



SHANGHAI MINGBEN POWER EQUIPMENT MANUFACTURING CO., LTD

CE LVD REPORT

Prepared For :	SHANGHAI MINGBEN POWER EQUIPMENT MANUFACTURING CO., LTD Building A-3, No.1518, Songzhen Road, Xiaokunshan Town, Songjiang District, Shanghai
Product Name:	SINGLE PHASE DRY ISOLATION TRANSFORMER
Main Test Model:	BK-10KVA
Additional Model:	BK-500VA, BK-1KVA, BK-3KVA, BK-5KVA, BK-15KVA, BK-20KVA, BK-30KVA, BK-40KVA, BK-50KVA
Prepared By :	BST Testing (Shenzhen)Co., Ltd. Add: No.7, New Era Industrial Zone, Guantian, Bao'an District, Shenzhen, Guangdong, China
Test Date:	Mar . 04, 2021 — Mar . 19, 2021
Date of Report :	Mar . 19, 2021
Report No.:	BSTXD210316013402SR

**TEST REPORT****EN 61558-1****Safety of power transformers, power supply units and similar****Testing laboratory**

Name.....: BST Testing (Shenzhen)Co., Ltd.
Address.....: No.7,New Era Industrial Zone, Guantian, Bao'an District, Shenzhen,
Guangdong, China
Testing location.....: BST Testing (Shenzhen)Co., Ltd.

Client

Name.....: SHANGHAI MINGBEN POWER EQUIPMENT MANUFACTURING
CO., LTD
Address.....: Building A-3, No.1518, Songzhen Road, Xiaokunshan Town,
Songjiang District, Shanghai

Test specification

Standard.....: EN 61558-1:2005+A1:2009
Test procedure: Compliance with EN 61558-1:2005+A1:2009
Procedure deviation.....: N.A.
Non-standard test method.....: N.A.
Trade Name.....: N.A.

Test item

Description.....: SINGLE PHASE DRY ISOLATION TRANSFORMER
Model and/or type reference.....: See page1
Manufacturer.....: SHANGHAI MINGBEN POWER EQUIPMENT MANUFACTURING
CO., LTD
Address.....: Building A-3, No.1518, Songzheng Road, Xiaokunshan Town,
Songjiang District, Shanghai
Rating(s).....: See copy of marking plate

**Particulars: test item vs. test requirements**

Type of transformers.....: Safety isolating transformers
Application.....: Fixed transformer
Protection against electric shock.....: Class I
Short-circuit protection.....: Thermal link
- inherently short-circuit proof.....: No
- non-inherently short-circuit proof.....: No
- non short-circuit proof.....: No
- fail-safe.....: Yes
Protection index.....: IPX0
Other characteristics.....: N/A
Rated ambient temperature t_a (°C).....: N/A
Short-circuit voltage (V).....: N/A

Test case verdicts

Test case does not apply to the test object.....: N(A.)
Test item does meet the requirement.....: P(ass)
Test item does not meet the requirement.....: F(ail)

General remarks

This test report shall not be reproduced except in full without the written approval of the testing laboratory.

The test results presented in this report relate only to the item tested.

The series products have the same circuit diagram, PCB layout and functionality. The differences are the model name and power, so, we select BK-10KVA to test.



Copy of marking plate

SINGLE PHASE DRY ISOLATION TRANSFORMER

Model: BK-10KVA

Rating(s): 660 Vac, 50/60Hz, 15A



SHANGHAI MINGBEN POWER EQUIPMENT
MANUFACTURING CO., LTD

MADE IN CHINA

Prepared by :

Adam Chen

Engineer

Reviewer :

Jacky Zhang



Approved & Authorized Signer :

Manager



EN 61558-1			
Clause	Requirement – Test	Result - Remark	Verdict
8	MARKING AND OTHER INFORMATION		---
8.1	Transformer marked with: See manual		---
	a) rated supply voltage or voltage range (V)	See manual	P
	b) rated output voltage (V)	See manual	P
	c) rated output (VA, kVA or W)	See manual	P
	d) rated output current (A)	See manual	P
	e) rated frequency (Hz)	See manual	P
	f) rated power factor (if not 1)	See manual	P
	g) symbol for nature of output current for transformers with rectifier	See manual	P
	h) symbol for electrical function (according to Part 2)	See manual	P
	i) manufacturer's name or trademark	See manual	P
	j) model or type reference	See manual	P
	k) vector group according to EN 76 for three-phase transformer		N
	l) symbol for Class II		N
	m) symbol for Class III		N
	n) index IP (if not IP00 or IP20) or ordinary transformer	IPX0	N
	o) rated max. ambient temperature t_a (if not 25 °C)	See manual	P
	p) short-time operation or intermittent operation: rated operating and resting time	Continuous operation	N
	- short-circuit voltage (% rated supply voltage) for stationary transformers > 1000 VA		P
8.2	Marking for transformers IP00 or for associated transformers: type and trademark, instruction sheets	IPX0	P
8.3	Adjusted voltage easily and clearly discernible	No adjusted voltage	N
8.4	For each tapping or winding: rated output voltage and rated output		P
8.5	Symbol for short-circuit proof transformers or non-inherently short-circuit proof transformers		N



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Clause	Requirement – Test	Result - Remark	Verdict
	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		P
	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
	Characteristic symbol for fail-safe transformers		P
8.6	Terminals for neutral: "N"		P
	Terminal for earthing		P
	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		N
8.8	Instruction sheet for type X, Y, Z attachments	Type Y	P
8.9	Transformer for indoor use shall be marked on the label or in the instruction sheet with the words: "for indoor use only"	Indoor use, see product manual	P
8.10	Symbol for Class II construction not confused with maker's name or trademark		N
8.11	Correct symbols: (See marking label)		---
	Volts		P
	Amperes		P
	Volt amperes (or volt-amperes reactive for reactors)		N
	Watts		P
	Hertz		P
	Input		P
	Output		P
	Direct current		P
	Neutral		P
	Single-phase a.c.		N
	Three-phase a.c.		N



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Clause	Requirement – Test	Result - Remark	Verdict
	Three-phase and neutral a.c.		P
	Power factor		P
	Class II construction		N
	Class III construction		N
	Fuse-link		P
	Rated max. ambient temperature	In product manual	P
	Frame or core terminal		P
	Protective earth		P
	IP number	IPX0	N
	For indoor use only (text)		P
8.12	Figures, letters or other visual means for different positions of regulating devices and switches		P
	OFF position indicated by figure 0		P
	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		P
	Marking for terminals: no confusion between input and output		P
	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		P
8.14	Special informations for installation if necessary		N
8.15	Marking durable and easily legible	After testing, the marking was still legible	P

9	PROTECTION AGAINST ACCESSIBILITY OF HAZARDOUS LIVE PARTS	---
9.1	Live parts are not hazardous live if:	---



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Clause	Requirement – Test	Result - Remark	Verdict
	- in case of a plug: 5 s after the interruption of the supply the voltage between the pins shall not exceed 35 V (peak) a.c. or 60 V ripple free d.c.		N
	The live part is not hazardous live if separated from the supply by double or reinforced insulation (see 19.8) and between any parts of contacts the following values do not exceed:		---
	a) touch voltage < 35 V (peak) a.c. or 60 V d.c.		N
	b) if the voltage higher than limited in a) touch current according to Annex J		N
	for a.c. U2: 0,35 V peak (0,7 mA peak)		N
	for d.c. U1: 1 V d.c. peak (2 mA d.c.)		N
	for a.c. U1: 35 V peak (70 mA a.c. higher frequencies)		N
	c) discharge: < 50 μ C (between 60 V and 15 kV)		N
	d) energy: < 350 mJ (> 15 kV)		P
9.2	If the no-load output voltage is \leq 35 V peak a.c. or 60 V ripple-free d.c., live parts may be accessible	Not accessible	P
	Transformers > IP00 shall have an adequate protection against accidental contact: (IPX0)		---
	- with hazardous live parts		P
	- with metal parts separated from hazardous live parts for Class II transformers by basic insulation even after removal of detachable parts except for:		N
	- lamps with caps other than E10		N
	- type D fuse-carriers		N
	Lacquers, enamel, paper, cotton, oxide film on metal parts not used for protection against accidental contact with hazardous live parts:		---
	- compliance is checked by inspection and by relevant tests according to EN 60 529		P
	- ordinary transformer: test according to fig. 2 (test finger)		P
	- Class II transformers and Class II parts of Class I construction are tested with the test pin shown in fig. 3		N
	- hazardous live parts shall not be touchable by test finger	Built-in	P



EN 61558-1			
Clause	Requirement – Test	Result - Remark	Verdict
	- 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	Hazardous live parts were enclosed after installing	P

10	CHANGE OF INPUT VOLTAGE SETTING (Single input voltage)		P
	Voltage setting not possible to change without a tool		P
	Different rated supply voltages:		---
	- indication of voltage on the transformer discernible		N

11	OUTPUT VOLTAGE AND OUTPUT CURRENT UNDER LOAD		P
11.1	Difference from rated value (without rectifier; with rectifier):		---
	a) inherently short-circuit proof transformers with one rated output voltage for output voltage: $\leq 10\%$; $\leq 15\%$	$\leq 10\%$	P
	b) inherently short-circuit proof transformers with one more than 1 rated output voltage for highest output voltage: $\leq 10\%$; $\leq 15\%$	$\leq 15\%$	P
	c) idem for other output voltages: $\leq 15\%$; $\leq 20\%$	$\leq 20\%$	P
	d) other transformers for output voltages: $\leq 5\%$; $\leq 10\%$ d.c.		N

12	NO-LOAD OUTPUT VOLTAGE (see supplementary requirements in Part 2)		---
	Remark: with rectifier measuring on both sides of the rectifier	Without rectifier in the appliance	N

13	SHORT-CIRCUIT VOLTAGE		---
	Difference from marking for short-circuit voltage $\leq 20\%$	$< 20\%$	P



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Clause	Requirement – Test	Result - Remark	Verdict
14	HEATING		---
14.1	No excessive temperature in normal use		P
14.1.1	Classified material according to EN 60 085 and EN 60 216 insulating class temperature index	Class B	P
14.1.2	No classified material but the measured temperature does not exceed the value of Class A		N
14.1.3	No classified material 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
14.2	Upri (V): 1,06 times rated supply voltage	660x1.1=726V	P
	Cos ϕ = rated power factor		N
	Room temperature: rated ambient temperature (°C)	35°C	P
	Type X, Y, Z attachments: 1 pull (5 N) to the connection windings	Type Y	P
	Temperature of windings:		---
	- 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:		---
	- metal: ≤ 70 K		P
	- other material: ≤ 80 K		P
	Temperature of external enclosure of stationary transformer ≤ 85 °C (not touchable with the EN test finger)		P
	Temperature of external enclosures, handles, etc. of portable transformers:		---
	- continuously held parts of metal: ≤ 55 °C		N
	- continuously held parts of other material: ≤ 75 °C		N



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Clause	Requirement – Test	Result - Remark	Verdict
	- not continuously held parts of metal: $\leq 60\text{ }^{\circ}\text{C}$		N
	- not continuously held parts of other material: $\leq 80\text{ }^{\circ}\text{C}$		N
	Temperature of terminals for external conductors $\leq 70\text{ }^{\circ}\text{C}$		P
	Temperature of terminals of switches $\leq 70\text{ }^{\circ}\text{C}$		P
	Temperature of internal and external wiring:		---
	- rubber: $\leq 65\text{ }^{\circ}\text{C}$		N
	- PVC: $\leq 70\text{ }^{\circ}\text{C}$		P
	Temperature of parts where safety can be affected:		---
	- rubber: $\leq 75\text{ }^{\circ}\text{C}$		N
	- phenol-formaldehyde: $\leq 105\text{ }^{\circ}\text{C}$		N
	- urea-formaldehyde: $\leq 85\text{ }^{\circ}\text{C}$		N
	- impregnated paper and fabric: $\leq 85\text{ }^{\circ}\text{C}$		N
	- impregnated wood: $\leq 85\text{ }^{\circ}\text{C}$		N
	- PVC, polystyrene and similar thermoplastic material: $\leq 65\text{ }^{\circ}\text{C}$		P
	- varnished cambric: $\leq 75\text{ }^{\circ}\text{C}$		N
	Temperature rise of supports $\leq 85\text{ }^{\circ}\text{C}$		P
	Temperature of printed boards:		---
	- bonded with phenol-formaldehyde: $\leq 105\text{ }^{\circ}\text{C}$		N
	- melamine-formaldehyde: $\leq 105\text{ }^{\circ}\text{C}$		N
	- phenol-furfural: $\leq 105\text{ }^{\circ}\text{C}$		N
	- polyester: $\leq 105\text{ }^{\circ}\text{C}$		N
	- bonded with epoxy: $\leq 140\text{ }^{\circ}\text{C}$		N
	Electric strength between input and output windings (18.3, 1 min); test voltage (V)		P
14.3	Cycling test (10 cycles):		---
	- no load current (mA) (18.4)		N
	- no load input (18.4)		N
14.3.1	- heat run (temperature in table 2)		N



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Clause	Requirement – Test	Result - Remark	Verdict
14.3.2	- moisture treatment (48 h, 17.2)		N
14.3.3	- vibration test: 30 min; amplitude 0,35 mm; frequency range: 10 Hz, 55 Hz, 100 Hz		N
14.3.4	After each test:		N
	- insulation resistance (18.1 and 18.2)		N
	- electric strength, no breakdown (18.3); 2 min; test voltage 35% of specified value (table VI)		N
	- electric strength, no breakdown (18.4); no load; duration (min): 2 min; Upri (V): 2 times rated supply voltage; frequency (Hz): 2 times rated frequency ...:		N
	- no load current $\leq 30\%$ (18.4) deviates from the first measurement		N
	- no load input $\leq 30\%$ (18.4) deviates from the first measurement		N

15	SHORT-CIRCUIT AND OVERLOAD PROTECTION		P
15.1	Upri (V): rated supply voltage factor		P
	Max. temperature of winding protected inherently (insulation class): $\leq 150\text{ }^{\circ}\text{C}$ (A); $\leq 165\text{ }^{\circ}\text{C}$ (E); $\leq 175\text{ }^{\circ}\text{C}$ (B); $\leq 190\text{ }^{\circ}\text{C}$ (F); $\leq 210\text{ }^{\circ}\text{C}$ (H)		P
	Max. temperature of winding protected by protective device during the time T given in table 4 (insulation class): $\leq 200\text{ }^{\circ}\text{C}$ (A); $\leq 215\text{ }^{\circ}\text{C}$ (E); $\leq 225\text{ }^{\circ}\text{C}$ (B); $\leq 240\text{ }^{\circ}\text{C}$ (F); $\leq 260\text{ }^{\circ}\text{C}$ (H)		N
	Max. temperature of winding protected by protective device after first hour, peak value (insulation class): $\leq 175\text{ }^{\circ}\text{C}$ (A); $\leq 190\text{ }^{\circ}\text{C}$ (E); $\leq 200\text{ }^{\circ}\text{C}$ (B); $\leq 215\text{ }^{\circ}\text{C}$ (F); $\leq 235\text{ }^{\circ}\text{C}$ (H)		N
	Max. temperature of winding protected by protective device after first hour, arithmetic mean value (insulation class): $\leq 150\text{ }^{\circ}\text{C}$ (A); $\leq 165\text{ }^{\circ}\text{C}$ (E); $\leq 175\text{ }^{\circ}\text{C}$ (B); $\leq 190\text{ }^{\circ}\text{C}$ (F); $\leq 210\text{ }^{\circ}\text{C}$ (H)		N
	Max. temperature of external enclosures (accessible by test finger) $\leq 105\text{ }^{\circ}\text{C}$		N
	Max. temperature of insulation of wiring (rubber and PVC) $\leq 85\text{ }^{\circ}\text{C}$		N



EN 61558-1			
Clause	Requirement – Test	Result - Remark	Verdict
	Temperature rise of supports $\leq 105\text{ }^{\circ}\text{C}$		P
15.2	For inherently short-circuit proof transformers and for transformers with rectifiers: temperature rises \leq values in table 3		P
15.3	For non-inherently short-circuit proof transformers and for transformers with rectifiers: temperature rises \leq values in table 3		N
15.3.1	Output terminals short-circuited: protection device operates		N
15.3.2	If protected by a fuse according to EN 60 269-2 or EN 60 269-3 or a technically equivalent fuse, transformer is loaded with time T and a current equal to k times values according to table 4		N
15.3.3	If protected by a fuse according to EN 60 127 or ISO 8820 or a technically equivalent fuse, transformer is loaded for the longest pre-arcing time with the redundant current as specified in the standard sheet		N
15.3.4	If protected by a circuit-breaker according to EN 60 898 the transformer is loaded with a current equal to 1,45 times the value of the circuit-breaker		N
15.3.5	If other overload protection than a fuse (EN 60 127) or a circuit-breaker (EN 60 898) test with 0,95 times of operating current		N
15.3.6	If thermal cut-outs, test with 0,95 times of operating current		N
15.4	For non-short-circuit proof transformers: temperature rises \leq values in table 3		N
15.5	For fail-safe transformers:		---
	- Upri (V): 1,1 times rated supply voltage	726V	P
	- Isec (A): 1,5 times rated output current		P
	- time until steady-state conditions t1 (h)		N
	- time until failure t2 (h): $\leq t1$; $\leq 5\text{ h}$		P
	During the test:		---
	- no flames, molten material, etc.		P
	- temperature of enclosure $\leq 175\text{ }^{\circ}\text{C}$		P



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Clause	Requirement – Test	Result - Remark	Verdict
	- temperature of plywood support $\leq 125^{\circ}\text{C}$		P
	After the test:		---
	- electric strength (Cl. 18, 1 min, test voltage: 35% of specified value); no flashover or breakdown for primary-to-secondary only for safety isolating, isolating and separating transformer and for primary-to-body for all kinds of transformer		P
	- bare hazardous live parts not accessible by test finger through holes of enclosure		P

16	MECHANICAL STRENGTH		P
16.1	After tests of 16.2 and 16.3 and 16.4:		---
	- no damage		P
	- hazardous live parts not accessible by test pin according to 9.2		P
	- no damage for insulating barriers		P
	- handles, levers, etc. have not moved on shafts	No such devices	N
16.2	For stationary and portable transformers: 3 blows, impact energy 0,5 Nm		P
16.3	For portable transformers: 100 falls, 25 mm		N
16.4	Transformers with integrated pins, the following tests are carried out:		---
	a) plug-in transformers: tumbling barrel test: $50\text{ x } \leq 250\text{ g}$; $25\text{ x } \leq 250\text{ g}$		P
	b) torque test of the plug pins with 0,4 Nm		P
	c) pull force according to table 5 for each pin		P

17	PROTECTION AGAINST HARMFUL INGRESS OF WATER AND MOISTURE		---
17.1	IP number marked on the transformer	IPX0	N
	Test according to 17.1.1 and for other IP ratings test according to EN 60 529:		---
	- stable operating temperature before starting the test for $< \text{IPX8}$		N
	- transformer mounted and wired as in normal use		N



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Clause	Requirement – Test	Result - Remark	Verdict
	- fixed transformer mounted as in normal use by the tests according to 17.1.1 A to J		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:		---
	- dielectric strength test according to 18.3		N
	Inspection:		---
	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 or insulation if hazard for the user or surroundings no reduction of creepage distances		N
	d) no accumulation of water in transformers \geq IPX1 so as to impair safety		N
	e) no trace of water entered in any part of watertight transformer		N
	f) no entry into the transformer by the relevant test probe		N
17.1.1	Tests:		---
	A) Solid-object-proof transformers: first IP numeral 2 test finger (EN 60 529) and test pin (fig. 3)		N
	B) Solid-object-proof transformers:		---
	- first IP numeral 3, wire 2,5 mm; force 3 N		N
	- first IP numeral 4, wire 1 mm; force 1 N		N
	C) Dust-proof transformers, first characteristic IP numeral 5; dust chamber according to EN 60 529, fig. 2:		---
	a) transformer has operating temperature		N
	b) transformer, still operating, is placed in the dust chamber		N
	c) the door of the dust chamber is closed		N



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Clause	Requirement – Test	Result - Remark	Verdict
	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 (IPX6) test according to C)		N
	E) Drip-proof transformers (IPX1) test according to fig. 3 of EN 60 529 for 10 min		N
	F) Rain-proof transformers (IPX3) test according to fig. 4 of EN 60 529 for 10 min in operation and 10 min switched off (the tube shall oscillate 2 x 120 °C)		N
	G) Splash-proof transformers (IPX4) test according to fig. 4 of EN 60 529 (see F) for 10 min in operation and 10 min switched off (the tube shall oscillate 2 x 360 °C)		N
	H) Jet-proof transformer (IPX5) test according to fig. 6 of EN 60 529		N
	I) Watertight transformers (IPX7)		N
	J) Pressure watertight transformers (IPX8)		N
17.2	After moisture test (48 h for ≤ IP20, 168 h for other transformers):		---
	- insulation resistance and electric strength (Cl. 18)		N

18	INSULATION RESISTANCE AND ELECTRIC STRENGTH		P
18.2	Insulation resistance between:		---
	- live parts and body for basic insulation $\geq 2 \text{ M}\Omega$		P
	- live parts and body for reinforced insulation $\geq 7 \text{ M}\Omega$		P
	- input circuits and output circuits for basic insulation $\geq 2 \text{ M}\Omega$		P
	- input circuits and output circuits for double or reinforced insulation $\geq 5 \text{ M}\Omega$	$>100 \text{ M}\Omega$	P
	- each input circuit and all other input circuits connected together $\geq 2 \text{ M}\Omega$		N
	- each output circuit and all other output circuits connected together $\geq 2 \text{ M}\Omega$		N



EN 61558-1			
Clause	Requirement – Test	Result - Remark	Verdict
	- hazardous live parts and metal parts with basic insulation (Class II transformers) $\geq 2 \text{ M}\Omega$	$>100 \text{ M}\Omega$	P
	- body and metal parts with basic insulation (Class II transformers) $\geq 5 \text{ M}\Omega$		N
	- metal foil in contact with inner and outer surfaces of enclosures $\geq 2 \text{ M}\Omega$		N
18.3	Electric strength test (1 min): no flashover or breakdown:		---
	1) basic insulation between input circuits and output circuits; working voltage (V); test voltage (V)		P
	2) double or reinforced insulation between input circuits and output circuits; working voltage (V); test voltage (V)		P
	3) basic or supplementary insulation between:		P
	a) live parts of different polarity; working voltage (V); test voltage (V)		P
	b) live parts and the body if intended to be connected to protective earth		P
	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)		P
18.4	Upri (V): 2 times rated input voltage; no load; frequency (Hz): 2 times rated frequency; duration (min): 5 min		P
	No breakdown between:		---
	- turns of winding		N
	- input and output windings		P
	- adjacent input or output windings		N
	- windings and iron core		P
19	CONSTRUCTION		---
19.1	Insulation input and output specified in relevant Part 2		N



EN 61558-1			
Clause	Requirement – Test	Result - Remark	Verdict
19.2	Fiercely burning material not used		P
	Unimpregnated cotton, silk, paper and fibrous material not used as insulation		P
	Wax, impregnants, etc. not used		P
19.3	Portable transformer: short-circuit proof or fail-safe		N
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		N
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 $\leq 50\%$ specified values (Cl. 26)		P
19.7	Parts connected to accessible metal parts by resistors or capacitors shall be separated from hazardous live parts by double or reinforced insulation	Not accessible metal parts	N
19.8	Resistors or capacitors connected between hazardous live parts and accessible metal parts consist of:		---
	- at least two separate components		P
	- if one component is short-circuited or open circuited, values specified in Cl. 9 shall not be exceeded		P
	- components according to EN 60 065, 14.1 or capacitor Y1 according to EN 60 384-14		P
19.9	Insulation material input/output and supplementary insulation of rubber resistant to ageing		P
	Creepage distances (if cracks) \geq specified values (Cl. 26)		P
19.10	Protection against accidental contact by insulating coating:		---
	a) ageing test (section I, EN 60 068-2-2), test Ba: 168 h; 70 °C		N
	b) impact test (spring-operated impact hammer according to EN 60 068-2-63; 0,5 \pm 0,05 J)		N



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Clause	Requirement – Test	Result - Remark	Verdict
	c) scratch test (hardened steel pin) electric strength test according to Cl. 18		N
19.11	Handles, levers, knobs, etc.:		---
	- insulating material	No such devices	N
	- supplementary insulation covering		N
	- separated from shafts or fixing by supplementary insulation		N
19.12	Windings construction		P
19.12.1	In all types of transformer, precautions shall be taken to prevent:		---
	- undue displacement of input or output windings or turns thereof		P
	- undue displacement of internal wiring or wires for external connection		P
	- undue displacement of parts of windings or of internal wiring in case of rupture or loosening		P
19.12.2	Serrated tape:		---
	- distance through insulation according to table 13		N
	- 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	Insulated windings wires:		---
	- to all types of transformers for basic or supplementary insulation taken separately		N
	- transformers for switch mode power supplies for all types of insulation even in combination		N
	a) Winding wire with basic or supplementary insulation:		---
	- comply with Annex K		N
	- the insulation of the conductor: two layers		N
	b) Winding wire with double or reinforced insulation:		N
	- comply with Annex K		N
	- the insulation of the conductor: three layers		N



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Clause	Requirement – Test	Result - Remark	Verdict
	- two adjacent insulated wires: separated by double insulation, each insulation (basic and supplementary) is rated for the working voltage of the insulation system		N
	c) Routine test according to Annex K.3 for windings giving double or reinforced insulation:		---
	- thermal cycling test according to 14.3		N
	- test according to 27.3		N
	- in table 13, table C.1 and table D.2, box 2) c), no value is required		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	No covers	N
19.15	Transformer with pins for fixed socket-outlets: no strain on socket-outlet		N
	Additional torque $\leq 0,25$ Nm		N
19.16	Protection index for portable transformers:		---
	≤ 200 VA \geq IP20 and instructions for use		N
	> 200 VA $\leq 2,5$ kVA \geq IPX4 (single-phase)		N
	> 200 VA $\leq 6,3$ kVA \geq IPX4 (polyphase)		N
	$> 2,5$ kVA (single-phase) \geq IP21		N
	$> 6,3$ kVA (polyphase) \geq IP21		N
19.17	Transformers IPX1-IPX6 totally enclosed, except for drain hole (diameter ≥ 5 mm or 20 mm ² with width ≥ 3 mm); drain hole not required for transformer completely filled with insulating materials		N
	Transformers \geq IPX7 totally enclosed		N
19.18	Transformers \geq IPX1 with a moulded, if any		N
19.19	Class I transformers with a non-detachable flexible cable or cord with earthing conductor and a plug with earthing contact		P
19.20	Live parts of SELV and PELV-circuits: separation not less than PRI/SEC of a safety isolating transformer	Safety isolating transformer	P



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Clause	Requirement – Test	Result - Remark	Verdict
19.20.1	SELV circuits and parts not connected to 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		P
19.20.2	PELV-circuits double or reinforced insulation is necessary		N
19.21	PELV-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 earthing		N
	For fixed transformers an earthing 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 earthing		N

20	COMPONENTS		---
20.1	Switches, plugs, fuses, lampholders, flexible cables and cords comply with relevant EN standard		P
	Appliance couplers for main supply shall comply with:		---
	- EN 60 320 for IPX0		N
	- EN 60 309 for other		N
	Automatic controls shall comply with EN 60 730- 1		N
20.2	Disconnection from the supply:		---
	- all-poles switches with contact separation ≥ 3 mm		P
	- flexible cable and cord with plug		P
	- instruction sheet: disconnection by all-poles switches (with normal gap) incorporated in fixed wiring		N
20.3	Socket-outlets in the output circuit shall not comply with socket-outlets of the input circuit		P
	Plugs and socket-outlets for SELV for general use comply with the requirements of EN 60 906- 3		N



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Clause	Requirement – Test	Result - Remark	Verdict
	Other plugs and socket-outlets for SELV for special use (associated transformers)		N
	Plugs and socket-outlets for PELV systems shall comply with:		---
	- plugs shall not be able to enter in socket-outlets of other standardized voltage systems		N
	- socket-outlets shall not admit plugs of other standardized voltage systems		N
	- no protective earthing contact on socket-outlets		N
	Plugs and socket-outlets for PELV systems shall comply with:		---
	- plugs shall not be able to enter in socket-outlets of other standardized voltage systems		N
	- socket-outlets shall not admit plugs of other standardized voltage systems		N
20.4	Thermal cut-outs, overload releases etc. have adequate breaking capacity		N
20.5.1	Thermal cut-out tested as component shall comply with EN 60 730-1		N
20.5.2	Thermal cut-out tested as a part of the transformer, number of cycles of automatic action:		---
	- 3000 cycles for thermal cut-outs with self-resettable reset		N
	- 300 cycles for thermal cut-outs which are non-self-resettable		N
	- 30 cycles for thermal cut-outs which are only resettable by a tool		N
20.5.3	Test of a PTC resistor:		N
	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
20.6	Thermal-links shall comply with EN 60 691	VDE approval	P
20.6.2	Thermal-links tested as a part of the transformer:		---
	- ageing test 300 h by 35 °C or ta + 10 °C		N
	- after opening the thermal-link shall have an insulation resistance of at least 0,2 MΩ		N



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Clause	Requirement – Test	Result - Remark	Verdict
	- 10 cycles for replaceable thermal-links		N
	- 3 new specimens for not replaceable thermal-links		N
20.7	Self-resetting devices not used if mechanical, electrical, etc. hazards		N
20.8	Overload protection by thermal cut-outs which can be reset by soldering operation not allowed		N
20.9	Overload protection devices do not operate during test (20 times switched on and off, no load); Upri (V): 1,06 times rated supply voltage		N

21	INTERNAL WIRING		---
21.1	Internal wiring and electrical connections protected or enclosed		P
	Wireways smooth and free from sharp edges		P
21.2	Openings in sheet metal: edges rounded (radius $\geq 1,5$ mm) or bushings of insulating material		P
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 14.2		P

22	SUPPLY CONNECTION AND EXTERNAL FLEXIBLE CABLES AND CORDS		---
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:		---



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Clause	Requirement – Test	Result - Remark	Verdict
	- possible to connect after fixing		P
	- inside space for wires allow easy introduction and connection of conductors		P
	- fitting of cover without damage to conductors		P
	- contact between insulation of external supply wires and live parts of different polarity not allowed		P
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 for indoor use only with a mass < 3 kg: H03 VV-F		P
	- for transformers IPX0 for outdoor use only with a mass > 3 kg: H05 RR-F or H05 VV-F		N
	- for transformers IPX0 for outdoor use: H05 RN-F		N
22.6	Power supply cords for single-phase portable transformers with input current ≤ 16 A:		---
	- cord set fitted with an appliance coupler in accordance with EN 60 320		P
22.7	Nominal cross-sectional area (mm ²); input current (A) at rated output not less than shown in table 9 ...:		P
22.8	Class I transformer with power supply flexible cable: green/yellow core connected to earthing terminal		P
	Plug for single-phase transformer with input current at rated output ≤ 16 A according to EN 60 083, EN 60 906-1 or EN 60 309		P
22.9	Type X, Y, or Z attachments: see relevant Part 2	Type Y	P
22.9.1	For type Z attachment: moulding enclosure and power supply cable do not affect insulation of cable		N
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:		---
	- for Class I transformer: insulation of conductor plus separate basic insulation		P
	- for Class II transformer: insulation of conductor plus double or reinforced insulation		N



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Clause	Requirement – Test	Result - Remark	Verdict
22.9.3	Inlet bushings:		---
	- no damage to power supply cord		P
	- reliably fixed		P
	- not removable without tool		P
	- 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		P
22.9.4	For portable transformers which are moved while operating:		---
	- cord guards, if any, of insulating material and fixed		N
	Compliance is tested by the oscillating test according to fig. 7:		---
	- loaded force during the test according to fig. 7		N
	- 10 N for a cross-sectional area $> 0,75$		N
	- 5 N for a cross-sectional area $\leq 0,75$		N
	After the test according to fig. 7:		---
	- no short-circuit between the conductors		N
	- no breakage of more than 10% of strands 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
	- 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



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Clause	Requirement – Test	Result - Remark	Verdict
	- the whole 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
	- screws do not serve to fix any other component unless if omitted or incorrectly mounted the transformer is inoperative or clearly incomplete; compliance or parts not removable without tool		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 external flexible cable or cord insulated from accessible metal parts by:		---
	- 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 whole 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		N
	Test for type X attachments one test with a cord with smallest and one test with a cord with the largest cross-sectional area:		---



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Clause	Requirement – Test	Result - Remark	Verdict
	- 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)		—
	- not possible to push cable into transformer		N
	- during test: cable not damaged		N
	- after test: longitudinal displacement ≤ 2 mm for cable or cord and ≤ 1 mm for conductors in terminals		N
	- creepage distances and clearances \geq values specified in Cl. 26		N
22.9.6	Space for supply cables or external flexible cable or cord for fixed wiring and for type X, and Y attachments:		---
	- 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, 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:		---
	- 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	Type Y attachment	P
	Terminals are integral part of the transformer:		P



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Clause	Requirement – Test	Result - Remark	Verdict
	- comply with EN 60 999- 1 under transformer conditions		P
	Other terminals:		---
	- separately checked according to EN 60 998- 2- 1 , EN 60 998- 2- 2 or EN 60 947- 7- 1		N
	- used in accordance with their marking		P
	- checked according to EN 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 $\geq 50\%$ 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 $\geq 50\%$ 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:		---
	- test by inspection according to 23.1 and 23.2		N
	- pull of 5 N to the connection before test according to 14.2		N
23.3	Other terminals than Y and Z attachments shall be so fixed that when the clamping means is tightened or loosened:		---
	- 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:		---
	- they clamp the conductor between metallic surfaces with sufficient contact pressure		N



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Clause	Requirement – Test	Result - Remark	Verdict
	- 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
23.5	Terminals for fixed wiring and for type X: located near their associated terminals of different polarities and the earthing 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):		---
	- Class I transformers: no connection between live parts and accessible metal parts		N
	- free wire of earthing 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
	Terminals for a current > 25 A:		---
	- pressure plate, or		N
	- two clamping screws		N
23.8	When terminal, other than protective earthing conductor, screws loosened as far as possible, no contact:		---
	- between terminal screws and accessible metal parts		N
	- between terminal screws and accessible metal parts for Class II transformers		N
24	PROVISION FOR PROTECTIVE EARTHING		---
24.1	Class I transformers: accessible parts connected to earthing terminal		P
	Class II transformers: no provision for earthing		N



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Clause	Requirement – Test	Result - Remark	Verdict
24.2	Protective earthing 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 earthing terminal and other terminal		P
	In case of earthing terminal body of A1, no risk of corrosion from contact between Cu and A1		P
	Body of earthing terminal or screws/nuts of brass or other metal resistant to corrosion		P
24.4	Resistance of connection between earthing terminal and metal parts $\leq 0,1 \Omega$ with a min. 25 A or 1,5 times rated input current at 1 min	0.05 Ω	P
24.5	Class I transformers with external flexible cables or cords		---
	- current-carrying conductors becoming taut before the earthing conductor		P

25	SCREWS AND CONNECTIONS		P
25.1	Screwed connections withstand mechanical stresses		P
	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		P
	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 replacement 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



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Clause	Requirement – Test	Result - Remark	Verdict
25.2	Screws in engagement with thread of insulating material:		---
	- length of engagement $\geq 3 \text{ mm} + 1/2$ screw diameter or 8 mm		N
	- correct introduction into screw hole		N
25.3	Electrical connections: contact pressure not transmitted through insulating material		P
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 earthing 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
25.5	Screws for current-carrying mechanical connections locked against loosening		N
	Rivets for current-carrying connections subject to torsion locked against loosening		P

26	CREEPAGE DISTANCES AND CLEARANCES		P
26.1	Specified values according to:		---
	- table 13, material group IIIa		P
	- table C, material group II		N
	- table D, material group I		N
	1. Insulation between input and output circuits (basic insulation):		---
	a) measured values \geq specified values (mm)		P
	2. Insulation between input and output circuits (double or reinforced insulation):		---
	a) measured values \geq specified values (mm)		P
	b) measured values \geq specified values (mm)		N
	c) measured values \geq specified values (mm)		N



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Clause	Requirement – Test	Result - Remark	Verdict
	3. Insulation between adjacent input circuits: measured values \geq specified values (mm)		N
	Insulation between adjacent output circuits: measured values \geq specified values (mm)		N
	4. Insulation between terminals for external connection:		---
	a) measured values \geq specified values (mm)		N
	b) measured values \geq specified values (mm)		N
	c) measured values \geq specified values (mm)		N
	5. Basic or supplementary insulation:		---
	a) measured values \geq specified values (mm)		N
	b) measured values \geq specified values (mm)		N
	c) measured values \geq specified values (mm)		N
	d) measured values \geq specified values (mm)		P
	e) measured values \geq specified values (mm)		N
	6. Reinforced or double insulation: measured values \geq specified values (mm)		N
	7. Distance through insulation:		--
	a) measured values \geq specified values (mm)		N
	b) measured values \geq specified values (mm)		N
	c) measured values \geq specified values (mm)		P
	d) measured values \geq specified values (mm)		N
	Creepage distances and clearances are measured:		---
	- for fixed wiring and type X attachments with max. and min. size		N
	- for type X with a special cord, Y or Z attachments with the supply cable as delivered		N
	- for layers of serrated tapes the values are so determined as if the serration coincided through the different layers		N
	- for printed wiring shall be used the unreduced values for live parts as in table 13, C.1 or D.1, except if printed wiring complies with EN 60 664-3		N



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Clause	Requirement – Test	Result - Remark	Verdict
	If the pollution generates high and persistent conductivity caused, for instance, by conductive dust or by rain or snow:		---
	- clearances of P3 increased with min. 1,6 mm		N
	- value X in Annex A increased with 4,0 mm		N
26.2	Creepage distances (cr)		N
	A) To test the potting or impregnation, three transformers are used:		---
	- thermal class		N
	- working voltage		N
	Test with three transformers		N
	Two of the three specimens are subjected to:		---
	- 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
	Impulse dielectric test according to 4.1.1.2.1 of EN 60 664-1 (1,2 / 50 μ s waveform)		N
	Impulse test voltage		N
	Requirements of reduced values as stated for pollution degree 1 (P1) are fulfilled (see 26.1)		N
	B) To test parts which are connected (stuck) together		---
	- thermal class		N
	- working voltage		N
	Test with three specially prepared specimens		N
	Two of the three specimens are subjected to:		---
	- the humidity treatment according to 17.2 (48 h)		N
	- the relevant dielectric strength test of 18.3 multiplied with factor 1,6		N
	One of the three specimens is subjected to the relevant dielectric strength test of 18.3 multiplied by the factor 1,6 immediately at the end of the last cycle with high temperature		N



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Clause	Requirement – Test	Result - Remark	Verdict
	Impulse dielectric test according to 4.1.1.2.1 of EN 60 664- 1 (1,2 / 50 μ s waveform)		N
	Impulse test voltage		N
	Requirements of reduced values as stated for pollution degree 1 (P1) are fulfilled (see 26.1)		N
26.3	Insulation in thin sheet form:		---
	- consist of at least three layers (separable or non-separable)		N
	- fulfils the requirements of distance through insulation shown in square brackets in boxes 2 and 7 of table 13 (C.1 / D.1)		N
	- separate or separable layers fulfil the thermal classification according to EN 60 085 and EN 60 216 for each layer		N
	- non-separable layers fulfil the thermal classification of the transformer in the whole composite sheet		N
	Mandrel test of insulation in thin sheet form:		---
	- with two thirds of the number of separate or separable layers in any combination, high voltage test: 5,5 kV one minute, no flashover or breakdown		N
	- with the whole composite sheet of non-separable layers, high voltage test: 5,5 kV one minute, no flashover or breakdown		N
	- with one of the two layers according to note 6 of table 13 (C.1/D.1) without requirements of thickness, high voltage test: 5,5 kV one minute, no flashover or breakdown		N
	The figures within square brackets in boxes 2 and 7 of table 13 (C.1/D.1) are used for insulation in thin sheet form as follows:		---
	- 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 values in square brackets apply		N
	- test according to 14.3 if smaller distances through insulation are used		N



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Clause	Requirement – Test	Result - Remark	Verdict
	Solid insulation consist of a thickness of:		---
	- solid insulation only		N
	- or solid insulation plus one or more air layers (min. 2 layers of insulation)		N
	Reduced values of table 13 (C.1/D.1) may be used for serrated tape if:		---
	- min. 4 layers serrated tape		N
	- and one additional layer without serration covering the location of the serration		N

27	RESISTANCE TO HEAT, ABNORMAL HEAT, FIRE AND TRACKING		---
27.1	Ball-pressure test: diameter of impression ≤ 2 mm; heating cabinet temperature ($^{\circ}\text{C}$)	Plastic parts: 125°C , 0.91mm;	P
27.2	Glow-wire test (650°C):	Plastic parts	P
	- any flame or glowing of the specimen extinguish within 30 s of withdrawing the glow-wire		P
	- no ignition of a single layer of tissue paper		P
27.3	Insulating material retaining live parts in position of transformers $\geq \text{IP20}$: no source of ignition for surroundings in case of abnormal heat or fire		N
	Two special prepared specimens for the test in which short-circuit windings are built-in		N
27.3.1	Portable transformers are placed on a dull painted plywood support		N
	Stationary transformers fixed in the most unfavourable position on a dull painted support:		---
	- if this position for use is vertical or ceiling transformer and support 200 mm above a pinewood board with tissue paper		N
	Self-resettable devices are short-circuit		N
	Input circuits protected with 10 times rated current, min. 16 A (fuse)		N
	Test time for protective devices of the transformer without load:		---
	- max. 15 days, or		N
	- definitive interruption in the input circuit		N



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Clause	Requirement – Test	Result - Remark	Verdict
	If non-self-resettable or replaceable protective devices are used the following cycle test is necessary:		---
	- non-self-resettable: 30 cycles with no load until interruption and 2 h cool down		N
	- replaceable protective device: 10 cycles with no load until interruption and 2 h cool down		N
	During the tests:		---
	- no flames occur		N
	- support temperature shall not exceed 125 °C		N
	- no ignition of the tissue paper		N
27.3.2	After the tests:		---
	a) transformer with definitive interruption in the input circuit withstands the test with 35% of the values according to table 8		N
	b) transformer with no definitive interruption withstands the test voltage (100%) according to table 8 of Cl. 18: hazardous live parts are not touchable by the stranded test finger		N
27.4	Insulating material retaining live parts in position: resistant to abnormal heat and to fire		N
	Ball-pressure test; test temperature (°C)		N
	Glow-wire test (850 °C) for insulating material retaining external conductor terminals (if > 0,5 A):		---
	- any flame or glowing of the specimen extinguish within 30 s of withdrawing the glow-wire		N
	- no ignition of a single layer of tissue paper		N
27.5	For IP other than IPX0: insulating parts retaining live parts in position of material resistant to tracking at least material of group IIIa	IPX0	N
	Test (175 V): no flashover or breakdown before 50 drops		N
28	RESISTANCE TO RUSTING		---
	Ferrous parts protected against rusting		P



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Clause	Requirement – Test	Result - Remark	Verdict

F	ANNEX F, REQUIREMENTS FOR SWITCHES COMPLYING WITH EN 61058		P
F.1	a) Manually operated mechanical switches shall comply with EN 61058 with the conditions specified under F.1 a) and F.5		P
	b) Manually operated mechanical switches tested as part of the apparatus shall comply with the conditions specified under F.2, F.3, F.4 and F.5		P

H	ANNEX H, ELECTRONIC CIRCUITS		N
H.15	Short-circuit and overload protection		---
H.15.6	Circuits designed and applied so that fault conditions do not render the appliance unsafe		N
	During and after each test:		---
	- temperatures do not exceed values specified in table 3 of Cl. 15		N
	- transformer complies with conditions specified in 15.1		N
	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.15.7	Fault conditions a) to f) of B.15.8 are not tested if the following conditions are met:		---
	- 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.15.8	Fault conditions tested as specified when relevant:		---
	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		N
	- short-circuit of capacitors, unless they comply with EN 60 384- 14		N
	d) short-circuit of any two terminals of an electronic component as specified		N
	e) any failure of an integrated circuit as specified		N



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Clause	Requirement – Test	Result - Remark	Verdict
	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		N
	Fault condition e) is applied for encapsulated and similar components		N
	PTC's and NTC's are not short-circuited if they are used as specified		N
H.15.9	If for a fuse-link complying with EN 60 127-3 rated fuse current I1 is used, current I2 is measured as specified:		---
	- if $I2 < 2,1 \times I1$ test of 15.8 is repeated with fuse-link short-circuited		N
	- if $I2 > 2,75 \times I1$, no other tests are necessary		N
	If $I2 > 2,1 \times I1$ and $I2 < 2,75 \times I1$ test of 15.8 is repeated as specified		N
	For fuses other than those complying with EN 60 127-3, the test is carried out as specified 15.3.2 to 15.3.5		N
H.26	CREEPAGE DISTANCES, CLEARANCES AND DISTANCES THROUGH INSULATION		N
H.26.1	For conductive pattern's on pcb's, except their edges, creepage distances between different polarity may be reduced as specified		N
	For peak voltages > 50 V reduced creepage distances only apply if proof tracking index (PTI) has a resistance to tracking corresponding to at least material group IIIa		N
	The distances may be further reduced as specified (see H.15)		N
	Creepage distances and clearances within optocouplers are not measured as specified		N
H.26.2	For optocouplers the conditioning procedure of 26.2 is carried out as specified		N



EN 61558-1			
Clause	Requirement – Test	Result - Remark	Verdict
K	ANNEX K, INSULATED WINDING WIRES FOR USE AS MULTIPLE LAYER INSULATION		N
K.1	Wire construction:		N
	- insulated winding wire with min. two layers for basic or supplementary insulation		N
	- insulated winding wire with min. three layers for reinforced insulation		N
	- winding insulation material		N
K.2	Conformance test		N
K.2.1	Test 13 of EN 60 851-5 nominal conductor diameter $\geq 0,018 \text{ mm} \leq 0,1 \text{ mm}$		N
	Test as specified in 4.2.1 and 4.2.2 of EN 60 851-5		N
	Nominal conductor diameter $> 0,1 \text{ mm}, \leq 2,5 \text{ mm}$, test as specified in 4.3.1 and 4.3.2 of EN 60 851-5		N
	Nominal conductor diameter $< 2,5 \text{ mm}$, test as specified in 4.4.1 and 4.4.2 of EN 60 851-5		N
	High voltage test immediately after the above specified tests:		---
	- test voltage for two layers 3 kV		N
	- test voltage for three layers 5,5 kV		N
K.2.2	Adherence and flexibility, test as specified under 5.1.4 of EN 60 851-3		---
	- high voltage test immediately after this test		N
	- test voltage for two layers 3 kV		N
	- test voltage for three layers 5,5 kV		N
K.2.3	Heat shock, test as specified under 3.1 or 3.2 of EN 60 851-6:		---
	- high voltage test immediately after this test		N
	- test voltage for two layers 3 kV		N
	- test voltage for three layers 5,5 kV		N
K.2.4	Retention of dielectric strength after bending, test as specified under test 13 of 4.6.1 c) of EN 60 851-5		---
	- high voltage test immediately after this test		N
	- test voltage for two layers 3 kV		N
	- test voltage for three layers 5,5 kV		N



11	TABLE: output voltage and output current under load; no-load output voltage					P
Clause		11		12		
type / rated output	rated voltage Vac	sec. voltage Vac	delta Usec %	Usec Vac no-load output	delta Usec no-load output %	further information
660	660	726	1 %			under load

14	TABLE: heating					P
	test voltage (V)	726V				—
	t1 (°C)	25.1				—
	t2 (°C)	25.2				—
temperature rise dT of part/at:		dT (°C)		required dT (°C)		
Transformer primary winding		75.3		120		
Transformer secondary winding		80.2		120		
Transformer core		78.9		---		
Input wire		62.3		105		
Output wire		50.1		80		
Enclosure, inside near core		48.2		80		
Enclosure, outside near core		45.4		80		
Supporting		46.5		85		
temperature rise dT of winding:		R ₁ (Ω)	R ₂ (Ω)	dT (°C)	required dT (°C)	insulation class
Primary winding		25.3	30.4	82.3	120	B

15	TABLE: Short-circuit and overload protection					N
	test voltage (V)	726V				—
	t1 (°C)	25.3				—
	t2 (°C)	25.6				—
temperature rise dT of part/at:		dT (°C)		required dT (°C)		
Ambient		24.6		--		
temperature rise dT of winding:		R ₁ (Ω)	R ₂ (Ω)	dT (°C)	required dT (°C)	insulation class
Primary winding		25.3	32.6	100.3	150	B
Note: after 4h12mins, temperature of the unit is steady, then output was short-circuited, the unit shut down immediately, recoverable after removal the fault condition.						
18.2	TABLE: Insulation resistance:					P



Test points		Measured insulation	Limited insulation resistance
Between	To		
Hazardous live part	Enclosure	>100MΩ	7MΩ
Inner of surface of enclosure	Outer of surface of enclosure	>100MΩ	2MΩ
Primary winding	Secondary winding	>100MΩ	5MΩ
Primary winding	Core	>100MΩ	2MΩ
Secondary winding	Core	>100MΩ	2MΩ

18.3	TABLE: electric strength measurements:		P
Test voltage applied between:		Test voltage (V)	Breakdown
L to N		AC 2500	No
Input to output		AC 5000	No
Input to enclosure		AC 5000	No

26	TABLE: creepage distances and clearances and distances through insulation						P
	Test with three specially prepared specimens						
Clearance (cl) and creepage distance (cr) at/of/between:	U peak (V)	U r.m.s. (V)	Required cl (mm)	Measured cl (mm)	Required cr(mm)	Measured cl (mm)	
L to N	670	660	4.0	5.4	5.0	5.4	
core to secondary	672	661	4.8	6.1	5.0	6.1	

27.1	TABLE: ball-pressure tests for thermoplastics			P
Limited impression diameter (mm)			≤2 mm	---
Part	Test temperature (°C)		Impression diameter (mm)	
Plastic parts	125 °C		0.91	

27.2	TABLE: glow wire test		P
Part	Test temperature (°C)	Result	
Plastic parts	650 °C	Not burning	



ANNEX A:

Photo-documentation



Photo 1

End of the report