Vojenský technický ústav, s.p.
odštěpný závod VTÚPV
Víta Nejedlého 691, 682 01 Vyškov, Czech Republic

CERTIFICATE
No VTÚPV – 032 / 2026 / ZAHR

Applicant: **Shanghai Matis Electric Co., Ltd.**
上海麦豆电气有限公司
Room318-320, No.83, West Huanghu Road, Pudong, Shanghai, China 201306

Product: **Smart Metering RCBO**

Tested Model: MT61GR
Derived Models: MT61SR

Manufacturer: **Shanghai Matis Electric Co., Ltd.**
Room318-320, No.83, West Huanghu Road, Pudong, Shanghai, China 201306

Rating and principal characteristics:
Ue: 230/240 V AC (2P); 400/415 V AC (4P);
Frequency: 50/60 Hz;
In: 6/10/16/20/25/32/40/50/63A/80A/100A/125A (B/C/D-type);
Icn=Ics= 6.0 kA;
IΔn= 100, 300 mA; Type -A & -AC;
With time delay: Type S

Test results are described in the Test Reports No.:
STE03092666S (tests made by STE Testing Laboratory Co., Ltd)

The sample of tested product conforms with the requirements of the following standards harmonized with the LVD Directive No. 2014/35/EU

- EN 61009-1: 2012 + A1: 2014 + A2: 2014 + A11: 2015 + A12: 2016 + A13: 2021

This certificate is valid until: **13. 04. 2031**

After preparation of the necessary technical documentation as well as the conformity declaration, the required CE marking can be affixed on the product. Other relevant directives have to be observed.
The CE mark shall appear according to this sample:

CE

odštěpný závod VTÚPV
VTÚPV
VOJENSKÝ TECHNICKÝ ÚSTAV, s.p.

Vyškov 13. 04. 2026

Tel./Fax: +420 910 105 580
e-mail: milan.bezdek@vtusp.cz
http://www.vtusp.cz

Milan Bezděk
Certification Head

EU DECLARATION OF CONFORMITY

This Is Hereby Declared That Following Designated Product Complied With The Essential

Manufacturer **Name: Shanghai Matis Electric Co., Ltd** **Address: Room318-320, No.83,West Huanghu Road, Pudong, Shanghai, China 201306**
Authorized Representative Established Within The Eu: **Company Name:Shanghai Matis Electric Co., Ltd** **Company Address:Room318-320, No.83,West Huanghu Road, Pudong, Shanghai, China 201306**
Product Name：Smart Metering RCBO
Model：MT61GR，MT61SR
Trademark: Matis/Matismart
Meets All Relevant Requirements Of The Following European Directives： **2014/35/EU Low Voltage Directive**
Applicable Standards： **EN 61009-1:2012/A13:2021**

THIS DECLARATION APPLIES TO ALL SPECIMENS MANUFACTURED IDENTICAL TO THE MODELSUBMITTED FOR TESTING / EVALUATION. ASSESSMENT OF COMPLIANCE OF THE PRODUCT WITHTHE REOUIREMENTS RELATING TO SAFETY STANDARDS LISTED ABOVE WAS PERFORMED BYMANUFACTURE.

SIGNED ON BEHALF OF Shanghai Matis Electric Co., Ltd

CE

Title and Signature: Timmy Bao

Date and place: 2026.3.24, Shanghai

Seal:

TEST REPORT

Report No.:	**STE03092666S**
Product:	Smart Metering RCBO
Model No.:	MT61GR
Prepared for:	**Shanghai Matis Electric Co., Ltd**
Address:	Room 318-320, No. 83, West Huanghu Road, Pudong, Shanghai, China 201306
Prepared by:	**Shenzhen STE Testing Laboratory Co., Ltd.**
Lab Location:	3/F, Building 9, Hongde Factory, No. 63 Yuchang Road, Niuhu Community, Guanlan Street, Longhua District, Shenzhen, China
Tel. :	+86-755-2373 0717
Fax. :	+86-755-2373 0717
Website:	http://www.stecert.com

TEST REPORT

EN 61009-1

Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBOs)

Part 1: General rules

Report Number.....:	STE03092666S
Tested by (name + signature).....:	Plum Xiao / Test engineer
Approved by (name + signature).....:	Allen Huang / Project manager
Date of issue.....:	March 25, 2026
Total number of pages.....:	81
Testing Laboratory .....:	**Shenzhen STE Testing Laboratory Co., Ltd.**
Address .....:	3/F, Building 9, Hongde Factory, No. 63 Yuchang Road, Niuhu Community, Guanlan Street, Longhua District, Shenzhen, China
Applicant's name.....:	**Shanghai Matis Electric Co., Ltd**
Address.....:	Room 318-320, No. 83, West Huanghu Road, Pudong, Shanghai, China 201306
Manufacturer's name.....:	**Shanghai Matis Electric Co., Ltd**
Address.....:	Room 318-320, No. 83, West Huanghu Road, Pudong, Shanghai, China 201306
Test specification:	
Standard.....:	EN 61009-1: 2012 +A1: 2014 +A2: 2014 +A11: 2015 +A12: 2016 +A13: 2021
Test procedure.....:	CE-LVD
Non-standard test method.....:	N/A
Test Report Form No.....:	IEC61009-1G
Test Report Form(s) Originator.....:	STE
Master TRF.....:	Dated 2023-05

Test item description.....:	Smart Metering RCBO
Model/Type reference.....:	**MT61GR**, MT61SR
Trade Mark.....:	Matis
Ratings.....:	Ue: 230/240 V AC (2P); 400/415 V AC (4P); Frequency: 50/60 Hz; In:10/16/20/25/32/40/50/63A/80A/100A/125A (B/C/D-type); Icn=Ics= 6.0 kA I Δ n= 100, 300mA; Type -A & -AC With time delay: Type S

Summary of testing:

Testing location:

Shenzhen STE Testing Laboratory Co., Ltd.

3/F, Building 9, Hongde Factory, No. 63 Yuchang Road, Niuhu Community, Guanlan Street, Longhua District, Shenzhen, China

Tests performed (name of test and test clause):

The submitted samples were found to comply with the requirements of:

- EN 61009-1: 2012 +A1: 2014 +A13: 2021

Copy of marking plate:

The artwork below may be only a draft. The use of certification marks on a product must be authorized by the respective NCBs that own these marks.

Matis

Smart Metering RCBO

Model: MT61GR

Ue: 230/240 V AC (2P); 400/415 V AC (4P);

Frequency: 50/60 Hz;

In:10/16/20/25/32/40/50/63A/80A/100A/125A (B/C/D-type);

Icn=Ics= 6.0 kA

I Δ n= 100, 300mA; Type -A & -AC

With time delay: Type S

Shanghai Matis Electric Co., Ltd

Room 318-320, No. 83, West Huanghu Road, Pudong, Shanghai, China 201306

Importer: xxxx

Address: xxxx

Made in China

Remarks:

1. Name and address of the Importer and Manufacturer must be affixed on the product when the product placed on the EU market.
2. Minimum height of CE mark is 5mm, minimum height of WEEE mark is 7mm.

Test item particulars.....:	
Type of RCBO .....:	Type -A & -AC
Time delay .....:	Type S
Method of operating .....:	independent of / ~~dependent on the line voltage~~
Type of installation .....:	fixed / ~~mobile installation~~
Number of poles .....:	~~single~~ / two / ~~three~~ / four pole
Protection against external influences .....:	~~enclosed~~ / unenclosed
Method of mounting .....:	Din rail mounting
Method of connection .....:	Terminal with stirrup
Instantaneous tripping current .....:	B / C / D
Rated current (I_N).....:	10/16/20/25/32/40/50/63A/80A/100A/125A
Rated residual operating current ($I\Delta_N$).....:	100, 300mA
Rated voltage (U_N).....:	400V
Rated impulse withstand voltage (U_{imp}).....:	4 kV
Rated frequency (Hz).....:	50/60Hz
Rated short-circuit capacity (I_{CN}) .....:	6000A
Rated residual making and breaking capacity ($I_{\Delta M}$) .....:	630A
Nature of supply .....:	~
Type of terminal .....:	Screw in
Classification of RCBOs functionally dependent on the line voltage:.....:	~~Yes~~ / No
Opening automatically in case of failure of the line voltage.....:	Yes / ~~No~~
- reclosing automatically when the line voltage is restored .....:	Yes / ~~No~~
- not reclosing automatically when the line voltage is restored .....:	~~Yes~~ / No
Not opening automatically in case of failure of the line voltage.....:	~~Yes~~ / No
-able to trip in a hazardous situation arising on failure of line voltage .....:	Yes / ~~No~~
-not able to trip in a hazardous situation arising on failure of line voltage .....:	~~Yes~~ / No

POSSIBLE TEST CASE VERDICTS:

- test case does not apply to the test object..... : N or N/A (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..... : February 26, 2026

Date (s) of performance of tests..... : February 26, 2026 to March 25, 2026

General remarks:

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

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

Clause numbers between brackets refer to clauses in IEC 61347-1.

"(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.

General product information

1, The evaluation of electric shock depended on the end product.

2, All models are same except the appearance.

3, The laboratory tests and evaluates the main model.
Adding models based on the guarantee letter provided by the Applicant.
STE takes no responsibility for any mistakes and the problems of product consistency caused by inaccurate and/or invalid information submitted by the Applicant.

EN 61009-1			
Clause	Requirement + Test	Result - Remark	Verdict
	TEST SEQUENCE "A1"		--
6	**MARKING AND OTHER INFORMATION**		--
	Circuit-breaker marked with:		--
	a) Manufacturer's name or trade mark.....:	Matis	P
	b) Type designation, catalogue number or other serial number.....:	MT61GR	P
	c) Rated voltage (V).....:	400/ 415V	P
	d) Rated current without symbol "A", preceded by the symbol of instantaneous tripping.....:	6,10,16,20,25,32,40,50,63,80, 100, 125	P
	e) Rated frequency (Hz).....:	50/60Hz	P
	f) Rated residual operating current.....:	10, 30, 100, 300	P
	g) Settings of residual operating current.....:	Adjustable	P
	h) Rated short-circuit capacity, in amperes.....:	6000A	P
	j) Reference calibration temperature, if different from 30°C.....:	°C	P
	k) Degree of protection.....:	IP 20	P
	l) Position of use.....:		N
	m) Rated residual making and breaking capacity, if different from rated short-circuit capacity.....:	630A	P
	n) Symbol S for type S.....:		N
	p) Operating means of test device by letter T.....:	T	P
	q) Wiring diagram.....:		P
	r) Operating characteristic in presence of residual currents with d.c. components		P
	- RCBOs of type AC with the symbol.....		P
	- RCBOs of type A with the symbol.....		P
	s) type D RCBOs, the max. instantaneous tripping current, if higher than 20 I_N.....:		N
	Marking on the RCBO itself or on nameplate or nameplates attached to the RCBO and located so that for small devices at least d), f), n), p) and r) (only for type A) is legible when the RCBO is installed		P
	The information under a), b), c), h), l), r) (only for type AC) and s) may be marked on the side or the back of the device and be visible only before the device is installed		P
	The information under q) may be on the inside of any cover which has to be removed in order to connect the supply wires		P

EN 61009-1			
Clause	Requirement + Test	Result - Remark	Verdict
	Any remaining information not marked shall be given in the manufacturer's catalogues.		P
	The suitability for isolation, which is provided by all circuit-breakers of this standard, may be indicated by the symbol on the device		P
	If a degree of protection higher than IP20 is marked on the device, it shall comply with it, whichever the method of installation. If the higher degree of protection is obtained only by a specific method of installation and/or with the use of specific accessories this shall be specified in the manufacturers literature		P
	Open position indicated by "**0**" and closed position by "|"		P
	For push-buttons the OFF push-button shall either be red and/or marked with "**0**"		P
	If necessary to distinguish between supply and load terminals they shall be clearly marked		P
	Terminals for neutral conductor N		P
	Terminal for protective conductor		P
	Marking indelible, easy legible and not on removable parts		P
	Labels not easy to remove and no curling. Test acc. to cl. 9.3: 15 s with water and 15 s with hexane		P
	For universal terminals (rigid-solid, rigid-stranded and flexible conductors:	**I ON – O OFF**	P
	- no markings		P
	For non-universal terminals:		--
	- terminals for rigid-solid conductors only, marked by the letters "s" or "sol"		P
	- terminals for rigid (solid and stranded) conductors only, marked by the letter "r"		P
	marking on the RCBO or if the space available is not sufficient, on the smallest package unit or in technical information		P

8.	**REQUIREMENTS FOR CONSTRUCTION AND OPERATION**	--
8.1.1	**General**	--

EN 61009-1			
Clause	Requirement + Test	Result - Remark	Verdict
	Not possible to alter the operating characteristics by means of external interventions other than those specifically intended for changing the setting of the residual operating current.		P
	Changing from one setting to another shall not be possible without a tool. It shall not be possible to disable or inhibit the RCBO function by any means. NOTE In Australia, Germany, Denmark, Italy, the UK and Switzerland, multiple settings are not allowed.		P
	In case of an RCBO having multiple settings of residual operating current, the rating refers to the highest setting.		P
8.1.2	**Mechanism**		--
	Moving contacts of all poles so mechanically coupled that all poles except switched neutral make and break substantially together		P
	Switched neutral of four-pole RCBOs shall not close after and shall not open before the other poles		P
	Neutral pole having adequate making and breaking capacity and RCBO with independent manual operation:		P
	- all poles operate together including neutral pole		P
	Trip-free mechanism		P
	Possible to switch on and off by hand		P
	No intermediate position of the contacts		P
	RCBOs shall provide in the open position an isolating distance in accordance with the requirements necessary to satisfy the isolating function (see 8.3)		P
	Indication of the open and closed position of the main contacts shall be provided by one or both of the following means:		P
	- the position of the actuator (this being preferred)		P
	- a separate mechanical indicator		N
	If a separate mechanical indicator is used to indicate the position of the main contacts, this shall show the colour:		N
	- red for the closed position (ON)		P
	- green for the opened position (OFF)		P

EN 61009-1			
Clause	Requirement + Test	Result - Remark	Verdict
	The means of indication of the contact position shall be reliable (Compliance is checked by inspection and by the test of 9.9.2.2		P
	RCBOs shall be designed so that the actuator, front plate or cover can only be correctly fitted in a manner which ensures correct indication of the contact position (Compliance is checked by inspection and by the tests of 9.12.12.1 and 9.12.12.2)		N
	When means are provided or specified by the manufacturer to lock the operating means in the open position, locking in that position shall only be possible when the main contacts are in the open position. (Compliance is checked by inspection , taking into account the instructions of the manufacturer)		N
	If operating means is used for indication it shall, when released, automatically take up the position to that of the moving contacts; operating means shall have two rest positions except that for automatic opening a third distinct position may be provided, when necessary to reset before reclosing		N
	When an indicator light is used this shall be lit when the RCBO is in the closed position		P
	The indicator light shall not be the only means to indicate the closed position.		P
	The action of the mechanism shall not be influenced by the position of enclosures or covers and shall be independent of any removable part.		P
	If the cover is used as a guiding means for push-buttons, it shall not possible to remove the buttons from the outside		P
	Operating means securely fixed, not possible to remove them without a tool.		P
	For "up-down" operating means the contacts are closed by the up movement.		P
9.11	**Test:**		P
	- The RCBO is mounted and wired as in normal use.		P
	- Test circuit according to figure 4.		P

EN 61009-1			
Clause	Requirement + Test	Result - Remark	Verdict
9.11.2	A residual current equal to 1,5 $I_{\Delta N}$ is passed by closing S_2, the RCBO having been closed and the operating means being held in the closed position. The RCBO shall trip.		P
	Test repeated by moving the operating means slowly (1 s) to a position where the current starts to flow. Tripping shall occur without further movement.		P
8.1.3	Clearances and creepage distances (external parts) --> see “Clearances and creepage distances internal and external parts”		P
8.1.4	**Screws, current-carrying parts and connections**		--
8.1.4.1	Connections withstand mechanical stresses occurring in normal use.		P
	Screws for mounting the RCBO are not of thread-cutting type.		N
	Screws and nuts which are operated when mounting and connecting		P
	Test according to cl. 9.4:		P
	- 10 times (screw Ø / torque Nm)	Ø mm Nm	N
	- 5 times (screw Ø / torque Nm)	Ø4.82 mm 2.0 Nm	P
8.1.4.2	Screws with a thread of insulating material operated when mounting the RCBO; correct introduction ensured.		N
8.1.4.3	Electrical connections contact pressure not transmitted through insulating material unless there is sufficient resilience in the metallic parts.		P
8.1.4.4	Current-carrying parts including parts intended for protective conductors, if any, shall be made of a metal having, under the conditions occurring in the equipment, mechanical strength, electrical conductivity and resistance to corrosion adequate for their intended use. Examples below:		N
	- copper		N
	- alloy 58% copper for worked cold parts		N
	- alloy 50% copper for other parts		N
	- other metal		N
	In case of using ferrous alloys or suitably coated ferrous alloys, compliance to resistance to corrosion is checked by a test of resistance to rusting (see 9.25).		N

EN 61009-1				
Clause	Requirement + Test		Result - Remark	Verdict
	The requirements of this subclause do not apply to contacts, magnetic circuits, heater elements, bimetals, shunts, electronic components, including printed circuit board or to screws, nuts, washers, clamping plates, similar parts of terminals and parts of the test circuit			N
8.1.5	Terminals for external conductors			--
	Compliance is checked by inspection and by the tests as relevant for the type of connection:			P
	9.5 for screw-type terminals			P
	by specific tests for plug-in or bolt-on RCBOs included in the standard			P
	by the tests of Annexes J, K or L			P
8.1.5.1	Terminals ensure the necessary contact pressure			--
	Test see cl. 9.5 Torque			--
	Ø mm	Nm		N
	Ø mm	Nm		N
	Ø mm	Nm		N
	Max. cross-sect.:_____ mm²			N
9.5	**Test of reliability of screw-type terminals for external copper conductors**			N
9.5.1	Pull test:			N
	Terminal shall be suitable for all types of conductors: rigid (solid or stranded) and flexible, unless otherwise specified by the manufacturer.			N
	Min. cross-section solid /stranded / flexible (mm²):		mm²	--
	Max. cross-section solid /stranded / flexible (mm²).		mm²	--
	Torque $^{2}/_{3}$ (Nm)..... :		Nm	--
	Pull for 1 min solid / stranded / flexible (N)..:		N	--
	During the test no noticeable move of conductor			P
9.5.2	Min. cross-section (mm²).....		mm²	--
	Max. cross-section (mm²).....		mm²	--
	Torque $^{2}/_{3}$ (Nm).....		Nm	--
	The conductor shows no damage			P
	Terminals not worked loose and no damage			P

EN 61009-1			
Clause	Requirement + Test	Result - Remark	Verdict
9.5.3	Terminals fitted with the largest cross-section area specified in Table 8, for stranded and/or flexible copper conductor.		--
	Max. cross-section stranded (mm²).....		N
	Max. cross-section flexible (mm²).....		N
	Torque $^2/_3$ (Nm).....	Nm	--
	After the test no strand of conductor escaped outside		P

8.1.5.2	Circuit breakers shall be provided with:		N
Table 8	Rated current (A) / Range of nominal cross sections to be clamped* (mm²) — Rigid (solid or stranded) conductors / Flexible conductors ≤ 13: 1 to 2,5 / 1 to 2,5 > 13 ≤ 16: 1 to 4 / 1 to 4 > 16 ≤ 25: 1,5 to 6 / 1,5 to 6 > 25 ≤ 32: 2,5 to 10 / 2,5 to 6 > 32 ≤ 50: 4 to 16 / 4 to 10 > 50 ≤ 80: 10 to 25 / 10 to 16 > 80 ≤ 100: 16 to 35 / 16 to 25 > 100 ≤ 125: 24 to 50 / 25 to 35	to mm²	N
	*It is required that, for current ratings up to and including 50 A, terminals be designed to clamp solid conductors as well as rigid stranded conductors. Nevertheless, it is permitted that terminals for conductors having cross-sections from 1 mm² up to 6 mm² be designed to clamp solid conductors only.		N
	– or terminals for external untreated aluminium conductors and with aluminium screw-type terminals for use with copper or with aluminium conductors according to Annex L.		N
8.1.5.3	Means for clamping the conductors in the terminals not serve to fix any other component (See test sub-clause 9.5)		N
8.1.5.4	Terminals for $I_N \leq 32$ A allow the connection of conductors without special preparation.		N
8.1.5.5	Terminals have adequate mechanical strength and metric ISO thread or equivalent. (See tests of sub-clauses 9.4 and 9.5.1)		N
8.1.5.6	Clamping of conductor without undue damage to conductor. (See tests of sub-clause 9.5.2)		N

EN 61009-1			
Clause	Requirement + Test	Result - Remark	Verdict
8.1.5.7	Clamping of conductor reliably and between metal surfaces. (See tests of sub-clauses 9.4 and 9.5.1)		P
8.1.5.8	Terminals so designed or positioned that no conductor can slip out while the clamping screws or nuts are tightened. (See tests of sub-clause 9.5.3)		P
8.1.5.9	Terminals so fixed or located that they do not work loose when the clamping screws or nuts are tightened or loosened. (See tests of sub-clause 9.4)		P
8.1.5.10	Clamping screws or nuts of terminals for the protective conductors adequately secured against accidental loosening and not possible to unclamp without a tool.		P
8.1.5.11	Screws and nuts of terminals for external conductors shall be in engagement with a metal thread and not be of the tapping screw type.		P
8.1.5.12	Screws and nuts of terminals for external conductors shall be in engagement with a metal thread, and the screws shall not be the thread cutting type		P
8.1.6	**Non-interchangeability**		P
	Plug-in or screw-in RCBOs must not be replace-able, without aid of a tool, by another of the same make, but having a higher rated current.		P
8.2	**Protection against electric shock**		--
	Live parts not accessible in normal use		P
	For RCBOs other than plug-in type, external parts, other than screws or other means for fixing covers, which are accessible in normal use shall be of insulating material or be lined throughout with insulating material.		P
	Linings		--
	- reliably fixed		N
	- adequate thickness and		N
	- mechanical strength		N
	Inlet openings for cables or conduits shall be of insulating material or be provided with bushings or similar devices of insulating material.		N
	Such devices		--
	- reliably fixed		N
	- adequate mechanical strength		N

EN 61009-1			
Clause	Requirement + Test	Result - Remark	Verdict
	For plug-in RCBOs external parts other than screws or other means for fixing covers, which are accessible, shall be of insulating material.		N
	Metallic operating means insulated from live parts.		N
	Metal parts of mechanism not accessible, insulated from accessible metal parts, from metal frames (for flush-type), from screws or other means for fixing the base and from metal plates.		N
	Possible to replace plug-in RCBOs easily with-out touching live parts.		N
	Lacquer or enamel not considered to provide adequate insulation.		N
9.6	**Test: Standard test finger**		--
	Straight test finger with a force of 75 N for 1 min at 35°C ± 2°C		N
	Enclosures or covers not deformed to such an extent that live parts can be touched.		N
8.9	**Resistance to heat**		--
	RCBO sufficiently resistant to heat		P
9.14.1	Test:		N
	- without removable covers..... 1 h (100 ± 2) °C		N
	- removable covers..... 1 h (70 ± 2) °C		N
	No change impairing further use and no flow of sealing compound that live parts are exposed		N
	No access to live parts even with test finger with a force not exceeding 5 N.		N
	The RCBO shall trip with a test current of 1,25 $I_{\Delta N}$ - break time not exceeding the value for $I_{\Delta N}$ in table 2	[ms]	N
	Marking still legible after test		N
9.14.2	Ball pressure test for external parts of insulating material necessary to retain current-carrying parts or parts of the protective circuit in position:		N
	- T = 125 ± 2°C	Enclosure,125 °C Contact support parts,125 °C Lock,125 °C	P
	After 1 h Ø of impression ≤ 2 mm	1.3 mm,1.1 mm,1.2 mm	P

EN 61009-1			
Clause	Requirement + Test	Result - Remark	Verdict
9.14.3	Ball pressure test for external parts of insulating material not necessary to retain current-carrying parts or parts of the protective circuit in position:	The material of handle is same as enclosure	P
	☐ T = 70 ± 2°C		P
	☐ T = _____ ± 2°C (40°C + max. temperature rise of sub-clause 9.8)		P
	Ø of impression ≤ 2 mm		P
8.1.3	Clearances and creepage distances (internal and external parts)		P
	The minimum required clearances and creepage distances are based on the RCBO being designed for operating in an environment with pollution degree 2		P
	Compliance for item 1 in is checked by measurement and by the test of 9.7.7.4.1 and 9.7.7.4.2. The test is carried out with samples not submitted to the humidity treatment described in 9.7.1.		P
	The clearances of items 2 and 4 (except accessible surface after installation) may be reduced provided that the measured clearances are not shorter than the minimum allowed in IEC 60664-1 for homogenous field conditions.		P
	In this case, after the humidity treatment in 9.7.1, compliance for item 2 and 4 and arrangements of 9.7.2 items b), c), d) and e) is checked:		P
	- Tests according to 9.7.2 to 9.7.6 as applicable		P
	- Test according to 9.7.7.2 with test voltages acc. Table 19 with test arrangements of 9.7.2 items b), c), d), e)		P
	If measurement does not show any reduced clearance, test 9.7.7.2 is not applied		P
	Compliance for item 3, checked by measurement		P
	Parts of PCBs connected to the live parts protected against pollution by the use of a type 2 protection according to IEC 60664-3 are exempt from this verification		P
	The insulating materials are classified into Material Groups on the basis of their comparative tracking index (CTI) acc. to IEC 60664-1 and measured according to IEC 60112		P
	Clearances [mm] U_{imp}		N

EN 61009-1			
Clause	Requirement + Test	Result - Remark	Verdict
	4kV (see table 5) **2,5kV(see table 5)**	☐ ☐	N
		minimum clearances [mm]	N
	1. between live parts which are separated when the main contacts are in the open position		P
	2. between live parts of different polarity		P
	3. between circuits supplied from different sources, one of which being PELV or SELV		N
	4. between live parts and:		N
	- accessible surfaces of operating means		N
	- screws or other means for fixing covers which have to be removed when mounting the RCBO		N
	- surface on which the RCBO is mounted		N
	- screws or other means for fixing the RCBO		N
	- metal covers or boxes		N
	- other accessible metal parts		N
	- metal frames supporting flush-type RCBOs		N
	Creepage distances [mm] (see table 5)		N
	Material group	IIIb ☐ IIIa ☐ II ☐ **I** ☐	N
		minimum clearances [mm]	N
	1. between live parts which are separated when the main contacts are in the open position		P
	2. between live parts of different polarity		P
	3. between circuits supplied from different sources, one of which being PELV or SELV		P
	4. between live parts and:		--
	- accessible surfaces of operating means		P
	- screws or other means for fixing covers which have to be removed when mounting the RCBO		P
	- surface on which the RCBO is mounted		P
	- screws or other means for fixing the RCBO		P
	- metal covers or boxes		P
	- other accessible metal parts		P

EN 61009-1			
Clause	Requirement + Test	Result - Remark	Verdict
	- metal frames supporting flush-type RCBOs		P
9.25	Test of resistance to rusting:		--
	- 10 min immersed in a cold chemical degreaser such as methyl-chloroform or refined petrol		P
	- 10 min immersed in a 10% solution of chloride in water at 20°C±5°C		P
	- 10 min in a box containing air saturated with moisture at 20°C±5°C		P
	- 10 min at 100°C		P
	No sign of rust		P

EN 61009-1			
Clause	Requirement + Test	Result - Remark	Verdict

	TEST SEQUENCE "A_2"	**A_2 1 A_2 2 A_2 3**	--
8.10	**Resistance to abnormal heat and to fire**		P
	External parts of insulating material are not liable to ignite and to spread fire under fault or overload conditions.		P
9.15	**Glow-wire test**		P
	Test performed on a complete RCBO		P
	Test made on three samples, points of application being different from one sample to another		P
	- External parts of insulating material necessary to retain current-carrying parts or parts of the protective circuit in position.....:	T = 960 ± 15 °C	P
	- All other external parts of insulating material.....:	T = 650 ± 10 °C	P
	No visible flame and no sustained glowing		P
	Flames and glowing extinguish within 30 s after removal		P
	No ignition of tissue paper or scorching of the pinewood board		P

EN 61009-1			
Clause	Requirement + Test	Result - Remark	Verdict

	TEST SEQUENCE "B"	**B1 B2 B3**	--
8	**Requirements for construction and operation**		--
8.3	Dielectric properties and isolating capability		--
	RCBOs have adequate dielectric properties		P
9.7	**Test of dielectric properties and isolating capability**		--
9.7.7.4	Verification of resistance of the insulation of open contact and basic insulation against an impulse voltage in normal conditions		N
	These tests are not preceded by the humidity treatment described in 9.7.1.		N
	The test is carried out on an RCBO fixed on a metal support		N
	The impulses are given by a generator producing positive and negative impulses having a front time of 1,2μs, and a time to half-value of 50μs		N
	The shape of the impulses is adjusted with the RCBO under test connected to the impulse generator.		N
	For RCBOs with incorporated surge arresters that cannot be disconnected, the shape of the impulses is adjusted without connection of the RCBO to the impulse generator.		N
	rated impulse withstand voltage [kV]:		--
	see level of test laboratory [m]		--
	test voltage (acc. Table 28) [kV]:		--
9.7.7.4.2	RCBO in open position (contacts in open position)		N
	The impulses are applied between:		N
	the line terminals connected together and the load terminals connected together		N
9.7.7.4.3	RCBO in closed position		--
	All components bridging the basic insulation disconnected		N
	A first series of tests is made applying the impulse voltage between the phase pole(s) and the neutral pole (or path) connected together and the metal support connected to the terminal(s) intended for the protective conductor(s), if any		N

EN 61009-1					
Clause	Requirement + Test	Result - Remark			Verdict
	A second series of tests is made applying the impulse voltage between the phase pole(s), connected together, and the neutral pole (or path) of the RCBO				N
	Five positive impulses and five negative impulses are applied, the interval between consecutive impulses being at least 1 s for impulses of the same polarity and being at least 10 s for impulses of the opposite polarity.				N
	no disruptive discharges during the test				N
9.7.7.5	Verification of the behaviour of components bridging the basic insulation				--
	A new RCBO sample is tested				N
	Test only performed on RCBOs, where components bridging the basic insulation have been disconnected during the impulse voltage test of 9.7.7.4.3				N
	test voltage 1200V+U0	V			N
	The voltage is applied during 5s between the phase pole(s) and the neutral pole (or path) connected together and the metal support connected to the terminal(s) intended for the prospective conductor(s), if any				N
	after test, no component bridging the basic insulation should show a visible alteration.				N
	Then, the equipment is connected to the mains acc. manufacturer's instruction				N
	The RCBO shall trip with a test current of 1,25 $I_{\Delta N}$	[ms]			--
	Test switch S2 and RCBO in the closed position, test voltage established by closing the test switch S1.				N
9.7.1	Resistance to humidity				--
9.7.1.1	Parts which can be removed without a tool are removed, spring lids kept open, inlet openings are left open and if knock-outs one is opened.				P
9.7.1.2	Test conditions: 48 h in humidity cabinet RH = 91% to 95% T = 20 to 30°C ± 1°C	93%...94% 28°C…29°C			--
9.7.1.4	The samples show no damage				P
9.7.2	Insulation resistance of the main circuit measured between 30 and 60 min after this treatment with 500 V DC after 5 s:	B1 [MΩ]	B2 [MΩ]	B3 [MΩ]	--

EN 61009-1					
Clause	Requirement + Test	Result - Remark			Verdict
	a) between the terminals which are electrically connected together when the RCBO is in the closed position.....≥ 2 MΩ	> 500	> 500	> 500	P
	b) between each pole and the others connected together (electronic components, connected between current path being disconnected)≥ 2 MΩ	> 500	> 500	> 500	P
	c) between all poles connected together and the frame.....≥ 5 MΩ	> 500	> 500	> 500	P
	d) between metal parts of the mechanism and the frame.....≥ 5 MΩ				N
	e) between the frame and a metal foil in contact with the inner surface of the lining of insulating material.....≥ 5 MΩ				N
9.7.3	Dielectric strength of the main circuit measured with an AC voltage (45-65Hz) for 1 min:				--
	a) electronic components disconnected.....2000 V				P
	b) electronic components disconnected.....2000 V				P
	c) electronic components disconnected.....2000 V				P
	d) electronic components disconnected.....2000 V				N
	e) electronic components disconnected.....2500 V				N
	No flashover or breakdown				P
9.7.4	Insulation resistance of auxiliary circuits measured with 500 V DC after 1 min:				--
	1) between all auxiliary circuits and the frame.....≥ 2 MΩ	B1 [MΩ]	B2 [MΩ]	B3 [MΩ]	--
	2) between each part of the auxiliary circuits which might be isolated from the other parts and the whole of the other parts connected together.....≥ 2 MΩ				P
	Dielectric strength of auxiliary circuits measured with an AC voltage at rated frequency for 1 min:				P
	Rated voltage of..... Test voltage (V) auxiliary circuits (a.c. or d.c.) ≤ 30.....600 > 30 ≤ 50.....1000 > 50 ≤ 110.....1500 > 110 ≤ 250.....2000 > 250 ≤ 500.....2500	V			P
	1) between all auxiliary circuits and the frame				P

EN 61009-1			
Clause	Requirement + Test	Result - Remark	Verdict
	2) between each part of the auxiliary circuits which might be isolated from the other parts and the whole of the other parts connected together		P
	No flashover or breakdown		P
9.7.7.2	Verification of clearances with the impulse withstand voltage		P
	If the measurement of clearances of items 2 and 4 in Table 7 shows a reduction of the required length, this test applies.		P
	The test is carried out on an RCBO fixed on a metal support and being in the closed position		P
	The impulses are given by a generator producing positive and negative impulses having a front time of 1,2μs, and a time to half-value of 50μs		P
	The shape of the impulses is adjusted with the RCBO under test connected to the impulse generator.		P
	For RCBOs with incorporated surge arresters that cannot be disconnected, the shape of the impulses is adjusted without connection of the RCBO to the impulse generator.		N
	test performed with:		--
	- surge impedance of the test apparatus ≤500Ω and surge protective devices disconnected before testing or		N
	- hybrid generator with an surge impedance of 2 Ω and surge protective devices not disconnected before testing		N
	rated impulse withstand voltage [kV]:	4	--
	see level of test laboratory [m]	<100	--
	test voltage (acc. Table 19) [kV]:	4.9	--
	A first series of tests is made applying the impulse voltage between the phase pole(s) and the neutral pole (or path) connected together and the metal support connected to the terminal(s) intended for the protective conductor(s), if any		N
	A second series of tests is made applying the impulse voltage between the phase pole(s), connected together, and the neutral pole (or path) of the RCBO		N

EN 61009-1											
Clause	Requirement + Test						Result - Remark				Verdict
	A third series of tests is made applying the impulse voltage between (and not tested during the two first sequences described here above):										N
	b) between each pole and the others connected together (electronic components, connected between current path being disconnected)										N
	c) between all poles connected together and the frame										N
	d) between metal parts of the mechanism and the frame										N
	e) between the frame and a metal foil in contact with the inner surface of the lining of insulating material										N
	Five positive impulses and five negative impulses are applied, the interval between consecutive impulses being at least 1 s for impulses of the same polarity and being at least 10 s for impulses of the opposite polarity.										N
	no disruptive discharges during the test										P
9.7.5	Secondary circuit of detection transformers										--
	No insulation test, provided that no connection with accessible metal parts or with protective conductor or live parts exists.										N
9.7.6	Capability of control circuits connected to the main circuit of withstanding high DC voltages due to insulation measurements										--
	RCBO fixed on metal support in closed position with all control circuits connected as in service.										P
	Open test voltage 600 V +25 / -0 V Maximum ripple 5% Short-circuit current 12 mA +2 / -0 mA Applied for 1 min between each pole and the other poles connected together to the frame.										P
	Type	I_N A	$I_{\Delta N}$ A	Standard values of break time and non-actuating time at a residual current equal to							--
				$I_{\Delta N}$	2 $I_{\Delta N}$	5 $I_{\Delta N}$	5 $I_{\Delta N}$ or 0,25A a)	5A-200A, 500A b)	$I_{\Delta t}$ c)		--
	General	Any value	<0,03	0,3	0,15	--	0,04	0,04	0,04	Max. break times	--
			0,03	0,3	0,15	--	0,04	0,04	0,04		--
			>0,03	0,3	0,15	0,04	--	0,04	0,04		--

EN 61009-1											
Clause	Requirement + Test							Result - Remark			Verdict
	S	≥ 25	>0,03	0,5	0,2	0,15	--	0,15	0,15	Max. break times	--
				0,13	0,06	0,05	--	0,04	0,04	Min. non-actuating times	--
	a) value to be decided by the manufacturer for this test										--
	b) The test are only made during verification of the correct operation as mentioned in 9.9.1.2 d) but in any case values exceeding the lower limit of the overcurrent instantaneous tripping range are not tested.										--
	c) The test is made with a current IΔt equal to the lower limit of the overcurrent instantaneous tripping range according to type B, C or D, as applicable. For the tests of 9.9.1.3 and 9.9.1.4 b), the current $I_{\Delta t}$ is established so that the vector sum $I_{\Delta t}$ + In is equal to the lower limit of the overcurrent instantaneous tripping range, according to type B, C or D, as applicable.										--
9.9.1.2.c)	Verification of the correct operation in case of sudden appearance of residual current by closing S1, (S2 and RCBO in closed position):										P
	Maximum break times at:							[ms]	[ms]	[ms]	--
	- $I_{\Delta N}$							24	35	24	P
	- 2 $I_{\Delta N}$							25	26	23	P
	- 5 $I_{\Delta N}$ or							20	22	19	P
	- 0,25 A										N
	- $I_{\Delta t}$ 315 A							20	22	18	P
	No value exceeds the relevant specified limiting value										N
	Additional test for type S:										--
	Minimum non-actuating time at:							[ms]	[ms]	[ms]	--
	- $I_{\Delta N}$ ..... 0,13 s										N
	- 2 $I_{\Delta N}$ ..... 0,06 s										N
	- 5 $I_{\Delta N}$ ..... 0,05 s										N
	- $I_{\Delta t}$ ..... 0,04 s										N
	The test switch S1 and the RCBO being in the closed position, the test voltage is suddenly established by closing the test switch S2 for min. non-operating times acc. table 2										N

EN 61009-1					
Clause	Requirement + Test	Result - Remark			Verdict
	No tripping during tests				N
8.4	Temperature rise				--
	Temperature rises do not exceed the limiting values stated in table 7.				P
	Cross-section (mm²)	16 mm²			--
9.8.1	Ambient air temperature (°C)	23.4°C			--
9.8.2	Test current IN (A) until steady state values are reached.	63A			--
	Four pole RCBOs:				P
	Current passing through				P
	- 3 phase poles (1)				P
	- neutral and adjacent pole (2)				P
	Parts ..... Temperature rise K	[K]	[K]	[K]	--
	Terminals for external connections..... 65	56.3	58.2	57.9	P
	External parts liable to be touched during manual operation of the RCBO, including operating means of insulating material and metallic means for coupling insulated operating means of several poles	9.8	9.9	9.7	P
	External metallic parts of operating means..... 25				N
	Other external parts, including that face of the RCBO in direct contact with the mounting surface 60	17.8	22.6	18.6	P

8.16	**Reliability**				--
	RCBOs operate reliably even after long service.				P
9.22.2	Test with 28 cycles at 40 ± 2°C				--
	Cross-section (mm²)..... :	mm²			--
	Torque 2/3 (Nm)..... :	Nm			--
	Test current IN (A)..... :	A			--
	- with current passing .....21 h				P
	- without current..... 3 h				P
	For 4 pole RCBOs with 3 overcurrent protected poles only 3 poles loaded				N
	At the end of the last period of 21 h with current passing the temperature rise of the terminals shall not exceed 65K	[K]	[K]	[K]	--
		58.1	58.6	58.9	P

EN 61009-1					
Clause	Requirement + Test	Result - Remark			Verdict
	After cool down the RCBO shall trip with a test current of 1,25 $I_{\Delta N}$ – break time not exceeding the value for $I_{\Delta N}$ in table 2	[ms]	[ms]	[ms]	--
		21	19	23	P
	Test switch S2 and RCBO in the closed position, test voltage established by closing the test switch S1.				P
9.23	Verification of ageing of electronic components				--
	168 h at 40 ± 2°C.....:	40°C			--
	Test current I_N (A).....:	63A			--
	Cross-section (mm²).....:	16mm²			--
	Electronic parts at 1,1 U_N.....:	264V			--
	After cool down:				P
	- electronic parts show no damage				P
	The RCBO shall trip with a test current of 1,25 I∆N - break time not exceeding the value for I∆N in table 2	[ms]	[ms]	[ms]	--
					N
	Test switch S2 and RCBO in the closed position, test voltage established by closing the test switch S1				N

EN 61009-1					
Clause	Requirement + Test	Result - Remark			Verdict
	TEST SEQUENCE "C"	C1 1C1 2C1 3			--
	Tests C1				--
8	**Requirements for construction and operation**				--
8.6	Mechanical and electrical endurance				--
	RCBOs shall be capable of performing an adequate number of mechanical and electrical operations.				P
9.10	**Verification of Mechanical and electrical endurance**				--
	Test:				--
	- IN ≤ 25 A2s ON / 13s OFF				P
	- IN > 25 A2s ON / 28s OFF				P
	2000 operating cycles				--
	Test voltage UN (V):	242V			--
	Test current IN (A):	64A			--
	Cos phi = 0,85 - 0,9:	0.86			--
	Cross-section (mm²):	16mm²			--
9.10.2	Test procedure				--
	$I_{\Delta N}$ > 0,01 A:				P
	- 1000 cycles manual operation				P
	- 500 cycles test device				P
	- 500 cycles $I_{\Delta N}$				P
	$I_{\Delta N}$ ≤ 0,01 A:				--
	- 500 cycles manual operation				N
	- 750 cycles test device				N
	- 750 cycles IΔN				N
	Without load - manual operation				--
	- IN ≤ 25 A.....2000 cycle				N
	- IN > 25 A.....1000 cycle				P
9.10.3	After test:				--
	No undue wear, no damage, no loosening of connections, no seepage of sealing compound				P
	The RCBO shall trip with a test current of 1,25 IΔN - break time not exceeding the value for IΔN in table 2	[ms]	[ms]	[ms]	--
		24	19	19	P

EN 61009-1					
Clause	Requirement + Test	Result - Remark			Verdict
	Test switch S2 and RCBO in the closed position, test voltage established by closing the test switch S1.				P
	Dielectric strength test with 900 V AC for 1 min:				--
	a)				P
	b)				P
	c)				P
	d)				N
	e)				N
	2,55 I_N through all poles:	161A			P
		[s]	[s]	[s]	--
	- Opening time ≥ 1s but ≤ 60 s for IN ≤ 32 A				N
	- Opening time ≥ 1s but ≤ 120 s for IN > 32 A	32.7	43.2	35.2	P
9.12.11.2.1	Test at reduced short-circuit current.....:	Figure 7			--
	Test current:				--
	- 500 A				N
	- 10 I_N	643A			P
	Power factor 0,93 - 0,98.....	0.95			--
	Each overcurrent protected pole:				--
		[KA²s]	[KA²s]	[KA²s]	--
	Sequence: 6-0 and 3-CO..... I²t max.	3.45	2.98	4.55	P
	Ipeak (A) max. value..... :	895A			--
	No permanent arcing				N
	No flash-over between poles or between poles and frame				P
	No blowing of the fuse F				P
	No damage, polyethylene sheet shows no hole				P
9.12.12	The RCBO shall show no damage impairing their further use an shall be capable without maintenance to withstand the following tests:				P
9.12.12.1.a)	Leakage current across open contacts, according to 9.7.7.3, each pole is supplied at a voltage 1,1 times Un.= _____ V. The RCBO is in the open position	[mA]	[mA]	[mA]	--
	The leakage current shall not exceed 2 mA	<0.01	<0.01	<0.01	P
9.12.12.1.b)	Dielectric strength test:				--

EN 61009-1					
Clause	Requirement + Test	Result - Remark			Verdict
	Test voltage:				--
	a) 1500 V				P
	b) 1500 V				P
	c) 1500 V				P
	d) 1500 V				N
	e) 2000 V				N
	During these test, after the test has carried out under the conditions specified in 9.7.2 a), it shall be verified that the indicating means show the open position and during the test carried out under the conditions specified in 9.7.2 b) the indication means shall show the closed position				P
	Tests C2: 2P C63; 30mA; Type A	C_2 1 C_2 2 C_2 3			P
9.12.11.2.2	short circuit test on rcbos for verifying their suitability for use in it systems				P
	figure.....:	Figure 8			--
	Test current:				--
	- 500A	A			N
	- 1,2 times the upper limit of the standard range of instantaneous tripping (not exceeding 2500 A)	756A			P
	Power factor 0,93-0,98:	0.94			P
	test voltage 105% of the rated phase to phase voltage	421V			P
	test voltage 105% of U0 for the pole marked N, if any	V			N
	Each pole of RCBO is subjected individually to a test in a circuit, the connection of which is shown in Figure 7.				P
		[KA²s]	[KA²s]	[KA²s]	--
	Sequence: O-t-CO..... I²t max.	4.62	4.61	4.58	P
	Ipeak (A) max. value.....:	1080A			--
	Sequence.....:	O-t-CO			--
	Point of initiation of the O operation (protected poles): 0 ± 5° for the first tested pole, shifted by 30° for the other poles				P
	Point of initiation of the O operation (neutral pole): 60 ± 5°				N
	No flash-over between poles or between poles and frame				P

EN 61009-1					
Clause	Requirement + Test	Result - Remark			Verdict
	No blowing of the fuse F				P
	No damage, polyethylene sheet shows no hole				P
	The RCBO shall show no damage impairing their further use an shall be capable without maintenance to withstand the following tests:				P
9.12.12.1 .a)	Leakage current across open contacts, according to 9.7.7.3, each pole is supplied at a voltage 1,1 times Un.= _____ V. The RCBO is in the open position	[mA]	[mA]	[mA]	--
	The leakage current shall not exceed 2 mA	<0.01	<0.01	<0.01	P
9.12.12.1 .b)	Dielectric strength test:				--
	Test voltage:				--
	a) 1500 V				P
	b) 1500 V				P
	c) 1500 V				P
	d) 1500 V				N
	e) 2000 V				N
	During these test, after the test has carried out under the conditions specified in 9.7.2 a), it shall be verified that the indicating means show the open position and during the test carried out under the conditions specified in 9.7.2 b) the indication means shall show the closed position				P

EN 61009-1			
Clause	Requirement + Test	Result - Remark	Verdict

	TEST SEQUENCE "D"						**D1 D2 D3**				--
	TEST D_0										--
8	**Requirements for construction and operation**										--
8.5	Operating characteristics										--
9.9	**Verification of the operating characteristic**										--
9.9.1	RCBO installed as for normal use, test circuit according to figure 4										P
	For multiple settings of I∆N tests are made for each setting										N
	RCBOs with more than one rated frequency, tests at the lowest and highest frequency, except for test in 9.9.1.2 e),test at only one frequency.										N
	Tests performed with no load at 20 ± 5°C										N
9.9.1.4	For RCBOs functionally dependent on line voltage each test is made at:										N
	- 1,1 UN (V) and						V				--
	- 0,85 UN (V)						V				--
Table 2	Type	I_N A	$I_{\Delta N}$ A	Limiting values of break time and non-actuating time (s) for type AC and A RCBOs in event of alternating residual currents (r.m.s. values) equal to							--
				$I_{\Delta N}$	2 $I_{\Delta N}$	5 $I_{\Delta N}$	5 $I_{\Delta N}$ or 0,25A a)	5A-200A, 500A b)	$I_{\Delta t}$ c)		--
	General	Any value	<0,03	0,3	0,15	--	0,04	0,04	0,04	Max. break times	--
		Any value	0,03	0,3	0,15	--	0,04	0,04	0,04		--
		Any value	>0,03	0,3	0,15	0,04	--	0,04	0,04		--
	S	≥ 25	>0,03	0,5	0,2	0,15	--	0,15	0,15	Max. break times	--
				0,13	0,06	0,05	--	0,04	0,04	Min. non-actuating times	--
	a) value to be decided by the manufacturer for this test										--
	b) The test are only made during verification of the correct operation as mentioned in 9.9.1.2 d) but in any case values exceeding the lower limit of the overcurrent instantaneous tripping range are not tested.										--

EN 61009-1					
Clause	Requirement + Test	Result - Remark			Verdict
	c) The test is made with a current IΔt equal to the lower limit of the overcurrent instantaneous tripping range according to type B, C or D, as applicable. For the tests of 9.9.1.3 and 9.9.1.4 b), the current $I_{\Delta t}$ is established so that the vector sum $I_{\Delta t}$ + In is equal to the lower limit of the overcurrent instantaneous tripping range, according to type B, C or D, as applicable.				--
9.9.1.2	Tests for all RCBOs				N
a)	Verification of the correct operation in case of a steady increase of residual current:	[mA]	[mA]	[mA]	--
	- Steady increase from 0,2 IΔN to IΔN within 30s Tripping current between IΔN0 and IΔN	22.8 23.5	23.6 24.2	21.8 22.8	P
b)	Verification of the correct operation at closing on residual current (S1 and S2 closed) :	[ms]	[ms]	[ms]	--
	- The RCBO closes on IΔN, no value exceeds the specified limiting value	19	22	18	P
c)	Verification of the correct operation in case of sudden appearance of residual current by closing S1, (S2 and RCBO in closed position):				
	Maximum break times at:	[ms]	[ms]	[ms]	--
	- $I_{\Delta N}$	26	35	24	P
	- 2 $I_{\Delta N}$	27	26	23	P
	- 5 $I_{\Delta N}$ or	20	22	18	P
	- 0,25 A				N
	- $I_{\Delta t}$ 315 A	21	22	19	P
	No value exceeds the relevant specified limiting value				P
	Additional test for type S:				N
	Minimum non-actuating time at:				--
	- $I_{\Delta N}$ .....0,13 s				N
	- 2 $I_{\Delta N}$ ..... 0,06 s				N
	- 5 $I_{\Delta N}$ ..... 0,05 s				N
	- $I_{\Delta t}$ .....0,04 s				N
	The test switch S1 and the RCBO being in the closed position, the test voltage is suddenly established by closing the test switch S2 for min. non-operating times acc. table 2				N
	No tripping during tests				N

EN 61009-1					
Clause	Requirement + Test	Result - Remark			Verdict
d)	Verification of the correct operation in case of sudden appearance of residual current between 5 $I_{\Delta N}$ and 500A among the following list: 5A - 10A - 20A - 50A - 100A - 200A by closing S2, (S1 and RCBO in closed position):				N
	- A (value 1 between 5A and 200A)				N
	- A (value 1 between 5A and 200A)				N
	No value exceeds the relevant specified limiting value				N
f) 1)	Tests repeated at -5°C:				N
	Verification of the correct operation in case of sudden appearance of residual current by closing S1, (S2 and RCBO in closed position):				--
	Maximum break times at:	[ms]	[ms]	[ms]	--
	- $I_{\Delta N}$	18	14	19	P
	- 2 $I_{\Delta N}$	21	20	22	P
	- 5 $I_{\Delta N}$	18	17	19	P
	- 0,25 A				N
	- $I_{\Delta t}$ 315 A	17	16	19	P
	No value exceeds the relevant specified limiting value				P
	Additional test for type S:				N
	Minimum non-actuating time at:				--
	- $I_{\Delta N}$ .....0,13 s				N
	- 2 $I_{\Delta N}$ ..... 0,06 s				N
	- 5 $I_{\Delta N}$ ..... 0,05 s				N
	- $I_{\Delta t}$ .....0,04 s				N
	The test switch S1 and the RCBO being in the closed position, the test voltage is suddenly established by closing the test switch S2 for min. non-operating times acc. table 2				N
	No tripping during tests				N
e)	Tests repeated, with the pole under test and one other pole of the RCBO loaded with rated current, current being established shortly before the test.	I_N = A			N
	Cross-section (mm²).....:	mm²			--
	Verification of the correct operation at closing on residual current (S1 and S2 closed) :	[ms]	[ms]	[ms]	--
	-no value exceeds the specified limiting value				N

EN 61009-1					
Clause	Requirement + Test	Result - Remark			Verdict
	Verification of the correct operation in case of sudden appearance of residual current by closing S2, (S1 and RCBO in closed position):				N
	Maximum break times at:				--
	- $I_{\Delta N}$				N
	- 2 $I_{\Delta N}$				N
	- 5 $I_{\Delta N}$				N
	- 0,25 A				N
	- $I_{\Delta t}$ A				N
	No value exceeds the relevant specified limiting value				N
	Additional test for type S:				N
	Minimum non-actuating time at:				--
	- $I_{\Delta N}$ .....0,13 s				N
	- 2 $I_{\Delta N}$ ..... 0,06 s				N
	- 5 $I_{\Delta N}$ ..... 0,05 s				N
	- $I_{\Delta t}$ .....0,04 s				N
	The test switch S1 and the RCBO being in the closed position, the test voltage is suddenly established by closing the test switch S2 for min. non-operating times acc. table 2				N
	No tripping during tests				N
f) 2)	Tests repeated with the RCBO loaded with rated current IN at +40°C until steady-state conditions are reached	I_N = A			N
	Cross-section (mm²).....:	mm²			--
	Verification of the correct operation in case of sudden appearance of residual current by closing S1, (S2 and RCBO in closed position):				
	Maximum break times at:	[ms]	[ms]	[ms]	--
	- $I_{\Delta N}$				N
	- 2 $I_{\Delta N}$				N
	- 5 $I_{\Delta N}$				N
	- 0,25 A				N
	- $I_{\Delta t}$ A				N
	No value exceeds the relevant specified limiting value				N
	Additional test for type S:				N

EN 61009-1			
Clause	Requirement + Test	Result - Remark	Verdict
	Minimum non-actuating time at:		--
	- $I_{\Delta N}$ .....0,13 s		N
	- 2 $I_{\Delta N}$ ..... 0,06 s		N
	- 5 $I_{\Delta N}$ ..... 0,05 s		N
	- $I_{\Delta t}$ .....0,04 s		N
	The test switch S1 and the RCBO being in the closed position, the test voltage is suddenly established by closing the test switch S2 for min. non-operating times acc. table 2		N
	No tripping during tests		N

8.15	**Behaviour of RCBOs in case of earth fault currents comprising a DC component**					--
9.9.1.3	Verification of the correct operation at residual currents with DC components					--
	Type A residual current devices					--
	RCBO installed as for normal use, test circuits according to figures 5 and 6					N
	RCBOs with more than one rated frequency, tests at the lowest and highest frequency, except for test in 9.9.1.2 e),test at only one frequency.					N
	For RCBOs functionally dependent on line voltage each test is made at					N
	- 1,1 U_N.....:	V				--
	- 0,85 U_N ..... :	V				--
a)	Verification of the correct operation in case of a continuous rise of the residual pulsating direct current (S1, S2 and RCBO closed)					N
	Test acc. figure 5					--
	Angle α	Tripping current (A)				--
		Lower limit	Upper limit			--
	0°	0,35 $I_{\Delta N}$	1,4 $I_{\Delta N}$ or 2 $I_{\Delta N}$ (sub-clause 5.3.8)			--
	90°	0,25 $I_{\Delta N}$				--
	135°	0,11 $I_{\Delta N}$				--
	Steady increase from zero to:			[mA]	[mA]	[mA] --
	- 1,4 $I_{\Delta N}$ for $I_{\Delta N}$ > 0,01A with 1,4 $I_{\Delta N}$ /30 A/s					N
	- 2 $I_{\Delta N}$ for $I_{\Delta N} \leq$ 0,01 A with 2 $I_{\Delta N}$ /30 A/s					N
	α = 0° +/-					N

EN 61009-1											
Clause	Requirement + Test							Result - Remark			Verdict
	α = 90° +/-										N
	α = 135° +/-										N
	No value exceeds the relevant specified limiting values										N
b)	Verification of the correct operation in case of suddenly appearing residual pulsating direct currents by closing S2 (S1 and RCBO in closed position)										N
Table 3	Type	I_N A	$I_{\Delta N}$ A	Maximum values of break time and non-actuating time (s) for type A RCBOs in the event of half-wave pulsating residual currents (r.m.s. values) equal to							--
				1,4 $I_{\Delta N}$	2 $I_{\Delta N}$	2,8 $I_{\Delta N}$	4 $I_{\Delta N}$	7 $I_{\Delta N}$	0,35 A	0,5 A	350A a)	--
	General	Any value	<0,03		0,3		0,15			0,05	0,04	--
		Any value	0,03	0,3		0,15			0,04		0,04	--
		Any value	>0,03	0,3		0,15		0,04			0,04	--
	S	≥ 25	>0,03	0,5		0,2		0,15			0,15	--
	a)This value shall be limited to the lower limit of the overcurrent instantaneous tripping ranges according to type B, C or D, as applicable.											--
	Test acc. figure 5											--
	Angle α.....:							α = 0°				--
	RCBOs with $I_{\Delta N}$ < 0,03 A											N
	Maximum break times at:							[ms]	[ms]	[ms]		--
	- 2 $I_{\Delta N}$ +/-											N
	- 4 $I_{\Delta N}$ +/-											N
	- 0,5 A +/-											N
	- 350A or +/-											N
	- IΔt A +/-											N
	RCBOs with $I_{\Delta N}$ = 0,03 A											N
	Maximum break times at:							[ms]	[ms]	[ms]		--
	- 1,4 $I_{\Delta N}$ +/-											N
	- 2,8 $I_{\Delta N}$ +/-											N
	- 0,35 A +/-											N
	- 350A or +/-											N
	- $I_{\Delta t}$ A +/-											N

EN 61009-1					
Clause	Requirement + Test	Result - Remark			Verdict
	RCBOs with $I_{\Delta N}$ > 0,03 A				
	Maximum break times at:	[ms]	[ms]	[ms]	--
	- 1,4 $I_{\Delta N}$ +/-				N
	- 2,8 $I_{\Delta N}$ +/-				N
	- 7 $I_{\Delta N}$ +/-				N
	- 350A or +/-				N
	- $I_{\Delta t}$ A +/-				N
	No value exceeds the specified limiting values				N
c)	Verification of the correct operation with the pole under test and one other pole loaded with rated current IN	I_N = A			N
	Test acc. 9.9.1.3 a) repeated, pole under test an one other pole loaded with rated current				--
	Steady increase from zero to:	[mA]	[mA]	[mA]	--
	- 1,4 $I_{\Delta N}$ for $I_{\Delta N}$ > 0,01A with 1,4 $I_{\Delta N}$ /30 A/s				N
	- 2 $I_{\Delta N}$ for $I_{\Delta N} \leq$ 0,01 A with 2 $I_{\Delta N}$ /30 A/s				N
	α = 0° +/-				N
	α = 90° +/-				N
	α = 135° +/-				N
	No value exceeds the relevant specified limiting values				N
d)	Verification of the correct operation in case of residual pulsating direct currents with α = 0° superimposed by smooth direct current of 0,006 A				N
	Test acc. figure 6				--
	Steady increase of pulsating DC current from zero to:	[mA]	[mA]	[mA]	--
	- 1,4 $I_{\Delta N}$ for $I_{\Delta N}$ > 0,01A with 1,4 $I_{\Delta N}$ /30 A/s				N
	- 2 $I_{\Delta N}$ for $I_{\Delta N} \leq$ 0,01 A with 2 $I_{\Delta N}$ /30 A/s				N
	(I1) α = 0° +/- (I0) 6mA DC +/-				N
	No value exceeds the relevant specified limiting values				N

EN 61009-1					
Clause	Requirement + Test	Result - Remark			Verdict
	Tests D1				--
8	**Requirements for construction and operation**				--
8.12	RCBOs functionally dependent on line voltage				--
	RCBOs functionally dependent on the line voltage operate correctly between 0,85 and 1,1 U_N				--
9.17	**Verification of the behaviour of RCBOs opening automatically in case of failure of the line voltage**				--
9.17.1	Limiting value of the line voltage Ux				--
	UN applied to the line terminals and progressively lowered to attain zero within about 30s until automatic opening occurs	[V]	[V]	[V]	--
	All values less than 0,85 U_N				N
	Tripping test:				N
	Test voltage (V)..... :	V			--
	Residual current $I_{\Delta N}$..... :	$I_{\Delta N}$ =A			--
	Time corresponding to value for I∆N in table 2	[ms]	[ms]	[ms]	--
	No value exceeds the specified limiting values				N
	Not possible to close the apparatus by manual operating means below Ux				N
9.17.2	Verification of automatic opening in case of failure of the line voltage				--
	RCBO supplied with UN and line voltage, then switched off				N
	Time interval between switching off and opening of the main contacts:	[ms]	[ms]	[ms]	--
a)	RCBOs opening without delay				N
	- no value exceeds 0,5 s				N
b)	RCBOs opening with delay				N
	Values within the range indicated by manufacturer	toms			N
9.17.3	Verification of the correct operation, in presence of a residual current, for RCBOs opening with delay in case of failure of the line voltage				--
	RCBO connected according to figure 4 at UN				N
	All phases but one switched off by means of S3				N
9.9.1.2	During the delay: Off-load tests at 20 ± 5°C				--
a)	Verification of the correct operation in case of a steady increase of residual current:	[mA]	[mA]	[mA]	--

EN 61009-1					
Clause	Requirement + Test	Result - Remark			Verdict
	- Steady increase from 0,2 $I_{\Delta N}$ to $I_{\Delta N}$ within 30s Tripping current between $I_{\Delta N}$ 0 and $I_{\Delta N}$ (only if delay > 30s)				N
b)	Verification of the correct operation at closing on residual current (S1 and S2 closed) :	[ms]	[ms]	[ms]	--
	- The RCBO closes on $I_{\Delta N}$, no value exceeds the specified limiting value				N
c)	Verification of the correct operation in case of sudden appearance of residual current by closing S1, (S2 and RCBO in closed position):				N
	Maximum break times at:	[ms]	[ms]	[ms]	--
	- $I_{\Delta N}$				N
	- 2 $I_{\Delta N}$				N
	- 5 $I_{\Delta N}$ or				N
	- 0,25 A				N
	- $I_{\Delta t}$ A				N
	No value exceeds the relevant specified limiting value				N
d)	Verification of the correct operation in case of sudden appearance of residual current between 5 IΔN and 500A by closing S2, (S1 and RCBO in closed position):				N
	- A (value 1 between 5A and 200A)				N
	- A (value 1 between 5A and 200A)				N
	No value exceeds the relevant specified limiting value				N
	Additional test for type S:				--
	Minimum non-actuating time at:				--
	- $I_{\Delta N}$ ..... 0,13 s				N
	- 2 $I_{\Delta N}$ .....0,06 s				N
	- 5 $I_{\Delta N}$ .....0,05 s				N
	- $I_{\Delta t}$ ..... 0,04 s				N
	The test switch S1 and the RCBO being in the closed position, the test voltage is suddenly established by closing the test switch S2 for min. non-operating times acc. table 2				N
	No tripping during tests				N
9.17.4	Verification of the correct operation of RCBOs with 3 or 4 current paths, neutral and one line terminal only being energized in turn				--

EN 61009-1					
Clause	Requirement + Test	Result - Remark			Verdict
	RCBO connected according to figure 4				N
9.9.1.2.c)	Verification of the correct operation in case of sudden appearance of residual current by closing S1, (S2 and RCBO in closed position):				
	Maximum break times at:	[ms]	[ms]	[ms]	--
	- $I_{\Delta N}$				N
	- 2 $I_{\Delta N}$				N
	- 5 $I_{\Delta N}$ or				N
	- 0,25 A				N
	- $I_{\Delta t}$ A				N
	No value exceeds the relevant specified limiting value				N
	Additional test for type S:				--
	Minimum non-actuating time at:				--
	- $I_{\Delta N}$ ..... 0,13 s				N
	- 2 $I_{\Delta N}$ .....0,06 s				N
	- 5 $I_{\Delta N}$ .....0,05 s				N
	- $I_{\Delta t}$ ..... 0,04 s				N
	The test switch S1 and the RCBO being in the closed position, the test voltage is suddenly established by closing the test switch S2 for min. non-operating times acc. table 2				N
	No tripping during tests				N

8.14	**Behaviour of RCBOs in case of current surges caused by impulse voltages**				--
9.19.1	Current surge test for all RCBOs (0,5µs/100kHz ring wave test)				--
	One pole of the RCBO submitted to 10 surge current applications, polarity inverted after every two applications				N
	Peak value.....:	200A +10/-0% or (25A +10/-0% for I∆N≤10mA)			--
	Virtual front time..... :	0,5µs ± 30%			--
	Period of following oscillatory wave..... :	10µs ±20%			--
	Each successive reverse peak..... :	60% of preceding peak			--
	No tripping during tests	No trip			P
	After the test the RCBO shall trip with a test current of I∆N	[ms]	[ms]	[ms]	--

EN 61009-1					
Clause	Requirement + Test	Result - Remark			Verdict
		18	21	19	P
	Test switch S2 and RCBO in the closed position, test voltage established by closing the test switch S1				P
	No value exceed the relevant specified limiting value				P
9.19.2	Verification of behaviour at surge currents up to 3000A (8/20μs surge current test)				--
	One pole of the RCBO chosen at random, submitted to 10 surge current applications, polarity inverted after every two applications				P
	Peak value.....:	3000A +10/-0%			--
	Virtual front time..... :	0,8μs ± 20%			--
	Virtual time of half value.....:	20μs ± 20%			--
	Peak of reverse current.....:	less than 30 % of peak value			--
9.19.2.2	Test results for S-type RCBOs: No tripping during tests				P
9.19.2.3	Test results for RCBOs of the general type: During the test the RCBO may trip. After any tripping, the RCBO shall be re-closed				P
	No tripping during tests				
	After the test the RCBO shall trip with a test current of $I_{\Delta N}$	[ms]	[ms]	[ms]	--
					P
	Test switch S2 and RCBO in the closed position, test voltage established by closing the test switch S1				P
	No value exceed the relevant specified limiting value				P
9.12.13	Verification of the rated residual making and breaking capacity $I_{\Delta m}$				P
	$I_{\Delta m}$ (A)..... :	630A			--
	Test circuit according to figure..... :	8			--
	Cross-section (mm²)..... :	25mm²			--
	Grid distance a (mm)..... :	35mm			--
	Prospective current (A)..... :	630A			--
	Prospective current obtained (A)..... :	643A			--
	Power factor..... :	0.93 ~ 0.98			--
	Power factor obtained..... :	0.95			--
	I^2t max sequence O-t-CO-t-CO	[KA²s]	[KA²s]	[KA²s]	--

EN 61009-1					
Clause	Requirement + Test	Result - Remark			Verdict
		3.04	3.88	2.85	P
	Phases which do not carry the short circuit current during this test shall be connected to the supply voltage at the line terminals				P
	On each pole in turn excluding the switched neutral pole				P
	RCBOs functionally dependent on the line voltage supplied with rated voltage.				P
	No permanent arcing				P
	No flashover				P
	No blowing of fuse F				P
	No damage, polyethylene sheet shows no holes				P
9.12.13.2	The RCBO shall show no damage impairing their further use an shall be capable without maintenance to withstand the following tests:				P
9.7.3	Dielectric strength test of the main circuit:				--
	2 UN (V) for 1 min..... :	2 U_N = V			--
	a)				P
	b)				P
	c)				P
	d)				N
	e)				N
	No flashover or breakdown				P
	Making and breaking IN at UN				P
	The RCBO shall trip with a test current of 1,25 $I_{\Delta N}$ - break time not exceeding the value for $I_{\Delta N}$ in table 2	[ms]	[ms]	[ms]	--
		22	27	23	P
	Test switch S2 and RCBO in the closed position, test voltage established by closing the test switch S1.				P
	Additional tests for RCBOs functionally depending on line voltage if applicable:				N
9.17	**VERIFICATION OF THE BEHAVIOUR OF RCBOS OPENING AUTOMATICALLY IN CASE OF FAILURE OF THE LINE VOLTAGE**				--
9.17.1	Limiting value of the line voltage Ux				N
	UN applied to the line terminals and progressively lowered to attain zero within about 30s until automatic opening occurs	[V]	[V]	[V]	--

EN 61009-1					
Clause	Requirement + Test	Result - Remark			Verdict
	All values less than 0,85 U_N				N
	Tripping test:				N
	Test voltage (V).....:	V			--
	Residual current IΔN.....	IΔN = A			--
	Time corresponding to value for IΔN in table 2	[ms]	[ms]	[ms]	--
	No value exceeds the specified limiting values				N
	Not possible to close the apparatus by manual operating means below UX				N
9.17.2	Verification of automatic opening in case of failure of the line voltage				--
	RCBO supplied with UN and line voltage then switched off				P
	Time interval between switching off and opening of the main contacts:				P
	a) RCBOs opening without delay				P
	- no value exceeds 0,5 s				N
	b) RCBOs opening with delay				P
	values within the range indicated by manufacturer:	to ms			N
9.17.3	Verification of the correct operation, in presence of a residual current, for RCBOs opening with delay in case of failure of the line voltage				--
	RCBO connected according to figure 4 at UN				P
	All phases but one switched off by means of S3				P
9.9.1.2	During the delay: Off-load tests at 20 ± 5°C				P
a)	Verification of the correct operation in case of a steady increase of residual current:	[mA]	[mA]	[mA]	--
	- Steady increase from 0,2 IΔN to IΔN within 30s Tripping current between IΔN0 and IΔN (only if delay > 30s)	17.3 18.6	27.2 28.7	20.6 20.9	P
b)	Verification of the correct operation at closing on residual current (S1 and S2 closed) :	[ms]	[ms]	[ms]	--
	- The RCBO closes on IΔN, no value exceeds the specified limiting value	21	20	20	P
c)	Verification of the correct operation in case of sudden appearance of residual current by closing S1, (S2 and RCBO in closed position):				P
	Maximum break times at:	[ms]	[ms]	[ms]	--
	- $I_{\Delta N}$	22	20	24	P
	- 2 $I_{\Delta N}$	21	22	26	P

EN 61009-1					
Clause	Requirement + Test	Result - Remark			Verdict
	- 5 $I_{\Delta N}$ or	21	20	1	P
	- 0,25A				N
	- $I_{\Delta t}$ 315 A	18	21	21	P
	No value exceeds the relevant specified limiting value				N
d)	Verification of the correct operation in case of sudden appearance of residual current between 5 IΔN and 500A by closing S2, (S1 and RCBO in closed position):				N
	- 50 A (value 1 between 5A and 200A)	16	10	17	P
	- 200 A (value 1 between 5A and 200A)	12	21	18	P
	No value exceeds the relevant specified limiting value				P
	Additional test for type S:				--
	Minimum non-actuating time at:	[ms]	[ms]	[ms]	--
	- $I_{\Delta N}$ ..... 0,13 s				N
	- 2 $I_{\Delta N}$ ..... 0,06 s				N
	- 5 $I_{\Delta N}$ ..... 0,05 s				N
	- $I_{\Delta t}$ ..... 0,04 s				N
	The test switch S1 and the RCBO being in the closed position, the test voltage is suddenly established by closing the test switch S2 for min. non-operating times acc. table 2				N
	No tripping during tests				N
9.17.4	Verification of the correct operation of RCBOs with 3 or 4 current paths, neutral and one line terminal only being energized in turn				N
	RCBO connected according to figure 4				N
9.9.1.2.c)	Maximum break times at:	[ms]	[ms]	[ms]	--
	- $I_{\Delta N}$				N
	- 2 $I_{\Delta N}$				N
	- 5 $I_{\Delta N}$ or				N
	- 0,25A				N
	- IΔt A				N
	No value exceeds the relevant specified limiting value				N
	Additional test for type S:				N
	Minimum non-actuating time at:	[ms]	[ms]	[ms]	--

EN 61009-1					
Clause	Requirement + Test	Result - Remark			Verdict
	- $I_{\Delta N}$ ..... 0,13 s				N
	- 2 $I_{\Delta N}$ ..... 0,06 s				N
	- 5 $I_{\Delta N}$ ..... 0,05 s				N
	- $I_{\Delta t}$ ..... 0,04 s				N
	The test switch S1 and the RCBO being in the closed position, the test voltage is suddenly established by closing the test switch S2 for min. non-operating times acc. table 2				N
	No tripping during tests				N

8.11	**Test device**		--
	RCBOs provided with a test device		P
	Ampere-turns produced when operating the test device do not exceed 2,5 times the ampere turns produced by I∆N		P
	Not possible to energize the circuit on the load side by operating the test device when the RCBO is in the open position		P
9.16	**Verification of the operation of the test device at the limits of rated voltage**		--
	a) RCBO at 0,85 UN, test device actuated 25 times at intervals of 5s	204V	P
	b) Test a) repeated at 1,1 UN	264V	P
	c) Test b) repeated, but only once, the operating means of the test device being held in the closed position for 30s		P
	RCBO operated at each test		P
	No change impairing further use		P

EN 61009-1			
Clause	Requirement + Test	Result - Remark	Verdict

	TEST SEQUENCE "E"	E1 E2 E3			--
	Tests E_0				--
9.9	**verification of the Operating characteristics**				--
9.9.2	Verification of the Operating characteristics under overcurrent conditions				--
	I_N (A).....:	A			--
	Cross-section (mm²)..... :	mm²			--
	Instantaneous tripping current (B / C / D).....:				--
9.9.2.1	Test of time-current characteristic				N
a)	Test current 1,13 IN starting from cold for..... :	1,13 I_N = 71.2A			--
	- 1 h (IN ≤ 63 A)				P
	- 2 h (IN > 63 A)				N
	No tripping				P
	Then steadily increased within 5 s to 1,45 I_N.....:	1,45 I_N =91.35 A			--
	Tripping within	[min]	[min]	[min]	--
	- 1h (< 63 A)	1min16s	6min51s	32s	P
	- 2h (> 63 A)				N
b)	Test current 2,55 IN starting from cold..... :	2,55 I_N = A			--
	Opening time not less than 1 s or more than	[s]	[s]	[s]	--
	- 60 s (≤ 32 A)				N
	- 120 s (> 32 A)	22.4	28.6	40.3	P
9.9.2.2	Test of instantaneous tripping:				--
a)	General test conditions				P
	For the lower values of the test current of 9.9.2.2.b), 9.9.2.2.c) and 9.9.2.2.d) respectively the test is made once, at any convenient voltage				P
	For the upper value of the test current, the two following tests are carried out:				P
	- At any convenient voltage, one opening operation on each combination of two poles connected in series . The tripping time is measured and shall be within the limits of Table 10. test results see b) or c) or d)				P
	- At rated voltage U0 (phase to neutral) with a power factor between 0,95 and 1 separately on each protected pole of the RCBO The sequence of operation is: O-t-CO-t-CO-t-CO Interval time: > 3 min.				P

EN 61009-1					
Clause	Requirement + Test	Result - Remark			Verdict
	The tripping time of the O operation is measured	[s]	[s]	[s]	--
					N
	After each operation the indication means shall show the open position of the contacts				N
b)	☐ B				N
	Test current 3 I_N starting from cold.....:	3 I_N =A			--
		[s]	[s]	[s]	--
	- Opening time not less than 0,1 s				N
	Test current 5 I_N starting from cold.....:	5 I_N =A			--
		[s]	[s]	[s]	--
	- Tripping time less than 0,1 s				N
c)	☒ C				P
	Test current 5 I_N starting from cold.....:	5 I_N =316 A			--
		[s]	[s]	[s]	--
	- Opening time not less than 0,1 s				P
	Test current 10 I_N starting from cold..... :	10 I_N =635 A			--
		[s]	[s]	[s]	--
	- Tripping time less than 0,1 s				P
d)	☒ D				P
	Test current 10 I_N starting from cold..... :	10 I_N =630A			--
		[s]	[s]	[s]	--
	- Opening time not less than 0,1 s	9.3	8.9	10.1	P
	Test current 20 I_N starting from cold..... :	20 I_N =1280A			
		[s]	[s]	[s]	--
	- Tripping time less than 0,1 s	12.2	9.9	10.1	P
9.9.2.3	Test of effect of ambient temperature on the tripping characteristics:				P
a)	Ambient temperature of (- 5 ± 2)°C.....:	-5°C			--
	Test current 1,13 I_N.....:	1,13 I_N = 71.2A			--
	- passed for 1 h				P
	- passed for 2 h				N
	Current is then steadily increased within 5s to 1,9 I_N	1,9 I_N = A			--
	Tripping:	[min]	[min]	[min]	--
	- 1 h	1min18s	1mn09s	3min01s	P

EN 61009-1					
Clause	Requirement + Test	Result - Remark			Verdict
	- 2 h				N
b)	Ambient temperature of (40 ± 2)°C.....:	40°C			--
	Test current IN	I_N =A			--
	No tripping within				--
	- 1 h				P
	- 2 h				N

EN 61009-1			
Clause	Requirement + Test	Result - Remark	Verdict
	Tests E1		--
8	**requirements for construction and operation**		--
8.8	Resistance to mechanical shock and impact		--
	RCBO' shall have adequate mechanical behaviour so as to withstand stresses imposed during installation and use		P
9.13	**Verification to resistance to mechanical shock and impact**		--
9.13.1	Mechanical shock		--
9.13.1.2	Test procedure:		--
	- 50 falls of 40 mm on one side		P
	- 50 falls on opposite side		P
	C turned through 90°		P
	- 50 falls on one side		P
	- 50 falls on opposite side		P
	No opening of RCBO during test		P
9.13.2	Mechanical impact		--
	- 9.13.2.2 for RCBOs intended to be mounted on a rail		P
	- 9.13.2.3 for plug-in type RCBOs		P
9.13.2.1	Impact test:		P
	10 blows from a height of 10 cm		--
	No damage		P
9.13.2.2	RCBOs for rail mounting:		P
	- downward vertical force of 50 N for 1 min		P
	- upward vertical force of 50 N for 1 min		P
	RCBO shall not become loose during test and shall not show any damage impairing its further use		P
9.13.2.3	RCBOs of plug-in type		N
	Under consideration		--
9.12.11.3	Test at 1500 A:		--
	Prospective current of 1500 A		--
	Cross-section (mm²).....:	25mm²	--
	Grid distance a (mm).....:	a = 35 mm	--
	Power factor 0,93 – 0,98.....:	0.96	--

EN 61009-1					
Clause	Requirement + Test	Result - Remark			Verdict
	Prospective current obtained..... :	1540A			--
	Power factor.....:	0.96			--
	Test circuit:.....:	Figure			--
	I_{peak} (A) max. value..... :	1920A			--
	Sequence: 6-O and 3-COI	[KA²s]	[KA²s]	[KA²s]	--
		12.3	11.1	12.8	P
	RCBOs functionally dependent on the line voltage supplied with rated voltage				P
	No permanent arcing				P
	No flash-over between poles or between poles and frame				P
	No blowing of fuse				P
	No damage, polyethylene sheet shows no holes				P
9.12.12	The RCBO shall show no damage impairing their further use an shall be capable without maintenance to withstand the following tests:				N
9.12.12.1 .a)	leakage current across open contacts, according to 9.7.7.3, each pole is supplied at a voltage 1,1 times Un.= _____ V. The RCBO is in the open position	[mA]	[mA]	[mA]	--
	The leakage current shall not exceed 2 mA	<0.01	<0.01	<0.01	P
9.12.12.1 .b)	The RCBO shall show no damage impairing their further use an shall be capable without maintenance to withstand the following tests:				--
	Dielectric strength test:				--
	Test voltage:				--
	a) 1500 V				P
	b) 1500 V				P
	c) 1500 V				P
	d) 1500 V				N
	e) 2000 V				N
	During these test, after the test has carried out under the conditions specified in 9.7.2 a), it shall be verified that the indicating means show the open position and during the test carried out under the conditions specified in 9.7.2 b) the indication means shall show the closed position				P
9.12.12.1	Test current equal to 0,85 times the conventional non-tripping current for:	60.8A			--
	- 1h starting from cold				P

EN 61009-1					
Clause	Requirement + Test	Result - Remark			Verdict
	- 2h				N
	Increasing the current within 5s to 1,1 times the conventional tripping current	100A			--
	- tripping within	[min]	[min]	[min]	--
	- 1h (< 63 A)	39s	4min01s	1min27s	P
	- 2h (> 63 A)				N

EN 61009-1					
Clause	Requirement + Test	Result - Remark			Verdict
	TEST SEQUENCE "F"	**F1 F2 F3**			--
	Tests F_0				--
9.12	**Short-circuits test**				--
9.12.11.4	Test above 1500 A				P
b)	Test at service short-circuit capacity Ics				P
	Service short-circuit capacity (A)..... :	A			--
	Figure..... :				--
	Cross-section (mm²)..... :	mm²			--
	Grid distance a (mm)..... :	mm			--
	Prospective current (A)..... :	A			--
	Prospective current obtained (A)..... :	A			--
	Power factor..... :				--
	Power factor obtained..... :				--
	Sequence..... :				--
	Ipeak (A) max. value..... :	A			--
	I²t max..... :	[KA²s]	[KA²s]	[KA²s]	--
					P
	RCBOs functionally dependent on the line voltage supplied with rated voltage				N
	No permanent arcing				P
	No flash-over between poles or between poles and frame				P
	No blowing of fuse				N
	No damage, polyethylene sheet shows no holes				P
9.12.12	The RCBO shall show no damage impairing their further use an shall be capable without maintenance to withstand the following tests:				P
9.12.12.1 .a)	Leakage current across open contacts, according to 9.7.7.3, each pole is supplied at a voltage 1,1 times Un.= _____ V. The RCBO is in the open position	[mA]	[mA]	[mA]	--
	The leakage current shall not exceed 2 mA	<0.01	<0.01	<0.01	P
9.12.12.1 .b)	Dielectric strength test:				--
	Test voltage:				--
	a) 1500 V				P

EN 61009-1					
Clause	Requirement + Test	Result - Remark			Verdict
	b) 1500 V				P
	c) 1500 V				P
	d) 1500 V				N
	e) 2000 V				N
	During these test, after the test has carried out under the conditions specified in 9.7.2 a), it shall be verified that the indicating means show the open position and during the test carried out under the conditions specified in 9.7.2 b) the indication means shall show the closed position				P
	Test current equal to 0,85 times the conventional non-tripping current for:	60.8A			--
	- 1h starting from cold				P
	- 2h				P
	Increasing the current within 5s to 1,1 times the conventional tripping current	A			--
	- tripping within	[min]	[min]	[min]	--
	- 1h (< 63 A)				N
	- 2h (> 63 A)				N

EN 61009-1					
Clause	Requirement + Test	Result - Remark			Verdict
	Tests F1				--
9.12	**Short-circuits test**				--
9.12.11.4	Test above 1500 A				P
c)	Test at rated short-circuit capacity Icn				P
	Rated short-circuit capacity (A)..... :	6000A			--
	Figure..... :	8			--
	Cross-section (mm²)..... :	25mm²			--
	Grid distance a (mm)..... :	40mm			--
	Prospective current (A)..... :	6000A			--
	Prospective current obtained (A)..... :	6130A			--
	Power factor..... :	0.65…0.70			--
	Power factor obtained..... :	0.68			--
	Sequence..... :	O-t-CO			--
	I_{peak} (A) max. value..... :	4560A			--
	I²t max..... :	[KA²s]	[KA²s]	[KA²s]	--
		44.4	56.9	34.8	P
	RCBOs functionally dependent on the line voltage supplied with rated voltage				N
	No permanent arcing				N
	No flash-over between poles or between poles and frame				N
	No blowing of fuse				N
	No damage, polyethylene sheet shows no holes				N
9.12.12	The RCBO shall show no damage impairing their further use an shall be capable without maintenance to withstand the following tests:				P
9.12.12.2 .a)	Leakage current across open contacts, according to 9.7.7.3, each pole is supplied at a voltage 1,1 times Un.= _____ V. The RCBO is in the open position	[mA]	[mA]	[mA]	--
	The leakage current shall not exceed 2 mA	<0.01	<0.01	<0.01	P
9.12.12.2 .b)	Dielectric strength test:				--
	Test voltage:				--
	a) 900 V				P
	b) 900 V				N

EN 61009-1					
Clause	Requirement + Test	Result - Remark			Verdict
	c) 900 V				N
	d) 900 V				P
	e) 900 V				N
	During these test, after the test has carried out under the conditions specified in 9.7.2 a), it shall be verified that the indicating means show the open position and during the test carried out under the conditions specified in 9.7.2 b) the indication means shall show the closed position				P
9.12.12.2 .c)	Test current 2,8 I_N.....:	2,8 I_N = A			--
	Tripping within > 0,1 s up to	[s]	[s]	[s]	--
	- 60 s				N
	- 120 s				N

EN 61009-1			
Clause	Requirement + Test	Result - Remark	Verdict

	TEST SEQUENCE "G"	**G1**	**G2**	**G3**	--
9.22	**Verification of reliability**				--
9.22.1	Climatic test				--
	Based on IEC 60068-2-30 taking into account IEC 60068-3-4				P
	28 cycles				P
	Upper temperature 55°C ± 2°C				P
	Initial verification:	[ms]	[ms]	[ms]	--
	Maximum break time at IΔN	23	30	26	P
	Test switch S2 and RCBO in the closed position, test voltage established by closing the test switch S1.				P
	No value exceeds the specified limiting value				P
	Additional test for type S:				N
	Maximum non-actuating time at IΔN				N
	No tripping				N
	The test switch S1 and the RCBO being in the closed position, the test voltage is suddenly established by closing the test switch S2 for min. non-operating times acc. table 2				N
	Climatic test:				--
	No tripping during 28 cycles				P
9.22.1.5	Final verification:				
	The RCBO shall trip with a test current of 1,25 IΔN in the test chamber - break time not exceeding the value for IΔN in table 2	[ms]	[ms]	[ms]	--
		21	25	18	P
	Test switch S2 and RCBO in the closed position, test voltage established by closing the test switch S1.				

EN 61009-1			
Clause	Requirement + Test	Result - Remark	Verdict
	TEST SEQUENCE "H"	H1 H2 H3	--
IEC 61543:			P
Table 4-T1.1	Harmonics, interharmonics		P
Table 4-T1.2	Signalling voltage		P
Table 5-T2.3	Conducted unidirectional transients of the ms and μs time scale		N
	Test results of test sequence H:		--
	see test report No.		N
	Testing location / address.....		P

EN 61009-1			
Clause	Requirement + Test	Result - Remark	Verdict

	TEST SEQUENCE "I"	I1 I2 I3	--
IEC 61543:			P
Table 5-T2.1	Conducted sine-wave voltages or currents		N
Table 5-T2.5	Radiated high-frequency phenomena		P
Table 5-T2.2	Fast transients (burst)		N
	Test results of test sequence I:		--
	see test report No.		P
	Testing location / address.....		N

EN 61009-1			
Clause	Requirement + Test	Result - Remark	Verdict

	TEST SEQUENCE "J"	J1 J2 J3	--
IEC 61543:			P
Table 5-T2.6	Conducted common mode disturbances in the frequency range lower than 150 kHz		N
Table 6-T3.1	Electrostatic discharges		N
	Test results of test sequence J:		--
	see test report No.		N
	Testing location / address.....		P

EN 61009-1			
Clause	Requirement + Test	Result - Remark	Verdict

ANNEX A (NORMATIVE)

Test sequence and number of samples to be submitted for certification purposes
Table A.1 - Test sequences

Test sequence		Clause or subclause	Test (or inspection)
A	A_1	6 8.1.1 8.1.2 9.3 8.1.3 8.1.6 9.11 9.4 9.5 9.6 9.14 8.1.3 9.25	Marking General Mechanism Indelibility of marking Clearance and creepage distances (external parts only) Non-interchangeability Trip free mechanism Reliability of screws, current-carrying parts and connections Reliability of terminals for external conductors Protection against electric shock Resistance to heat Clearances and creepage distances (internal parts) Resistance to rusting
	A_2	9.15	Resistance to abnormal heat and fire
B		9.7.7.4 9.7.7.5 a) 9.7.1 9.7.2 9.7.3 9.7.4 9.7.7.2 9.7.5 9.7.6 9.8 9.22.2 9.23	Resistance of the insulation of open contacts and basic insulation against an impulse voltage in normal conditions Verification of the behaviour of components bridging the basic insulation Resistance to humidity Insulation resistance of the main circuit Dielectric strength of the main circuit Insulation resistance an dielectric strength of auxiliary circuits Verification of clearances with the impulse withstand voltage Secondary circuit of detection transformers Capability of control circuits connected to the main circuits Temperature-rise Reliability at 40°C Ageing of electronic components
C	C_1	9.10 9.12.11.2.1 (and 9.12.12)	Mechanical and electrical endurance Performance at reduced short-circuit currents (Verification of the RCBO after short-circuit tests)
	C_2	9.12.11.2.2 (and 9.12.12)	Short-circuit test for verifying the suitability of RCBOs for use in IT systems (Verification of the RCBO after short-circuit tests)
D	D_0	9.9.1	Operating characteristics under residual current conditions
	D_1	9.17 9.19 9.12.13 9.16	Behaviour in case of failure of the line voltage Behaviour in case of surge currents Performance at $I_{\Delta m}$ Test device
E	E_0	9.9.2	Overcurrent operating characteristics
	E_1	9.13 9.12.11.3 (and 9.12.12)	Resistance to mechanical shock and impact Short-circuit performance at 1500 A
F	F_0	9.12.11.4 b) (and 9.12.12)	Performance at service short-circuit capacity
	F_1	9.12.11.4 c) (and 9.12.12.2)	Performance at rated short-circuit capacity
G		9.22.1	Reliability (climatic tests)
H a) b)		IEC 61543 Table 4-T1.1 IEC 61543 Table 4-T1.2 IEC 61543 Table 5-T2.3	Harmonics, inter harmonics Signalling voltages Conducted unidirectional transients of the ms and µs time scale
I		IEC 61543 Table 5-T2.1 IEC 61543 Table 5-T2.5 IEC 61543 Table 5-T2.2	Conducted sine-wave voltages or currents Radiated electromagnetic field Fast transients (burst)
J		IEC 61543 Table 5-T2.6 IEC 61543 Table 6-T3.1	Conducted common mode disturbances in the frequency range lower than 150 kHz Electrostatic discharges

a) This test may be done on separate samples.

b) For devices containing a continuously operating oscillator, the test of CISPR 14-1 shall be carried out on the samples prior to the tests of this sequence.

EN 61009-1			
Clause	Requirement + Test	Result - Remark	Verdict

Table A.2 - Number of samples for full test procedure

Test sequence	Number of samples	Minimum number of accepted samples (a) (b)	number of samples for repeated tests (c)
A_1	1	1	--
A_2	3	2	3
B	3	2	3
C_1	3	2 (d)	3
C_2	3	2 (d)	3
D	3	2 (d)	3
E	3	2 (d)	3
F_0	3	2 (d)	3
F_1	3	2 (d)	3
G	3	2	3
H (e)	3	2	3
I (e)	3	2	3
J (e)	3	2	3

a)In total a maximum of three test sequences may be repeated.

b)It is assumed that a sample which has not passed a test has not met the requirements due to workmanship or assembly defects which are not representative of the design.

c)In the case of repeated tests, all test results must be acceptable.

d) Except for test of 9.12.10, 9.12.11.2, 9.12.11.3, 9.12.11.4, 9.12.13 as appropriate, which all samples shall pass.

e)At the manufacturer's request, the same set of samples may be subjected to more than one of these test sequences.

EN 61009-1			
Clause	Requirement + Test	Result - Remark	Verdict

Table A.3 - Number of samples for simplified test procedure

Test sequence	Number of samples according to the number of poles [a) g)]		
	2-poles [b) c)]	3-poles [d) f) j)]	4-poles [e)]
A_1	1 max. rating I_N min. rating $I_{\Delta N}$	1 max. rating I_N min. rating $I_{\Delta N}$	1 max. rating I_N min. rating $I_{\Delta N}$
A_2	3 max. rating I_N min. rating $I_{\Delta N}$	3 max. rating I_N min. rating $I_{\Delta N}$	3 max. rating I_N min. rating $I_{\Delta N}$
B	3 max. rating I_N min. rating $I_{\Delta N}$	3 max. rating I_N min. rating $I_{\Delta N}$	3 max. rating I_N min. rating $I_{\Delta N}$
C	3 max. rating I_N min. rating $I_{\Delta N}$	3 max. rating I_N min. rating $I_{\Delta N}$	3 max. rating I_N min. rating $I_{\Delta N}$
$D_0 + D_1$	3 max. rating I_N min. rating $I_{\Delta N}$	3 max. rating I_N min. rating $I_{\Delta N}$	3 max. rating I_N min. rating $I_{\Delta N}$
D_0	1 for all other ratings of $I_{\Delta N}$ with max. I_N		
$E_0 + E_1$	3 max. rating I_N min. rating $I_{\Delta N}$	3 max. rating I_N min. rating $I_{\Delta N}$	3 max. rating I_N min. rating $I_{\Delta N}$
E_0	1 [i)] for all other ratings of I_N with min. $I_{\Delta N}$		
F_0	3 max. rating I_N min. rating $I_{\Delta N}$ 3 min. rating I_N max. rating $I_{\Delta N}$	3 max. rating I_N min. rating $I_{\Delta N}$ 3 min. rating I_N max. rating $I_{\Delta N}$	3 max. rating I_N min. rating $I_{\Delta N}$ 3 min. rating I_N max. rating $I_{\Delta N}$
F_1	3 max. rating I_N min. rating $I_{\Delta N}$ 3 min. rating I_N max. rating $I_{\Delta N}$	3 max. rating I_N min. rating $I_{\Delta N}$ 3 min. rating I_N max. rating $I_{\Delta N}$	3 max. rating I_N min. rating $I_{\Delta N}$ 3 min. rating I_N max. rating $I_{\Delta N}$
G	3 max. rating I_N min. rating $I_{\Delta N}$	3 max. rating I_N min. rating $I_{\Delta N}$	3 max. rating I_N min. rating $I_{\Delta N}$
H [k)]			3 [h)] samples of the same rating I_N chosen at random min. rating $I_{\Delta N}$
I			3 [h)] samples of the same rating I_N chosen at random min. rating $I_{\Delta N}$
J			3 [h)] samples of the same rating I_N chosen at random min. rating $I_{\Delta N}$

a)If a test is to be repeated according to the minimum performance criteria of clause A.2, a new set of samples is used for the relevant test. In the repeated test all test results must be acceptable.
b)If only 3-pole or 4-pole RCBOs are submitted, this column shall also apply to a set of samples with the smallest number of poles.
c)Also applicable to 1-pole RCBOs with uninterrupted neutral and 2-pole RCBOs with 1 protected pole.
d)Also applicable to 3-pole RCBOs with two protected poles
e)Also applicable to 3-pole RCBOs with uninterrupted neutral and 4-pole RCBOs with 3 protected poles.
f)This column is omitted when 4-pole RCBOs have been tested.
g)If only one value of $I_{\Delta N}$ is submitted, min. rating $I_{\Delta N}$ and max. rating $I_{\Delta N}$ are replaced by $I_{\Delta N}$.
h)Only the highest number of current paths.
i)For this sequence only the test of 9.9.2 is required.
j)If a 3-pole RCBO with 4 current paths and a 4-pole RCBO are submitted, then only the 4-pole RCBO is tested, with exception of the test of 9.8 of test sequence B for which both types are submitted to the test.
k)If the requirement to test max. rating I_N and minimum rating $I_{\Delta N}$ does not cover all the possible range of RCBOs, the minimum $I_{\Delta N}$ shall in any case be chosen for the test.

EN 61009-1			
Clause	Requirement + Test	Result - Remark	Verdict

Table A.4 - Test sequences for RCBOs having different instantaneous tripping currents

RCBO type tested first	Test sequences for other RCBO types		
	B-type	C-type	D-type
B-type	---	$(E_0 + E_1) + F$	$(E_0 + E_1) + F$
C-type	E_0 a) + B a)	---	$(E_0 + E_1) + F$
D-type	E_0 a) + B a)	E_0 a) + B a) b)	---

a) For this sequence only the tests of 9.8 and 9.9.2.2 are required.

b) When certification is requested at the same time for B-type, C-type and D-type RCBOs having the same rated short-circuit capacity, only test sequence E0 is required if B-type and D-type samples have been tested.

Table A.5 - Test sequences for RCBOs of different classification according to 4.6

Test sequence	Number of samples according to the number of poles a)		
	2-pole b) c)	3-pole d) f)	4-pole e)
$D_0 + D_1$	1 max. rating I_N min. rating $I_{\Delta N}$	1 max. rating I_N min. rating $I_{\Delta N}$	1 max. rating I_N min. rating $I_{\Delta N}$
D_0	1 for all other ratings of $I_{\Delta N}$ with max. $I_{\Delta N}$		

a)If a test is to be repeated according to the minimum performance criteria of clause A.2, a new set of samples is used for the relevant test. In the repeated test all test results must be acceptable.

b)If only 3-pole or 4-pole RCBOs are submitted, this column shall also apply to a set of samples with the smallest number of poles.

c)Also applicable to 1-pole RCBOs with uninterrupted neutral and to 2-pole RCBOs with 1 protected pole.

d)Also applicable to 3-pole RCBOs with 2 protected poles

e)Also applicable to 3-pole RCBOs with uninterrupted neutral and to 4-pole RCBOs with 3 protected poles.

f)This column is omitted when 4-pole RCBOs have been tested.

EN 61009-1			
Clause	Requirement + Test	Result - Remark	Verdict

ANNEX B	**DETERMINATION OF CLEARANCES AND CREEPAGE DISTANCES**	--
B.1	General	--
	In determining clearances and creepage distances, it is recommended that the following points should be considered.	P
B.2	Orientation and location of a creepage distance	--
	If necessary, the manufacturer shall indicate the intended orientation of the equipment or component in order that creepage distances be not adversely affected by the accumulation of pollution for which they were not designed.	P
B.3	Creepage distances where more than one material is used	--
	A creepage distance may be split in several portions of different materials and/or have different pollution degrees if one of the creepage distances is dimensioned to withstand the total voltage or if the total distance is dimensioned according to the material having the lowest CTI.	P
B.4	Creepage distances split by floating conductive part	--
	A creepage distance may be split into several parts, made with insulation material having the same CTI, including or separated by floating conductors as long as the sum of the distances across each individual part is equal or greater than the creepage distance required if the floating part did not exist. The minimum distance X for each individual part of the creepage distance is given in IEC 60664-1:2007, 6.2 (see also Example 11 in Figure B.1).	P
B.5	Measurement of creepage distances and clearances	--
	In determining creepage distances according to IEC 60664-1, the dimension *X*, specified in the following examples, has a minimum value of 1,0 mm for pollution degree 2.	P
	If the associated clearance is less than 3 mm, the minimum dimension *X* may be reduced to one third of this clearance.	P
	The methods of measuring creepage distances and clearances are indicated in Figure B.1. These cases do not differentiate between gaps and grooves or between types of insulation.	P
	The following assumptions are made:	P
	- any recess is assumed to be bridged with an insulating link having a length equal to the specified width *X* and being placed in the most unfavourable position (see Example 3);	P
	- where the distance across a groove is equal to or larger than the specified width *X*, the creepage distance is measured along the contours of the groove (see Example 2);	P
	- creepage distances and clearances measured between parts which can assume different positions in relation to each other, are measured when these parts are in their most unfavourable position.	N

EN 61009-1			
Clause	Requirement + Test	Result - Remark	Verdict

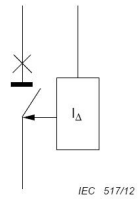
ANNEX C	**ARRANGEMENT FOR THE DETECTION OF THE EMISSION OF IONIZED GASES DURING SHORT-CIRCUIT TESTS**	--
	The device under test is mounted as shown in figure C.1, which may require adapting to the specific design of the device, and in accordance with the manufacturer's instructions.	N
	When required (i.e. during "O" operations), a clear polyethylene sheet (0,05 ± 0,01) mm thick, of a size at least 50 mm larger, in each direction, than the overall dimensions of the front face of the device but not less than 200 mm × 200 mm, is fixed and reasonably stretched in a frame, placed at a distance of 10 mm from	N
	– either the maximum projection of the operating means of a device without recess for the operating means;	P
	– or the rim of a recess for the operating means of a device with recess for the operating means.	P
	The sheet should have the following physical properties: Density at 23 °C: 0,92 ± 0,05 g/cm³ Melting-point: 110 °C – 120 °C.	N
	When required, a barrier of insulating material, at least 2 mm thick, is placed, as shown in figure C.1, between the arc vent and the polyethylene sheet to prevent damage of the sheet due to hot particles emitted from the arc vent.	P
	When required, a grid (or grids) according to figure C.2 is (are) placed at a distance of "a" mm from each arc vent side of the device.	P
	The grid circuit (see figure C.3) shall be connected to the points B and C (see figures 7 or 8, as applicable).	N
	The parameters for the grid circuit are as follows:	P
	Resistor R': 1,5 Ω	N
	Copper wire F': length 50 mm, and diameter as required in 9.12.9.1.	P

ANNEX D	**ROUTINE TESTS**				--
D.1	General				--
	The tests specified in this standard are intended to reveal, as far as safety is concerned, unacceptable variations in material or manufacture.				P
	In general, further tests have to be made to ensure that every RCBO conforms with the samples that withstood the tests of this standard, according to the experience gained by the manufacturer.				N
D.2	Tripping test				--
	A residual current is passed through each pole of the RCBO in turn. The RCBO shall not trip at a current less than or equal to 0,5 $I_{\Delta N}$, but it shall trip at $I_{\Delta N}$ within a specified time (see Table 2).	[ms]	[ms]	[ms]	P

EN 61009-1					
Clause	Requirement + Test	Result - Remark			Verdict
					N
	The test current shall be applied at least five times to each RCBO and shall be applied at least twice to each pole.				N
D.3	Electric strength test				--
	A voltage of substantially sine-wave form of 1 500 V having a frequency of 50 Hz/60 Hz is applied for 1 s as follows:				P
	a) with the RCBO in the open position, between the terminals which are electrically connected together, when the RCBO is in the closed position				N
	b) for RCBOs not incorporating electronic components, with the RCBO in the closed position, between each pole in turn and the others connected together				P
	c) for RCBOs incorporating electronic components, with the RCBO in the open position, either between all incoming terminals of poles in turn or between all outgoing terminals of poles in turn, depending on the position of the electronic components.				P
	No flashover or breakdown shall occur				P
D.4	Performance of the test device				--
	With the RCBO in the closed position, and connected to a supply at the appropriate voltage, the test device, when operated, shall open the RCBO.				P
	Where the test device is intended to operate at more than one value of rated voltage, the test shall be made at the lowest value of rated voltage.				P

ANNEX E	**SPECIAL REQUIREMENTS FOR AUXILIARY CIRCUITS FOR SAFETY EXTRA-LOW VOLTAGE**		--
8.1.3	Clearances and creepage distances		--
	Live parts separated from circuits of higher voltage in accordance with IEC 60364-4-41 subclause 414.4.3		P
9.7.4	Insulation resistance and dielectric strength of auxiliary circuits		--
	Under consideration		--

ANNEX F	**COORDINATION BETWEEN RCBOS AND SEPARATE FUSES ASSOCIATED IN THE SAME CIRCUIT**	--

EN 61009-1			
Clause	Requirement + Test	Result - Remark	Verdict
	The information given in Annex D of IEC 60898-1:2002 to ensure coordination between circuit-breakers and separate fuses associated in the same circuit may also be applicable to ensure coordination between RCBOs and separate fuses associated in the same circuit.		P
ANNEX G	**Additional requirements and tests for RCBOs consisting of a circuit-breaker and a residual current unit designed for assembly on site**		
G.4	**Marking and other product information**		--
G.4.1	**Manufacturers name or trademark**		--
	Circuit-breaker and r.c.-unit bear the same manufacturers name or trade mark		P
G.4.2	**Marking**		--
G.4.2.1	Marking of the circuit-breaker:		--
	Circuit-breakers comply with IEC 60898		P
G.4.2.2	Marking of the r.c.-unit:		--
	R.c.-unit marked with items a), b), c), e), f), g), k), m), n), q) and if necessary l) according to clause 6		N
	Addition:		--
	- max. rated current of circuit-breaker for assembling		P
	- Symbol		P
G.4.2.3	Marking of assembled circuit-breaker and r.c.-unit:		--
	Not visible after assembly on r.c unit:		N
	- c)		N
	- max. rated current of circuit-breaker for assembling		P
	visible after assembly:		P
	- l) if applicable		N
G.4.3	**Instructions for assembly and operation**		--
	Adequate instructions with the r.c. -unit provided		P
	Instructions shall cover at least:		P

EN 61009-1			
Clause	Requirement + Test	Result - Remark	Verdict
	- reference to type(s) and catalogue-no, covering current and voltage ratings, number of poles, of circuit breakers for assembling		N
	- derating factors, if any		P
	- checking of operation		P
	- verification of tripping operation by use of test button		P
G.5	**CONSTRUCTIONAL REQUIREMENTS**		--
G.5.1	**General**		--
	possible to assemble the RCBO on site only		P
	device may be disassembled on site in accordance with the manufacturer's instructions		P
	For devices declared not suitable for disassembling, the disassembly shall leave permanent visible damage.		N
	Compliance is checked according to G.6.4		P
G.5.2	**Degree of protection**		--
	Degree of protection of r.c.-unit not less than of circuit-breaker for assembling		N
G.5.3	**Mechanical requirements**		--
	Design is such as to prevent incorrect assembly		P
	No loose parts for coupling the tripping mechanisms		N
	Fixing means are captive		P
G.5.4	**Electrical compatibility**		--
	Not possible to assemble a circuit-breaker with a r.c.-unit		N
	- of lower rated voltage		P
	- of lower max. current		N
	Terminals of r.c.-unit able to clamp nominal cross-sections acc. to table IV of IEC 898 for rated currents of circuit-breakers to be assembled		P
	I_N (A).....:	A	N
	Cross section (mm²)..... :	to mm²	P
	Electrical interconnections form part of the r.c.-unit		P

EN 61009-1			
Clause	Requirement + Test	Result - Remark	Verdict
	Not possible to assemble a circuit-breaker with given rated short circuit capacity with a r.c.-unit such as to result in a lower short circuit performance		N
	Compliance is checked by inspection and manual test.		N
G.6	**TYPE TESTS AND VERIFICATIONS**		--
G.6.2	**Test on r.c.-units**		--
	According to table 10:		P
	- 9.3 / 9.4 / 9.5/		P
	- 9.11 if applicable		P
	- 9.14 / 9.15		P
G.6.3	**Tests on assembled circuit-breaker and r.c.-unit (rcbo)**		--
	According to table 10 except:		P
	- 9.3 / 9.5 / 9.9.2.3 / 9.14 / 9.15 do not apply		P
	- 9.4 made on interconnections		N
	- 9.12 applies except of 9.12.11.3 unless I_{cn} = 1500 A and of 9.12.11.4 b)		P
	- Conventional non-tripping current 1,13 I_n replaced everywhere by I_n		P
G.6.4	VERIFICATION OF MARKING AND CONSTRUCTIONAL REQUIREMENTS OF RCBOS		--
	Compliance with the requirements of G.4.1, G.4.2, G.4.3, G.5.1, G.5.2, G.5.3 and G.5.4 shall be checked by inspection and manual test, as applicable.		P
	For devices declared suitable to be disassembled, compliance with the requirements of G.5.1 is checked by the following test to be performed at the beginning of test sequence D0 in Table A.1.		N
	number of samples acc. D0+D1 in Table A.3.		N
	The r.c. unit and compatible circuit-breakers as declared by the manufacturer have to be assembled and disassembled five times. The r.c. unit and the compatible circuit breaker are then reassembled and used for the test of test sequence D0. After each assembly the correct operation of the combination shall be verified by using the test button. The RCBO shall trip each time.		P

EN 61009-1			
Clause	Requirement + Test	Result - Remark	Verdict
ANNEX J	**Particular requirements for RCBOs with screwless type terminals for external copper conductors**		P
J.1	**THIS ANNEX APPLIES TO RCBOS WITHIN THE SCOPE OF CLAUSE 1, EQUIPPED WITH SCREWLESS TERMINALS, FOR CURRENT NOT EXCEEDING 20 A PRIMARILY SUITABLE FOR CONNECTING UNPREPARED (SEE J.3.6) COPPER CONDUCTORS OF CROSS-SECTION UP TO 4 MM^2.**		--
J.6	**Marking and other product information**		--
	in addition to clause 6:		P
	universal terminals:		N
	no markings		P
	non-universal terminals:		P
	terminals for rigid-solid conductors marked by “sol”		N
	terminals for rigid (solid and stranded) conductors marked by “r”		N
	terminals for flexible conductors marked by “f”		P
	Marking on the RCBO or		N
	if the space available is not sufficient on the smallest package unit or in technical information		N
	Marking indicating the length of insulation to be removed before insertion of the conductor into the terminal shown on the RCBO		P
	Manufacturer shall provide information in his literature, on the maximum number of conductors which may be clamped.		N
J.8	**Standard conditions for operating in service and for installation**		--
	clause 8 applies with the following modifications: in 8.1.5, only 8.1.5.1, 8.1.5.2, 8.1.5.3, 8.1.5.6 and 8.1.5.7 apply		N
	Compliance is checked by inspection and by the tests of J.9.1 and J.9.2 of this annex, instead of 9.4 and 9.5.		P
J.8.1	Connection or disconnection of conductors		--
	The connection or disconnection of conductors shall be made:		P
	- by the use of a general purpose tool or by a convenient device integral with the terminal to open it and to assist the insertion or the withdrawal of the conductors (e.g. for universal terminals)		P

EN 61009-1			
Clause	Requirement + Test	Result - Remark	Verdict
	- or, for rigid conductors by simple insertion. For the disconnection of the conductors an operation other than a pull on the conductor shall be necessary (e.g. for push-wire terminals).		P
	Universal terminals shall accept rigid (solid or stranded) and flexible unprepared conductors.		P
	Non-universal terminals shall accept the types of conductors declared by the manufacturer.		P
	Compliance is checked by inspection and by the tests of J.9.1 and J.9.2.		P
J.8.2	Dimensions of connectable conductors		--
	The dimensions of connectable conductors are given in Table J.1.		P
	The ability to connect these conductors shall be checked by inspection and by the tests of J.9.1 and J.9.2.		P
J.8.3	Connectable cross-sectional areas		--
	nominal cross-sections to be clamped acc. table J.2		N
	compliance checked by inspection and tests of J.9.1 and J.9.2.		N
J.8.5	Design and construction of terminals		P
	terminals so designed and constructed that:		--
	- each conductor clamped individually		P
	- during operation of connection or disconnection the conductors can be connected or disconnected either at the same time or separately		N
	- inadequate insertion of the conductor is avoided		N
	It shall be possible to clamp securely any number of conductors up to the maximum provided for		P
	compliance checked by inspection and tests of J.9.1 and J.9.2.		N
J.8.6	Resistance to ageing		--
	compliance checked by the test of J.9.3.		N
J.9	**Tests**		--
	Clause 9 applies, by replacing 9.4 and 9.5 by the following tests		N
J.9.1	Test of reliability of screwless terminals		--
J.9.1.1	Reliability of screwless system		N

EN 61009-1			
Clause	Requirement + Test	Result - Remark	Verdict
	three terminals of poles of new samples, with copper conductors of the rated cross sectional area in accordance with Table J.2, types of conductors in accordance with J.8.1.		N
	The connection and subsequent disconnection shall be made five times with:		N
	Min. cross-section (mm²).....:	mm²	N
	Max. cross-section (mm²).....:	mm²	N
	new conductors used each time, except for the fifth time, when the conductor used for the fourth insertion is clamped at the same place. Before insertion into the terminal, wires of stranded rigid conductors re-shaped and wires of flexible conductors twisted to consolidate the ends.		N
	After each insertion, the conductor being inserted rotated 90 ° along its axis at the level of the clamped section and subsequently disconnected.		N
	After tests, the terminal not damaged in such a way as to impair its further use.		N
J.9.1.2	Test of reliability of connection		--
	three terminals of poles of new samples, with copper conductors of the rated cross sectional area in accordance with Table J.2, types of conductors in accordance with J.8.1.		N
	Before insertion into the terminal, wires of stranded rigid conductors and flexible conductors reshaped and wires of flexible conductors twisted to consolidate the ends.		N
	possible to fit the conductor into the terminal without undue force in the case of universal terminals and with the force necessary by hand in the case of push-wire terminals.		N
	conductor pushed as far as possible into the terminal or inserted so that adequate connection is obvious.		N
	Min. cross-section (mm²).....:	mm²	N
	Max. cross-section (mm²).....:	mm²	N
	After the test, no wire of the conductor shall have escaped outside the terminal.		N
J.9.2	Tests of reliability of terminals for external conductors: mechanical strength		--

EN 61009-1					
Clause	Requirement + Test	Result - Remark			Verdict
	three terminals of poles of new samples fitted with new conductors of the type and of the minimum and maximum cross-sectional areas acc. Table J.2.				N
	Min. cross-section (mm²)..... :	mm²			N
	Max. cross-section (mm²)..... :	mm²			N
	wires of stranded rigid conductors and flexible conductors reshaped and wires of flexible conductors twisted to consolidate the ends.				N
	Pull for 1 min, min. cross-section (N).....	N			N
	Pull for 1 min, max. cross-section (N).....	N			N
	During the test no noticeable move of conductor				N
J.9.3	Cycling test				--
	Universal, rigid conductors - 3 samples Universal, flexible conductors - 3 samples				N
	Non-universal, solid conductors - 3 samples				N
	Non-universal, rigid (solid) stranded conductors - 3 samples Non-universal, rigid (stranded) stranded conductors - 3 samples				N
	Non-universal, flexible conductors - 3 samples				N
	Cross-section (mm²).....	mm²			N
	Test current I_N (A)..... :	A			N
	samples subjected to 192 temperature cycles				N
	Voltage drop after 192 cycles:				--
	voltage drop, measured at each terminal, at the end of the 192nd cycle, exceeded not the smaller of the two following values:				N
	– 22,5 mV				N
	– 1,5 times the value measured after the 24th cycle				N
		sample 1	sample 2	sample 3	--
		[mV]	[mV]	[mV]	--
	- rigid solid conductors..... :				N
	- rigid stranded conductors..... :				N
	- flexible conductors..... :				N
	Voltage drop after 24th cycle:				--

EN 61009-1					
Clause	Requirement + Test	Result - Remark			Verdict
		sample 1	sample 2	sample 3	--
		[mV]	[mV]	[mV]	--
	- rigid solid conductors.....:				N
	- rigid stranded conductors..... :				N
	- flexible conductors.....:				N
	after this test: no changes evidently impairing further use, such as cracks, deformations or the like.				N

ANNEX K	**Particular requirements for RCBOs with flat quick-connect terminations**		P
K.1	**This annex applies to RCBOs within the scope of clause 1, equipped with flat quick-connect terminations consisting of a male tab (see k.3.2) with nominal width 6.3 mm and thickness 0.8 mm, to be used with a mating female connector for connecting electrical copper conductors according to the manufacturer's instructions, for rated currents up to and including 16 a.**		--
K.6	**Marking and other product information**		--
	in addition to clause 6, addition after the lettered item k):		--
	Information regarding the female connector acc. to IEC 61210 and type of conductor to be used shall be given in the manufacturers' instructions:		P
	l) manufacturer´s name or trade mark		P
	m) type reference		P
	n) information on cross-sections of conductors and colour code of insulated female connectors (see Table K.1)		P
	o) the use of only silver or tin-plated copper alloys		P
K.8	**Requirements for construction and operation**		--
	Clause 8 applies, with the following exceptions:		P
	subclause 8.1.3 applies, the female connectors being fitted to the male tabs of the RCBO		P
	replace the contents of 8.1.5 by the following:		P
K.8.2	Terminals for external conductors		--
K.8.2.1	Male tabs and female connectors shall be of a metal having mechanical strength, electrical conductivity and resistance to corrosion adequate for their intended use.		P
K.8.2.2	The nominal width of the male tab is 6,3 mm and the thickness 0,8 mm, applicable to rated currents		P

EN 61009-1							
Clause	Requirement + Test			Result - Remark			Verdict
	up to and including 16 A. NOTE 1:The use for rated currents up to and including 20 A is accepted in BE, FR, IT, PT, ES and US						
	The dimensions of the male tab shall comply with those specified in Table K.3 and in figures K.2, K.3, K.4 and K.5						P
Dimensions of tabs according Table K.3				Measured in mm			--
		Minimum [mm]	Maximum [mm]				--
A	Dimple	0,7	1,0				P
	Hole	0,5	1,0				P
B	Dimple	7,8 min					P
	Hole	7,8 min					P
C	Dimple	0,77	0,84				P
	Hole	0,77	0,84				P
D	Dimple	6,20	6,40				P
	Hole	6,20	6,40				P
E	Dimple	3,6	4,1				P
	Hole	4,3	4,7				P
F	Dimple	1,6	2,0				P
	Hole	1,6	2,0				P
J	Dimple	8°	12°				P
	Hole	8°	12°				P
M	Dimple	2,2	2,5				P
	Hole	---	---				--
N	Dimple	1,8	2,0				P
	Hole	---	---				--
P	Dimple	0,7	1,8				P
	Hole	0,7	1,8				P
Q	Dimple	8,9 min	---				--
	Hole	8,9 min	---				--
Dimensions of the female connector which may be fitted-on are given in Figure K.6 and in Table K.4.							P
				--	request acc. table K.3	measured value	--
				B_3 max	7,8mm		P

EN 61009-1			
Clause	Requirement + Test	Result - Remark	Verdict
		L_2 max 3,5mm	P
K.9	**Tests**		--
	clause 9 applies with the following modifications:		P
	replace the contents of 9.5 by the following text:		P
K.9.1	Mechanical overload-force		--
	Test done on 10 terminals of RCBOs, mounted as in normal use when wiring takes place.		P
	Axial push force, and successively the axial pull force gradually applied to the male tab integrated in the RCBO		P
	Push 96N		P
	Pull 88N		P
	No damage occurred to the tab or to the RCBO in which the tab is integrated.		P
	addition to 9.8.3:		P
	Fine -wire thermocouples shall be placed in such a way as not to influence the contact or the connection area. An example of placement is shown in fig K.1		P

ANNEX L	**Specific requirements for RCBOs with screw-type terminals for external untreated aluminium conductors and with aluminium screw-type terminals for use with copper or with aluminium conductors**		
L.6	Marking and other product information		--
	In addition to clause 6 the following apply:		P
	Terminal marking according table L.1, on the RCBO, near the terminals		P
	Conductor types accepted:		P
	Copper only	☐ None	P
	Aluminium only	☐ “Al”	P
	Aluminium and copper	☐ “Al/Cu”	P
	Other information concerning the number of conductors, screw torque (if different from table 10) and cross-section shall be indicated on the RCBO	Nm mm²	P
L.7	**Standard conditions for operation in service**		--
	Clause 7 applies		P
L.8	**Constructional requirements**		--
	Clause 8 applies with the following exceptions:		P

EN 61009-1			
Clause	Requirement + Test	Result - Remark	Verdict
8.1.5.2	add the following text at the end of 8.1.5.2:		--
	For connection of aluminium conductors, RCBOs shall be provided with screw-type terminals allowing the connection of conductors having nominal cross-sections as shown in table L.2		P
	Terminals for the connection of aluminium conductors and terminals of aluminium for the connection of copper or aluminium conductors shall have mechanical strength adequate to withstand the tests of 9.4, with the test conductors tightened with the torque indicated in table 14, or with the torque specified by the manufacturer, which shall never be lower than that specified in table 14.		P
	Compliance is checked by inspection, by measurement and by fitting in turn one conductor of the smallest and one of the largest cross-section areas as specified		P
8.1.5.4	replace the text of 8.1.5.4 by the following:		--
	Terminals shall allow the conductors to be connected without special preparation		P
	Compliance is checked by inspection and by the tests of L.9		P
L.9	**Tests**		--
	Clause 9 applies with the following modifications/additions:		P
	For the tests which are influenced by the material of the terminal and the type of conductor that can be connected, the test conditions of table L.3 are applied		P
	Additionally the test of L.9.2 is carried out on terminals separated from the RCBO		P
L.9.2	Current cycling test		--
	This test is carried out on separate terminals		P
L.9.2.3	Test arrangement		--
	The general arrangement of the samples shall be as shown in figure L.1		P
	90 % of torque stated by the manufacturer or selected in table 10 used for the specimens	torque: Nm	P
	The test is carried out with conductors according to table L.5. The length of the test conductor from the point of entry to the screw-type terminal specimens to the equalizer shall be as in table L.6	cross-section: mm^2 minimum conductor length: mm	P
	Cross section of equalizer not greater than that	max. cross-section: mm^2	N

EN 61009-1				
Clause	Requirement + Test	Result - Remark		Verdict
	given in table L.7			
L.9.2.5	Test method and acceptance criteria			--
	Test loop subjected to 500 cycles of 1h current-on and 1h current-off, starting at an a.c. current value of 1,12 times the test current value determined in table L.8	test current: A		N
	Near the end of each current-on period of the first 24 cycles, the current shall subsequently be adjusted to raise the temperature of the reference conductor to 75°C			P
	At the end of the 25th cycle the test current shall be adjusted the last time and the stable temperature shall be recorded as the first measurement. No further adjustment of test current for the remainder of the test			N
	Temperatures recorded for at least one cycle of each working day, and after approximately 25, 50, 75, 100, 125, 175, 225, 275, 350, 425 and 500 cycles			P
	For each screw-type terminal:			P
	- the temperature rise shall not exceed 110 K			P
	- the stability factor Sf shall not exceed ± 10 °C			P
	ambient air temperature: °C	25.0		P
		max. temperature rise [K]	max. stability factor Sf [°C]	--
	Terminal 1	43.3	85	P
	Internal wire	42.3	105	P
	PCB	77.9	130	P
	Enclosure outside	35.6	65	P
	Ambient	25.0	--	--

EN 61009-1			
Clause	Requirement + Test	Result - Remark	Verdict

	TABLE: Critical components information				P
Object / part No.	**Manufacturer/ trademark**	**Type / model**	**Technical data**	**Standard**	**Mark(s) of conformity[1)]**
Enclosure	Suzhou Banleantone International Logistics CO,.Ltd	PA66	V-0	UL 94	UL
Enameled copper wire	JIANGSU DARTONG M&E CO.,LTD	Q (ZY/XY) BP-2/200	Class E, 120℃	UL1446	UL E237377
Terminal block material	Foshan Huaru Copper Industry Co., Ltd	COPPER	COPPER	--	Test with appliance
Inside plastic parts	Interchangeable	Interchangeable	V-0	UL 94	UL
Supplementary information: 1) Provided evidence ensures the agreed level of compliance. See OD-CB2039.					

Product Photos

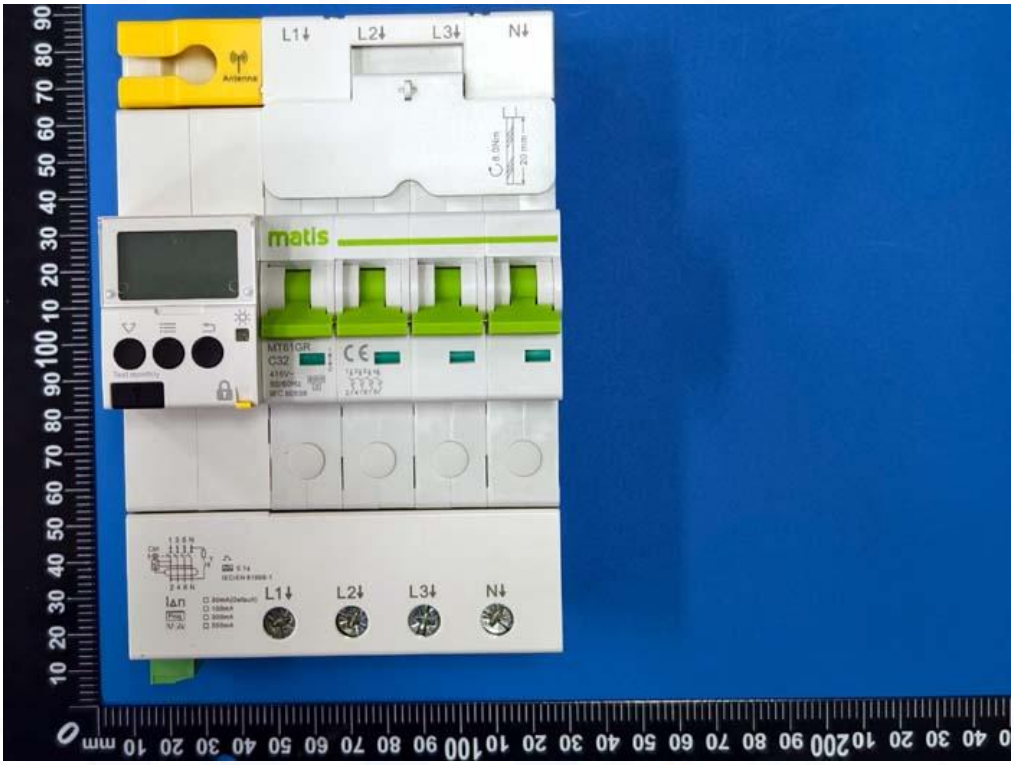


Fig. 1

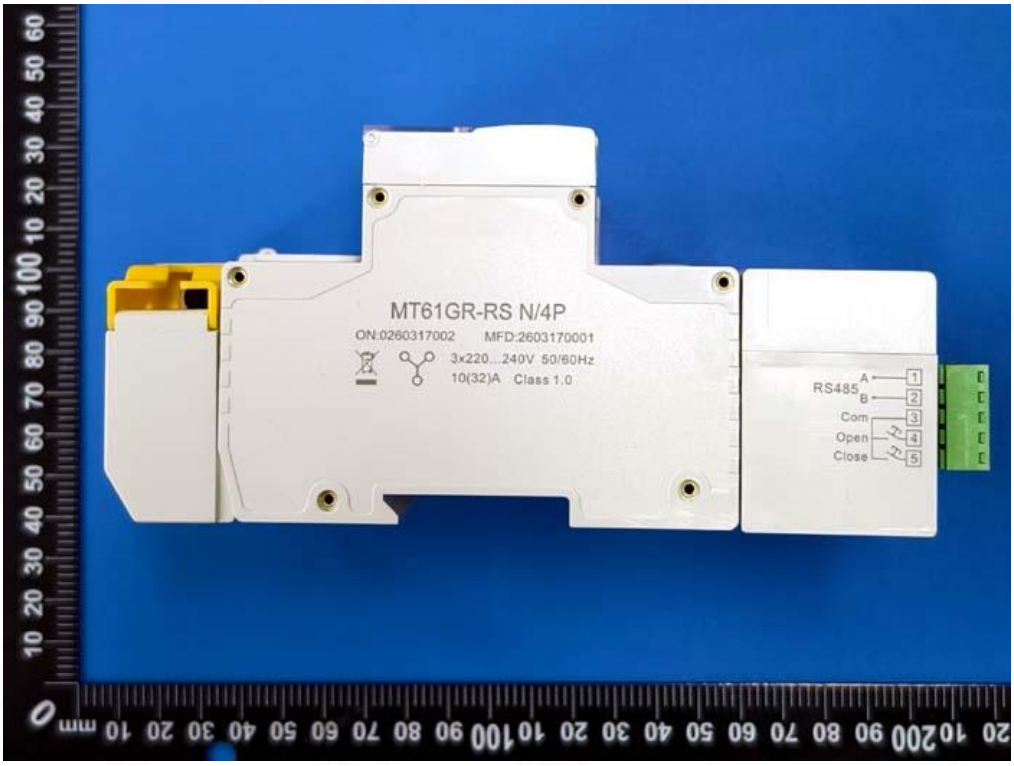


Fig. 2

Product Photos

Fig. 3

Fig. 4

---------- END OF REPORT ----------