61558-2-16:2009+A1:2013)		N
19.1.2.1	Input and output circuits electrically separated. (IEC 61558-2-16:2009+A1:2013)		N
19.1.2.2	The insulation between input and output winding(s) consist of basic insulation (IEC 61558-2-16:2009+A1:2013)		N
	Class I SMPS		N
	– Insulation between input windings and body consist of basic insulation		N
	– Insulation between output windings and body consist of basic insulation		N
	Class II SMPS (IEC 61558-2-16:2009+A1:2013)		N
	– Insulation between input windings and body consist of double or reinforced insulation		N
	– Insulation between output windings and body consist of double or reinforced insulation		N
19.1.2.3	The insulation between input windings and intermediate conductive parts and the output windings and intermediate part consist of basic insulation (IEC 61558-2-16:2009+A1:2013)		N
	For class I SMPS the insulation between input and output windings via the intermediate conductive parts consist of basic insulation (IEC 61558-2-16:2009+A1:2013)		N
	For class II SMPS the insulation between input winding and the body and between the output windings and the body via the intermediate conductive parts consist of double or reinforced insulation. (IEC 61558-2-16:2009+A1:2013)		N

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Clause	Requirement + Test	Result - Remark	Verdict
19.1.2.4	Parts of output circuits may be connected to protective earth (IEC 61558-2-16:2009+A1:2013)		N
19.1.2.5	No direct contact between output circuits and the body, unless: (IEC 61558-2-16:2009+A1:2013)		N
	– Allowed for associated transformers by the equipment standard		N
	– Clause 19.8 of part 1 is fulfilled		N
19.1.3	SMPS incorporating isolating transformers and safety isolating transformers (IEC 61558-2-16:2009+A1:2013)		P
19.1.3.1	Input and output circuits electrically separated (IEC 61558-2-16:2009+A1:2013)		P
	No possibility of any connection between these circuits		P
19.1.3.2	The insulation between input and output winding(s) consist of double or reinforced insulation (exception see 19.1.3.4) (IEC 61558-2-16:2009+A1:2013)		P
	Class I SMPS **not** intended for connection to the mains by a plug:		—
	– Insulation between input windings and body connected to earth consist of basic insulation rated to the input voltage		N
	– Insulation between output windings and body, connected to earth consist of basic insulation rated for the output voltage		N
	Class I SMPS intended for connection to the mains by a plug (EN 61558-2-16:09):		N
	– Insulation between input windings and body connected to earth consist of basic insulation rated to the working voltage		N
	– Insulation between output windings and body, connected to earth consist of supplementary insulation rated for the working voltage		N
	Class II SMPS (IEC 61558-2-16:2009+A1:2013)		P
	– Insulation between input windings and body consist of double or reinforced insulation rated to the input voltage		P
	– Insulation between output windings and body consist of double or reinforced insulation, rated to the output voltage		N
19.1.3.3	SMPS with intermediate conductive parts not connected to the body (between input/output) (EN 61558-2-16:09):		N

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Clause	Requirement + Test	Result - Remark	Verdict
19.1.3.3.1	For class I and class II SMPS the insulation between input and output windings, via intermediate conductive parts, consist of double or reinforced insulation, rated to the working voltage (EN 61558-2-16:09).		P
	– For class II SMPS the insulation between input winding and the body and between the output windings and the body via the intermediate conductive parts consist of double or reinforced insulation. (rated to the input voltage, for SELV circuits only basic insulation to the body)		P
	– For transformers, different from independent, the insulation between input and output windings, via intermediate conductive parts, consist of double or reinforced insulation, rated to the working voltage.		P
19.1.3.3.2	Class I transformers with earthed core, and not allowed for class II equipment (EN 61558-2-16:09)		N
	– Insulation from the input to the earthed core: basic insulation rated for the input voltage		N
	– Insulation from the output voltage to the earthed core: basic insulation rated for the output voltage		N
19.1.3.3.3	Insulation between: input to intermediate conductive parts and output and intermediate parts consist of at least basic insulation (EN 61558-2-16:09)		P
	– If the insulation from input or output to the intermediate metal part is less than basic insulation, the part is considered to be connected to input or output.	The transformer core considered as primary circuit.	P
19.1.3.4	For class I SMPS, with protective screen, not connected to the mains by a plug the following conditions comply (EN 61558-2-16:09):		N
	– The insulation between input winding and protective screen consist of basic insulation (rated input voltage)		N
	– The insulation between output winding and protective screen consist of basic insulation (rated output voltage)		N
	– The protective screen consist of metal foil or a wire wound screen extending the full width of the windings and has no gaps or holes		N
	– Where the protective screen does not cover the entire width of the input winding, additional insulation to ensure double insulation in this area, is used.		N

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Clause	Requirement + Test	Result - Remark	Verdict
	– If the screen is made by a foil, the turns are isolated, overlap at least 3 mm		N
	– The cross-section of the screen and the lead out wire is at least corresponding to the rated current of the overload device		N
	– The lead out wire is soldered or fixed to the protective screen.		N
	Protective screening is not allowed for SMPS with plug connection to the mains (EN 61558-2-16:09)		N
19.1.3.5	No connection between output circuit and protective earth, except of associated transformers (allowed by equipment standard) or 19.8 is fulfilled (EN 61558-2-16:09).		N
19.1.3.6	No connection between output circuit and body, except of associated transformers (allowed by equipment standard) (EN 61558-2-16:09)		N
19.1.3.7	The distance between input and output terminals for the connection of external wiring is > 25 mm		P
19.1.3.8	Portable SMPS having an rated output < 630 VA (EN 61558-2-16:09)		P
19.1.3.9	No connection between output circuit and body except of associated transformers (allowed by equipment standard) (EN 61558-2-16:09)		P
19.1.3.10	Protective screening is not allowed for SMPS with plug connection to the mains (EN 61558-2-16:09)		P
19.2	Fiercely burning material not used	No such material	P
	Unimpregnated cotton, silk, paper and fibrous material not used as insulation		P
	Wax-impregnated, etc. not used		P
19.3	Portable transformer: short-circuit proof or fail-safe	Non-inherently short-circuit proof	P
19.4	Class II transformers: contact between accessible metal parts and conduits or metal sheaths of supply wiring impossible		N
19.5	Class II transformers: part of supplementary or reinforced insulation, during reassembly after routine servicing not omitted		P
19.6	Class I and II transformers: creepage distances and clearances over supplementary or reinforced insulation if wire, screw, nut, etc. become loose or fall out of position not < 50% specified values (Cl. 26)	Internal wire was double fixed by soldering and glue or hooking-in before soldering.	P

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Clause	Requirement + Test	Result - Remark	Verdict
19.7	Conductive parts connected to accessible metal parts by resistors or capacitors shall be separated from hazardous live parts by double or reinforced insulation		N
19.8	Resistors or capacitors connected between hazardous live parts and the body (accessible metal parts) consist of:		N
	– components according to IEC 60 065, 14.1 or capacitor Y1 according to IEC 60 384-14		N
	– at least two separate components		N
	– if one component is short-circuited or opened, values specified in Cl. 9 shall not be exceeded		N
	– if the working voltage is < 250 V, one Y1 capacitor according 60384-14 is allowed		N
19.9	Insulation material input/output and supplementary insulation of rubber resistant to ageing		N
	Creepage distances (if cracks) ≥ specified values (Cl. 26)		N
19.10	Protection against accidental contact by insulating coating:		N
	a) ageing test (section I, IEC 60 068-2-2), test Ba: 168 h; 70 ºC		N
	b) impact test (spring-operated impact hammer according to IEC 60 068-2-63; 0,5 ± 0,05 J)		N
	c) scratch test (hardened steel pin) electric strength test according to Cl. 18		N
19.11	Handles, levers, knobs, etc.:		N
	– insulating material		N
	– supplementary insulation covering		N
	– separated from shafts or fixing by supplementary insulation		N
19.12	Windings construction		P
19.12.1	Undue displacement in all types of transformers not allowed:		P
	– of input or output windings or turns thereof	Fixed by bobbin and insulating tape	P
	– of internal wiring or wires for external connection	Fixed by soldering	P
	– of parts of windings or of internal wiring in case of rupture or loosening	Fixed by bobbin and insulating tape	P
19.12.2	Serrated tape:		N
	– distance through insulation according to table 13		N

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Clause	Requirement + Test	Result - Remark	Verdict
	– one additional layer of serrated tape, and		N
	– one additional layer without serration		N
	– in case of cheekless bobbins the end turns of each layer shall be prevented from being displaced		N
19.12.3 (A1)	Insulated windings wires providing basic, supplementary or reinforced insulation, meet the following requirements:	Approved TIW used	P
	• Multi-layer extruded or spirally wrapped insulation, passed the tests of annex K		N
	• Basic insulation: two wrapped or one extruded wire		N
	• Supplementary insulation: two layers, wrapped or extruded		N
	• Reinforced insulation: three layers wrapped or extruded		P
	Spirally wrapped insulation:		N
	• creepage distances between wrapped layers > cl. 26 _ P1 values		N
	• path between wrapped layers sealed, the test voltage of K2 is multiplied with 1,35		N
	• test 26.2.3 – Test A, passed for wrapped layers		N
	• the finished component pass the electric strength test according to cl. 18.3		N
a)	Insulated winding wire used for basic or supplementary insulation in a wound part:		N
	• comply with annex K		N
	• two layers for supplementary insulation		N
	• one layer for basic insulation		N
	• one layer for mechanical separation between the insulated wires of primary and secondary. This layer fulfils the requirement of basic insulation.		N
b)	Insulated winding wire used for reinforced insulation in a wound part:	Approved TIW used	P
	• comply with annex K		P
	• three layers		P
	• relevant dielectric strength test of 18.3		P
	Where the insulated winding wire is wound:		P
	• upon metal or ferrite cores		N

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Clause	Requirement + Test	Result - Remark	Verdict
	• upon enamelled wire		P
	• under enamelled wire		P
	• one layer for mechanical separation between the insulated wires and the core or the enamelled wires is required. This layer fulfils the requirement of basic insulation.		P
	• both windings shall not touch each other and also not the core.		P
	100 % routine test of Annex K3 of part 1 is fulfilled		N
	no creepage distances and clearances for insulated winding wirers		N
	for TIW wires values of box 2) c) of table 13, table C.1 and table D.1 of part 1 and of clause 26.106 are not required		P
FIW	Transformers which use FIW wire		--
19.12.101 (A1)	Max. class F for transformers which use FIW-wire		N
19.12.102 (A1)	FIW wires comply with IEC 60851-5, Ed.4.1; IEC 60317-0-7 and IEC 60317-56, Ed.1.		N
	• other nominal diameter as mentioned in table 19.101 can be calculated with the formula after table 19.111		N
	FIW wire used for basic or supplementary insulation for transformers according 19.1.2 (separating-transformers) of IEC 61558-2-16:		–
	• the test voltage of table 8a – part 1, based on the working voltage of basic or supplementary insulation, comply with the min. voltage strength of table 19.111		N
	• one layer for mechanical separation is located between the insulated wires of primary and secondary. This layer fulfil the requirement of basic insulation		N
	• between FIW and enamelled wire, no requirements of creepage distances and clearances		N
	• no touch of FIW and enamelled wires (grad 1, or grad 2 …)		N
	FIW wire used for double or reinforced insulation for transformers according 19.1.3 (isolating and safety isolating transformers) of IEC 61558-2-16 (PRI and SEC basic insulated FIW-wire):		N

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Clause	Requirement + Test	Result - Remark	Verdict
	• the test voltage of table 8a – part 1, based on the working voltage of basic or supplementary insulation, comply with the min. voltage strength of table 19.111		N
	• for primary and secondary winding FIW-wire for basic insulation is used		N
	• one layer for mechanical separation is located between the insulated wires of primary and secondary. This layer fulfil the requirement of basic insulation		N
	• no touch between the basic insulated PRI and SEC FIW-wires		N
	• between PRI- and SEC-FIW wires, no requirements of creepage distances and clearances		N
	Alternative construction used for reinforced insulation (reinforced insulated FIW wire and enamelled wire)		N
	• the test voltage of table 8a – part 1, based on the working voltage reinforced insulation, comply with the min. voltage strength of table 19.111		N
	• one layer for mechanical separation is located between the reinforced insulated FIW wire and the enamelled wire. This layer fulfil the requirement of basic insulation		N
	• no touch between the FIW wire and the enamelled wire		N
	• between the reinforced FIW wire and any other parts, no requirements of creepage distances and clearances exist		N
	Alternative construction with FIW wires, basic or supplementary insulated for transformers with double or reinforced insulation according to 19.1.3 (basic/supplementary insulated FIW wire + enamelled wire + creepage distance and clearances for basic insulation)		–
	• the test voltage of table 8a – part 1, based on the working voltage of basic or supplementary insulation, comply with the min. voltage strength of table 19.111		N
	• PRI or SEC basic insulated FIW wire and to the other winding (enamelled wire) requirements of supplementary insulation		N

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Clause	Requirement + Test	Result - Remark	Verdict
	• creepage distances and clearances between the basic insulated FIW wire and the enamelled wire for basic or supplementary insulation are required.		N
	Where the FIW wire is wound		N
	• upon metal or ferrite cores		N
	• one layer for mechanical separation between the insulated wires and the core or the enamelled wires is required. This layer fulfils the requirement of basic insulation.		N
	• both windings shall not touch each other and also not the core.		N
19.13	Handles, operating levers and the like shall be fixed		N
19.14	Protection against electric shock: covers securely fixed, 2 independent fixing means, one with tool		N
19.15	Transformer with pins for fixed socket-outlets: no strain on socket-outlet		N
	Additional torque ≤ 0,25 Nm		N
19.16	Protection index for portable transformers:		N
	≤ 200 VA ≥ IP20 and instructions for use		N
	> 200 VA ≤ 2,5 kVA ≥ IPX4 (single-phase)		N
	> 200 VA ≤ 6,3 kVA ≥ IPX4 (polyphase)		N
	> 2,5 VA (single-phase) ≥ IP21		N
	> 6,3 VA (polyphase) ≥ IP21		N
19.17	Transformers IPX1 - IPX6 totally enclosed, except for drain hole (diameter ≥ 5 mm or 20 mm² with width ≥ 3 mm); drain hole not required for transformer completely filled with insulating materials		N
19.18	Transformers ≥ IPX1 with a moulded, if any		N
19.19	Class I transformers with a non-detachable flexible cable or cord with earth conductor and a plug with earth contact		N
19.20	Live parts of SELV and PELV-circuits: separation not less than PRI/SEC of a safety isolating transformer		P
	– SELV output circuits separated by double or reinforced insulation from all other than SELV or PELV circuits	SELV output is separated from primary circuit by reinforced insulation	P
	– SELV output circuits separated by basic insulation from other SELV or PELV circuits		N

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Clause	Requirement + Test	Result - Remark	Verdict
19.20.1	SELV circuits and parts not connected to protective earth, to live parts, or protective conductors forming part of other circuits		P
	Nominal voltage (V) > 25 V a.c. or 60 V d.c., the required insulation fulfils the high voltage test according to table 8 a		N
19.20.2	PELV-circuits double or reinforced insulation is necessary		N
19.21	FELV-circuits: protection against contact fulfils the min. test voltage required for the primary circuit		N
19.22	Class II transformers shall not be provided with means for protective earth		P
	For fixed transformers an earth conductor with double or reinforced insulation to accessible metal parts is allowed		N
19.23	Class III transformers shall not be provided with means for protective earth		N

20	**COMPONENTS**		P
	Components such as switches, plugs, fuses, lamp holders, flexible cables and cords, comply with relevant IEC standard	(see appended table)	P
	Components inside the transformer pass all tests of this standard together with the transformer tests	(see appended table)	P
	Testing of components separately to the transformer according the relevant standard:	(see appended table)	P
	– Ratings of the component in line with the transformer ratings, including inrush current. Component test according the component standard, based on the component marking (rating).		P
	– Components without markings tested under transformer conditions including inrush current.		P
	– If no IEC standard exists, the component is tested under transformer conditions.		P
20.1	Appliance couplers for main supply shall comply with:		N
	– IEC 60 320 for IPX0		N
	– IEC 60 309 for other		N
20.2	Automatic controls shall comply with IEC 60 730-1		N
20.3	Thermal-links comply with IEC 60691		N
20.4	Switches shall comply with annex F		N
	Disconnection from the supply:		N

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Clause	Requirement + Test	Result - Remark	Verdict
	– by a switch, disconnecting all poles of the supply (full disconnection under the relevant overvoltage category		N
	– or a flexible supply cable and cord with plug		N
	– or an instruction sheet: disconnection by all-poles switches incorporated in fixed wiring		N
20.5	Socket-outlets of the output circuit shall be such that there is no unsafe compatibility to plugs complying with input circuit.		P
	Plugs and socket-outlets for SELV systems with both a rated current = 3A and a rated voltage =24 Va.c.or 60V d.c. shall comply with following:		P
	SELV plug and socket-outlets shall comply with IEC 60 884-2-4 and IEC 60 906-3		N
	– It is not possible for plugs to enter socket-outlets of other standardised voltage system		N
	– Socket outlets do not accommodate plugs of other standardised voltage systems		N
	– Socket outlets do not have a protective earth contact		N
	PELV plug and socket-outlets shall comply with following:		N
	– It is not possible for plugs to enter socket-outlets of other standardised voltage system		N
	– Socket outlets do not accommodate plugs of other standardised voltage systems		N
	– Socket outlets do not have a protective earth contact		N
	FELV plug and socket-outlets shall comply with following:		N
	– It is not possible for plugs to enter socket-outlets of other standardised voltage system		N
	– Socket outlets do not accommodate plugs of other standardised voltage systems		N
20.6	Thermal cut-outs, overload releases etc. have adequate breaking capacity		P
	– Thermal cut outs fulfil the relevant requirements of 20.7 and 20.8		N
	– Thermal links fulfil the relevant requirements of 20.8		N
	– The breaking capacity is in accordance with the relevant fuse standard		N

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Clause	Requirement + Test	Result - Remark	Verdict
20.6.1	For Fuses According IEC 60127 and IEC 60269, the fuse current does not exceed 1,1 times of the rated value		P
20.7	Thermal cut outs shall meet the requirements of 20.7.1.1 and 20.7.2, or 20.7.1.2 and 20.7.2.		N
20.7.1	Requirements according to IEC 60730-1		N
20.7.1.1	Thermal cut-out tested as component shall comply with IEC 60 730-1		N
	Thermal cut-out tested as a part of the transformer		N
	a) Thermal cut outs type 1 or type 2 (IEC 60730-1)		N
	b) Thermal cut outs fulfil the requirements of micro-interruption (type 1C or 2 C) or micro-disconnection, (type 1B or 2B) (see IEC 60730-1)		N
	c) Thermal cut outs with manual rest have a trip free mechanism (type 1E and 2E) (see IEC 60730-1)		N
	d) The number of cycles of automatic action shall be:		N
	– 3000 cycles for self-resetting thermal cut-outs		N
	– 300 cycles for non-self-resetting thermal cut-outs resetting by hand		N
	– 300 cycles for non-self-resetting thermal cut-outs resetting disconnecting		N
	– 30 cycles for non-self-resetting thermal cut-outs which are only resettable by a tool		N
	e) Thermal cut outs fulfil the electrical stress according IEC 60730-1, 6.14.2		N
	f) Characteristic of thermal cut-outs:		N
	– ratings according IEC 60730-1, cl. 5		N
	– classification according to:		N
	1) nature of supply to IEC 60730-1, cl. 6.1		N
	2) type of load controlled to IEC 60730-1, cl. 6.2		N
	3) degree of protection IPX0 to IEC 60730-1, cl. 6.5.1		N
	4) degree of protection IP0X to IEC 60730-1, cl. 6.5.2		N
	5) pollution degree to IEC 60730-1, cl. 6.5.3		N
	6) comparative tracking index to IEC 60730-1, cl. 6.13		N

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Clause	Requirement + Test	Result - Remark	Verdict
	7) max. ambient temperature to IEC 60730-1, cl. 6.7		N
20.7.1.2	Thermal cut-out tested as a part of the transformer, test with 3 samples:		N
	– at least micro-interruption or micro-disconnection (IEC 60730-1)		N
	– 300 h aged at ta (transformer) + 10°C		N
	– subjected to a number of cycles for automatic operating according 20.7.1.1		N
	During the test no sustaining arcing shall occur, during and after the test no damage at the thermal cut out and the transformer in the sense of this standard		N
20.7.2	Thermal cut-outs shall have adequate breaking capacity		--
20.7.2.1	The output of the transformer with a non-self-resetting thermal cut out is short circuited at a supply voltage 1, 1 of rated supply voltage. After opening of the cut off, the supply voltage is switched of, until the transformer is cooling down.		N
	– 3 cycles at 25° C for transformers without ta min		N
	– 3 cycles at ta min for transformers with ta min		N
	– after the 3 cycles short circuit of the output at 1,1 of rated supply voltage for 48 h.		N
	During the tests no sustaining arcing shall occur After the test: withstand the test of clause 18, show no damage in sense of this standard, and be operational.		N
20.7.2.2	The output of the transformer with a self-resetting thermal cut out is short circuited at a supply voltage 1, 1 of rated supply voltage.		N
	– 48 h at 25° C for transformers without ta min		N
	– 24 h at ta and 24 h at ta min for transformers with ta min		N
	During the tests no sustaining arcing shall occur After the test: withstand the test of clause 18, show no damage in sense of this standard, and be operational.		N
20.7.3	Test of a PTC resistor:		-
	5 cycles: transformer short-circuited for 48 h by 1,1 times of the input voltage and max. ta		N
	5 cycles: transformer short-circuited for 48 h by 0,9 times of the input voltage and min. ta (if declared)		N

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Clause	Requirement + Test	Result - Remark	Verdict
	After the test: withstand the test of clause 18, show no damage in sense of this standard, and be operational.		N
20.8	Thermal links shall be tested in one of the following two ways.		--
20.8.1	Thermal-links shall comply with IEC 60 691 as a separate component.		N
	– electrical conditions to IEC 60691, cl. 6.1		N
	– thermal conditions to IEC 60691, cl. 6.2		N
	– ratings to IEC 60691, cl. 8 b		N
	– suitability of sealing components, impregnating fluids or cleaning solvents IEC 60691, cl. 8 c		N
20.8.2	Thermal-links tested as a part of the transformer:		N
	– ageing test 300 h by 35°C or ta + 10°C		N
	– After transformer fault condition the thermal link operate without sustaining arcing		N
	– after opening the thermal-link shall have an insulation resistance of at least 0,2 MΩ		N
	– 3 cycles for replaceable thermal-links		N
	– 3 new specimens for not replaceable thermal-links		N
20.9	Self-resetting devices not used if mechanical, electrical, etc. hazards		N
20.10	Thermal cut-outs which can be reset by soldering operation are not allowed		N
20.11	Overload protection devices do not operate during test (20 times switched on and off, at no load); Upri (V): 1,1 times rated supply voltage.		N

21	**INTERNAL WIRING**		P
21.1	Internal wiring and electrical connections protected or enclosed	The internal wires were double fixed by soldering and glue	P
	Wire-ways smooth and free from sharp edges		P
21.2	Openings in sheet metal: edges rounded (radius ≥ 1,5 mm) or bushings of insulating material		N
21.3	Bare conductors: distances adequately maintained		P
21.4	When external wires are connected to terminal, internal wiring shall not work loose		P
21.5	Insulation of heat-resistant and non-hygroscopic material for insulated conductors subject to temperature rise > limiting values given in 14.1		P

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Clause	Requirement + Test	Result - Remark	Verdict
22	**SUPPLY CONNECTION AND EXTERNAL FLEXIBLE CABLES AND CORDS**		P
22.1	All cables, flexible cords etc. shall have appropriate current and voltage ratings		P
22.2	Input and output wiring inlet and outlet openings for external wiring: separate entries without damage to protective covering of cable or cord		P
	Input and output wiring inlet and outlet openings for flexible cables or cords: insulating material or bushing of insulating material		P
	Bushings for external wiring: reliably fixed, not of rubber unless part of cord guard		P
22.3	Fixed transformer:		N
	– possible to connect after fixing		N
	– inside space for wires allow easy introduction and connection of conductors		N
	– fitting of cover without damage to conductors		N
	– contact between insulation of external supply wires and live parts of different polarity not allowed		N
22.4	Length of power supply cord for portable transformers between 2 m and 4 m; without 0,5 mm^2		N
22.5	Power supply cords for transformers IPX0 and transformers “for indoor use only” > IPX0:		N
	– for transformers with a mass < 3 kg: 60227 IEC52 (H03VV-..) (60245 IEC 53)		N
	– for transformers with a mass > 3 kg: 60227 IEC53 (H05VV-..) or 60245 IEC 53		N
	Power supply cords for transformers for outdoor use: > IPX0: 60245 IEC57 (H05RN-..)		N
22.6	Power supply cords for single-phase portable transformers with input current ≤ 16A:		N
	– cord set fitted with an appliance coupler in accordance with IEC 60320		N
22.7	Nominal cross-sectional area (mm^2); input current (A) at rated output not less than shown in table 9	Output cord min. 20AWG	P
22.8	Class I transformer with power supply flexible cable: green/yellow core connected to earth terminal		N
	Plug for single-phase transformer with input current at rated output ≤ 16 A according to IEC 60 083, IEC 60 906-1 or IEC 60 309		N
22.9	Type X, Y or Z attachments: see relevant part 2	Type Z attachment for output cord	P

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Clause	Requirement + Test	Result - Remark	Verdict
22.9.1	For type Z attachment: moulding enclosure and power supply cable do not affect insulation of cable		P
22.9.2	Inlet openings or inlet bushing: without risk of damage to protective covering of power supply cord		P
	Insulation between conductor and enclosure:		N
	– for Class I transformer: insulation of conductor plus separate basic insulation		N
	– for Class II transformer: insulation of conductor plus double or reinforced insulation		P
22.9.3	Inlet bushings:		N
	– no damage to power supply cord		N
	– reliably fixed		N
	– not removable without tool		N
	– not integral with power supply cord (for type X attachment)		N
	– not of natural rubber except for Class I transformer with type X, Y and Z attachments		N
22.9.4	For portable transformers which are moved while operating:	Nor moved while operating	N
	– cord guards, if any, of insulating material and fixed		N
	Compliance is tested by the oscillating test according to fig. 7:		N
	– loaded force during the test according to fig. 7		N
	– 10 N for a cross-sectional area > 0,75 mm²		N
	– 5 N for a cross-sectional area ≤ 0,75 mm²		N
	After the test according to fig. 7:		N
	– no short-circuit between the conductors		N
	– no breakage of more than 10% of stands of any conductor		N
	– no separation of the conductor from the terminal		N
	– no loosening of any cord guards		N
	– no damage of the cord or cord guard		N
	– no broken strands piercing the insulation and not becoming accessible		N
22.9.5	Cord anchorages for type X attachment:		N
	– glands in portable transformers not used unless possibility for clamping all types and sizes of cable		N
	– moulded-on designs, tying the cable into a knot and tying the end with string not allowed		N

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Clause	Requirement + Test	Result - Remark	Verdict
	– labyrinths, if clearly how, permitted		N
	– replacement of cable easily possible		N
	– protection against strain and twisting clearly how		N
	– suitable for different types of cable unless only one type of cable for transformer		N
	– the entire flexible cable or cord with covering can be mounted into the cord anchorage		N
	– if tightened or loosened no damage		N
	– no contact between cable or cord and accessible or electrically connected clamping screws		N
	– cord clamped by metal screw not allowed		N
	– one part securely fixed to transformer		N
	– for Class I transformer: insulating material or insulated from metal parts		N
	– for Class II transformers: insulating material or supplementary insulation from metal parts		N
	Cord anchorages for type X, Y, Z attachments: cores of power external flexible cable or cord insulated from accessible metal parts by:		N
	– basic insulation (Class I transformers), separate insulating barrier/cord anchorage		N
	– supplementary insulation (Class II transformers), special lining/cable or cord sheath of cable sheath of cable		N
	Cord anchorages for type X and Y attachments:		N
	– replacement of external flexible cable or cord does not impair compliance with standard		N
	– the entire flexible cable or cord with covering can be mounted into the cord anchorage		N
	– if tightened or loosened no damage		N
	– no contact between cable or cord and accessible or electrically connected clamping screws		N
	– cord clamped by metal screws not allowed		N
	– knots in cord not used		N
	– labyrinths, if clearly how, permitted		N
	Tests for type X with special cords, type Y, type Z	Type Z attachment for output cord	P

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Clause	Requirement + Test	Result - Remark	Verdict
	Test for type X attachments one test with a cord with smallest and one test with a cord with the largest cross-sectional area:		N
	– for the test with clamping screws or tightened with torque 2/3 of that specified in table 11		N
	– not possible to push cable into transformer		N
	– 25 pulls of 1 s		N
	– 1 min torque according to table 10		N
	– mass (kg); pull (N); torque (Nm) ..... :		—
	– during test: cable not damaged		N
	– after test: longitudinal displacement ≤ 2 mm for cable or cord and ≤ 1 mm for conductors in terminals	0.35 mm for output cord	N
	– creepage distances and clearances ≥ values specified in Cl. 26		N
22.9.6	Space for external cords or cable for fixed wiring and for type X and Y attachments:		N
	– before fitting cover, possibility to check correct connection and position of conductors		N
	– cover fitted without damage to supply cords		N
	– for portable transformers: contact with accessible metal parts if conductor becomes loose not allowed unless for type X and Y attachments terminations of cords do not slip free of conductor		N
	Space for external cords or cable for type X attachment and for connection to fixed wiring, in addition:		N
	– conductor easily introduced and connected		N
	– possibility of access to terminal for external conductor after removal of covers without special purpose tool		N

23	**TERMINALS FOR EXTERNAL CONDUCTORS**		P
23.1	Transformer for connection to fixed wiring and transformer without power supply cords with type Y and Z attachments: only connections by screws, nuts, terminals	No such terminals used	N
	Terminals are integral part of the transformer:		N
	– comply with IEC 60 999-1 under transformer conditions		N
	Other terminals:		N

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Clause	Requirement + Test	Result - Remark	Verdict
	– separately checked according to IEC 60 998-2-1, IEC 60 998-2-2 or IEC 60 947-7-1		N
	– used in accordance with their marking		N
	– checked according to IEC 60 999-1 under transformer conditions		N
	Transformer with type X attachments: soldered connection permitted if reliance not placed upon soldering, crimping or welding alone unless by barriers, creepage distances and clearances between hazardous live parts and metal parts should conductor break away ≥ 50% of specified value (Cl. 26)		N
	Transformer with type Y and Z attachments for external conductors: soldered, welded, crimped, etc. connections allowed		N
	For Class II transformer: reliance not placed upon soldering, crimping or welding alone unless by barriers, creepage distances and clearances between hazardous live parts and metal parts should conductor break away ≥ 50% of specified value (Cl. 26)		N
23.2	Terminals for type X with special cords Y and Z attachments shall be suitable for their purpose:		P
	– test by inspection according to 23.1 and 23.2		P
	– pull of 5 N to the connection before test according to 14.1		P
23.3	Other terminals than Y and Z attachments shall be so fixed that when the clamping means is tightened or loosened:		N
	– terminal does not work loose		N
	– internal wiring is not subjected to stress		N
	– creepage distances and clearance are not reduced below the values specified in Cl. 26		N
23.4	Other terminals than Y and Z attachments shall be so designed that:		N
	– they clamp the conductor between metallic surfaces with sufficient contact pressure		N
	– without damage to the conductor		N
	– test by inspection according to 23.3 and 23.4		N
	– 10 times fastening and loosening a conductor with the largest cross-sectional area with 2/3 of the torque specified in Cl. 25		N

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Clause	Requirement + Test	Result - Remark	Verdict
23.5	Terminals for fixed wiring and for type X: located near their associated terminals of different polarities and the earth terminal if any		N
23.6	Terminal blocks not accessible without the aid of a tool		N
23.7	Transformer with type X attachments: stranded conductor test (8 mm removed):		N
	– Class I transformers: no connection between live parts and accessible metal parts		N
	– free wire of earth terminal: no touching of live parts		N
	– Class II transformers: no connection between live parts and accessible metal parts, no connection between live parts and metal parts separated from accessible metal parts by supplementary insulation		N
23.8	Terminals for a current > 25 A:		N
	– pressure plate, or		N
	– two clamping screws		N
23.9	When terminal, other than protective earth conductor, screws loosened as far as possible, no contact:		N
	– between terminal screws and accessible metal parts		N
	– between terminal screws and inaccessible metal parts for Class II transformers		N
24	**PROVISION FOR PROTECTIVE EARTHING**		P
24.1	Class I transformers: accessible conductive parts connected to earth terminal	Class II transformer	N
	Class II transformers: no provision for earth		P
24.2	Protective earth terminal for connection to fixed wiring and for type X attachment transformers: comply with Cl. 23, adequately locked, not possible to loosen without a tool		N
24.3	No risk of corrosion from contact between metal of earth terminal and other terminal		N
	In case of earth terminal body of Al, no risk of corrosion from contact between Cu and Al		N
	Body of earth terminal or screws/nuts of brass or other metal resistant to corrosion		N
24.4	Resistance of connection between earth terminal and metal parts ≤ 0,1Ω with a min. 25 A or 1,5 rated input current at 1 min		N

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Clause	Requirement + Test	Result - Remark	Verdict
24.5	Class I transformers with external flexible cables or cords:		N
	– current-carrying conductors becoming touch before the earth conductor		N
25	**SCREWS AND CONNECTIONS**		N
25.1	Screwed connections withstand mechanical stresses	No such screw used	N
	Screws transmitting contact pressure or likely to be tightened by the user or having a diameter < 2,8 mm, shall screw into metal		N
	Screws not of metal which is soft or liable to creep (Zn, Al)		N
	Screws of insulating material: not used for electrical connection		N
	Screws not of insulating material if their replacement by metal screws can impair supplementary or reinforced insulation		N
	Screws to be removed (replacement etc. of power supply cord) not of insulating material if their re-placement by metal screws can impair basic insulation		N
	No damage after torque test: diameter (mm); torque (Nm); ten times		N
	No damage after torque test: diameter (mm); torque (Nm); five times		N
25.2	Screws in engagement with thread of insulating material:		N
	– length of engagement ≥ 3 mm + ½ screw diameter or 8 mm		N
	– correct introduction into screw hole		N
25.3	Electrical connections: contact pressure not transmitted through insulating material		N
25.4	In case of use of thread-forming (sheet metal) screws for connection of current-carrying parts: clamping and locking means provided		N
	Thread-cutting (self-tapping) screws used for the connection of current-carrying parts allowed if they generate a full form machine screw thread and if not operated by the user		N
	Thread-cutting screws and thread-forming screws used for earth continuity allowed if at least 2 screws for each connection are used and it is not necessary to disturb the connection in normal use		N

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Clause	Requirement + Test	Result - Remark	Verdict
25.5	Screws for current-carrying mechanical connections locked against loosening		N
	Rivets for current-carrying connections subject to torsion locked against loosening		N
25.6	Test of screwed glands with a torque according table 12. After the test no damage at the transformer and the gland.		N

26	**CREEPAGE DISTANCES AND CLEARANCES**		P
26.1	See 26.101		P
26.2	Creepage distances (cr) and clearances (cr)		P
26.2.1	Windings covered with adhesive tape		N
	– the values of pollution degree 1 are fulfilled		N
	– all isolating material are classified acc. To IEC 60085 and IEC 60216		N
	– test A of 26.2.3 is fulfilled		N
26.2.2	Uncemented insulating parts pollution degree P2 or P3		N
	– all isolating material are classified acc. To IEC 60085 and IEC 60216		N
	– values of pollution degree 1 are not applicable		N
26.2.3	Cemented insulating parts		N
	– all isolating materials are classified acc. To IEC 60085 and IEC 60216		N
	– values of distance through insulation (dti) are fulfilled		N
	– creepage distances and clearances are not required		N
	– test A of this sub clause is fulfilled		N
	Test A		N
	– thermal class		N
	– working voltage		N
	– Test with three specially specimens, with uninsulated wires, without impregnation or potting	(see appended table)	N
	Two of the three specimens are subjected to:		N
	– the relevant humidity treatment according to 17.2 (48 h)		N
	– the relevant dielectric strength test of 18.3 multiplied with factor 1,35		N

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Clause	Requirement + Test	Result - Remark	Verdict
	– One of the three specimens is subjected to the relevant dielectric strength test of 18.3 multiplied by the factor 1,35 immediately at the end of the last cycle with high temperature		N
	Impulse dielectric test according to 4.1.1.2.1 of IEC 60 664-1 (1,2 / 50 s waveform) – see Annex R of IEC 61558-1		N
26.2.4	Enclosed parts, by impregnation or potting		N
26.2.4.1	– The requirements of reduced values as stated for pollution degree 1 (P1) are fulfilled		N
	– all isolating materials are classified acc. To IEC 60085 and IEC 60216		N
	Test B		N
	– thermal class		N
	– working voltage		N
	– Test with three specially specimens, potted or impregnated. The dielectric strength test is applied directly to the joint.	(see appended table)	N
	Two of the three specimens are subjected to:		N
	– the relevant humidity treatment according to 17.2 (48 h)		N
	– the relevant dielectric strength test of 18.3 multiplied with factor 1,25		N
	– One of the three specimens is subjected to the relevant dielectric strength test of 18.3 multiplied by the factor 1,25 immediately at the end of the last cycle with high temperature		N
	The three spacemen pass the Impulse dielectric test according to 4.1.1.2.1 of IEC 60 664-1 (1,2 / 50 s waveform) – see Annex R of IEC 61558-1		N
26.2.4.2	– The requirements of distance through insulation (dti) are fulfilled. (P1 values are not required)		N
	– all isolating materials are classified acc. To IEC 60085 and IEC 60216		N
	Test C		N
	– thermal class		N
	– working voltage		N
	– Test with three specimens, potted or impregnated. (finished components)	(see appended table)	N
	– Neither cracks, nor voids in the insulating compounds		N

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Clause	Requirement + Test	Result - Remark	Verdict
	Two of the three specimens are subjected to:		N
	– the relevant humidity treatment according to 17.2 (48 h)		N
	– the relevant dielectric strength test of 18.3 multiplied with factor 1,35		N
	– One of the three specimens is subjected to the relevant dielectric strength test of 18.3 multiplied by the factor 1,35 immediately at the end of the last cycle with high temperature		N
	The three spacemen pass the Impulse dielectric test according to 4.1.1.2.1 of IEC 60 664-1 (1,2 / 50 s waveform) – see Annex R of IEC 61558-1		N
26.3	Distance through insulation		P
	For double or reinforced insulation, the required values of Tables 13, C1, and D1 – boxes 2b, 2c and 7 are fulfilled		P
	The insulation fulfil the material classification according IEC 60085 or 60216 or the test of 14.3	Approved insulation material used	P
26.3.1	Reduced values of the thickness of insulation for supplementary or reinforced insulation are allowed if the following conditions are fulfilled:		N
	– the isolating materials are classified acc. To IEC 60085 and IEC 60216		N
	– the test of 14.3 is fulfilled		N
	– If both requirements are fulfilled, the required values for solid insulation can be multiplied by 0,4		N
	– Minimum thickness of reinforced insulation >0,2 mm		N
	– Minimum thickness of supplementary insulation >0,1 mm		N
26.3.2	Insulation in thin sheet form		P
	– If the layers are non-separable (glued together):		N
	– The requirement of 3 layers is fulfilled		N
	– The mandrel test according 26.3.3 is fulfilled with 150 N		N
	– The required values for d.t.i. of Tables 13, C.1 and D.1 – marked by index “e” is fulfilled.		N
	– If the layers are separated:		N
	– The requirement of 2 layers is fulfilled		N

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Clause	Requirement + Test	Result - Remark	Verdict
	– If serrated tape is used, 1 additional layer (serrated) and one additional layer without serration is required		N
	– The mandrel test according 26.3.3 is fulfilled on each layer with 50 N		N
	– The required values for d.t.i. of Tables 13, C.1 and D.1 – marked by index “e” is fulfilled.		N
	– If the layers are separated (alternative:	Insulation tape around the transformer	P
	– The requirement of 3 layers is fulfilled		P
	– If serrated tape is used, 1 additional layer (serrated) and one additional layer without serration is required		N
	– The mandrel test according 26.3.3 is fulfilled on 2/3 of the layers with 100 N		N
	– The required values for d.t.i. of Tables 13, C.1 and D.1 – marked by index “e” is fulfilled.		P
	Test according to 14.3 and if the isolating materials are classified acc. To IEC 60085 and IEC 60216 no distances through insulation are required for insulation in thin sheet form		N
	The figures within square brackets in box 2 and 7 of table 13 (C.1/D.1) are used for insulation in thin sheet form as follows:		P
	– rated output > 100 VA values in square brackets apply		N
	– rated output ≥ 25 VA ≤ 100 VA 2/3 of the value in square brackets apply		N
	– rated output ≤ 25 VA 1/3 of the value in square brackets apply		P
26.3.3	Mandrel test of insulation in thin sheet form (specimen of 70 mm width are necessary):		N
	– If the layers are non-separable – at least 3 layers glued together fulfil the test:		N
	– pull force of 150 N		N
	– high voltage test of 5,0 Kv or the test voltage of 18.3 multiplied by 1,25 whatever is the greater. No flashover, no breakdown.		N
	– If the layers are separable and 2/3 of at least 3 layers fulfil the test.		N
	– pull force of 100 N		N

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Clause	Requirement + Test	Result - Remark	Verdict
	– high voltage test of 5,0 kV or the test voltage of 18.3 multiplied by 1,25 whatever is the greater. No flashover, no breakdowns.		N
	– If the layers are separable 1 of at least 2 layers fulfil the test:		N
	– pull force of 50 N		N
	– high voltage test of 5,0 kV or the test voltage of 18.3 multiplied by 1,25 whatever is the greater. No flashover, no breakdown.		N
26.101	Creepage distances, clearances and distances through insulation, specified values according to (EN 61558-2-16:09):		P
	– table 13, material group IIIa (part 1)		P
	– table C, material group II (part 1)		N
	– table D, material group I (part 1)		N
	– working voltage	(see appended table)	P
	– rated supply frequency 50/60 Hz		P
	– rated internal frequency		P
	1.Insulation between input and output circuits (basic insulation):		N
	a)measured values ≥ specified values (mm) ..... :		N
	2.Insulation between input and output circuits (double or reinforced insulation):		P
	a)measured values ≥ specified values (mm) ..... :	(see appended table)	P
	b)measured values ≥ specified values (mm) ..... :		N
	c)measured values ≥ specified values (mm) ..... :	(see appended table)	P
	3.Insulation between adjacent input circuits: measured values specified values (mm) ..... :		N
	Insulation between adjacent output circuits: measured values ≥ specified values (mm) ..... :		N
	4.Insulation between terminals for external connection:		N
	a)measured values ≥ specified values (mm) ..... :		N
	b)measured values ≥ specified values (mm) ..... :		N
	c)measured values ≥ specified values (mm) ..... :		N
	5.Basic or supplementary insulation:		P
	a)measured values ≥ specified values (mm) ..... :	(see appended table)	P
	b)measured values ≥ specified values (mm) ..... :		N
	c)measured values ≥ specified values (mm) ..... :		N
	d)measured values ≥ specified values (mm) ..... :		N

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Clause	Requirement + Test	Result - Remark	Verdict
	e)measured values ≥ specified values (mm) ..... :		N
	6.Reinforced or double insulation: measured values ≥ specified values (mm) ..... :	(see appended table)	P
	7.Distance through insulation:		P
	a)measured values ≥ specified values (mm) ..... :		N
	b)measured values ≥ specified values (mm) ..... :		N
	c)measured values ≥ specified values (mm) ..... :	(see appended table)	P
26.102	Values of IEC 61558-2-16 applicable for frequency up to 3 MHz (EN 61558-2-16:09)		P
	For frequency above 3 MHz clause 7 of IEC 60664-4 is applicable (high frequency testing)		N
26.103	Clearance (EN 61558-2-16:09)		P
	a) Clearance for frequency > 30 kHz according figure 101 two determinations are necessary:		P
	– determination based on peak working voltage according Table 104 :		N
	Peak working voltage		N
	Basic insulation: required / measured		N
	Double or reinforced insulation: required / measured value		N
	– and alternative if applicable for approximately homogeneous field according to Table 102		N
	Peak working voltage		N
	Basic insulation: required / measured		N
	Double or reinforced insulation: required / measured value		N
	– determination based on measured r.m.s. working voltage according Tables 13, C1 and D1 (see clause 26.101)		P
	The minimum clearance is the greater of the two values.		P
	b) Clearance for frequency ≤ 30 kHz according figure 101 two determinations are necessary:		N
	– determination based on peak working voltage with recurring peak voltages according Table 103 :		N
	– determination based on measured r.m.s. working voltage according Tables 13, C1 and D1 (see clause 26.101)		N
	The minimum clearance is the greater of the two values.		N

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Clause	Requirement + Test	Result - Remark	Verdict
26.104	The working voltages of Table 102, 103 and 104 are peak voltages including µsec peaks (EN 61558-2-16:09)		N
	The working voltage according to Table 13 of part 1 are r.m.s. voltages		N
26.105	Creepage distances		P
	Two determinations of creepage distances are necessary (see Figure 102)		P
	– determination based on measured peak working voltage according Tables 105 to 110		N
	Peak working voltage		N
	Pollution degree	2	N
	Basic or supplementary insulation: required / measured		N
	Double or reinforced insulation: required / measured value		N
	– determination based on measured r.m.s. working voltage according Tables 13, C1 and D1 (see clause 26.101)		P
	If the values based on table 105 to 110 are lower than the relevant values in Tables 13, C.1 or D.1, the higher values shall be applicable		P
26.106	Distance through insulation (EN 61558-2-16:09)		N
	Instead of partial discharge with high frequency voltage the test of the distance and the calculation of the electric field is applicable under the following conditions:		N
	– the max. frequency is < 10 MHz		N
	– the field strength approximately comply with Figure 103		N
	– no voids or gaps are present in between the solid insulation		N
	For thick layers d1 ≥ 0,75mm the peak value of the field strength is < 2 kV/mm		N
	For thin layers d2 ≤ 30 µm the peak value of the field strength is ≤ 10 kV/mm		N
	For d1 > d > d2 equation (1) is used for calculation the field strength		N
26.107 (A1)	For transformers with FIW wires the following test is required		N
	• 10 cycles are required		N

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Clause	Requirement + Test	Result - Remark	Verdict
	• 68 h test at max heating temperature + 10°C or test at max. allowed winding temperature based on the insulation class (required in table 1) + 10°C		N
	• 1 h at 25° C		N
	• 2 h at 0° C		N
	• 1 h at 25° C – (next cycle start again with 68 h max winding temp + 10)		N
	• during the 10 cycles test 2 x working voltage is connected between PRI and SEC		N
	• after 10 cycle test 2 transformers are subjected to the 17.2 test for 48 h and direct after the 48 h the dielectric strength test of 18.3 (100 % test voltage) is done		N
	• after the 10 cycle test the third sample is tested at the end of the last cycle in the hot position with the dielectric strength test of 18.3 (100 % test voltage)		N
	• the partial discharge test according to 18.101 is done after the cycling test and after the high voltage test, if the **peak** working voltage is >750 V		N

27	**RESISTANCE TO HEAT, FIRE AND TRACKING**		P
27.1	Resistance to heat		P
	All insulating parts are resistant to heat		P
	For parts of rubber, which passed the test of 19.9, no additional test is required.		N
	The tests are not required for cables and small connectors with a rated current ≤ 3 A, a rated voltage ≤ 24 V a.c. or 60 V d.c. and a power ≤ 72 W		P
27.1.1	External accessible parts		P
	The Ball-pressure test -: diameter of impression ≤ 2 mm; heating cabinet temperature (°C) at 70 ° C or the temperature T of 14.1 (T + 15) – is fulfilled.	(See appended table)	P
27.1.2	Internal parts		P
	For insulating material retaining current carrying parts in position, the ball-pressure test -: diameter of impression ≤ 2 mm; heating cabinet temperature (°C) at 125 ° C or the temperature T of 14.1 (T + 15) – is fulfilled	(See appended table)	P
27.2	Resistance to abnormal heat under fault conditions		N
27.3	Resistance to fire		P

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Clause	Requirement + Test	Result - Remark	Verdict
	All isolating parts of the transformer shall be resistant to ignition and spread of fire. The test according to IEC 60696-2-10 is required		P
27.3.1	External accessible parts (glow wire tests)		P
	– 650° C for enclosures	(See appended table)	P
	– 650° C for parts retaining current carrying parts in position and terminals for external conductors Current ≤ 0,2 A		N
	– 750° C for parts retaining current carrying parts in position and terminals for external conductors with fixed wiring. Current > 0,2 A	(See appended table)	P
	– 850° C for parts retaining current carrying parts in position and terminals for external conductors with non-fixed wiring. Current > 0,2 A		N
27.3.2	Internal parts		P
	– 550°C for internal insulating material – not retaining current carrying parts in position		M
	– 650°C for coil formers (bobbins)	(See appended table) T1 bobbin (no ignition)	P
	– 650°C for parts retaining current carrying parts in position and terminals for external conductors. Current < 0,2 A		P
	– 750°C for parts retaining current carrying parts in position and terminals for external conductors with fixed wiring. Current > 0,2 A	(See appended table) T1 bobbin and PCB (no ignition)	N
	– 850°C for parts retaining current carrying parts in position and terminals for external conductors with non-fixed wiring. Current > 0,2 A	(See appended table) T1 bobbin and PCB (no ignition)	P
27.4	For IP other than IPX0:If insulating parts retaining current carrying parts in position and under P3 conditions, the material resistance to tracking is at least material of group IIIa		N
	Test (175 V): no flashover or breakdown before 50 drops		N

28	**RESISTANCE TO RUSTING**		P
	Ferrous parts protected against rusting		P

E	**ANNEX E , GLOW WIRE TEST**		P
	The test is required according to IEC 60695-2-10 and IEC 60695-2-11 with the following additions:		--
E.1	Clause 6, “Severities” of IEC 6095-2-11, apply with the temperature stated in 27.3 of IEC 61558-1		P

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Clause	Requirement + Test	Result - Remark	Verdict
E2	Clause 8, “Conditioning”, of IEC 60695-2-11 apply, preconditioning is required		P
E3	Clause 10, “Test Procedure”, of IEC 60695-2-11apply, The tip of the glow wire is applied to the flat side of the surface.		P

F	**ANNEX F, REQUIREMENTS FOR MANUALLY OPERATED SWITCHES WHICH ARE PARTS OF THE TRANSFORMER**		N
F.2	Manually operated mechanical switches, tested as separate component, shall comply with IEC 61058 under the conditions of F2.		N
F.§	Manually operated mechanical switches tested as part of the transformer shall comply with the conditions specified under F.3		N

H	**ANNEX H, ELECTRONIC CIRCUITS** (IEC 61558-1)		P
H1	General notes on tests (addition to clause 5)		P
H.2	Short-circuit and overload protection (addition to clause 15)		P
H.2.1	Circuits designed and applied so that fault conditions do not render the appliance unsafe		P
	During and after each test:		P
	– temperatures do not exceed values specified in table 3 of Cl. 15.1		P
	– transformer complies with conditions specified in sub-clause 15.1		P
	If a conductor of a pcb becomes open circuited, the transformer is considered to have withstood the particular test, provided that all six conditions as specified are met		N
H.2.2	Fault conditions a) to f) of sub-clause H.2.3 are not tested if the following conditions are met:		N
	– electronic circuit is a low-power circuit as specified		N
	– safety of the appliance as specified does not rely on correct functioning of the electronic circuit		N
H.2.3	Fault conditions tested as specified when relevant:	(See appended table)	P
	a) short-circuit of creepage distances and clearances, if less than specified in Cl. 26		N
	b) open circuit at the terminals of any component		P
	c) short-circuit of capacitors, unless they comply with IEC 60 384-14		P

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Clause	Requirement + Test	Result - Remark	Verdict
	d) short-circuit of any two terminals of an electronic component as specified		P
	e) any failure of an integrated circuit as specified		P
	f) low-power circuit: low-power points are connected to the supply source		N
	Cl. 15 is repeated with a simulated fault as indicated in a) to e), if the transformer incorporates an electronic circuit to ensure compliance with Cl. 15		P
	Fault condition e) is applied for encapsulated and similar components		P
	PTC's and NTC's are not short-circuited if they are used as specified		N
H.2.4	If for a fuse-link complying with IEC 60 127-3 rated fuse current I1 is used, current I2 is measured as specified:		N
	– if I2 < 2,1 x I1 test of 15.8 is repeated with fuse-link short-circuited		N
	– if I2 > 2,75 x I1, no other tests are necessary		N
	If I2 > 2,1 x I1 and I2 < 2,75 x I1 test of 15.8 is repeated as specified		N
	For fuses other than those complying with IEC 60 127-3, the test is carried out as specified 15.3.2 to 15.3.5		N
H.3	Creepage distances, clearances and distances through insulation		P
H.3.1	For live parts separated by basic insulation smaller cr and cl as in 26 are allowed, if H2 is fulfilled.		N
	In optocouplers no requirements of cr and cl		P
	For coatings annex W applies. Smaller distances as required in IEC 60664-3, clause 4 are applicable,		N
	For potted transformers cycling tests acc, 26.2. are applicable		N
H.3.2	The ma. Surface temperature of optocouplers is 50 K		P

K (A1)	**ANNEX K, INSULATED WINDING WIRES FOR USE AS MULTIPLE LAYER INSULATION**		P
K.1	Wire construction:		P
	• insulated winding wire for basic or supplementary insulation (see 19.12.3)		N
	• insulated winding wire for reinforced insulation (see 19.12.3)	Approved TIW used	P
	• splid circular winding wires and stranded winding wires with 0,05 to 5 mm diameter		N

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Clause	Requirement + Test	Result - Remark	Verdict
	• spirally wrapped insulation – overlapping		N
K.2	Type tests		N
K.2.1	General Tests between ambient temperature between 15° C and 35° C and at an humidity between 45% and 75 %		N
K.2.2	Electric strength test		N
K.2.2.1	Solid circular winding wires and stranded winding wires		N
	Test samples prepared according to clause 4.4.1 of IEC 60851-5:2008 (twisted pair)		N
	Dielectric strength test: 6 kV for reinforced insulation		N
	Dielectric strength test: 3 kV for basic or supplementary insulation		N
K.2.2.2	Square or rectangular wires		N
	Test samples prepared according to clause 4.7.1 of IEC 60851-5:2008		N
	Dielectric strength test: 5,5 kV for reinforced insulation		N
	Dielectric strength test: 2,75 kV for basic or supplementary insulation		N
K.2.3	Flexibility and adherence		N
	Claus 5.1 in Test 8 of IEC 60851-3:2009 shall be used		N
	Test samples prepared according to clause 5.1.1.4 of IEC 60851-3:2009		N
	Dielectric strength test: 5,5 kV for reinforced insulation		N
	Dielectric strength test: 2,75 kV for basic or supplementary insulation		N
	Mandrel diameter according table K.1		N
	The tension to the wire during winding on mandrel is 118 N/mm² (118 Mpa)		N
K.2.4	Heat shock		N
	Test samples prepared according to 3.1.1 (in Test 9) of IEC 60851-6:1996		N
	• high voltage test immediately after this test		N
	• Dielectric strength test: 5,5 kV for reinforced insulation		N
	• Dielectric strength test: 2,75 kV for basic or supplementary insulation		N

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Clause	Requirement + Test	Result - Remark	Verdict
K.2.5	Retention of dielectric strength after bending (test as specified under test 13 of 4.6.1 c) of IEC 60 851-5)		N
	• high voltage test immediately after this test • Dielectric strength test: 5,5 kV for reinforced insulation • Dielectric strength test: 2,75 kV for basic or supplementary insulation		
K.3.1	General Tests as subjected in K.3.2 and K.3.3		N
K.3.2	Routine test		N
	• Dielectric strength test: 4,2 kV for reinforced insulation		N
	• Dielectric strength test: 2,1 kV for basic or supplementary insulation		N
K.3.3	Sampling test		N
K.3.3.1	Solid circular winding wires and stranded winding wires		N
	Test with a twisted pair, prepared according clause 4.4.1 of IEC 60851-5:2008		N
	• Dielectric strength test: 6 kV for reinforced insulation		N
	• Dielectric strength test: 3 kV for basic or supplementary insulation		N
K.3.3.2	Square rectangular wire		N
	Samples prepared according to clause 4.7.1 of IEC 60851-5:2008		N
	• Dielectric strength test: 5,5 kV for reinforced insulation		N
	• Dielectric strength test: 3 kV for basic or supplementary insulation		N

U	**ANNEX U – INFORMATIVE – OPTIONAL TW – MARKING FOR TRANSFORMERS**		N
	The tests of Annex U are based on constant S = 4500. Other constants are possible, if the test of U.5.2 is done with positive result.		N
U1	General notes and tests		N
	8 transformers of one type are necessary for the test. Tests according U5.		N
U.2	Heating (addition to clause 14)		N
14.4	Thermal endurance test		N

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Clause	Requirement + Test	Result - Remark	Verdict
	Test according U5 and measurements according 11.1		N
	Transformers tested as an integral part of the equipment (option), assigned with tw		N
	The thermal conditions are so adjusted, that the duration of test is as indicated by the manufacturer.		N
	If no indications are given, the test period is 30 days		N
	After the test, when the transformers have returned to room temperature, they fulfil the following requirements:		N
	a) The output voltage has not changed from the measured value at the beginning by more than allowed value of clause 11.1		N
	b) The insulation resistance between input and output winding and between windings and body is, measured with 500 V d.c., not less than 1 Mohm		N
	c) The transformer fulfil the dielectric strength test with 35% of the values in Clause 18, Table 8.a.		N
	The test result is positive, is min. 6 of the 7 samples have passed the test.		N
	The test result is negative, if 2 or more samples fail the test		N
	If the result is negative, the test can be repeated with 7 new samples		N
U.3	Short circuit and overload protection (addition to clause 15)		N
	At short circuit and overload tests the winding temperature if less than the required value of table U.1		N
U.5	General requirements and information about thermal endurance test on windings		N
U.5.1	Thermal endurance test		N
	Transformers tested at rated output		N
	Loads outside of the oven		N
	7 transformers are placed in the oven		N
	The temperature of the hottest winding of each of the 7 transformers is-together with the oven temperature, at the applicable temperature of table U.2		N
	After 4 hours measuring of the actual winding temperatures. Regulation of the oven temperature if necessary		N

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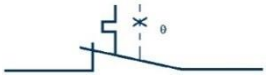
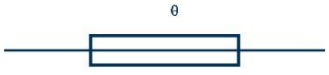
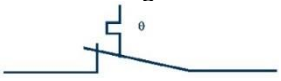
Clause	Requirement + Test	Result - Remark	Verdict
	After 24 hours again measuring of the winding temperature. The temperatures of the 7 samples are very near to the required temperature of the values of table U.2. The test time of the coldest winding is not longer than twice the theoretical test time based on table U.2		N
U.5.2	The use of constant S other than 4500 in tw tests		N
U.5.2.1	Procedure a)		N
	The manufacturer prepares test results with a minimum of samples of 30.		N
	T and log L are calculated from the dates		N
	The diagram according to Figure U.2 will be founded.		N
U.5.2.3	Procedure b)		N
	The testing authority shall test 14 new transformers		N
	Test 1, based on clause U.5.1 but at the calculated test room temperature for 10 days. The test is continued until all transformer fail.		N
	Calculation of the mean life L2 at temperature T2 according to U4		N
	Test 2, based on clause U.5.1 but at a calculated room temperature T2 (for 120 days).The test time with T2 exceeds L2.		N
	If all transformers fail before L2, the result is negative.		N

V	**ANNEX V, SYMBOLS TO BE USED FOR THERMAL CUT-OUTS**		N
V.2.1.1	Restored by manual operation  IEC 489/98		N
V.2.1.2	Restored by disconnection of the supply  IEC 490/98		N
V.2.1.3	Thermal link  IEC 491/98		N
V.2.2	Self-resetting thermal cut-out  IEC 492/98		N

AA	**Annex AA (IEC 61558-2-16:2009+A1:2013)**		N

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Clause	Requirement + Test	Result - Remark	Verdict
	Partial discharge (PD) test		N

BB	**Annex BB (IEC 61558-2-16:2009+A1:2013)**		N
	Particular requirements for associated transformers for switch mode power supplies with internal frequencies > 500 Hz		N
	See separate test report-form for these Annex.		N

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Clause	Requirement + Test	Result - Remark	Verdict

11 and 12	TABLE: Output Voltage and Output Current Under Load; No-Load Output Voltage	P

Clause		11		12		
Type/rated output	Rated voltage (V)	Sec. voltage (V)	Delta Usec (%)	Usec V no-load output	Delta Usec no-load output %	Further information
XRS-2kV-300W-F5A-3U-S / 15Vdc, 5A	15	15.01	0.07%	15.08	0.53%	Input: 180Vdc
XRS-2kV-300W-F5A-3U-S / 15Vdc, 5A	15	15.03	0.2%	15.11	0.73%	Input: 264Vdc
Supplementary information:--						

14.1	TABLE: Heating Test		P
	Test voltage (V).....:	See below	—
	Ambient (°C).....:	See below	—

Thermocouple Locations	Max. temperature measured, (°C)				Max. temperature limit, (°C)
	180Vac/ 60Hz		264Vac/ 60Hz		
	--	--	--	--	
Input wire	45.6	65.6	44.9	64.9	80
Transformer winding	81.2	101.2	80.6	100.6	110
Transformer core	72.6	92.6	71.7	91.7	110
Transformer Bobbin	53.4	73.4	52.6	72.6	150
Transformer Insulating tape	51.3	71.3	50.8	70.8	130
Output wire	40.6	60.6	40.2	60.2	80
Ambient	25.0	45.0	25.0	45.0	--

Supplementary information:
1. Thermocouple method used.
2. The above temperature data are fixed at ambient temperature 40°C.

15	TABLE: Short-Circuit and Overload Protection		N
	Ambient temperature (°C) ..... :	--	—

Type/rated output	R-cold Ω	R-warm Ω	Temp. °C	Ext. encl. °C	Support °C	Int. + ext. wire	Further information
--	--	--	--	--	--	--	--
Supplementary information:--							

15	TABLE: Short-Circuit and Overload Protection	P

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Clause	Requirement + Test	Result - Remark	Verdict

	Test voltage (V)……..:	264	—
	Ambient (°C) ……..:	25	—

Thermocouple Locations	Max. temperature measured, (°C)	Max. temperature limit, (°C)
Transformer winding	135.1	165
Transformer core	111.8	165
Transformer Bobbin	108.6	165

Supplementary information:

1. All the conditions were considered for clause 15, and also Max. temperature with rated 1.1 times voltage during test output overload for recorded as above.
2. The above temperature data are fixed at ambient temperature 40°C.
3. Thermocouple method used.
4. Limited temperature for winding is 165°C (Class B) under 40°C ambient.
5. When short-circuited output terminals for above model, the unit shut down, no output, no hazards.

18.2	TABLE: Insulation Resistance Measurements		P
Insulation resistance R between:		R (MΩ)	Required R (MΩ)
Between mains poles (F1 disconnected)		>100	2
Between live parts and output circuit		>100	5
Between live parts and external enclosure		>100	7
Between primary winding of transformer and secondary winding of transformer		>100	5
Between core of transformer and secondary winding of transformer		>100	5
Supplementary information:--			

18.3	TABLE: Dielectric Strength		P
Test voltage applied between:		Test potential applied (V)	Breakdown / flashover (Yes/No)
Between mains poles (F1 disconnected)		1820VAC	No
Between live parts and output circuit		4200VAC	No
Between live parts and external enclosure		4200VAC	No
Between primary winding of transformer and secondary winding of transformer		4200VAC	No
Between core of transformer and secondary winding of transformer		4200VAC	No
Supplementary information:--			

20	TABLE: Critical components information	P

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Clause	Requirement + Test	Result - Remark	Verdict

Object/part No.	Manufacturer/ trademark	Type/model	Technical data	Standard (Edition / year)	Mark(s) of conformity[1])
Primary lead wire	Dongguan Zhengwei Electric Wire & Cable Industry Co Ltd	1007, 1015, 1672	PVC, Rated VW-1, Min. 80°C, 300V, Min. 22AWG	UL 758	UL E326510
Output wire	Zhuang Shan Chuan Electrical Products (Kunshan) Co Ltd	2464, 2468, 1185	Rated VW-1, Min. 80°C, 300V, Min. 20AWG	UL 758	UL E333601
Transformer (T1)	SUQIAN BOER HIGH VOLTAGE POWER SUPPLIES CO., LTD. (GENVOLT CHINA)	XRS-2kV-300 W-F5A-3U-S	Class B	--	--
-Core	--	--	Ferrite, two pieces provided. approximately 23 by 17 by 15 mm.	--	--
-Bobbin	Sumitomo Bakelite Co Ltd	PM-9820	Phenolic, Min.0.7mm, V-0, 150°C	UL 94	UL E41429
Triple insulated wire	Totoku Electric Co. Ltd.	TIW-2	130°C	IEC 60950-1	VDE 40005152
-Magnet Wire	Shantou Shengang Electrical Industrial Co Ltd	MW75, MW79	130°C	UL 1446	UL E239508
-Insulation tape	3M Company Electrical Markets Div (Emd)	1350F-1	130°C	UL 510	UL E17385
-Tube	Fluo Tech Industries Co Ltd	TFT	Rated 200°C, 300V, VW-1	UL 224	UL E175982
- Varnishes	Elantas Electrical Insulation Elantas Pdg Inc	468-2FC(+)	155°C	UL 1446	UL E75225

Supplementary information:

[1]) Provided evidence ensures the agreed level of compliance. See OD-CB2039.

25	TABLE: Threaded Part Torque Test			N
Threaded part identification	Diameter of thread (mm)	Column number (I, II, or III)	Applied torque (Nm)	
--	--	--	--	

Supplementary information:--

26	TABLE: Working Voltage Measurement			P
Location	RMS voltage (V)	Peak voltage (V)	Comment	

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Clause	Requirement + Test	Result - Remark	Verdict

T1 Pin 7-A	293	560	Max. VPeak voltage Max. VRMS voltage
T1 Pin 8-A	219	356	--
T1 Pin 4-A	219	352	--
T1 Pin 3-A	220	386	--
T1 Pin 7-B	272	536	--
T1 Pin 8-B	220	404	--
T1 Pin 3-B	220	372	--
T1 Pin 4-B	219	358	--
U3 Pin 3-1	229	360	--
U3 Pin 4-1	228	360	--
U3 Pin 3-2	226	360	--
U3 Pin 4-2	226	358	--
CY2 Primary pin to secondary pin	219	350	--
Supplementary information:--			

26	**TABLE: Clearance and Creepage Distance Measurements**					**P**
Clearance cl and creepage distance dcr at/of:	Up (V)	U r.m.s. (V)	Required cl (mm)	Cl (mm)	Required dcr (mm)	Dcr (mm)
Basic / supplementary:						
Different polarity of L/N before fuse F1	<420	<300	1.5	5.4	2.5	5.4
Different polarity of fuse F1	<420	<300	1.5	3.1	2.5	3.1
Live parts to metal enclosure	<420	<300	1.5	4.3	2.5	4.3
Reinforced:						
Primary trace to secondary trace under U2	<420	<300	3.0	7.6	5.0	7.6
Primary trace to secondary trace under CY2	<420	<300	3.0	7.6	5.0	7.6
Primary circuit to accessible enclosure	<420	<300	3.0	14.3	5.0	14.3
Primary component (EC5) and secondary component (C17)	560	293	3.0	7.4	6.0	7.4
Primary component (R5C) and secondary winding	560	293	3.0	6.2	6.0	6.2
Primary component to secondary component (USB terminal)	560	293	3.0	7.5	6.0	7.5

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Clause	Requirement + Test	Result - Remark	Verdict

Core of T1 to secondary component	560	293	3.0	11.2	6.0	14.2
Primary winding to secondary winding of T1	560	293	3.0	11.2	6.0	14.2

Supplementary information:

1. BI: Basic insulation; SI: Supplementary insulation; RI: reinforced insulation.
2. If no specified, the worst condition was considered.
3. The core of T1 is considered as primary live part.
4. A force of 10 N applied to the internal components and 250 N applied to the enclosure for measure.

26	**TABLE: Distance Through Insulation Measurements**			**N**
Distance through insulation di at/of:	U r.m.s. (V)	Test voltage (V)	Required di (mm)	Di (mm)
--	--	--	--	--
Supplementary information:--				

26.2 TEST A	**TABLE: Creepage Distances and Clearances and Distances Through Insulation**				**N**
	Test with three special prepared specimens with uninsulated wires, without potting or impregnation		--		--
Cycles with 2 x working voltage between pri / sec	68 h at the temperature acc. Cl. 14 (min. 85°C)	1 hour 25°C	2 hour 0°C	1 hour 25°C	--
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
Supplementary information:--					

26.2 TEST B	**TABLE: Creepage Distances and Clearances and Distances Through Insulation**		**N**
	Test with three specially prepared specimens with potted – P1 values are required	--	--

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Clause	Requirement + Test	Result - Remark	Verdict

Cycles with 2 x working voltage between pri / sec	68 h at the temperature acc. Cl. 14 (min. 85°C)	1 hour 25°C	2 hour 0°C	1 hour 25°C	
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
Supplementary information:--					

26.2 TEST C	**TABLE: Creepage Distances and Clearances and Distances Through Insulation**		**N**
	Test with three specially prepared specimens with potting (only dti is required)	--	--

Cycles with 2 x working voltage between pri / sec	68 h at the temperature acc. Cl. 14 (min. 85°C)	1 hour 25°C	2 hour 0°C	1 hour 25°C	--
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
Supplementary information:--					

26.107 61558-2-16/A1	**TABLE: Creepage Distances and Clearances and Distances Through Insulation**		**N**
	Test for transformers, use FIW-wire	--	--

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Clause	Requirement + Test	Result - Remark	Verdict

Cycles with 2 x working voltage between pri / sec	68 h at the temperature acc. Cl. 14 (min. 85°C)	1 hour 25°C	2 hour 0°C	1 hour 25°C	
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
Supplementary information:--					

27.1	**TABLE: Ball Pressure Test of Thermoplastics**		**N**
Allowed impression diameter (mm) .....:		≤2mm	—
Object/ Part No./ Material	Manufacturer/ trademark	Test temperature (°C)	Impression diameter (mm)
--	--	--	--
Supplementary information:--			

27.3	**TABLE: Resistance to heat and fire - Glow wire tests**								**N**
Object/ Part No./ Material	Manufacturer/ trademark	Glow wire test (GWT); (°C)							Verdict
		550	650		750		850		
			te	ti	te	ti			
--	--	--	--	--	--	--	--	--	--
Object/ Part No./ Material	Manufacturer/ trademark	Glow-wire flammability index (GWFI),°C				GW ignition temp. (GWIT),°C			Verdict
		550	650	750	850	675	775		
--	--	--	--	--	--	--	--	--	--
If no, then surrounding parts passed the needle-flame test of annex E (Yes/No):									
The test specimen passed the test by virtue of most of the flaming material being withdrawn with the glow-wire (Yes/No)? :									
Ignition of the specified layer placed underneath the test specimen (Yes/No):									

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Clause	Requirement + Test	Result - Remark	Verdict

Supplementary information:
550°C GWT not relevant (or applicable) to parts of material classified at least HB40 or if relevant HBF
The GWIT pre-selection option, the 850°C GWFI pre-selection option, and the 850°C GWT are not relevant (or applicable) for attended appliances.

Annex H	**TABLE: Electronic circuit fault test**		**P**
	Ambient temperature (°C) ……..:	See below	--
	Power source for EUT: Manufacturer, model/type, output rating ……..:	See nameplate	--

Component No.	Fault	Supply voltage (V)	Test time	Fuse #	Fuse current (A)	Observation
Openings	Blocked	264Vac	4h9mins	F1	1.543	The unit operated under the fault condition and ran for thermal equilibrium. No hazard, No damage.
Transformer T1 output (15Vdc)	OL	264Vac	6h11mins	F1	1.889	Output current load to 3.7A maximum. T1 output shutdown when output current to 3.75A maximum. No damaged, no hazards.
DC FAN	Locked-in	264Vac	7h	F1	1.543	The unit operated under the fault condition and ran for thermal equilibrium. No hazard, No damage.
BG1 Pin 1-4	SC	264Vac	1s	F1	1.543→0	Unit shut down, F1 fuse immediately open, no hazardous.
EC1	SC	264Vac	1s	F1	1.543→0	Unit shut down, F1 fuse immediately open, no hazardous.
EC2	SC	264Vac	1s	F1	1.543→0	Unit shut down, F1 fuse immediately open, no hazardous.
U1 pin 2-5	SC	264Vac	1s	F1	1.543→0	Unit shut down, F1 fuse immediately open, no hazardous.
U1 pin 1-5	SC	264Vac	1s	F1	1.543→0	Unit shut down, F1 fuse immediately open, no hazardous.
D1	SC	264Vac	1s	F1	1.543→0	Unit shut down, F1 fuse immediately open, no hazardous.
Q1 pin G-D	SC	264Vac	1s	F1	1.543→0	Unit shut down, F1 fuse immediately open, no hazardous.
Q1 pin G-S	SC	264Vac	10mins	F1	1.543→0.018	Unit shut down immediately, No damage. No hazards.
Q1 pin D-S	SC	264Vac	1s	F1	1.543→0	Unit shut down, F1 fuse immediately open, no hazardous.
T1 pin 1*-3	SC	264Vac	10mins	F1	1.543→0.018	Unit shut down immediately, No damage. No hazards.

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Clause	Requirement + Test	Result - Remark	Verdict

Component No.	Fault	Supply voltage (V)	Test time	Fuse #	Fuse current (A)	Observation
T1 pin 4-5*	SC	264Vac	10mins	F1	1.543→ 0.018	Unit shut down immediately, No damage. No hazards.
T1 pin S*-F	SC	264Vac	10mins	F1	1.543→ 0.018	Unit shut down immediately, No damage. No hazards.
U2 pin 1-2	SC	264Vac	10mins	F1	1.543→ 0.018	Unit shut down immediately, No damage. No hazards.
U2 pin 3-4	SC	264Vac	10mins	F1	1.543→ 0.018	Unit shut down immediately, No damage. No hazards.
U2 pin 1	OC	264Vac	10mins	F1	1.543→ 0.018	Unit shut down immediately, No damage. No hazards.
U2 pin 3	OC	264Vac	10mins	F1	1.543→ 0.018	Unit shut down immediately, No damage. No hazards.
D2	SC	264Vac	10mins	F1	1.543→ 0.018	Unit shut down immediately, No damage. No hazards.
Z2	SC	264Vac	10mins	F1	1.543→ 0.018	Unit shut down immediately, No damage. No hazards.
R19	SC	264Vac	10mins	F1	1.543→ 0.018	Unit shut down immediately, No damage. No hazards.
UL2 pin 2-4	SC	264Vac	10mins	F1	1.543→ 0.018	Unit shut down immediately, No damage. No hazards.
C10	SC	264Vac	10mins	F1	1.543→ 0.018	Unit shut down immediately, No damage. No hazards.
U5 pin 1-4	SC	264Vac	10mins	F1	1.543→ 0.018	Unit shut down immediately, No damage. No hazards.
U5 pin 2-4	SC	264Vac	10mins	F1	1.543	Unit normal working, No damage. No hazards.
C59	SC	264Vac	10mins	F1	1.543	Unit normal working, No damage. No hazards.
U4 pin 1-4	SC	264Vac	10mins	F1	1.543→ 0.018	Unit shut down immediately, No damage. No hazards.
U4 pin 1-5	SC	264Vac	10mins	F1	1.543	Unit normal working, No damage. No hazards.
U11 pin 2-3	SC	264Vac	10mins	F1	1.543→ 0.018	Unit shut down immediately, No damage. No hazards.
R6	SC	264Vac	10mins	F1	1.543	Unit normal working, No damage. No hazards.

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Clause	Requirement + Test	Result - Remark	Verdict

Component No.	Fault	Supply voltage (V)	Test time	Fuse #	Fuse current (A)	Observation
Supplementary information: 1. S-C: short-circuit; O-L: overload; O-C: Open-circuited. 2. All the tested samples have passed the Dielectric Strength between primary and secondary (4200VAC, 1 min) after the fault test. 3. The appliance didn't emit flames, molten metal, or poisonous or ignitable gas in hazardous amounts and temperature exceed the values shown in table 15 during the tests. 4. All tests were considered in AC 90V also, same result generated.						

Annex U	**U.5.1 THERMAL ENDURANCE TEST**
Type ref.	—
Rated PRI-Voltage	—
Rated SEC-Voltage	—
Material of Winding	—
Material of bobbin	—
Material of resin	—
Material of potting	—
Material of foil	—
Components removed for test	—
tw	—
S	—
Objective test duration (days)	—
Theoretical test temperature	—

Sample	1		2		3		4		5		6		7	
Winding	PRI	SEC	PRI	SEC	PRI	SEC	PRI	SEC	PRI	SEC	PRI	SEC	PRI	SEC
Start – Rk	—	—	—	—	—	—	—	—	—	—	—	—	—	—

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Clause	Requirement + Test	Result - Remark	Verdict

After 4 h – Rw	—	—	—	—	—	—	—	—	—	—	—	—	—	—
After 4 h – winding temperature	—	—	—	—	—	—	—	—	—	—	—	—	—	—
After 4 h - oven temperature	—		—		—		—		—		—		—	
After 24 h – Rw	—	—	—	—	—	—	—	—	—	—	—	—	—	—
After 24 h – winding temperature	—	—	—	—	—	—	—	—	—	—	—	—	—	—
After 24 h - oven temperature	—		—		—		—		—		—		—	
Final test period (days)	—		—		—		—		—		—		—	
Output voltage (11.1) under load	—		—		—		—		—		—		—	
Insulating resistance	—		—		—		—		—		—		—	
High voltage test (35% of the values in Table 8.a	—		—		—		—		—		—		—	
Annex U	**U.5.2 The use of another constant S other than 4500 in tw tests Test 1:10 days**													
Type ref.	—													
Rated PRI-Voltage	—													
Rated SEC-Voltage	—													
Material of Winding	—													
Material of bobbin	—													
Material of resin	—													
Material of potting	—													

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Clause	Requirement + Test	Result - Remark	Verdict

Material of foil	—													
Components removed for test	—													
tw	—													
S	—													
Objective test duration (days)	—													
Theoretical test temperature	—													
Sample	1		2		3		4		5		6		7	
Winding	PRI	SEC	PRI	SEC	PRI	SEC	PRI	SEC	PRI	SEC	PRI	SEC	PRI	SEC
Start – Rk	—	—	—	—	—	—	—	—	—	—	—	—	—	—
After 4 h – Rw	—	—	—	—	—	—	—	—	—	—	—	—	—	—
After 4 h – winding temperature	—	—	—	—	—	—	—	—	—	—	—	—	—	—
After 4 h - oven temperature	—		—		—		—		—		—		—	
After 24 h – Rw	—	—	—	—	—	—	—	—	—	—	—	—	—	—
After 24 h – winding temperature	—	—	—	—	—	—	—	—	—	—	—	—	—	—
After 24 h - oven temperature	—		—		—		—		—		—		—	
Final test period (days)	—		—		—		—		—		—		—	
Output voltage (11.1) under load	—		—		—		—		—		—		—	
Insulating resistance	—		—		—		—		—		—		—	

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Clause	Requirement + Test	Result - Remark	Verdict

High voltage test (35% of the values in Table 8.a	—	—	—	—	—	—	—

Annex U	**U.5.2 The use of another constant S other than 4500 in tw tests Test 2:120 days**
Type ref.	—
Rated PRI-Voltage	—
Rated SEC-Voltage	—
Material of Winding	—
Material of bobbin	—
Material of resin	—
Material of potting	—
Material of foil	—
Components removed for test	—
tw	—
S	—
Objective test duration (days)	—
Theoretical test temperature	—

Sample	1		2		3		4		5		6		7	
Winding	PRI	SEC	PRI	SEC	PRI	SEC	PRI	SEC	PRI	SEC	PRI	SEC	PRI	SEC
Start – Rk	—	—	—	—	—	—	—	—	—	—	—	—	—	—
After 4 h – Rw	—	—	—	—	—	—	—	—	—	—	—	—	—	—
After 4 h – winding temperature	—	—	—	—	—	—	—	—	—	—	—	—	—	—

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Clause	Requirement + Test	Result - Remark	Verdict

After 4 h - oven temperature	—		—		—		—		—		—		—	
After 24 h – Rw	—	—	—	—	—	—	—	—	—	—	—	—	—	—
After 24 h – winding temperature	—	—	—	—	—	—	—	—	—	—	—	—	—	—
After 24 h - oven temperature	—		—		—		—		—		—		—	
Final test period (days)	—		—		—		—		—		—		—	
Output voltage (11.1) under load	—		—		—		—		—		—		—	
Insulating resistance	—		—		—		—		—		—		—	
High voltage test (35% of the values in Table 8.a	—		—		—		—		—		—		—	

Figure 1. Overall view

Figure 1. Overall view

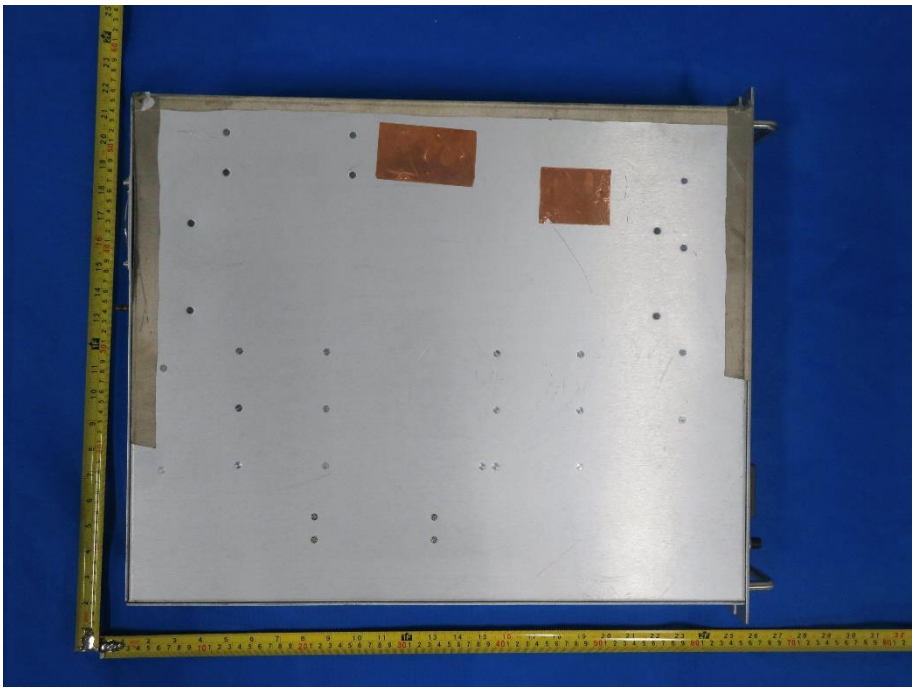

Figure 3. Overall view

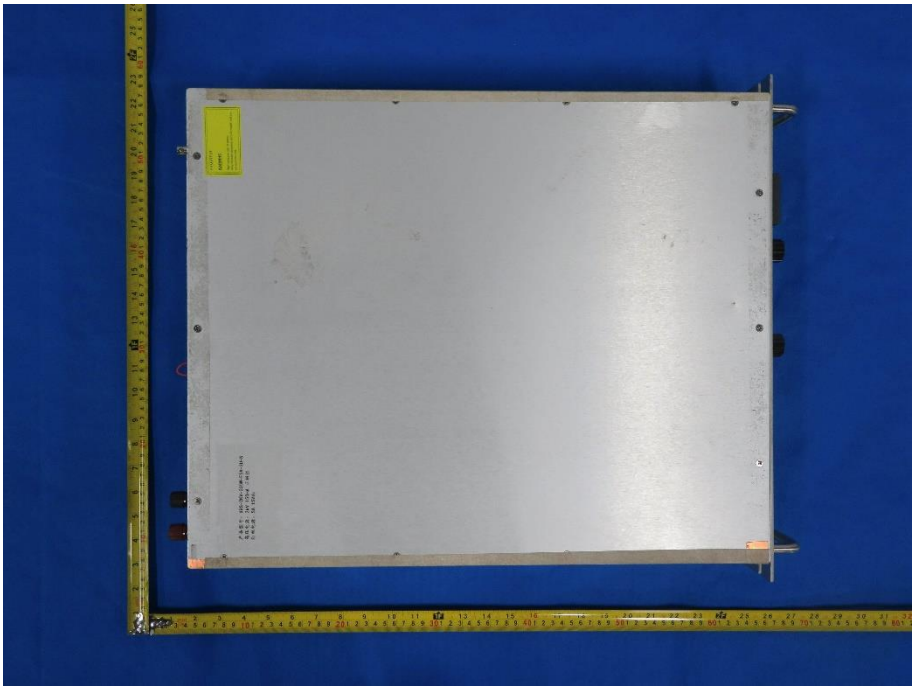

Figure 4. Overall view

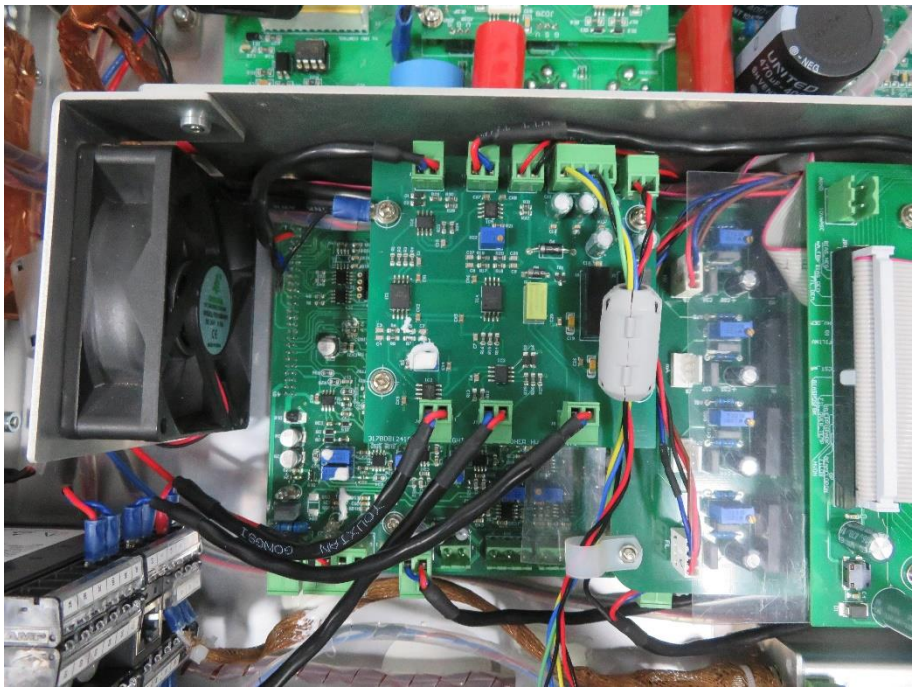

Figure 5. Internal view

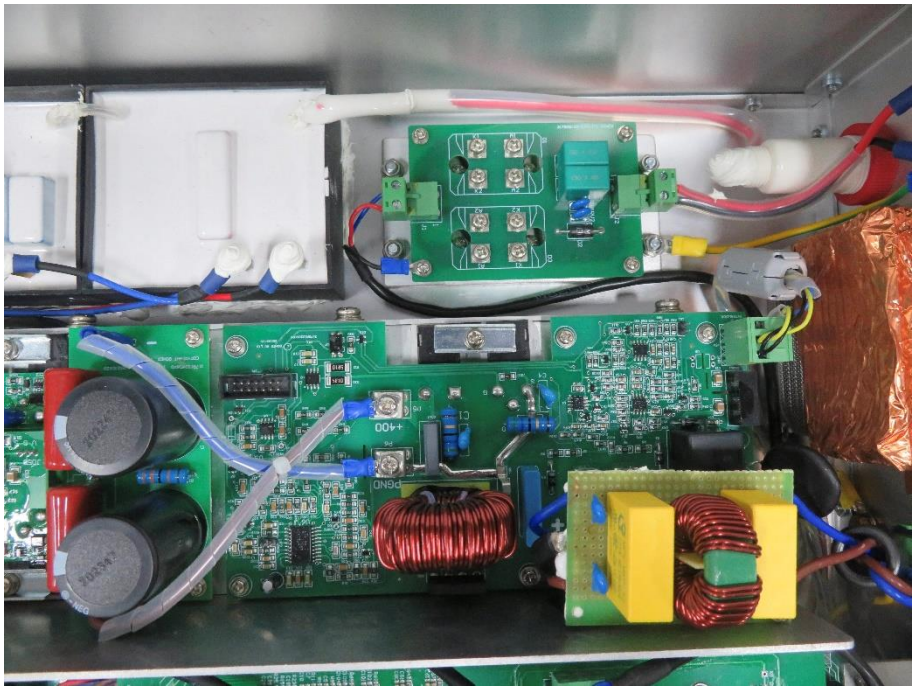

Figure 6. Internal view

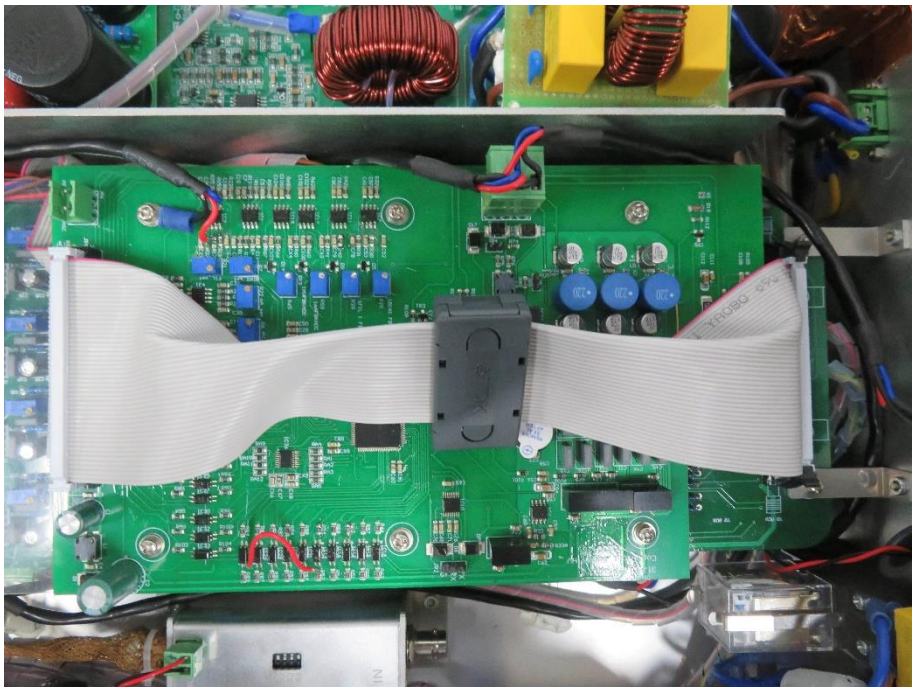

Figure 7. Internal view

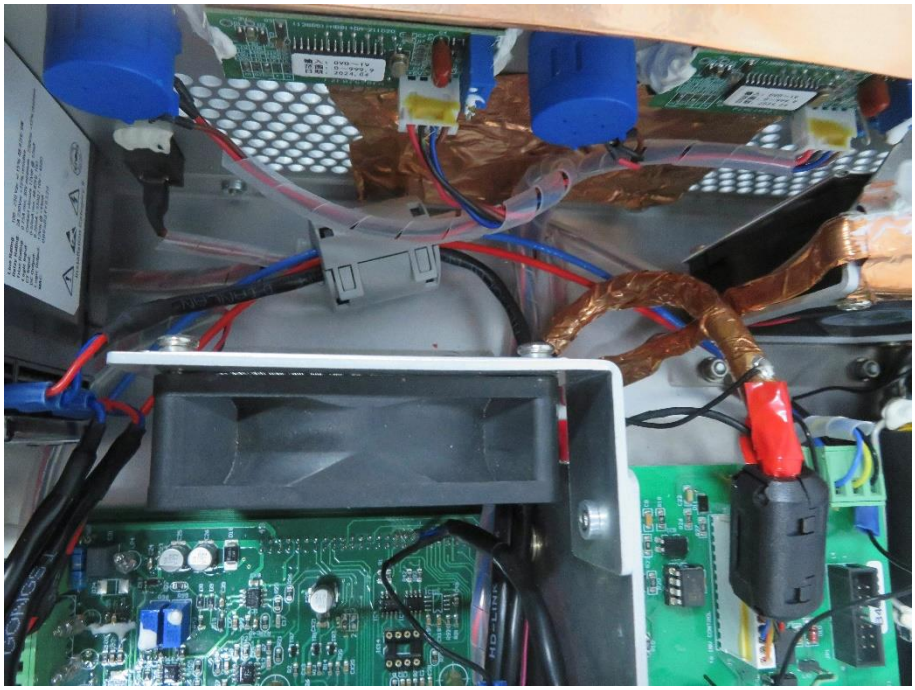

Figure 8. Internal view

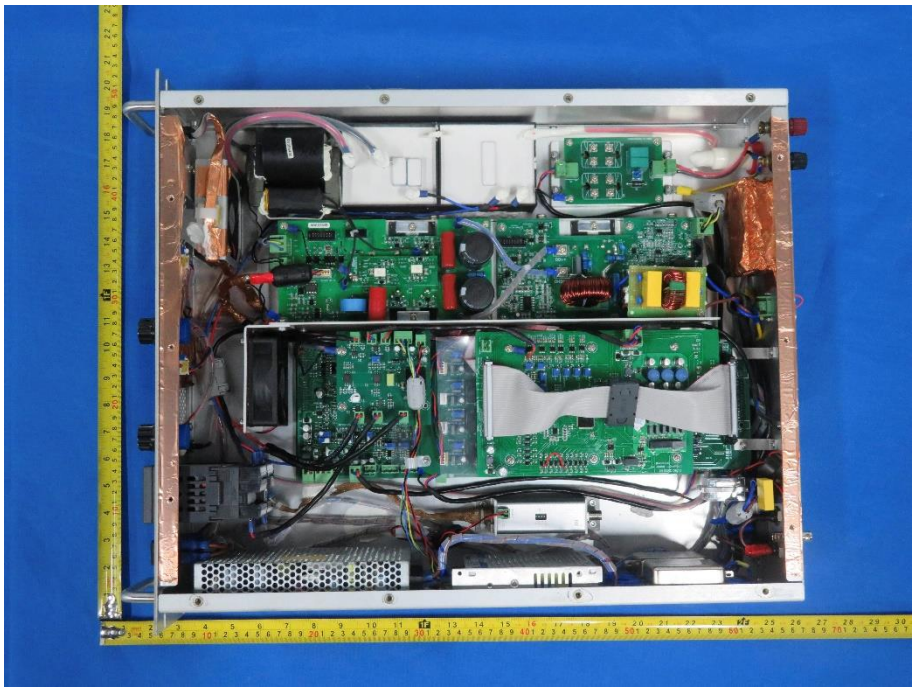

Figure 9. Internal view

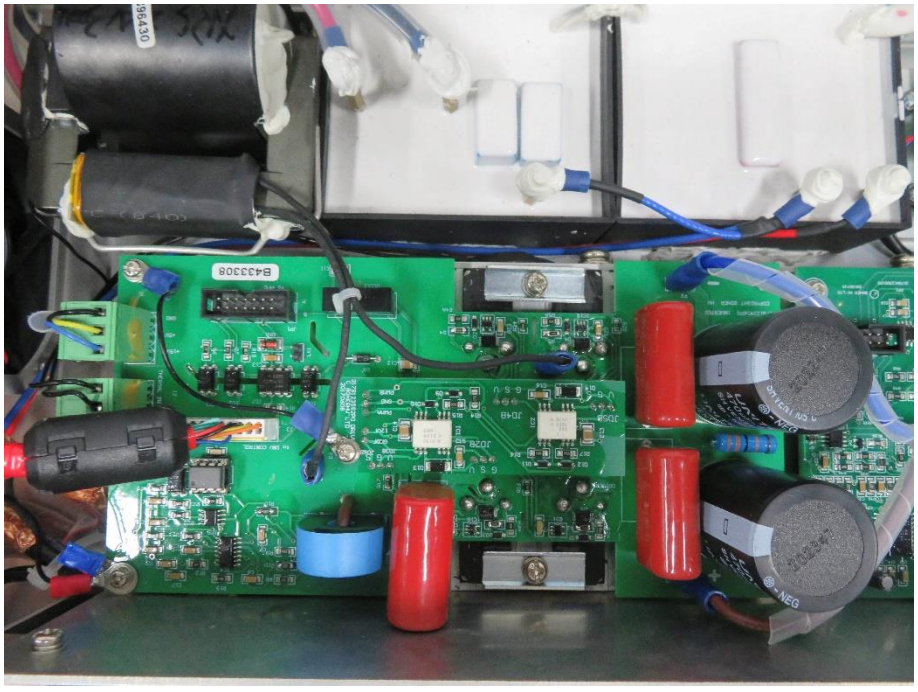

Figure 10. Internal view

---------- End of test report ----------