Zhejiang Zhangzhou Electric Technology Co., Ltd

CE LVD REPORT

Prepared For:	Zhejiang Zhangzhou Electric Technology Co., Ltd No. 1166 Liujiang Road, Daxing Village, Beibaixiang Town, Yueqing City, Wenzhou City, Zhejiang Province
Product Name:	Intelligent WIFI Circuit Breaker
Trade Name:	N/A
Model:	CZWF-63 1-63A
Additional Model:	CZWF-40, CZWF-63, (CZWF-40：In 1-40A; CZWF-63 In 1-63A) Un: 230/240V, Ui：500V
Prepared By:	BST Testing (Shenzhen) Co.,Ltd. No.7,New Era Industrial Zone, Guantian, Bao’an District, Shenzhen, Guangdong, China
Test Date:	Oct.21,2024 - Oct.29,2024
Date of Report:	Oct.29,2024
Report No.:	XDX29243864102901FAR

TEST REPORT

EN 60947-2
Low-voltage switchgear and controlgear
EN 60898-1
Circuit breakers for overcurrent protection for household and similar installations -Part 1: Circuit-breakers for a.c.operation
EN 60898-2
Part 2: Circuit-breakers for a.c and d.c.operation

Testing Laboratory.....:	BST Testing (Shenzhen) Co.,Ltd.
Address.....:	No.7,New Era Industrial Zone, Guantian, Bao’ an District, Shenzhen, Guangdong, China
Applicant’s name.....:	Zhejiang Zhangzhou Electric Technology Co., Ltd
Address.....:	No. 1166 Liujiang Road, Daxing Village, Beibaixiang Town, Yueqing City, Wenzhou City, Zhejiang Province
Manufacturer’s name.....:	Zhejiang Zhangzhou Electric Technology Co., Ltd
Address.....:	No. 1166 Liujiang Road, Daxing Village, Beibaixiang Town, Yueqing City, Wenzhou City, Zhejiang Province
Test specification:	
Standard.....:	EN 60898-1:2019/A11:2024 EN 60898-2:2021 EN 60947-2:2017/A1:2020
Test procedure.....:	CE-LVD
Non-standard test method.....:	N/A
Test Report Form No.....:	EN 60898-1:2019/A11:2024 EN 60898-2:2021 EN 60947-2:2017/A1:2020
Master TRF.....:	Dated Oct.29,2024
Trade Mark.....:	N/A
Manufacturer.....:	Zhejiang Zhangzhou Electric Technology Co., Ltd
Model/Type reference.....:	CZWF-63 1-63A
Ratings.....:	Un: 230/240V, Ui：500V,1-63A

Copy of marking plate (take model CZWF-63 1-63A for example)

Product: Intelligent WIFI Circuit Breaker
Model: CZWF-63 1-63A
Input: Un: 230/240V, Ui：500V,1-63A

Zhejiang Zhangzhou Electric Technology Co., Ltd
Made In China

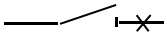
Test item particulars	:	
Equipment mobility	:	[x] movable [] hand-held [] transportable [] stationary [] for building-in [] direct plug-in
Connection to the mains	:	[] pluggable equipment [] type A [] type B [] permanent connection [] detachable power supply cord [] non-detachable power supply cord [x] not directly connected to the mains
Operating condition	:	[x] continuous [] rated operating / resting time:
Access location	:	[x] operator accessible [] restricted access location
Over voltage category (OVC)	:	[] OVC I [] OVC II [x] OVC III [] OVC IV [] other:
Mains supply tolerance (%) or absolute mains supply values	:	No direct connection with mains
Tested for IT power systems	:	[x] Yes [] No
IT testing, phase-phase voltage (V)	:	N/A
Class of equipment	:	[] Class I [] Class II [x] Class III [] Not classified
Considered current rating of protective device as part of the building installation (A)	:	
Pollution degree (PD)	:	[x] PD 1 [] PD 2 [] PD 3
IP protection class	:	IP21
Altitude during operation (m)	:	< 2000 m
Altitude of test laboratory (m)	:	Shenzhen of China < 2000 m
Mass of equipment (kg)	:	Approx. 0.25

General remarks: 1.”（see remark #）” refers to a remark appended to the report. 2. Throughout this report a point is used as the decimal separator. 3. The test results presented in this report relate only to the object tested.
Summary of testing: Tests performed (name of test and test clause): The sample(s) tested complies with the requirements of EN 61009-1 Heating test (4.5): Tma = 25 °C (Without declared by manufacturer) Tamb = 25.0°C – 25.3 °C
General product information:
Wireless N300 ADSL2+ / VDSL2 Modem Router, supplied by approved external AC adaptor.

Prepared by : Adam Chen
Engineer

Reviewer : Tracy Zhang
Supervisor

Approved & Authorized Signer :
Manager

EN 60947-2			
Clause	Requirement + Test	Result - Remark	Verdict
5.2	MARKING		P
a)	The following data shall be marked on the circuit-breaker itself or on a name plate or nameplates attached to the circuit-breaker, and located in a place such that they are visible and legible when the circuit-breaker is installed.		P
	- rated current:	See marking	P
	- suitability for isolation, if applicable, with the symbol 		P
	- indication of the open and closed position: with ○ and I respectively, if symbols are used		P
b)	Marking on equipment not needed to be visible after mounting:		P
	- manufacturer's name or trademark		P
	- type designation or serial number		P
	- IEC 60947-2 if the manufacturer claims compliance with this standard.		P
	- utilization category		N
	- rated operational voltage(s) Ue		P
	- Circuit-breaker for use in IT systems: Circuit-breaker for which all values of rated voltage have not been tested according to annex H or are not covered by such testing, shall be identified by the symbol  which shall be marked on the circuit-breaker immediately following these values of rated voltage		P
	- value (or range) of the rated frequency and/or the indication DC (or symbol)		N
	- rated service short-circuit breaking capacity. Ics		N
	- rated ultimate short-circuit breaking capacity. Icu		N
	- rated short-time withstand current, (Icw) and associated short-time delay, for utilization category B		N
	- line and load terminals, unless their connection is immaterial		N
	- neutral pole terminals, if applicable, by the letter N		P
	- protective earth terminal, where applicable, by the symbol acc. 7.1.9.3 of part 1		P
	- ref. temperature for non-compensated thermal releases, if different from 30°C		P

c)	Marked on the circuit-breaker as specified in item b), or shall be made available in the manufacturer's published information:		P
	- rated short-circuit making capacity (Icm) (if higher than specified in 4.3.5.1)		P
	- rated insulation voltage. (Ui) if higher than the maximum rated operational voltage)		P
	- rated impulse withstand voltage (Uimp), when declared.		P
	- pollution degree if other than 3		P
	- conventional enclosed thermal current (Ithe) if different from the rated current:		P
	- IP Code, where applicable:		N
	- minimum enclosure size and ventilation data (if any) to which marked ratings apply:		N
	- details of minimum distance between circuit-breaker and earthed metal parts for circuit-breaker intended for use without enclosure:		N
	- r.m.s sensing if applicable, according to F.4.1.1		P
	- suitability for environment A or B		N
d)	The following data concerning the opening and closing devices of the circuit-breaker shall be placed either on their own nameplates or on the nameplate of the circuit-breaker:		P
	- rated control circuit voltage of the closing device, and rated frequency for AC:		P
	- rated control circuit voltage of the shunt release and/or of the under-voltage release, and rated frequency:		P
	- rated current of indirect over-current releases:		P
	- number and type of auxiliary contacts and kind of current, rated frequency (if AC) and rated voltages of the auxiliary switches, if different from those of the main circuit.		P
e)	Terminal shall be clearly and permanently identified in acc. with IEC 60445 and annex L :		P
	- line terminal		P
	- load terminal		P
	- neutral pole terminal ”N”		P
	- protective earth terminal ⏚		P
	- terminal of coils (A/B)		P
	- terminal of shunt release (B)		P
	- terminals of under-voltage release (D)		P
	- terminals of interlocking electromagnets (E)		P

	- terminals of indicated light devices (X)		P
	- terminals of contact elements for switching devices (no)		P

7.1	CONSTRUCTION		--
7.1.1	Withdrawable circuit-breaker		P
	In the disconnected position (main- and auxiliary circuits)		P
	Isolating distances for circuit-breaker suitable for isolating warranted:		N
	Mechanism fitted with a reliable indicating device with indicates the position of the isolating contacts.		N
	Mechanism fitted with interlocks which only permit the isolating contacts to be separate or re-closed when main contacts are open		P
	Mechanism fitted with interlock, which only permit the main contacts to be closed when the isolating contacts are fully closed.		P
	Mechanism fitted with interlock, which only permit the main contacts to be closed when in disconnected position.		N
	The isolating distances between the isolating contacts cannot be inadvertently reduced.	The isolating contacts cannot be inadvertently reduced.	P
7.1.1.1 part 1	Resistance to abnormal heat and fire		P
7.1.2 part 1	Current-carrying parts and their connection		P
7.1.3	Clearances and creepage distances:		--
	For circuit-breakers for which the manufacturer has declared a value of rated impulse withstand voltage. (Uimp.)		P
	Clearances distances:		P
	- Uimp is given as:		N
	- max. value of rated operational voltage to earth		P
	- nominal voltage of supply system:		P
	- overvoltage category:		P
	- pollution degree:		P
	- field-in or homogeneous:		P
	- minimum clearances (mm):	1.5mm	P
	- measured clearances (mm):	2.8mm	P
	Creepage distances:		P
	- rated insulation voltage Ui (V)		N
	- pollution degree		P

	- comparative tracking index (V)		N
	- material group		P
	- minimum creepage distances (mm)	1.5mm	P
	- measured creepage distances (mm)	4.0mm	P
7.1.4 part 1	Actuator		--
7.1.4.1 part 1	Insulation		P
	The actuator of the equipment shall be insulated from the live parts for the rated insulation voltage and, if applicable, the rated impulse withstand voltage		P
	If it is made of metal, it shall be capable of being satisfactorily connected to a protective conductor unless it is provided with additional reliable insulation		N
	If it is made of or covered by insulating material, any internal metal part, which might become accessible in the event of insulation failure, shall also be insulated from live parts for the rated insulation voltage		P
7.1.4.2	Direction of movement		--
	The direction of operation for actuators of devices shall normally conform to IEC 60447.		N
	Where devices cannot conform to these requirements, e.g. due to special applications or alternative mounting positions, they shall be clearly marked such that there is no doubt as to the ”I” and ”O” positions and the direction of operation		N
7.1.5 part 1	Indication of contact position		P
7.1.5.1 part 1	Indicating means		P
	When an equipment is provided with means for indicating the closed and open positions, these positions shall be unambiguous and clearly indicated		P
	This is done by means of a position indicating device (see 2.3.18)		P
	If symbols are used, they shall indicate the closed and open position respectively, in accordance with IEC 60417-2:		P
	- 60417-2-IEC-50/6007 **I** On (power)		P
	- 60417-2-IEC-50/6007 **O** Off (power)		P
	For equipment operated by means of two push-buttons, only the push-button designated for the opening operation shall be red or marked with the symbol ”O”		P
	Red colour shall not be used for any other push-button		P

	The colours of other push-buttons, illuminated push-buttons and indicator lights shall be in accordance with IEC 60073		N
7.1.5.2 part 1	Indication by the actuator		N
	When the actuator is used to indicate the position of the contacts, it shall automatically take up or stay, when released, in the position corresponding to that of the moving contacts; in this case, the actuator shall have two distinct rest positions corresponding to those of the moving contacts, but for automatic opening a third distinct position of the actuator may be provided		N
7.1.6	Additional safety requirements for equipment suitable for isolation		--
7.1.6.1	Additional constructional requirements for equipment suitable for isolation (Ue > 50/60 V):		P
	Equipment suitable for isolation shall provide in the open position an isolation distance in acc. with the requirements necessary to satisfy the isolating function. Indication of the main contacts shall be provide by one or more of the following means:		P
	- the position of the actuator		P
	- a separate mechanical indicator		P
	- visibility of the moving contacts		N
	When means are provided or to lock the equipment in the open position, locking only be possible when contacts are in the open position		P
	Actuator front-plate fitted to the equipment in a manner which ensures correct contact position indication and locking		N
	The indicated open position is the only position in which the specified isolation distances between the contacts is ensured.		P
	- minimum clearances across open contacts (see Table XIII, Part 1) (mm) :		N
	- measured clearances (mm) :		N
	- test Uimp across gap (kV) :		--
7.1.6.2	Supplementary requirements for equipment with provision for electrical interlocking with contactors or circuit-breakers:		P
	auxiliary switch shall be rated according to IEC 60 947-5-1		P
	If equipment suitable for isolation is provided with an auxiliary switch for the purpose of electrical interlocking with contactor (s) or circuit-breaker(s) and intended to be used in motor circuits, the following requirements shall apply unless the equipment is rated for AC-23 utilization category		N

	The time interval between the opening of the contacts of the auxiliary switch and the contacts of the main poles shall be sufficient to ensure that the associated contactor or circuit-breaker interrupts the current before the main poles of the equipment open		N
	Unless otherwise stated in the manufacturer's technical literature, the time interval shall be not less than 20 ms when the equipment is operated according to the manufacturer instructions		N
	Compliance shall be verified by measuring the time interval between the instant of opening of the auxiliary switch and the instant of opening of the main poles under no-load conditions when the equipment is operated according to the manufacturer's instructions		N
	During the closing operation the contacts of the auxiliary switch shall close after or simultaneously with the contacts of the main poles		N
	A suitable opening time interval may also be provided by an intermediate position (between the ON and OFF position) at which the interlocking contact(s) is (are) open and the main poles remain closed		P
7.1.6.3	Supplementary requirements for equipment provided with means for padlocking the open position:		P
	the locking means shall be designed in such a way that it cannot be removed with the appropriate padlock(s) installed		N
	Alternatively, the design may provide padlockable means to prevent access to the actuator		P
	test force F applied to the actuator in an attempt to operate to the closed position (N) :		P
	rated impulse withstand voltage (kV) :		--
	test Uimp on open main contacts at the test force		--
7.1.7	Terminals		P
7.1.7.1	All parts of terminals which maintain contact and carry current shall be of metal having adequate mechanical strength		P
	Terminal connections shall be such that necessary contact pressure is maintained		P
	Terminals shall be so constructed that the conductor is clamped between suitable surfaces without damage to the conductor and terminal		P
	Terminal shall not allow the conductor to be displaced or to be displaced themselves in a manner detrimental to the operator of equipment and the insulation voltage shall not be reduced below the rated value		P
7.1.7.2	Connection capacity		P
	type of conductors :		P

	minimum cross-sectional area of conductor (mm²) :	0.5mm²	P
	maximum cross-sectional area of conductor (mm²) :	2.5mm²	P
	number of conductors simultaneously connectable to the terminal :		P
7.1.7.3	Connection		P
	terminals for connection to external conductors shall be readily accessible during installation		P
	clamping screws and nuts shall not serve to fix any other component		P
7.1.7.4	Terminal identification and marking		P
	terminal intended exclusively for the neutral conductor		P
	protective earth terminal		N
	other terminals		N
7.1.8 part 1	Additional requirements for equipment provided with a neutral pole		P
	When an equipment is provided with a pole intended only for connecting the neutral, this pole shall be clearly identified to that effect by the letter N (see 7.1.7.4.).		P
	A switched neutral pole shall break not before and shall make not after the other poles		P
	For equipment having a value of conventional thermal current (free air or enclosed, see 4.3.2.1 and 4.3.2.2) not exceeding 63 A, this value shall be identical for all poles		P
	For higher conventional thermal current values, the neutral pole may have a value of conventional thermal current different from that of the other poles, but not less than half that value or 63 A, whichever is the higher		P
	if a pole with a appropriate making and breaking capacity is used as a neutral pole, then all poles, incl. the neutral pole, shall operate substantially together.		P
7.1.9	Provisions for protective earthing		N
7.1.9.1	The exposed conductive parts (e.g. chassis, framework and fixed parts of metal enclosures) other than those which cannot constitute a danger shall be electrically interconnected and connected to a protective earth terminal for connection to an earth electrode or to an external protective conductor		N
part 1	This requirement can be met by the normal structural parts providing adequate electrical continuity and applies whether the equipment is used on its own or incorporated in an assembly		P

	Exposed conductive parts are considered not to constitute a danger if they cannot be touched on large areas or grasped with the hand or if they are of small size (approximately 60mm x 60mm) or are so located as to exclude any contact with live parts		P
7.1.9.2 part 1	Protective earth terminal		N
	The protective earth terminal shall be readily accessible and so placed that the connection of the equipment to the earth electrode or to the protective conductor is maintained when the cover or any other removable part is removed		N
	The protective earth terminal shall be suitably protected against corrosion		N
	In the case of equipment with conductive structures, enclosures, etc., means shall be provided, if necessary, to ensure electrical continuity between the exposed conductive parts the equipment and the metal sheathing of connecting conductors		N
	The protective earth terminal shall have no other function, except when it is intended to be connected to a PEN conductor (see 2.1.1.5 – Note). In this case, it shall also have the function of a neutral terminal in addition to meeting the requirements applicable to the protective earth terminal		N
7.1.9.3	Protective earth terminal marking and identification		N
	The protective earth terminal shall be clearly and permanently identified by its marking		N
	The identification shall be achieved by colour (green-yellow mark) or by the notation PE, or PEN, as applicable, in accordance with IEC 60445, subclause 5.3, or, in the case of PEN, by a graphical symbol for use on equipment		N
	Graphical symbol to be used: 60417-2-IEC-50/6019 ⏚ Protective earth (ground) in accordance with IEC 60417-2		N
7.1.10	Enclosure for equipment		P
7.1.10.1	Design		P
	The enclosure, when it is opened: all parts requiring access for installation and maintenance are readily accessible		P
	Sufficient space shall be provided inside the enclosure		P
	The fixed parts of a metal enclosure shall be electrically connected to the other exposed conductive parts of the equipment and connected to a terminal which enables them to be earthed or connected to a protective conductor		P

	Under no circumstances shall a removable metal part of the enclosure be insulated from the part carrying the earth terminal when the removable part is in place		P
	The removable parts of the enclosure shall be firmly secured to the fixed parts by a device such that they cannot be accidentally loosened or detached owing to the effects of operation of the equipment or vibrations		N
	When an enclosure is so designed as to allow the covers to be opened without the use of tools, means shall be provided to prevent loss of the fastening devices		P
	If the enclosure is used for mounting push-buttons, it shall not be possible to remove the buttons from the outside of the enclosure		P
7.1.10.2	Insulation		P
	If, in order to prevent accidental contact between a metallic enclosure and live parts, the enclosure is partly or completely lined with insulating material, then this lining shall be securely fixed to the enclosure		P
7.1.11	Degree of protection of enclosed equipment		--
	Degree of protection.	IP21	P
	Test for first characteristic.	IP21	P
	Test for first numeral .....:	1 2 3 4 5 6	N
	Test for second characteristic	IP21	P
	Test for second numeral ..... :	1 2 3 4 5 6 7 8	N
7.1.12 part 1	Conduit pull-out, torque and bending with metallic conduits		N
	Polymeric enclosures of equipment, whether integral or not, provided with threaded conduit entries, intended for the connection of extra heavy duty, rigid threaded metal conduits complying with IEC 60981, shall withstand the stresses occurring during its installation such as pull-out, torque, bending		N

7.2	Performance requirements		N
7.2.1	Operating condition		N
7.2.1.1	Closing		--
	For a circuit-breaker to be closed safely on to the making current corresponding to its rated short-circuit making capacity, it is essential that it should be operated with the same speed and the same firmness as during the type test for proving the short-circuit making capacity		P
7.2.1.1.1	Dependent manual closing		
	For a circuit-breaker having a dependent manual closing mechanism, it is not possible to assign a short-circuit making capacity rating irrespective of the conditions of mechanical operation		P
	Such a circuit-breaker should not be used in circuits having a prospective peak making current exceeding 10 kA		P
	However, this does not apply in the case of a circuit-breaker having a dependent manual closing mechanism and incorporating an integral fast-acting opening release which causes the circuit-breaker to break safely, irrespective of the speed and firmness with which it is closed on to prospective peak currents exceeding 10 kA; in this case, a rated short-circuit making capacity can be assigned		P
7.2.1.1.2	Independent manual closing		N
	A circuit-breaker having an independent manual closing mechanism can be assigned a short-circuit making capacity rating irrespective of the conditions of mechanical operation		N
7.2.1.1.3	Dependent power closing		P
	At 110% of the rated control supply voltage, the closing operation performed on no-load shall not cause any damage to the circuit-breaker.		P
	At 85% of the rated control supply voltage, the closing operation shall be performed when the current established by the circuit-breaker is equal to its rated making capacity within the limits allowed by the operation of its relays or releases and, if a maximum time is stated for the closing operation, in a time not exceeding this maximum time limit.		P
7.2.1.1.4	Independent power closing		N
	A circuit-breaker having an independent power closing operation can be assigned a rated short-circuit making capacity irrespective of the conditions of power closing		P

	Means for charging the operating mechanism, as well as the closing control components, shall be capable of operating in accordance with the manufacturer's specification		N
7.2.1.1.5	Stored energy closing		N
	Capable ensuring closing of the circuit-breaker in any condition between no-load and its rated making capacity		N
	- when the stored energy is retained within the circuit-breaker, a device is provided which indicates when the storing mechanism is fully charged.		N
	- means for charging the operating mechanism and closing control components operates when auxiliary supply voltage is between 85% and 110% of the rated control supply voltage.		N
	- not possible for the moving contacts to move from the open position, unless the charge is sufficient for satisfactory completion of the closing operation.		N
	- by manually operated circuit-breaker is the direction of operation indicated. (not for circuit-breaker with an independent manual closing operation.)		N
	- For trip free circuit-breaker it shall not be possible to maintain the contacts in the touching or closed position when the release is in the position to trip the circuit-breaker.		N
7.2.1.2	Opening		P
7.2.1.2.1	Circuit-breakers which open automatically shall be trip-free and, unless otherwise agreed between manufacturer and user, shall have their energy for the tripping operation stored prior to the completion of the closing operation		P
7.2.1.2.2	Opening by undervoltage releases		P
7.2.1.3. a part 1	Operating voltage		P
	An under-voltage relay or release, when associated with a switching device, shall operate to open the equipment even on a slowly falling voltage within the range between 70% and 35% of its rated voltage		P
	An under-voltage relay or release shall prevent the closing of the equipment when the supply voltage is below 35% of the rated voltage of the relay or release; it shall permit closing of the equipment at supply voltages equal to or above 85% of its rated value		P
	Unless otherwise stated in the relevant product standard, the upper limit of the supply voltage shall be 110% of its rated value		P

7.2.1.3. b part 1	Operating time		P
	For a time-delay under-voltage relay or release, the time-lag shall be measured from the instant when the voltage reaches the operating value until the instant when the relay or release actuates the tripping device of the equipment		P
7.2.1.2.3	Opening by shunt releases		N
7.2.1.4 part 1	Limits of operation of shunt releases		N
	A shunt release for opening shall cause tripping under all operating conditions of an equipment when the supply voltage of the shunt release measured during the tripping operation remains between 70% and 110% of the rated control supply voltage and, if a.c., at the rated frequency		N
7.2.1.5 part 1	Limits of operation of current operated relays and released		N
	Limits of operation of current operated relays and releases shall be stated in the relevant product standard		N
7.2.1.2.4	Opening by over-current releases		--
a)	Opening under short-circuit conditions		P
	The short-circuit release shall cause tripping of the circuit-breaker with an accuracy of 20% of the tripping current value of the current setting for all values of the current setting of the short-circuit current release		P
	Where necessary for over-current co-ordination the manufacturer shall provide information (usually curves) showing		P
	- maximum cut-off (let-through) peak current as a function of prospective current (r.m.s. symmetrical)		P
	- I^2t characteristics for circuit-breakers of utilization category A and, if applicable, B for circuit-breakers with instantaneous override (see note to 8.3.5)		P
b)	Opening under overload conditions		N
1)	Instantaneous or definite time-delay operation		N
	The release shall cause tripping of the circuit-breaker with an accuracy of ± 10% of the tripping current value of the current setting for all values of current setting of the overload release		N

2)	Inverse time-delay operation		N
	At the reference temperature and at 1,05 times the current setting with the conventional non-tripping current, the opening release being energized on all poles, tripping shall not occur in less than the conventional time from the cold state, i.e. with the circuit-breaker at the reference temperature		N
	Moreover, when at the end of the conventional time the value of current is immediately raised to 1,30 times the current setting, i.e. with the conventional tripping current, tripping shall then occur in less than the conventional time later		N
	If a release is declared by the manufacturer as substantially independent of ambient temperature, the current values of table 6 shall apply within the temperature band declared by the manufacturer, within a tolerance of 0,3%/K		N
	The width of the temperature band shall be at least 10 K on either side of the reference temperature		N
7.2.4.2	Operational performance capability		N
7.2.4.2 part 1	The operational performance off-load for which the tests are made with the control circuits energized and the main circuit not energized, in order to demonstrate that the equipment meets the operating conditions specified at the upper and lower limits of supply voltage and/or pressure specified for the control circuit during closing and opening operations		N
	The operational performance on-load during which the equipment shall make and break the specified current corresponding, where relevant, to its utilization category for the number of operations stated in the relevant product standard		N

8	TESTS		--
8.2.4	Mechanical properties of terminals		P
	Mechanical strength of terminals		P
	maximum cross-sectional area of conductor (mm²) :		--
	diameter of thread (mm) :		--
	torque (Nm) :		--
	5 times on 2 separate clamping units		--
	Testing for damage to and accidental loosening of conductor (flexion test)		--
	conductor of the smallest cross-sectional area (mm²) :		--
	number of conductors of the smallest cross section :		--
	diameter of bushing hole (mm) :		--
	height between the equipment and the platen :		--

	mass at the conductor(s) (kg) :		--
	135 continuous revolutions: the conductor shall neither slip out of the terminal nor break near the clamping unit		--
	Pull-out test		P
	force (N) :		--
	1 min, the conductor shall neither slip out of the terminal nor break near the clamping unit		P
	conductor of the largest cross-sectional area (mm²) :		P
	number of conductors of the largest cross section :		--
	diameter of bushing hole (mm) :		--
	height between the equipment and the platen :		--
	mass at the conductor(s) (kg) :		--
	135 continuous revolutions: the conductor shall neither slip out of the terminal nor break near the clamping unit		--
	Pull-out test		P
	force (N) :		--
	1 min, the conductor shall neither slip out of the terminal nor break near the clamping unit		P
	conductor of the largest and smallest cross-sectional area (mm²) :		--
	number of conductors of the smallest cross section, number of conductors of the largest cross section :		P
	diameter of bushing hole (mm) :		--
	height between the equipment and the platen :		N
	mass at the conductor(s) (kg) :		N
	135 continuous revolutions: the conductor shall neither slip out of the terminal nor break near the clamping unit		N
	Pull-out test		N
	force (N) :		N
	1 min, the conductor shall neither slip out of the terminal nor break near the clamping unit		N

8.3.3	TEST SEQUENCE I: GENERAL PERFORMANCE CHARACTERISTICS		--
8.3.3.1	Tripping limits and characteristic		P
8.3.3.1.2	Opening under short-circuit conditions		P
	Manufacturer's name or trademark	See marking	P
	Type designation or serial number		N

	Sample no:		N
	Rated operational voltage: Ue (V)		N
	Rated current: In (A)		N
	Ambient temperature 10-40 °C :		P
	Value of the tripping current declared by the manufacturer for a single pole, at which value they shall operate.		P
	Range of adjustable setting current. (A)		P
	Time delay stated by the manufacturer, in the case of definite time delay releases.		N
	Electromagnetic overcurrent releases		P
	Test current: 80% of the rated, or **minimum** adjustable setting current: (A)		N
	Operating time: >0,2s in case of instantaneous releases: L1-L2: L1-L3: L2-L3: N-Lx:		P
	Operating time: > twice time delay stated by the manufacturer, in the case of definite time delay releases: L1-L2: L1-L3: L2-L3: N-Lx:		P
	Test current: 120% of the rated, or **minimum** adjustable setting current: (A)		P
	Operating time: <0,2s in case of instantaneous releases: L1-L2: L1-L3: L2-L3: N-Lx:		N
	Operating time: < twice time delay stated by the manufacturer, in the case of definite time delay releases: L1-L2: L1-L3: L2-L3: N-Lx:		P
	Test current: 80% of the **maximum** adjustable setting current: (A)		P
	Operating time: >0,2s in case of instantaneous releases: L1-L2: L1-L3: L2-L3: N-Lx:		P

	Operating time: > twice time delay stated by the manufacturer, in the case of definite time delay releases: L1-L2: L1-L3: L2-L3: N-Lx:		P
	Test current: 120% of the **maximum** adjustable setting current: (A)		P
	Operating time: <0,2s in case of instantaneous releases: L1-L2: L1-L3: L2-L3: N-Lx:		N
	Operating time: < twice time delay stated by the manufacturer, in the case of definite time delay releases: L1-L2: L1-L3: L2-L3: N-Lx:		N
	For circuit-breakers with an electronic overcurrent release, the operation of the short-circuit releases shall be verified by one test only on each pole individually.		N
	Electronic overcurrent releases		P
	Test current: 80% of the rated, or **minimum** adjustable setting current: (A)		P
	Operating time: >0,2s in case of instantaneous releases: L1: L2: L3: N:		P
	Operating time: > twice time delay stated by the manufacturer, in the case of definite time delay releases: L1: L2: L3: N:		P
	Test current: 120% of the rated, or **minimum** adjustable setting current: (A)		P
	Operating time: <0,2s in case of instantaneous releases: L1: L2: L3: N:		P
	Operating time: < twice time delay stated by the manufacturer, in the case of definite time delay releases: L1: L2: L3: N:		P

	Test current: 80% of the **maximum** adjustable setting current: (A)		P
	Operating time: >0,2s in case of instantaneous releases: L1: L2: L3: N:		P
	Operating time: > twice time delay stated by the manufacturer, in the case of definite time delay releases: L1: L2: L3: N:		P
	Test current: 120% of the **maximum** adjustable setting current: (A)		P
	Operating time: <0,2s in case of instantaneous releases: L1: L2: L3: N:		P
	Operating time: < twice time delay stated by the manufacturer, in the case of definite time delay releases: L1: L2: L3: N:		P
	Test current: tripping current declared for single pole operation (A)		N
	Operating time: < 0,2 s in case of instantaneous release: L1: L2: L3: N:		N
	Operating time: < twice time delay stated by manufacturer in case of definite time delay releases L1: L2: L3: N:		N
8.3.3.1.3	Opening under overload conditions		--
a)	Instantaneous or definite time-delay releases		--
	Manufacturer's name or trademark		--
	Type designation or serial number		--
	Sample no:		--
	Rated operational voltage: Ue (V)		--
	Rated current: In (A)		--
	Ambient temperature 10-40 °C :		N

	Value of the tripping current declared by the manufacturer for a single pole, at which value they shall operate.		N
	Range of adjustable setting current. (A)		N
	Time delay stated by the manufacturer, in the case of definite time delay releases.		N
	Test current: 90% of the rated, or minimum adjustable setting current: (A)		N
	Operating time: >0,2s in case of instantaneous releases:		N
	Operating time: > twice time delay stated by the manufacturer, in the case of definite time delay releases.		N
	Test current: 90% of the maximum adjustable setting current: (A)		N
	Operating time: >0,2s in case of instantaneous releases		N
	Operating time: > twice time delay stated by the manufacturer, in the case of definite time delay releases.		N
	Test current: 110% of the rated, or minimum adjustable setting current: (A) circuit-breaker with neutral pole: 1,2x110% (A)		N
	Operating time: <0,2s in case of instantaneous releases:		N
	Operating time: < twice time delay stated by the manufacturer, in the case of definite time delay releases.		N
	Test current: 110% of the maximum adjustable setting current: (A) circuit-breaker with neutral pole: 1,2x110% (A)		N
	Operating time: <0,2s in case of instantaneous releases		N
	Operating time: < twice time delay stated by the manufacturer, in the case of definite time delay releases.		N
b)	Inverse time delay releases		--
	Manufacturer's name or trademark		--
	Type designation or serial number		--
	Sample no:		--
	Rated operational voltage: Ue (V)		--
	Rated current: In (A)		--
	For releases dependent of ambient air temperature: Reference temperature		N

	Test ambient temperature (°C)		N
	For electronic releases, the operating characteristic shall be verified at the ambient temperature of the test room (see 6.1.1 of IEC 60947-1), the release being energised on all phase poles.		N
	For releases dependent on ambient air temperature, the operating characteristics shall be verified at the reference temperature, the release being energized on all phase poles. If the test made at a different ambient temperature, a correction shall be made in accordance with the manufacturer's correction temperature/current data		N
	Range of adjustable setting current: (A)		P
	For releases independent of ambient temperature: Tests shall be made at 30°C and 20°C or 40°C		P
	Test ambient air temperature:		N
	Releases, dependent of ambient air temperature: Reference temperature (°C)		P
	Releases, independent of ambient air temperature: at 30°C		P
	Test current: 105% of the rated, or minimum adjustable setting current: (A)		P
	Conventional non-tripping time: 1h when In < 63A, 2h when In > 63 A		P
	Test current: 130% of the rated, or minimum adjustable setting current: (A)		P
	For circuit-breakers having an identified neutral pole provided with an overload release (see 8.3.3.1.1), the test current at the conventional tripping current shall be multiplied by the factor 1,2.		P
	Conventional tripping time: <1h when In < 63A, <2h when In > 63 A	80A	P
	Test current: 105% of the maximum adjustable setting current: (A)		P
	Conventional non-tripping time: 1h when In < 63A, 2h when In > 63 A		P
	Test current: 130% of the maximum adjustable setting current: (A)		P
	For circuit-breakers having an identified neutral pole provided with an overload release (see 8.3.3.1.1), the test current at the conventional tripping current shall be multiplied by the factor 1,2.		P
	Conventional tripping time: <1h when In < 63A, <2h when In > 63 A		P
	Releases, independent of ambient air temperature: at 20°C or 40°C		P
	Test ambient air temperature:		P

	Test current: 105% of the rated, or minimum adjustable setting current: (A)		P
	Conventional non-tripping time: 1h when In < 63A, 2h when In > 63 A		P
	Test current: 130% of the rated, or minimum adjustable setting current: (A)		P
	For circuit-breakers having an identified neutral pole provided with an overload release (see 8.3.3.1.1), the test current at the conventional tripping current shall be multiplied by the factor 1,2.		P
	Conventional tripping time: <1h when In < 63A, <2h when In > 63 A		P
	Test current: 105% of the maximum adjustable setting current: (A)		P
	Conventional non-tripping time: 1h when In < 63A, 2h when In > 63 A		P
	Test current: 130% of the maximum adjustable setting current: (A)		P
	For circuit-breakers having an identified neutral pole provided with an overload release (see 8.3.3.1.1), the test current at the conventional tripping current shall be multiplied by the factor 1,2.		P
	Conventional tripping time: <1h when In < 63A, <2h when In > 63 A		N
	An additional test, at a current specified by the manufacturer to verify the time/current characteristic of the releases conform to the curves provided by the manufacturer		N
	Releases, dependent of ambient air temperature: Reference temperature (°C)		N
	Releases, independent of ambient air temperature: at 30°C		N
	Test current: at current specified by the manufacturer to verify the time/current characteristic of the releases conform to the curves provided by the manufacturer. -% at the rated, or minimum adjustable setting current: (% or A)		N
	Tripping time acc. time/current characteristic of the releases conform to the curves provided by the manufacturer. (within the stated tolerances)		N
	Releases, independent of ambient air temperature: at 20°C or 40°C		--
	Test ambient air temperature:		P
	Test current: at current specified by the manufacturer to verify the time/current characteristic of the releases conform to the curves provided by the manufacturer. % at the rated, or minimum adjustable setting current: (% or A)		P

	Tripping time acc. time/current characteristic of the releases conform to the curves provided by the manufacturer. (within the stated tolerances)		P
8.3.3.1.4	Additional test for definite time-delay releases		P
a)	Time delay		--
	Test is made at a current equal to 1,5 times the current setting		N
	overload releases: (all phase poles loaded)		N
	for circuit-breakers having an identified neutral pole provided with an overload release, the test current for this release shall be 1,5 times the current setting;		N
	short-circuit releases		N
	Electromagnetic release: two poles in series carrying the test current, using successively all possible combinations of poles having a short-circuit release.		N
	Electronic releases: on one pole chosen at random.		N
	Test current: 1,5 times of the rated, or **minimum** adjustable setting current: (A)		N
	Operating time, overload releases: (s)		N
	Time-delay: between the limits stated by the manufacturer:		N
	Operating time, short-circuit releases (electromagnetic): (s) L1-L2: L1-L3: L2-L3:		N
	Time-delay: between the limits stated by the manufacturer:		N
	Operating time, short-circuit releases (electronic): (s) L1: L2: L3:		N
	Time-delay: between the limits stated by the manufacturer:		N
	Test current: 1,5 times of the **maximum** adjustable setting current: (A)		N
	Operating time, overload releases: (s)		N
	Time-delay: between the limits stated by the manufacturer:		N
	Operating time, short-circuit releases (electromagnetic): (s) L1-L2: L1-L3: L2-L3:		N
	Time-delay: between the limits stated by the manufacturer:		N

	Operating time, short-circuit releases (electronic): (s) L1: L2: L3:		N
	Time-delay: between the limits stated by the manufacturer:		N
b)	Non-tripping duration		--
	Firstly, the test current equal to 1,5 times the current setting is maintained for a time interval equal to the non-tripping duration stated by the manufacturer.		N
	overload releases: (all phase poles loaded)		N
	for circuit-breakers having an identified neutral pole provided with an overload release, the test current for this release shall be 1,5 times the current setting;		N
	short-circuit releases		N
	Electromagnetic release: two poles in series carrying the test current, using successively all possible combinations of poles having a short-circuit release.		N
	Electronic releases: on one pole chosen at random.		N
	Test current: 1,5 times of the rated, or **minimum** adjustable setting current: (A)		N
	Time interval: non-tripping duration stated by the manufacturer: (s)		N
	Operating time, overload releases: the circuit-breaker does not trip:		N
	Operating time, short-circuit releases (electromagnetic): (s) L1-L2: L1-L3: L2-L3:		N
	Operating time, short-circuit releases (electronic): (s) L1: L2: L3:		N
	Test current: 1,5 times of **maximum** adjustable setting current: (A)		N
	Time interval: non-tripping duration stated by the manufacturer: (s)		N
	Operating time, overload releases: the circuit-breaker does not trip:		N
	Operating time, short-circuit releases (electromagnetic): (s) L1-L2: L1-L3: L2-L3:		N
	Operating time, short-circuit releases (electronic): (s) L1: L2: L3:		N

	Then, the current is reduced to the rated current and maintained at this value for twice the time-delay stated by the manufacturer. The circuit-breaker shall not trip.		N
	Test current: of the rated, or **minimum** adjustable setting current: (A)		N
	Time interval: twice the delay-time stated by the manufacturer: (s)		N
	Operating time, overload releases: the circuit-breaker does not trip:		N
	Operating time, short-circuit releases (electromagnetic): (s) L1-L2: L1-L3: L2-L3:		N
	Operating time, short-circuit releases (electronic): (s) L1: L2: L3:		N
	Test current: **maximum** adjustable setting current: (A)		N
	Operating time, overload releases: the circuit-breaker does not trip:		N
	Operating time, short-circuit releases (electromagnetic): (s) L1-L2: L1-L3: L2-L3:		N
	Operating time, short-circuit releases (electronic): (s) L1: L2: L3:		N
8.3.3.2	Test of dielectric properties, impulse withstand voltage (Uimp indicated):		P
8.3.3.4 part1	The 1,2/50/60μs impulse voltage shall be applied five times for each polarity at intervals of 1s minimum		P
	- rated impulse withstand voltage (kV) :		P
	- sea level of the laboratory:		P
	- test Uimp main circuits (kV) :		P
	- test Uimp auxiliary circuits (kV) :		P
	- test Uimp control circuits (kV) :		P
	- test Uimp on open main contacts (equipment suitable for isolating) (kV) :		P
a)	Application of test voltage		P
	i) Between all terminals of the main circuit connected together (incl. control and auxiliary circuits connected to the main circuit) and the enclosure or mounting plate, with the contacts in all normal positions of operation.		P

	ii) Between all terminals of the main circuit and the other poles connected together and to the enclosure or mounting plate, with the contacts in all normal positions of operation.		P
	iii) Between each control and auxiliary circuit not normally connected to the main circuit and: - the main circuit		P
	- other circuits		P
	- exposed conductive parts		P
	- enclosure of mounting plate		P
	iv) equipment suitable for isolation		P
	equipment not suitable for isolation		P
	- no unintentional disruptive discharge during the test's		P
	Test of dielectric properties, dielectric withstand voltage (Uimp not indicated):		N
	- rated insulation voltage (V) :		N
	- main circuits, test voltage for 1 min (V)		P
	- auxiliary circuits, test voltage for 1 min (V)		P
	- control circuits, test voltage for 1 min (V)		P
8.3.3.2.2	Application of test voltage		P
1)	with circuit-breaker in the closed position		P
	- between all live parts of all poles connected together and the frame of the circuit-breaker .		P
	- between each pole and all the other poles connected to the frame of the circuit-breaker		P
2)	with the circuit-breaker in the open position and, additionally, in the tripped position, if any.		N
	- between all live parts of all poles connected together and the frame of the circuit-breaker.		N
	- between the terminals of one side connected together and the terminals of the other side connected together.		N
b)	Control and auxiliary circuits		N
1)	- between all the control and auxiliary circuits which are not normally connected to the main circuit, connected together, and the frame of the circuit-breaker.		N
2)	- where appropriate, between each part of the control an auxiliary circuits which may be isolated from the other parts during normal operation and all the other parts connected together.		N
	No unintentional disruptive discharge during the tests		N

8.3.3.2	For circuit-breaker suitable for isolation, the leakage current shall be measured through each pole with the contacts in the open position, at a test voltage of 1,1 Ue, and shall not exceed 0,5mA.		N
8.3.3.3	Mechanical operation and operational performance capability		P
8.3.3.3.2	Construction and mechanical operation		P
a)	Construction		P
	A withdrawable circuit-breaker shall be checked for the requirements stated in 7.1.1		P
	A circuit-breaker with stored energy operation shall be checked for compliance with 7.2.1.1.5, regarding the charge indicator and the direction of operation of manual energy storing		P
b)	Mechanical operation		P
	A circuit-breaker with dependent power operation shall comply with the requirements stated in 7.2.1.1.3		P
	A circuit-breaker with dependent power operation shall operate with the operating mechanism charged to the minimum and maximum limits stated by the manufacturer		P
	A circuit-breaker with stored energy operation shall comply with the requirements stated in 7.2.1.5 with the auxiliary supply voltage at 85% and 110% of the rated control supply voltage.		P
	It shall also be verified that the moving contacts cannot be moved from the open position when the operating mechanism is charged to slightly below the full charge as evidenced by the indicating device		P
	For a trip-free circuit-breaker it shall not be possible to maintain the contacts in the touching or closed position when the tripping release is in the position to trip the circuit-breaker		N
	If the closing and opening times of a circuit-breaker are stated by the manufacturer, such times shall comply with the stated values		N
c)	Undervoltage releases		N
	Undervoltage releases shall comply with the requirements of 7.2.1.3 of Part 1. For this purpose, the release shall be fitted to a circuit-breaker having the maximum current rating for which the release is suitable		N
i)	Drop out voltage		P
	It shall be verified that the release operates to open the circuit-breaker between the voltage limits specified		P
	The voltage shall be reduced from rated voltage at a rate to reach 0 V in approximately 30 s		P

	The test for the lower limit is made without current in the main circuit and without previous heating of the release coil		P
	In the case of a release with a range of rated voltages, this test applies to the maximum voltage of the range		P
	The test for the upper limit is made starting from a constant temperature corresponding to the application of rated control supply voltage to the release and rated current in the main poles of the circuit-breaker		N
	This test may be combined with the temperature-rise test of 8.3.3.6		N
	In the case of a release with a range of rated voltages, this test is made at both the minimum and maximum rated control supply voltages		P
ii)	Test for limits of operation		N
	Starting with the circuit-breaker open, at the temperature of the test room, and with the supply voltage at 30% rated maximum control supply voltage, it shall be verified that the circuit-breaker cannot be closed by the operation of the actuator		N
	When the supply voltage is raised to 85% of the minimum control supply voltage, it shall be verified that the circuit-breaker can be closed by the operation of the actuator		N
iii)	Performance under overvoltage conditions		N
	With the circuit-breaker closed and without current in the main circuit, it shall be verified that the undervoltage release will withstand the application of 110% rated control supply voltage for 4 h without impairing its functions		N
d)	Shunt releases		P
	Shunt releases shall comply with the requirements of 7.2.1.4 of Part 1. For this purpose, the release shall be fitted to a circuit-breaker having the maximum rated current for which the release is suitable		P
	It shall be verified that the release will operate to open the circuit-breaker at 70% rated control supply voltage when tested at an ambient temperature of + 55 °C ± 2 °C without current in the main poles of the circuit-breaker		P
	In the case of a release having a range of rated control supply voltages, the test voltage shall be 70% of the minimum rated control supply voltage		P
8.3.3.3.3	Operational performance capability without current.		N
	Type designation or serial number		N
	Sample no:		N

	Rated current In (A)		N
	Rated operational voltage: Ue (V)		N
	Rated control supply voltage of closing mechanism: Uc (V)		N
	Rated control supply voltage of shunt releases: Uc (V)		N
	Rated control supply voltage undervoltage releases: Uc (V)		N
	Ambient temperature 10-40 °C :		N
	Number of operating cycles per hour		N
	Number of cycles without current (total) (closing mechanism energized at the rated Uc)		N
	Number of cycles without current (without releases)		P
	Applied voltage: closing mechanism (V)		P
	10% of total cycles for circuit-breaker with fitted shunt release: (50/60% at the beginning- and 50/60% at the end of the test.) Energized at the rated Uc		P
	Applied voltage: shunt releases (V)		P
	10% of total cycles for circuit-breaker with undervoltage releases: (50/60% at the beginning- and 50/60% at the end of the test.) Energized at the minimum rated Uc		P
	10 cycles without applied voltage at the undervoltage releases. (Shall not possible to close the circuit-breaker.)		P
	Applied voltage: undervoltage releases (V)		P
	Electrical components do not exceed the value indicated in tab. 7.		P
8.3.3.3.4	Operational performance capability with current.		--
	Rated current: In (A)		--
	Maximum rated operational voltage: Ue (V)		--
	Conductor cross-sectional area (mm²) :		N
	Number of operating cycles per hour		N
	Number of cycles with current (total) (closing mechanism energized at the rated Uc)		N
	Applied voltage: closing mechanism (V)		N
	For circuit-breaker fitted with adjustable releases, test shall be made with the overload setting at maximum and short-circuit setting at minimum.		N

	Conditions, make/break operations:		N
	- test voltage U/Ue = 1,0 (V) ..... L1: ..... L2: L3:		N
	- test current I/Ie = 1,0 (A).....L1: ..... L2: L3:		N
	- power factor/time constant:		P
	- frequency: (Hz)		P
	- on-time (ms):	0.25	P
	- off-time (s):	0.85	P
	Electrical components do not exceed the value indicated in tab. 7.		P
8.3.3.3.5	Additional test of operational performance capability without current for withdrawable circuit-breaker.		N
	Number of operations cycles : 100		N
	After test, the isolating contacts, withdrawable mechanism and interlocks shall be suitable for further service.		N
8.3.3.4	Overload performance		N
	this test applies to circuit-breaker of rated current up to and including 500 A		N
	Type designation or serial number		N
	Sample no:		N
	Rated current In (A)		N
	Rated operational voltage: Ue (V)		N
	Rated control supply voltage of closing mechanism: Uc (V)		N
	Rated control supply voltage of shunt releases: Uc (V)		N
	Rated control supply voltage undervoltage releases: Uc (V)		N
	Ambient temperature 10-40 °C :		N
	Number of operating cycles per hour		N
	Maximum rated operational voltage: Ue (V)		N
	Number of operating cycles per hour		N
	Number of cycles with current (total) (closing mechanism energized at the rated Uc)		N
	Applied voltage: closing mechanism (V)		N
	For circuit-breaker fitted with adjustable releases, test shall be made with the overload/short-circuit settings at maximum.		N

	Conditions, overload operations:		N
	- test voltage U/Ue = 1,05 (V) ..... L1: ..... L2: L3:		N
	- test current AC/DC: I/Ie = 6,0/2.5 (A) ..... L1: ..... L2: L3:		N
	- power factor/time constant:		N
	- Number of cycles manually opened: 9		N
	- Number of cycles automatically opened by an overload release: 3		N
	- frequency: (Hz)		N
	- on-time max 2s:		N
8.3.3.5	Verification of dielectric withstand		N
	- equal to twice the rated operational voltage with a minimum of 1000 V for 5 seconds		P
	- no breakdown or flashover		P
8.3.3.6	Verification of temperature-rise		P
	- the values of temperature-rise do not exceed the those specified in tab. 7.		P
	Temperature rise of main circuit terminals ≤ 80 K (K) :		P
	conductor cross-sectional area (mm²) :		P
	test current Ie (A) :		P
8.3.3.7	Verification of overload releases		P
	Test current: 1.45 times the value of their current setting at the reference temperature: (A)		P
	Conventional tripping time: <1h when In < 63A, <2h when In > 63 A		P
8.3.3.8	Verification of undervoltage and shunt releases		P
	Circuit-breaker fitted with undervoltage releases. The release shall not operate at 70% of the minimum control supply voltage -		P
	and shall operate at 35% of the maximum control supply voltage.		P
	Circuit-breaker fitted with shunt releases. The release shall operate at 70% of the minimum rated control supply voltage. Test made at room temperature.		P

8.3.3.9	Verification of the main contact position for circuit-breakers for isolation		P
	actuating force for opening (N) .....:		—

	test force with blocked main contacts for 10 s (N) . :		—
	Dependent power operation		P
	Supply voltage of 110% of rated voltage (V)…….:		P
	Three attempts of 5 s to operate the equipment at intervals of 5 min.		P
	Independent power operation		P
	Three attempts to operate the equipment by the stored energy.		P
	Lock ability of driving mechanism in OFF-position at test force and blocked main contacts ..... :		P
	Position indicator does not show OFF-position after capture of test force at blocked main contacts		P

8.3.4	TEST SEQUENCE II (Ics):		--
8.3.4.1	Test of rated service short-circuit breaking capacity		--
	Test sequence of operation: O – t – CO – t – CO		--
	Type designation or serial number		--
	Sample no:		--
	Rated current: In (A)		--
	Rated operational voltage: Ue (V)		--
	Rated service short-circuit breaking capacity: (kA)		--
	Rated control supply voltage of closing mechanism: Uc (V)		--
	Rated control supply voltage of shunt release: Uc (V)		--
	For circuit-breaker fitted with adjustable releases, test shall be made with the current and time settings at maximum.		N
	closing mechanism energized with 85% at the rated Uc: (V)		N
	The circuit-breaker is mounted complete on its own support or an equivalent support.		N
	Test made in free air:		N
	Distances of the metallic screen's: (all sides)		N
	The characteristics of the metallic screen:		N
	- woven wire mesh		N
	- perforated metal		N
	- expanded metal		N
	- ratio hole area/total area: 0,45-0,65		N
	- size of hole: <30mm^2		N

	- finish: bare or conductive plating		N
	Test made in specified individual enclosure: Details of these tests, including the dimensions of the enclosure:		N
	Fuse ”F”: copper wire: diameter 0,8 mm, 60mm long		N

	Circuit is earthed at: (load-star- or supply-star point)		N
	Conductor cross-sectional area (mm²) :		N
	If terminals unmarked: line connected at: (underside/upside)		N
	Tightening torques: (Nm)		N
	Test sequence of operation: O – t – CO – t – CO		N
	- test voltage U/Ue = 1,05 (V)..... L1: ..... L2: L3:		N
	- r.m.s. test current AC/DC: (A) ..... L1: ..... L2: L3:		N
	power factor/time constant :		N
	- Factor ”n”		N
	- peak test current (A) :		N
	Test sequence ”O”		N
	- max. let-through current: (kApeak) ..... L1: ..... L2: L3:		N
	- Joule integral I²dt (A²s) ..... L1: ..... L2: L3:		N
	Pause, t: (min)		N
	Test sequence ”CO”		N
	- max. let-through current: (kApeak) ..... L1: ..... L2: L3:		N
	- Joule integral I²dt (A²s) ..... L1: ..... L2: L3:		N
	Pause, t: (min)		N
	Test sequence ”CO”		N
	- max. let-through current: (kApeak) ..... L1: ..... L2: L3:		N

	- Joule integral I²dt (A²s) ..... L1: ..... L2: L3:		N
	Melting of the fusible element		N
	Holes in the PE-sheet for test sequence ”O”		N
	Cracks observed		N
8.3.4.2	Operational performance capability with current.		P
	Rated current: In (A)		--
	Maximum rated operational voltage: Ue (V)		P
	Conductor cross-sectional area (mm²) :		P
	Number of operating cycles per hour		P
	Number (5% of the number given in column 4, tab. 8) of cycles with current (total) (closing mechanism energized at the rated Uc)		P
	Applied voltage: closing mechanism (V)		P
	For circuit-breaker fitted with adjustable releases, test shall be made with the overload setting at maximum and short-circuit setting at minimum.		P
	Conditions, make/break operations:		P
	- test voltage U/Ue = 1,0 (V) ..... L1: ..... L2: L3:		P
	- test current I/Ie = 1,0 (A).....L1: ..... L2: L3:		P
	- power factor/time constant:		P
	- frequency: (Hz)	50/60	P
	- on-time (ms):	0.28	P
	- off-time (s):	0.37	P
	Electrical components do not exceed the value indicated in tab. 7.		P
8.3.4.3	Verification of dielectric withstand		P
	- equal to twice the rated operational voltage with a minimum of 1000 V		P
	- no breakdown or flashover		P
	- the leaking current for circuit-breaker suitable for isolation: (<2mA / 1.1 Ue)		P
8.3.4.4	Verification of temperature-rise		P
	- the values of temperature-rise do not exceed the those specified in tab. 7.		P
	Temperature rise of main circuit terminals. ≤ 80 K (K) :	43.5K	P

	conductor cross-sectional area (mm²) :		P
	test current Ie (A) :		P
8.3.4.5	Verification of overload releases		P
	Test current: 1.45 times the value of their current setting at the reference temperature: (A)		P
	Conventional tripping time: <1h when In < 63A, <2h when In > 63 A		P

8.3.4	TEST SEQUENCE II/III (Ics=Icu):		N
8.3.4.1	Test of rated service short-circuit breaking capacity		N
	Test sequence of operation: O – t – CO – t – CO		N
	Type designation or serial number		N
	Sample no:		N
	Rated current: In (A)		N
	Rated operational voltage: Ue (V)		N
	Rated service short-circuit breaking capacity: (kA)		N
	Rated control supply voltage of closing mechanism: Uc (V)		N
	Rated control supply voltage of shunt release: Uc (V)		N
	For circuit-breaker fitted with adjustable releases, test shall be made with the current and time settings at maximum.		N
	closing mechanism energized with 85% at the rated Uc: (V)		N
	The circuit-breaker is mounted complete on its own support or an equivalent support.		N
	Test made in free air:		N
	Distances of the metallic screen's: (all sides)		N
	The characteristics of the metallic screen:		N
	- woven wire mesh		N
	- perforated metal		N
	- expanded metal		N
	- ratio hole area/total area: 0,45-0,65		N
	- size of hole: <30mm^2		N
	- finish: bare or conductive plating		N
	Test made in specified individual enclosure: Details of these tests, including the dimensions of the enclosure:		N

	Fuse ”F”: copper wire: diameter 0,8 mm, 60mm long		N
	Circuit is earthed at: (load-star- or supply-star point)		N
	Conductor cross-sectional area (mm²) :		N
	If terminals unmarked: line connected at: (underside/upside)		N
	Tightening torques: (Nm)		N
8.3.5.1	The operation of overload releases shall be verified at twice the value of their current setting on each pole separately.		P
	The operating time shall not exceed the max. value stated by the manufacturer for twice the current setting at the reference temperature, on a pole singly.		P
	Time specified by the manufacturer:		N
	- Operation time: (s) ..... L1: ..... L2: ..... L3: .....N :		N
8.3.4.1	Test of rated service short-circuit breaking capacity		N
	Test sequence of operation: O – t – CO – t – CO		N
	- test voltage U/Ue = 1,05 (V) ..... L1: ..... L2: L3:		N
	- r.m.s. test current AC/DC: (A) ..... L1: ..... L2: L3:		N
	power factor/time constant :		N
	- Factor ”n”		N
	- peak test current (A) :		N
	Test sequence ”O”		N
	- max. let-through current: (kApeak) ..... L1: ..... L2: L3:		N
	- Joule integral I²dt (A²s) ..... L1: ..... L2: L3:		N
	Pause, t: (min)		N
	Test sequence ”CO”		N
	- max. let-through current: (kApeak) ..... L1: ..... L2: L3:		N
	- Joule integral I²dt (A²s) ..... L1: ..... L2: L3:		N

	Pause, t: (min)		N
	Test sequence ”CO”		N
	- max. let-through current: (kApeak) ..... L1: ..... L2: L3:		N
	- Joule integral I²dt (A²s) ..... L1: ..... L2: L3:		N
	Melting of the fusible element		N
	Holes in the PE-sheet for test sequence ”O”		N
	Cracks observed		N
8.3.4.2	Operational performance capability with current.		N
	Rated current: In (A)		N
	Maximum rated operational voltage: Ue (V)		N
	Conductor cross-sectional area (mm²) :		N
	Number of operating cycles per hour		N
	Number (5% of the number given in column 4, tab. 8) of cycles with current (total) (closing mechanism energized at the rated Uc)		N
	Applied voltage: closing mechanism (V)		N
	For circuit-breaker fitted with adjustable releases, test shall be made with the overload setting at maximum and short-circuit setting at minimum.		N
	Conditions, make/break operations:		N
	- test voltage U/Ue = 1,0 (V) ..... L1: ..... L2: L3:		N
	- test current I/Ie = 1,0 (A).....L1: ..... L2: L3:		N
	- power factor/time constant:		N
	- frequency: (Hz)		N
	- on-time (ms):		N
	- off-time (s):		N
	Electrical components do not exceed the value indicated in tab. 7.		N
8.3.4.3	Verification of dielectric withstand		N
	- equal to twice the rated operational voltage with a minimum of 1000 V		N
	- no breakdown or flashover		N

	- the leaking current for circuit-breaker suitable for isolation: (<2mA / 1,1 Ue)		N
8.3.4.4	Verification of temperature-rise		N
	- the values of temperature-rise do not exceed the those specified in tab. 7.		N
	Temperature rise of main circuit terminals. ≤ 80 K (K) :		N
	conductor cross-sectional area (mm²) :		N
	test current Ie (A) :		N
8.3.4.5	Verification of overload releases		N
	Test current: 1,45 times the value of their current setting at the reference temperature: (A)		N
	Conventional tripping time: <1h when In < 63A, <2h when In > 63 A		N
8.3.5.4	Verification of overload releases		N
	The operation of overload releases shall be verified at 2,5 times the value of their current setting on each pole separately.		N
	The operating time shall not exceed the max. value stated by the manufacturer for twice the current setting at the reference temperature, on a pole singly.		N
	Time specified by the manufacturer:		N
	- Operation time: (s) ..... L1: ..... L2: ..... L3: .....N :		N

8.3.5	TEST SEQUENCE III (Icu)		--
	Rated ultimate short-circuit breaking		P
	Except where the combined test sequence applies, this test sequence applies to circuit-breaker of utilization category A and to circuit-breaker of utilization B having a rated ultimate short-circuit breaking capacity higher than the rated short-time withstand current.		P
	For circuit-breakers of utilization B having a rated short-time withstand current equal to their rated ultimate short-circuit breaking capacity, this test sequence need not be made, since, in this case, the ultimate short-circuit breaking capacity, is verified when carrying out test sequence IV.		P
	For integrally fused circuit-breakers, test sequence V applies in place of this sequence.		P
	Type designation or serial number		P
	Sample no:		P
	Rated current: In (A)		P
	Rated operational voltage: Ue (V)		P
	Rated ultimate short-circuit breaking capacity: (kA)		P

	Rated control supply voltage of closing mechanism: Uc (V)		P
	Rated control supply voltage of shunt release: Uc (V)		P
	This test sequence need not be made when Icu = Ics		P
8.3.5.1	The operation of overload releases shall be verified at twice the value of their current setting on each pole separately.		P
	The operating time shall not exceed the max. value stated by the manufacturer for twice the current setting at the reference temperature, on a pole singly.		P
	Time specified by the manufacturer:		P
	- Operation time: (s) ..... L1: ..... L2: ..... L3: .....N :		P

7.1.4	TABLE: Clearance And Creepage Distance Measurements					P
clearance cl and creepage distance dcr at/of:	**Up (kV)**	**U r.m.s. (V)**	**Required cl (mm)**	**cl (mm)**	**required dcr (mm)**	**dcr (mm)**
Between open contact	4	500	3,0	5,2	10,0	>15
Between different poles	4	500	3,0	>6	10,0	>15
Supplementary information:						

9.3.3.2.4	**TABLE 1: Operation on loss of supply voltage**											
	Ambient (°)							20 °				
	Test case							Operating times				
Test No	Rated voltage	Control supply voltage	Frequency	Threshold	Ts	Number of phases	N connection	Tested phases	Step Disconnect/ Reconnect	CTT ms	TOT s	Verdict
	V	V	Hz	%	s		Yes/No	L1/L2/L3				
1	230	240	60	95	9	2	N/A	L1	Disconnect	70	9,38	P
2	230	240	60	95	9	2	N/A	L2	Disconnect	72	9,38	P
3	230	240	60	95	9	2	N/A	L1	Reconnect	73	9,38	P
4	230	240	60	95	9	2	N/A	L2	Reconnect	71	9,38	P
Supplementary information:												
CTT: Contact Transfer Time (I -II/II -I)												
TOT: Total operating time (including Ts)												

9.3.3.3 (9.3.3.6.2)	TABLE: Temperature-rise after clause 9.3.3.6.2			P
	Test sample..... :	I-1		–
	Main circuit / Auxiliary circuit.....:	Main circuit		–
	Ambient (oC) .....:	25.5		–
	Ithe / Ith (A).....:	25		–
Thermocouple Locations	dT (K) measured		dT (K) required	
Line terminal L1	55 .23		80	
Line terminal L2	55		80	
Load terminal L1	52		80	
Load terminal L2	53		80	
Enclosure	29		50	
Support base	20		50	

9.3.3.3 (9.3.4.4)	TABLE: Temperature-rise after clause 9.3.4.4		P
	Test sample..... :	I-1	–

	Main circuit / Auxiliary circuit.....:	Main circuit		–
	Ambient (oC) .....:	25.5		–
	Ithe / Ith (A).....:	360		–
	Test voltage (V) .....:	24		–
Thermocouple Locations	dT (K) measured		dT (K) required	
Line terminal L1	53		80	
Line terminal L2	52		80	
Load terminal L1	51		80	
Load terminal L2	51		80	
Enclosure	21		50	
Support base	16		50	
Supplementary information:				

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Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
1	**Scope**		**P**
	This part of IEC 60898 applies to a.c. air-break circuit-breakers for operation at 50 Hz, 60 Hz or 50/60 Hz, having a rated voltage not exceeding 440 V (between phases), a rated current not exceeding 1 25 A and a rated short-circuit capacity not exceeding 25 000 A. As far as possible, it is in line with the requirements contained in IEC 60947-2. These circuit-breakers are intended for the protection against overcurrents of wiring installations of buildings and similar applications; they are designed for use by uninstructed people and for not being maintained. They are intended for use in an environment with pollution degree 2 and overvoltage category III. NOTE 1 Additional requirements are necessary for circuit-breakers used in locations having more severe overvoltage conditions. They are suitable for isolation. Circuit-breakers of this standard are suitable for use in IT systems provided that the requirements of HD 60364-4-43 are complied with. This standard also applies to circuit-breakers having more than one rated current, provided that the means for changing from one discrete rating to another is not accessible in normal service and that the rating cannot be changed without the use of a tool. This standard does not apply to – circuit-breakers intended to protect motors; – circuit-breakers, the current setting of which is adjustable by means accessible to the user. For circuit-breakers having a degree of protection higher than IP20 according to IEC 60529, for use in locations where arduous environmental conditions prevail (e.g. excessive humidity, heat or cold or deposition of dust) and in hazardous locations (e.g. where explosions are liable to occur), special constructions may be required.		P

EN 60898-1&EN 60898-2			
Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	This standard does not apply to circuit-breakers for a.c. and d.c. operation,which is covered by IEC 60898-2. This standard does not apply to circuit-breakers which incorporate residual current tripping devices, which is covered by IEC 61 009-1 , IEC 61 009-2-1 , and IEC 61 009-2-2. Supplementary requirements may be necessary for circuit-breakers of the screw-in types. A guide for co-ordination under short-circuit conditions between a circuit-breaker and another short-circuit protective device (SCPDs) is given in Annex D. For more severe overvoltage conditions, circuit-breakers complying with other standards (e.g. IEC 60947-2) should be used. For an environment with a higher pollution degree, enclosures giving the appropriate degree of protection should be used. NOTE 2 Circuit-breakers within the scope of this standard can also be used for protection against electric shock in case of fault, depending on their tripping characteristics and on the characteristics of the installation. The criterion of application for such purposes is dealt with by installation rules. NOTE 3 Recommendations for the dimensional coordination between enclosures and circuit-breakers for mounting on rails according to EN 6071 5 or equivalent means are given in the CENELEC report PD CLC/TR 50473. This standard contains all requirements necessary to ensure compliance with the operational characteristics required for these devices by type tests. It also contains the details relative to test requirements and methods of testing necessary to ensure reproducibility of test results. This standard states a) the characteristics of circuit-breakers; b) the conditions with which circuit-breakers shall comply, with reference to: 1) their operation and behaviour in normal service;		P

EN 60898-1&EN 60898-2			
Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	2) their operation and behaviour in case of overload; 3) their operation and behaviour in case of short-circuits up to their rated short-circuit capacity; 4) their dielectric properties; c) the tests intended for confirming that these conditions have been met and the methods to be adopted for the tests; d) the data to be marked on the devices; e) the test sequences to be carried out and the number of samples (see Annex C); f) the co-ordination under short-circuit conditions with another short-circuit protective device (SCPD) associated in the same circuit (see Annex D); g) the routine tests to be carried out on each circuit-breaker to reveal unacceptable variations in material or manufacture, likely to affect safety (see Annex I).		P
2	**Normative references**		P
	NOTE Normative references to international standards are given in Annex ZB.		P
3	**Terms and definitions**		P
	For the purposes of this document, the terms and definitions given in IEC 60050-441 , as well as the following apply.		P
3.1	**Devices**		P
3.1.1	switching device device designed to make or break the current in one or more electric circuits [SOURCE: IEC 60050-441 :1 984, 441 -1 4-01]		P
3.1.2	mechanical switching device switching device designed to close and open one or more electric circuits by means of separable contacts [SOURCE: IEC 60050-441 :1 984, 441 -1 4-02]		P
3.1.3	fuse device that, by the fusing of one or more of its specially designed and proportioned components, opens the circuit in which it is inserted and breaks the current when this exceeds a given value for a sufficient time [SOURCE: IEC 60050-441 :1 984, 441 -1 8-01 ,		P

EN 60898-1&EN 60898-2			
Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	modified – "The fuse comprises all the parts that form the complete device" has been deleted.]		P
3.1.4	circuit-breaker <mechanical> mechanical switching device, capable of making, carrying and breaking currents under normal circuit conditions and also making, carrying for a specified time, and automatically breaking currents under specified abnormal circuit conditions such as those of short-circuit [SOURCE: IEC 60050-441 :1 984, 441 -1 4-20]		P
3.1.5	plug-in circuit-breaker circuit-breaker having one or more plug-in terminals (see 3.3.20) and designed for use with appropriate means for the plug-in connection		P
3.2	**General terms**		P
3.2.1	overcurrent current exceeding the rated current [SOURCE: IEC 60050-441 :1 984, 441 -1 1 -06]		P
3.2.2	overload current overcurrent occurring in an electrically undamaged circuit Note 1 to entry: An overload current may cause damage if sustained for a sufficient time.		P
3.2.3	short-circuit current overcurrent resulting from a fault of negligible impedance between points intended to be at different potentials in normal service Note 1 to entry: A short-circuit current may result from a fault or from an incorrect connection.		P
3.2.4	main circuit <of a circuit-breaker> all the conductive parts of a circuit-breaker included in the circuit which it is designed to close and open		P
3.2.5	control circuit <of a circuit-breaker> circuit (other than a path of the main circuit) intended for the closing operation or opening operation, or both, of the circuit-breaker		P
3.2.6	auxiliary circuit <of a circuit-breaker> all the conductive parts of a circuit-breaker intended to be included in a circuit other than the main circuit and the control circuit of the circuit-breaker		P

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Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
3.2.7	pole <of a circuit-breaker> that part of a circuit-breaker associated exclusively with one electrically separated conducting path of its main circuit provided with contacts intended to connect and disconnect the main circuit itself and excluding those portions which provide a means for mounting and operating the poles together		P
3.2.7.1	protected pole pole provided with an overcurrent release (see 3.3.6)		P
3.2.7.2	unprotected pole pole without overcurrent release (see 3.3.6), but otherwise generally capable of the same performance as a protected pole of the same circuit-breaker Note 1 to entry: To ensure compliance with this requirement, the unprotected pole may be of the same construction as the protected pole(s), or of a particular construction. Note 2 to entry: If the short-circuit capacity of the unprotected pole is different from that of the protected pole(s), this has to be indicated by the manufacturer.		P
3.2.7.3	switched neutral pole pole only intended to switch the neutral, and not intended to have a short-circuit capacity		P
3.2.8	closed position position in which the predetermined continuity of the main circuit of the circuit-breaker is secured		P
3.2.9	open position position in which the predetermined clearance between open contacts in the main circuit of the circuit-breaker is secured		P
3.2.10	air temperature		P
3.2.10.1	ambient air temperature temperature, determined under prescribed conditions, of the air surrounding the circuit-breaker Note 1 to entry: For circuit breakers installed inside an enclosure, it is the temperature of air outside the enclosure [SOURCE: IEC 60050-441 :1 984, 441 -1 1 -1 3, modified – "complete switching device or fuse"		P

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Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	has been replaced by "circuit-breaker".]		
3.2.10.2	reference ambient air temperature ambient air temperature on which the time-current characteristics are based		P
3.2.11	operation transfer of the moving contact(s) from the open position to the closed position or vice versa Note 1 to entry: If distinction is necessary, an operation in the electrical sense (make or break) is referred to as a "switching operation" and an operation in the mechanical sense (close or open) is referred to as a "mechanicaloperation".		P
3.2.12	operating cycle succession of operations from one position to another and back to the first position		P
3.2.13	operation sequence <of a mechanical switching device> succession of specified operations with specified time intervals [SOURCE: IEC 60050-441 :1 984, 441 -1 6-03]		P
3.2.14	uninterrupted duty duty in which the main contacts of a circuit-breaker remain closed whilst carrying a steady current without interruption for long periods (which could be weeks, months, or even years)		P
3.2.15	type test test of one or more devices made to a certain design to show that the design meets certain requirements [SOURCE: IEC 60050-441:1984, 441-53-01,modifed]		P
3.2.16	routine test test to which each individual device is subjected during or after manufacture to ascertain whether it complies with certain criteria [SOURCE: IEV 411-53-02, modifed]		P
3.3	**Constructional elements**		P
3.3.1	main contact contact included in the main circuit of a circuit-breaker and intended to carry in the closed position the current of the main circuit		P
3.3.2	arcing contactcontact on which the arc is intended to be established Note 1 to entry: An arcing contact may serve as a main contact. It may also be a separate contact so designed that it opens after and closes before another		P

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Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	contact, which it is intended to protect from damage. [SOURCE: IEC 60050-441 :1 984, 441 -1 5-08]		
3.3.3	control contact contact included in a control circuit of a circuit-breaker and mechanically operated by the circuit-breaker		P
3.3.4	auxiliary contact contact included in an auxiliary circuit and mechanically operated by the circuit-breaker (e.g. for indicating the position of the contacts)		P
3.3.5	Release device, mechanically connected to (or integrated into) a circuit-breaker, which releases the holding means and permits the automatic opening of the circuit-breaker		**P**
3.3.6	overcurrent release release which causes a circuit-breaker to open, with or without time-delay, when the current in the release exceeds a pre-determined value Note 1 to entry: In some cases this value can depend upon the rate of rise of current.		P
3.3.7	inverse time-delay overcurrent release overcurrent release which operates after a time-delay inversely dependent upon the value of the overcurrent Note 1 to entry: Such a release may be designed so that the time-delay approaches a definite minimum for high values of overcurrent.		P
3.3.8	direct overcurrent release overcurrent release directly energized by the current in the main circuit of a circuit-breaker		P
3.3.9	overload release overcurrent release intended for protection against overloads		P
3.3.10	conductive part part which is capable of conducting current although it may not necessarily be used for carrying current in normal service		P
3.3.11	exposed conductive part conductive part which can be readily touched and which normally is not live, but which may become live under fault conditions Note 1 to entry: Typical exposed conductive parts are walls of metal enclosures, metal operating handles, etc.		P
3.3.12	Terminal conductive part of a device, provided for re-usable electrical connection to external circuits		P
3.3.12.1	screw-type terminal terminal for the connection and subsequent disconnection of a conductor or the inter-		**P**

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Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	connection of two or more conductors, capable of being dismantled, the connection being made, directly or indirectly, by means of screws or nuts of any kind		P
3.3.12.2	pillar terminal screw-type terminal in which the conductor is inserted into a hole or cavity, where it is clamped under the shank of the screw(s). Note 1 to entry: The clamping pressure may be applied directly by the shank of the screw or through an intermediate clamping element to which pressure is applied by the shank of the screw Note 2 to entry: Examples of pillar terminals are shown in Annex F, Figure F.1 . [SOURCE: IEC 60050-442:1 984, 442-06-22]		P
3.3.12.3	screw terminal terminal in which the conductor is clamped under the head of the screwand where the clamping pressure can be applied directly by the head of the screw or through an intermediate part, such as a washer, a clamping plate or an anti-spread device Note 1 to entry: Examples of screw terminals are shown in Annex F, Figure F.2. [SOURCE: IEC 60050-442:1 984, 442-06-08]		P
3.3.12.4	stud terminal screw-type terminal in which the conductor is clamped under a nut. Note 1 to entry: The clamping pressure may be applied directly by a suitably shaped nut or through an intermediate part, such as a washer, a clamping plate or an anti-spread device Note 2 to entry: Examples of stud terminals are shown in Annex F, Figure F.2. [SOURCE: IEC 60050-442:1 984, 442-06-23]		P
3.3.12.5	saddle terminal screw-type terminal in which the conductor is clamped under a saddle by means of two or more screws or nuts Note 1 to entry: Examples of saddle terminals are shown in Annex F, Figure F.3. [SOURCE: IEC 60050-442:1 984, 442-06-09]		P
3.3.12.6	lug terminal screw terminal or stud terminal, designed for clamping a cable lug or a bar directly or indirectly by means of a screw or nut Note 1 to entry: Examples of lug terminals are shown in Annex F, Figure F.4.		P

EN 60898-1&EN 60898-2			
Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	[SOURCE: IEC 60050-442:1 984, 442-06-1 6]		P
3.3.12.7	screwless terminal connecting terminal for the connection and subsequent disconnection of one conductor or the interconnection of two or more conductors capable of being dismantled, the connection being made, directly or indirectly, by means of springs, wedges, eccentrics or cones, etc., without special preparation of the conductor other than removal of insulation [SOURCE: IEC 60050-442:1 984, 442-06-1 3 modified by adding the last part of the text]		P
3.3.12.8	plug-in terminal terminal the electrical connection and disconnection of which can be effected without displacing the conductors of the corresponding circuit Note 1 to entry: The connection is effected without the use of a tool and is provided by the resilience of the fixed and/or moving parts and/or by springs		P
3.3.13	tapping screw screw manufactured from a material having a greater resistance to deformation when applied by rotary insertion to a hole in a material having a lesser resistance to deformation. Note 1 to entry: The screw is made with a tapered thread, the taper being applied to the core diameter of the thread at the end section of the screw. Note 2 to entry: The thread produced by application of the screw is formed securely only after sufficient revolutions have been made to exceed the number of threads on the tapered section		P
3.3.13.1	thread-forming tapping screw tapping screw having an uninterrupted thread Note 1 to entry: It is not a function of this thread to remove material from the hole Note 2 to entry: An example of thread-forming tapping screw is shown in Figure 1 .		P
3.3.13.2	thread-cutting tapping screw tapping screw having an interrupted thread. The thread is intended to remove material from the hole. Note 1 to entry: An example of thread-cutting tapping screw is shown in Figure 2.		P
3.4	**Conditions of operation**		P
3.4.1	closing operation operation by which the circuit-breaker is brought		P

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Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	from the open position to the closed position		P
3.4.2	opening operation operation by which the circuit-breaker is brought from the closed position to the open position		P
3.4.3	dependent manual operation operation solely by means of directly applied manual energy, such that the speed and force of the operation are dependent upon the action of the operator [SOURCE: IEC 60050-441 :1 984, 441 -1 6-1 3]		P
3.4.4	independent manual operation stored energy operation where the energy originates from manual power, stored and released in one continuous operation, such that the speed and force of the operation are independent of the action of the operator [SOURCE: IEC 60050-441 :1 984, 441 -1 6-1 6]		P
3.4.5	trip-free circuit-breaker circuit-breaker, the moving contacts of which return to and remain in the open position when the automatic opening operation is initiated after the initiation of the closing operation, even if the closing command is maintained Note 1 to entry: To ensure proper breaking of the current which may have been established, it may be necessary that the contacts momentarily reach the closed position.		P
3.5	**Characteristic quantities**		P
	NOTE Unless otherwise specified, all values of current and voltage are r.m.s. values.		P
3.5.1	rated value stated value of any one of the characteristic quantities that serve to define the working conditions for which the circuit-breaker is designed and built		P
3.5.2	prospective current current that would flow in the circuit if each pole of the circuit-breaker were replaced by a conductor of negligible impedance Note 1 to entry: The prospective current may be qualified in the same manner as an actual current, for example prospective breaking current, prospective peak current. [SOURCE: IEC 60050-441 :1 984, 441 -1 7-01 , modified – "complete switching device or fuse" has been replaced by "circuit-breaker".]		P
3.5.3	prospective peak current		P

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Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	peak value of a prospective current during the transient period following initiation Note 1 to entry: The definition assumes that the current is established by an ideal circuit-breaker, that is, with instantaneous transition from infinite to zero impedance. For circuits where the current can follow several different paths, for example polyphase circuits, it further assumes that the current is established simultaneously in all poles, even if the current in only one pole is considered. [SOURCE: IEC 60050-441 :1 984, 441 -1 7-02]		P
3.5.4	maximum prospective peak current prospective peak current when the initiation of the current takes place at the instant which leads to the highest possible value Note 1 to entry: For a multipole circuit-breaker in a polyphase circuit, the maximum prospective peak current refers to a single pole only. [SOURCE: IEC 60050-441 :1 984, 441 -1 7-04]		P
3.5.5	short-circuit making and breaking capacity alternating component of the prospective current, expressed by its r.m.s. value, which the circuit-breaker is designed to make, to carry for its opening time and to break under specified conditions		P
3.5.5.1	ultimate short-circuit breaking capacity breaking capacity for which the prescribed conditions according to a specified test sequence do not include the capability of the circuit-breaker to carry 0,85 times its non-tripping current for the conventional time		P
3.5.5.2	service short-circuit breaking capacity breaking capacity for which the prescribed conditions according to a specified test sequence include the capability of the circuit-breaker to carry 0,85 times its non-tripping current for the conventional time		P
3.5.6	breaking current current in a pole of a circuit-breaker at the instant of initiation of the arc during a breaking operation		P
3.5.7	applied voltage voltage which exists across the terminals of a pole of a circuit-breaker just before the making of the current Note 1 to entry: This definition refers to a single-pole device. For a multipole device the		P

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Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	applied voltage is the voltage across the supply terminals of the device.		P
3.5.8	recovery voltage voltage which appears across the terminals of a pole of a circuit-breaker after the breaking of the current Note 1 to entry: This voltage may be considered in two successive intervals of time, one during which a transient voltage exists, followed by a second one during which the power-frequency or the steady-state recovery voltage alone exists. Note 2 to entry: This definition refers to a single-pole device. For a multipole device the recovery voltage is the voltage across the supply terminals of the device. [SOURCE: IEC 60050-441 :1 984, 441 -1 7-25, modified –Note 2 to entry has been added.]		P
3.5.8.1	transient recovery voltage recovery voltage during the time in which it has a significant transient character Note 1 to entry: The transient voltage may be oscillatory or non-oscillatory or a combination of these, depending on the characteristics of the circuit and of the circuit-breaker. It includes the voltage shift of the neutral of a polyphase circuit. [SOURCE: IEC 60050-441 :1 984, 441 -1 7-26, modified –Note 2 has been deleted.]		P
3.5.8.2	power-frequency recovery voltage recovery voltage after the transient voltage phenomena have subsided [SOURCE: IEC 60050-441 :1 984, 441 -1 7-27]		P
3.5.9	opening time time measured from the instant at which, the circuit-breaker being in the closed position, the current in the main circuit reaches the operating value of the overcurrent release to the instant when the arcing contacts have separated in all poles Note 1 to entry: The opening time is commonly referred to as tripping time, although, strictly speaking, tripping time applies to the time between the instant of initiation of the opening time and the instant at which the opening command becomes irreversible.		P
3.5.10	arcing time		P

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Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
3.5.10.1	arcing time of a pole interval of time between the instant of initiation of the arc in a pole and the instant of final arc extinction in that pole [SOURCE: IEC 60050-441 :1 984, 441 -1 7-37, modified – “or a fuse” and "or that fuse" have been deleted.]		P
3.5.10.2	arcing time of a multipole circuit-breaker interval of time between the instant of first initiation of an arc and the instant of final extinction in all poles [SOURCE: IEC 60050-441 :1 984, 441 -1 7-38]		P
3.5.11	break time interval of time between the beginning of the opening time of a circuit-breaker and the end of the arcing time		P
3.5.12	I 2 t Joule integral integral of the square of the current over a given time interval $I^2t = \int_{t_0}^{t_1} i^2 \, dt$		P
3.5.13	I 2 t characteristic of a circuit-breaker curve giving the maximum values of I 2 t as a function of the prospective current under stated conditions of operation		P
3.5.14	co-ordination between overcurrent protective devices in series		P
3.5.14.1	overcurrent protective co-ordination of overcurrent protective devices co-ordination of two or more overcurrent protective devices in series to ensure overcurrent selectivity) and/or back-up protection [SOURCE: IEC 60947-1 :2007, 2.5.22]		P
3.5.14.2	overcurrent selectivity co-ordination of the operating characteristics of two or more overcurrent protective devices in series such that, on the incidence of overcurrents within stated limits, the device intended to operate within these limits does so, while the other(s) does (do) not [SOURCE: IEC 60947-2:2006/AMD2:201 3, 2.17.1]		P
3.5.14.3	back-up protection overcurrent co-ordination of two overcurrent protective devices in series, where the protective device, generally but not necessarily on the supply side, effects the overcurrent protection		P

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Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	with or without the assistance of the other protective device and prevents excessive stress on the latter [SOURCE: IEC 60947-1 :2007, 2.5.24]		P
3.5.14.4	total selectivity overcurrent selectivity where, in the presence of two overcurrent protective devices in series, the protective device on the load side effects the protection without causing the other protective device to operate [SOURCE: IEC 60947-2:2006, 2.1 7.2]		P
3.5.14.5	partial selectivity overcurrent selectivity where, in the presence of two overcurrent protective devices in series, the protective device on the load side effects the protection up to a given level of overcurrent, without causing the other protective device to operate [SOURCE: IEC 60947-2:2006, 2.1 7.3]		P
3.5.14.6	selectivity limit current I s current co-ordinate of the intersection between the total time-current characteristic of the protective device on the load side and the pre-arcing (for fuses), or tripping (for circuit-breakers) time-current characteristic of the other protective device Note 1 to entry: The selectivity limit current (see Figure D.1) is a limiting value of current – below which, in the presence of two overcurrent protective devices in series, the protective device on the load side completes its breaking operation in time to prevent the other protective device from starting its operation (i.e. selectivity is ensured); – above which, in the presence of two overcurrent protective devices in series, the protective device on the load side may not complete its breaking operation in time to prevent the other protective device from starting its operation (i.e. selectivity is not ensured) [SOURCE: IEC 60947-2:2006, 2.1 7.4]		P
3.5.14.7	take-over current I B current co-ordinate of the intersection between the time-current characteristics of two overcurrent protective devices Note 1 to entry: The take-over current is the		P

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Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	current co-ordinate of the intersection between the maximum break- time / current characteristics of two overcurrent protective devices in series. [SOURCE: IEC 60050-441 :1 984, 441 -1 7-1 6]		P
3.5.14.8	conditional short-circuit current (of a circuit or a switching device) prospective current that a circuit or a switching device, protected by a specified short-circuit protective device, can satisfactorily withstand for the total operating time of that device under specified conditions of use and behaviour Note 1 to entry: For the purpose of this standard, the short-circuit protective device is generally a circuit-breaker or a fuse. Note 2 to entry: This definition differs from IEC 60050-441 :1 984, 441 -1 7-20 by broadening the concept of current limiting device into a short-circuit protective device, the function of which is not only to limit the current. [SOURCE: IEC 60947-1 :2007, 2.5.29]		P
3.5.14.9	rated conditional short-circuit current I nc value of prospective current, stated by the manufacturer, which the equipment, protected by a short-circuit protective device specified by the manufacturer, can withstand satisfactorily for the operating time of this device under the test conditions in the relevant product standard [SOURCE: IEC 60947-1 :2007, 4.3.6.4]		P
3.5.15	conventional non-tripping current I nt specifed value of current which the circuit-breaker is capable of carrying for a specifed time designated as conventional time, without tripping [SOURCE: IEC 60050-442:1998, 442-05-54]		P
3.5.16	conventional tripping current I t specified value of current which causes the circuit-breaker to trip within a specified time (conventional time) [SOURCE: IEC 60050-441:1984, 442-05-55, modifed]		P
3.5.17	instantaneous tripping current minimum value of current causing the circuit-breaker to operate automatically without		P

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Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	intentional time-delay		P
3.6	**Definitions related to insulation co-ordination**		P
3.6.1	insulation coordination mutual correlation of insulation characteristics of electrical equipment taking into account the expected micro-environment and the influencing stresses [SOURCE: IEC 60664-1 :2007, 1 .3.1]		P
3.6.2	working voltage highest r.m.s. value of the a.c. or d.c. voltage across any particular insulation which can occur when the equipment is supplied at rated voltage Note 1 to entry: Transients are disregarded. Note 2 to entry: Both open-circuit conditions and normal operating conditions are taken into account. [SOURCE: IEC 60664-1 :2007, 3.5]		P
3.6.3	overvoltage any voltage having a peak value exceeding the corresponding peak value of maximum steady-state voltage at normal operating conditions [SOURCE: IEC 60664-1 :2007, 3.7]		P
3.6.4	impulse withstand voltage highest peak value of impulse voltage of prescribed form and polarity, which does not cause breakdown of the insulation under specific conditions [SOURCE: IEC 60664-1 :2007, 3.8.1]		P
3.6.5	overvoltage category numeral defining a transient overvoltage condition [SOURCE: IEC 60664-1 :2007, .3.1 0, modified – The notes have been deleted.]		P
3.6.6	macro-environment environment of the room or other location, in which the equipment is installed or used [SOURCE: IEC 60664-1 :2007, 3.1 2.1]		P
3.6.7	micro-environment immediate environment of the insulation which particularly influences the dimensioning of the creepage distances [SOURCE: IEC 60664-1 :2007, 3.1 2.2]		P
3.6.8	pollution any addition of foreign matter, solid, liquid or gaseous that can result in a reduction of electric strength or surface resistivity of the insulation [SOURCE: IEC 60664-1 :2007, 3.1 1]		P

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Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
3.6.9	pollution degree numeral characterising the expected pollution of the micro-environment Note 1 to entry: The pollution degree to which equipment is exposed may be different from that of the macro- environment where the equipment is located because of protection offered by means such as an enclosure or internal heating to prevent absorption or condensation of moisture. [SOURCE: IEC 60664-1 :2007, 3.1 3, modified – Note 1 to entry has been added.]		P
3.6.10	isolation isolating function function intended to cut off the supply from all or a discrete section of the installation by separating the installation from every source of electrical energy for reasons of safety [SOURCE: IEC 60947- 1 :2007, 2.1 .1 9,]		P
3.6.11	isolating distance <of a pole of a mechanical switching device> clearance between open contacts, meeting the safety requirements specified for isolation purposes [SOURCE: IEC 60050-441 :1 984, 441 -1 7-35 , modified		P
3.6.12	clearance shortest distance in air between two conductive parts along a string stretched the shortest way between these conductive parts (see Annex B) Note 1 to entry: For the purpose of determining a clearance to accessible parts, the accessible surface of an insulating enclosure is considered conductive as if it was covered by a metal foil wherever it can be touched by a hand or a standard test finger according to Figure 8. [SOURCE: IEC 60050-441 :1 984, 441 -1 7-31 , modified – Note 1 to entry has been added.]		P
3.6.13	creepage distance shortest distance along the surface of an insulating material between two conductive parts Note 1 to entry: See Annex B. Note 2 to entry: For the purpose of determining a creepage distance to accessible parts, the accessible surface of an insulating enclosure is considered conductive		P

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Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	as if it was covered by a metal foil wherever it can be touched by a hand or a standard test finger according to Figure 8. [SOURCE: IEC 60050-1 51 :1 984, 1 51 -1 5-50 modified – Notes 1 and 2 to entry have been added.]		P
4	**Classification**		P
4.1	**General**		P
	Circuit-breakers are classified according to several criteria.		P
4.2	**According to the number of poles:**		P
	– single-pole circuit-breakers; – two-pole-circuit-breakers with one protected pole; – two-pole circuit-breakers with two protected poles; – three-pole circuit-breakers with three protected poles; – four-pole circuit-breakers with three protected poles; – four-pole circuit-breakers with four protected poles. NOTE The pole which is not a protected pole can be – "unprotected" (see 3.2.7.2), or – "switched neutral" (see 3.2.7.3).		P
4.3	**According to the protection against external influences:**		P
	– enclosed-type (not requiring an appropriate enclosure); – unenclosed-type (for use with an appropriate enclosure).		P
4.4	**According to the method of mounting:**		P
	– surface-type; – flush-type; – panel board type, also referred to as distribution board type. NOTE These types may be intended to be rail mounted.		P
4.5	**According to the methods of connection**		P
4.5.1	**According to the fixation system:**		P
	– circuit-breakers, the electrical connections of which are not associated with the mecha-nical mounting; – circuit-breakers, the electrical connections of which are associated with the mechanical		P

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Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	mounting. NOTE Examples of this type are: – plug-in type; – bolt-on type; – screw-in type. Some circuit-breakers can be of the plug-in type or bolt-on type on the line side only, the load terminals being usually suitable for wiring connection.		P
4.5.2	**According to the type of terminals:**		P
	– circuit-breakers with screw-type terminals for external copper conductors; – circuit-breakers with screwless type terminals for external copper conductors; NOTE 1 The requirements for circuit-breakers equipped with this type of terminals are given in Annex J. – circuit-breakers with flat quick-connect terminals for external copper conductors; NOTE 2 The requirements for circuit-breakers equipped with this type of terminals are given in Annex K. – circuit-breakers with screw-type terminals for external aluminium conductors; NOTE 3 The requirements for circuit-breakers with this type of terminal are given in Annex L .		P
4.6	**According to the instantaneous tripping current (see 3.5.1 7)**		P
	– B-type; – C-type; – D-type. NOTE The selection of a particular type can depend on the installation rules.		P
4.7	**According to the I 2 t characteristic**		P
	Circuit-breakers of B-type and C-type, having rated current up to and including 63 A and having short-circuit breaking capacity of 3 000 A, 4 500 A, 6 000 A and 10 000 A, are classified according to the limits within which their I2t characteristics lie, measured according to 9.12.6 (see Annex ZA).		P
5	**Characteristics of circuit-breakers**		P
5.1	**List of characteristics**		P
	The characteristics of a circuit-breaker shall be stated in the following terms: – number of poles (see 4.2); – protection against external influences (see 4.3);		P

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Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	- method of mounting (see 4.4); - method of connection (see 4.5); - value of rated operational voltage (see 5.3.1); - value of rated current (see 5.3.2); - value of rated frequency (see 5.3.3); - range of instantaneous tripping current (see 4.5 and 5.3.5); - value of rated short-circuit capacity (see 5.3.4); - I 2 t characteristic (see 3.5.1 3); - I 2 t classification (see 4.6).		P
5.2	**Rated quantities**		P
5.2.1	**Rated voltages**		P
5.2.1.1	**Rated operational voltage (U e)**		P
	The rated operational voltage (hereinafter referred to as rated voltage) of a circuit-breaker is the value of voltage, assigned by the manufacturer, to which its performance (particularly the short-circuit performance) is referred. NOTE The same circuit-breaker can be assigned a number of rated voltages and associated rated short-circuit capacities.		P
5.2.1.2	**Rated insulation voltage (U i)**		P
	The rated insulation voltage of a circuit-breaker is the value of voltage, assigned by the manufacturer, to which dielectric test voltages and creepage distances are referred. Unless otherwise stated, the rated insulation voltage is the value of the maximum rated voltage of the circuit-breaker. In no case shall the maximum rated voltage exceed the rated insulation voltage.		P
5.2.1.3	**Rated impulse withstand voltage (U imp)**		P
	The rated impulse withstand voltage (U imp) of a circuit-breaker is the value of voltage, assigned by the manufacturer, to which impulse test voltages and clearances are referred. The rated impulse withstand voltage of a circuit-breaker shall be equal to or higher than the standard value of rated impulse withstand voltage given in 5.3.6. NOTE For dimensioning of clearances, for rated impulse withstand voltages higher than the standard value of rated impulse withstand voltage given in 5.3.6, see EN 60664 series.		P

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Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
5.2.2	**Rated current (I n)**		P
	A current assigned by the manufacturer as the current which the circuit-breaker is designed to carry in uninterrupted duty (see 3.2.1 4), at a specified reference ambient air temperature. The standard reference ambient air temperature is 30 °C. If a different reference ambient air temperature for the circuit-breaker is used, the effect on the overload protection of cables shall be taken into account, since this is also based on a reference ambient air temperature of 30 °C according to installation rules. Text deleted		P
5.2.3	**Rated frequency**		P
	The rated frequency of a circuit-breaker is the power frequency for which the circuit-breaker is designed and to which the values of the other characteristics correspond. The same circuit-breaker may be assigned a number of rated frequencies.		P
5.2.4	**Rated short-circuit capacity (I cn)**		P
	The rated short-circuit capacity of a circuit-breaker is the value of the ultimate short-circuit breaking capacity (see 3.5.5.1) assigned to that circuit-breaker by the manufacturer. NOTE A circuit-breaker having a given rated short-circuit capacity has a corresponding service short-circuit capacity (I cs) (see Table 1 8).		P
5.2.5	**Rated making and breaking capacity of an individual pole (I cn1)**		P
	The value of the limiting short-circuit making and breaking capacity on each individual protected pole of multipole circuit breakers. NOTE The corresponding rated quantity of RCBOs is the rated residual making and breaking capacity I Δm (see 5.2.7 of IEC 61 009-1 :201 0). The standard values are those given in 5.3.4.1 .		P
5.3	**Standard and preferred values**		P
5.3.1	**Standard values of rated voltage**		P
	Standard values of rated voltage are given in Table 1 .		P

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Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	Table 1 — Standard values of rated voltage Circuit-breakers / Circuit supplying the circuit-breaker / Rated voltage of circuit-breakers for use in systems 230 V, 230/400 V, 400 V Single pole / Single phase (phase to neutral or phase to phase) / 230 V Three-phase 4-wire / 230 V Single phase (phase to neutral) or three-phase, using 3 singlepole circuit-breakers (3-wire or 4-wire) / 230/400 V Two-pole / Single phase (phase to neutral or phase to phase) / 230 V Single phase (phase to phase) / 400 V Three phase (4-wire) / 230 V Three-pole / Three phase (3-wire or 4-wire) / 400 V Four-pole / Three phase (4-wire) / 400 V NOTE Wherever in this standard there is a reference to 230 V or 400 V, they may be read as 220 V or 240 V, 380 V or 415 V, respectively. Two-pole circuit-breakers rated 230 V may have one or two protected poles. Two-pole circuit-breakers rated 400 V shall have two protected poles. Three-pole circuit-breakers shall have three protected poles. Four-pole circuit-breakers may have three or four protected poles.		P
5.3.2	**Preferred values of rated current**		P
	Preferred values of rated current are: 6 A, 8 A, 1 0 A, 1 3 A, 1 6 A, 20 A, 25 A, 32 A, 40 A, 50 A, 63 A, 80 A, 1 00 A and 1 25 A.		P
5.3.3	**Standard values of rated frequency**		P
	Standard values of rated frequency are 50 Hz and 60 Hz.		P
5.3.4	**Values of rated short-circuit capacity**		P
5.3.4.1	**Standard values up to and including 1 0 000 A**		P
	Standard values of rated short-circuit capacities up to and including 1 0 000 A are: 1 500 A , 3 000 A, 4 500 A, 6 000 A, 1 0 000 A. (*) Only for circuit-breakers incorporated or associated with and in the immediate vicinity of socket-outlets or switches for household and similar applications.The corresponding power factor ranges are given in 9.1 2.5.		P
5.3.4.2	**Standard values above 10 000 A up to and including 25 000 A**		P
	For values above 1 0 000 A up to and including 25 000 A the standard values are:1 5 000 A, 20 000 A and 25 000 A.The corresponding power factor range is given in 9.1 2.5.		P

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Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
5.3.5	**Standard ranges of instantaneous tripping**		P
	Standard ranges of instantaneous tripping are given in Table 2. **Table 2 – Ranges of instantaneous tripping** Type: B — Range: Above 3 I_n up to and including 5 I_n Type: C — Range: Above 5 I_n up to and including 10 I_n Type: D — Range: Above 10 I_n up to and including 20 I_n [C) Text deleted (C]		P
5.3.6	**Standard value of rated impulse withstand voltage (U imp)**		P
	The standard value of the rated impulse withstand voltage (U imp) is 4 kV. Table 3 (void) Text deleted		P
6	**Marking and other product information**		P
6.1	**Standard marking**		P
	Each circuit-breaker shall be marked in a durable manner with the following: a) manufacturer's name or trade mark; b) type designation, catalogue number or serial number; c) rated voltage(s); d) rated current without symbol "A", preceded by the symbol of instantaneous tripping (B, C or D), for example B 1 6; e) rated frequency if the circuit-breaker is designed only for one frequency (see 5.3.3); f) rated short-circuit capacity, in A, within a rectangle, without symbol "A"; g) wiring diagram, unless the correct mode of connection is evident; h) reference calibration temperature, if diferent from 30 °C; i) degree of protection (only if diferent from IP20); j) void; k) void; l) making and breaking capacity on an individual protected pole of multipole circuit-breakers (I cn1), if diferent from I cn ; m) energy limiting class in a square in accordance with Annex ZA, if applied. I cn and the energy limiting class, when applied, shall be both on the device and combined.Marking d) shall be readily visible when the circuit-breaker is installed. If, for small devices,		P

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Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	the available space is insufcient, markings a), b), c), f), g), l) and m) may be put on the side or on the back of the circuit-breaker. Marking g) alternatively may be on the inside of any cover which has to be removed in order to connect the supply wires but shall not be on a label loosely attached to the circuit-breaker. Any other information not marked shall be given in the manufacturer's documentation. The suitability for isolation, which is provided by all circuit-breakers of this standard, may be indicated by the symbol (IEC 6041 7-61 69-1) on the device. When affixed, this marking may be included in a wiring diagram, where it may be combined with symbols of other functions, e.g. overload protection, or other symbols of IEC 6041 7. When the symbol is used on its own (i.e. not in a wiring diagram), combination with symbols of other functions is not allowed. Irrespective of type (B, C or D), the manufacturer shall publish in his literature the I 2 t characteristic (see 3.5.1 3). The manufacturer may indicate the I 2 t classifcation (see 4.7) and mark the circuit-breakers accordingly. For circuit-breakers other than those operated by means of push-buttons the open position shall be indicated by the symbol O (a circle) IEC 6041 7-5008 and the closed position by the symbol I (a short vertical straight line) IEC 6041 7-5007. Additional national symbols for this indication are allowed. Provisionally the use of this national indication alone is allowed. These indications shall be readily visible when the circuit-breaker is installed. For circuit-breakers operated by means of two push-buttons, only the push-button designed for the opening operation shall be red and/or be marked with the symbol O (IEC 6041 7-5008). Red shall not be used for any other push-button of the circuit-breaker. If a push-button is used for closing the contacts		P

Clause	Requirement-Test	Result-Remark	Verdict
	and is clearly identifed as such, its depressed position is sufcient to indicate the closed position. If a single push-button is used for closing and opening the contacts and is identifed as such, the button remaining in its depressed position is sufcient to indicate the closed position. On the other hand, if the button does not remain depressed, an additional means indicating the position of the contacts shall be provided. For circuit-breakers with multiple current ratings, the maximum value shall be marked in accordancewith marking d), and in addition the value for which the circuit-breaker is adjusted shall be indicated without ambiguity.If it is necessary to distinguish between the supply and the load terminals, the former shall be indicated by arrows pointing towards the circuit-breaker and the latter by arrows pointing away from the circuit-breaker. Terminals intended exclusively for the neutral shall be indicated by the letter N.Terminals intended for the protective conductor, if any, shall be indicated by the symbol (IEC 60417-5019).NOTE The symbol , (IEC 6041 7-501 7),previously recommended, will be progressively superseded by the preferred symbol IEC 6041 7-501 9 given above. For rail mounting circuit-breakers, appropriate rail(s) shall be indicated in manufacturer's documenta-tion. Marking shall be indelible and easily legible, and shall not be placed on screws, washers or other re-movable parts.Compliance is checked by inspection and by the test of 9.3.		P
6.2	**Additional marking**		P
	Additional marking to other standards (EN or IEC or other) is allowed under the following conditions: — the circuit-breaker shall comply with all the requirements of the additional standard; — the relevant standard to which the additional marking refers shall be indicated adjacent to this marking and shall be clearly diferentiated or separated from the standard marking according to 6.1.Compliance is checked by inspection and by carrying out all the test sequences required by the relevant standard. Equivalent or less severe test sequences need not be repeated.		P
6.3	**Guidance table for marking**		P

EN 60898-1&EN 60898-2			
Clause	**Requirement-Test**	**Result-Remark**	**Verdict**

P

Marking and other product information Each MCB shall be marked in a durable manner with all or, for small apparatus, part of the following data:		**Markings may be on the MCB itself**			**Product information in catalogue**
		If, for small devices the space available does not allow all the above data to be marked, at least this information shall be marked and **visible** when the device is installed	This information may be marked on the **side** or on the back of the device and be visible only before the device is installed.	Alternatively the information may be on the inside of any **cover** which has to be removed in order to connect the supply wires.	Any remaining information not marked shall be given in the manufacturer's **catalogues**.
a)	manufacturer's name o trademark		X		
b)	type designation, catalogue number or serial number		X		
c)	rated voltage, with the symbol ~		X		
d)	rated current without symbol "A" preceded by the symbol of overcurrent instantaneous tripping (B, C or D), for example B 16	X			
e)	rated frequency if the circuit-breaker is designed only for one frequency (see 5.3.3)				X
f)	rated short-circuit capacity in a rectangle, in amperes, without symbol "A"		X(*)		
g)	wiring diagram, unless the correct mode of connection is evident		X	X	
h)	reference calibration temperature, if different from 30 °C				X
i)	the degree of protection (only if different from IP20)				X
j)	void				
k)	void				

Clause	Requirement-Test	Result-Remark	Verdict
			P

l)	breaking capacity on one pole of multipole MCBs in case of shortcircuit to earth I_{cn1}		X		
m)	energy limiting class (e.g. 3) in a square in accordance with Annex ZA, as applicable		X(*)		X(**)
	the position of use (symbol according to EN 60051), if necessary;		X		
	indication of the terminal for the neutral with "N"		X		
	additional marking of performance to other standards		X		

(*) I_{cn} and the energy limiting class, as applicable, shall be both on the device and combined together.
(**) The manufacturer shall publish in his literature the I^2t characteristic.

7	**Standard conditions for operation in service and for installation**		P
7.1	**Standard conditions**		P
			P

Circuit-breakers complying with this standard shall be capable of operating under the standard conditions shown in Table Z.1.

Table Z.1 – Standard conditions for operation in service

Influencing quantity	Standard range of application	Reference value	Test tolerances[f]
Ambient temperature [a g]	–5 °C to +40 °C [b]	see 9.2	
Altitude	Not exceeding 2 000 m		
Relative humidity maximum value 40 °C	50 % [c]		
External magnetic field	Not exceeding 5 times the earth's magnetic field in any direction	Earth's magnetic field	[d]
Position	As stated by the manufacturer, with a tolerance of 2° in any direction [e]	As stated by the manufacturer	2° in any direction
Frequency	Reference value ± 5 % [f]	Rated value	± 5 %
Sinusoidal wave distortion	Not exceeding 5 %	Zero	Zero

[a] The maximum value of the mean daily temperature is +35 °C.
[b] Values outside the range are admissible where more severe climatic conditions prevail, subject to agreement between manufacturer and user.
[c] Higher relative humidities are admitted at lower temperature (for example 90 % at 20 °C).
[d] When a circuit-breaker is installed in proximity of a strong magnetic field, supplementary requirements may be necessary.
[e] The device shall be fixed without causing deformation liable to impair its functions.
[f] The tolerances given apply unless otherwise specified in the relevant test.
[g] Extreme limits of –20 °C and +60 °C are admissible during storage and transportation, and should be taken into account in the design of the device.

7.2	**Conditions of installation**		P
	Circuit-breakers shall be installed in accordance with the manufacturer's instructions.		P
8	**Requirements for construction and operation**		P
8.1	**Mechanical design**		P
8.1.1	**General**		P

EN 60898-1&EN 60898-2			
Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	Circuit-breakers shall be so designed and constructed that, in normal use, their performance is reliable and without danger to the user or surroundings. In general, compliance is checked by carrying out all the relevant tests specified.		P
8.1.2	**Mechanism**		P
	The moving contacts of all poles of multipole circuit-breakers shall be so mechanically coupled that all poles, except the switched neutral, if any, make and break substantially together, whether operated manually or automatically, even if an overload occurs on one protected pole only.The switched neutral pole (see 3.2.7.3) of four-pole circuit-breakers shall not close after and shall not open before the protected poles. Compliance is checked by inspection and by manual test, using any appropriate means (e.g. indicator lights, oscilloscope, etc.). If a pole having an appropriate short-circuit making and breaking capacity is used as a neutral pole and the circuit-breaker has an independent manual operation (see 3.4.4), then all poles, including the neutral pole, may operate substantially together. Circuit-breakers shall have a trip-free mechanism. Compliance with the above requirements is checked by inspection, by manual test and, for the trip-free function, by the test of 9.10.3. It shall be possible to switch the circuit-breaker on and off by hand. For plug-in type circuit- breakers, this requirement is not considered met by the fact that the circuit-breaker can be removed from its base. Circuit-breakers shall be so constructed that the moving contacts can come to rest only in the closed position (see 3.2.8) or in the open position (see 3.2.9), even when the operating means is released in an intermediate position. Circuit-breakers shall provide in the open position (see 3.2.9) an isolation distance in accordance with the requirements necessary to satisfy the isolating function (see 8.3). Indication of the open and closed position of the main contacts shall be provided by one or both of the following means: – the position of the actuator (this being preferred), or – a separate mechanical indicator.		P

EN 60898-1&EN 60898-2			
Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	If a separate mechanical indicator is used to indicate the position of the main contacts, this shall show the colour red for the closed position (ON) and the colour green for the open position (OFF). The means of indication of the contact position shall be reliable. Compliance is checked by inspection and by the tests of 9.10.3. Circuit-breakers 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. Where the operating means is used to indicate the position of the contacts, the operating means, when released, shall automatically take up the position corresponding to that of the moving contact(s); in this case, the operating means shall have two distinct rest positions corresponding to the position of the contacts but, for automatic opening, a third distinct position of the operating means may be provided. The action of the mechanism shall not be influenced by the position of enclosures or covers and shall be independent of any removable part. A cover sealed in position by the manufacturer is considered to be a non-removable part. If the cover is used as a guiding means for push-buttons, it shall not be possible to remove the buttons from the outside of the circuit-breaker. Operating means shall be securely fixed on their shafts and it shall not be possible to remove them without the aid of a tool. Operating means directly fixed to covers are allowed. If the operating means has an "up-down" movement, when the circuit-breaker is mounted as in normal use, the contacts shall be closed by the up movement. Text deleted Compliance is checked by inspection and by manual test. 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. NOTE Locking of the operating means in the closed position is possible for particular		P

EN 60898-1&EN 60898-2

Clause	Requirement-Test	Result-Remark	Verdict
	applications. Compliance is checked by inspection, taking into account the instructions of the manufacturer.		P
8.1.3	**Clearances and creepage distances**		P
8.1.3.1	**General**		P

The minimum required clearances and creepage distances are given in Table 4 that is based on the circuit-breaker being designed for operating in an environment with pollution degree 2.

The insulating materials are classified into material groups on the basis of their comparative
tracking index (CTI) according to EN 60664-1 .

NOTE 1 The comparative tracking index (CTI) is declared by the manufacturer on the basis of tests carried out on the
insulating material.

NOTE 2 Information on the requirements for design of solid insulation is provided in EN 60664-1 .

Table 4 — Minimum clearances and creepage distances

	Minimum clearances mm	Minimum creepage distances[a, f]											
		Group IIIa[h] (175 V ≤ CTI < 400 V)[d]				Group II (400 V ≤ CTI < 600 V)[d]				Group I (600 V ≤ CTI)[d]			
	Rated voltage V	Working voltage[e] V											
	U_{imp}												
	4 kV												
Item/Description	230/400 230 400	> 25 ≤ 50[i]	120	250	400	> 25 ≤ 50[i]	120	250	400	> 25 ≤ 50[i]	120	250	400
1. between live parts which are separated when the main contacts are in the open position[a,j]	4,0	1,2	2,0	4,0	4,0	0,9	2,0	4,0	4,0	0,6	2,0	4,0	4,0
2. between live parts of different polarity[a,j,k]	3,0	1,2	1,5	3,0	4,0	0,9	1,5	3,0	3,0	0,6	1,5	3,0	3,0
3. between circuits supplied from different sources, one of which being PELV or SELV[g]	8,0		3,0	6,0	8,0		3,0	6,0	8,0		3,0	6,0	8,0
		Rated voltage V											
		230 / 400				230 / 400				230 / 400			
4. between live parts and – accessible surfaces of operating means – screws or other means for fixing covers which have to be removed when mounting the circuit-breaker – surface on which the circuit-breaker is mounted[b] – screws or other means for fixing the circuit-breaker[b] – metal covers or boxes[b] – other accessible metal parts[c] – metal frames supporting flushtype circuit-breakers	**3,0**	**4,0**				**3,0**				**3,0**			

NOTE 1 The values given for 400 V are also valid for 440 V.

NOTE 2 The parts of the neutral path, if any, are considered to be live parts.

[a] For auxiliary and control contacts the values are given in the relevant standard.

[b] The values are doubled if clearances and creepage distances between live parts of the device and the metallic screen or the surface on which the circuit-breaker is mounted are not dependent on the design of the circuit-breaker only, so that they can be reduced when the circuit-breaker is mounted in the most unfavourable condition.

[c] Including a metal foil in contact with the surfaces of insulating material which are accessible after installation for normal use. The foil is pushed into corners, grooves, etc., by means of a straight unjointed test finger according to 9.6 (see Figure 8).

[d] See EN 60112.

[e] Interpolation is allowed in determining creepage distances corresponding to voltage values intermediate to those listed as working voltage. When interpolating, linear interpolation shall be used and values shall be rounded to the same number of digits as the values picked up from the tables. For determination of creepage distances, see Annex B.

[f] Creepage distances cannot be less than the associated clearances.

[g] To cover all different voltages including ELV in an auxiliary contact.

[h] For material group IIIb (100 V ≤ CTI < 175 V) the values for material group IIIa multiplied by 1,6 apply.

[i] For working voltages up to and including 25 V reference may be made to EN 60664-1.

[j] The clearance distances between the metal parts within the arc chamber may be less than 1 mm, provided that the sum of distances is greater than prescribed in item 1 of Table 4.

[k] This applies also to clearance and creepage distances between live parts of different polarity of circuit-breakers mounted close to one another.

Clause	Requirement-Test	Result-Remark	Verdict
8.1.3.2	**Clearances**		P
	Compliance for item 1 in Table 4 is checked by measurement and by the tests of 9.7.5.4. Compliance for item 2 and 4 in Table 4 is checked by measurement or by the tests of 9.7.5.2. The clearances of items 2 and 4 (except accessible surface after installation, see Note) may be reduced provided that the measured clearances are not shorter than the minimum allowed in IEC 60664-1 for homogenous feld conditions. In this case, compliance for items 2 and 4 is always checked by the test of 9.7.5.2. NOTE Accessible surface after installation means any surface accessible by the user when the circuit-breaker is installed according to the manufacturer's instructions. The test fnger can be applied to determine whether a surface is accessible or not. Compliance for item 3 in Table 4 is checked by measurement.		P
8.1.3.3	**Creepage distances**		P
	Compliance for item 1, 2, 3 and 4 is checked by measurementNOTE All measurements required in 8.1 .3 are carried out in Test sequence A on one sample.Tests according to 9.7.2 to 9.7.5 are carried out in Test sequence B on three samples.		P
8.1.3.4	**Solid insulation**		P
	Compliance is checked by the tests according to 9.7.2, 9.7.3, 9.7.4 and 9.7.5 as applicable.		P
8.1.4	**Screws, current-carrying parts and connections**		P
8.1.4.1	Connections, whether electrical or mechanical, shall withstand the mechanical stresses occurring in normal use. Screws operated when mounting the circuit-breaker during installation shall not be of the thread-cutting type. NOTE 1 Screws (or nuts) which are operated when mounting the circuit-breaker include screws for fixing covers or cover-plates, but not connecting means for screwed conduits and for fixing the base of a circuit-breaker. Compliance is checked by inspection and by the test of 9.4. NOTE 2 Screwed connections are considered as checked by the tests of 9.8, 9.9, 9.1 2, 9.1 3 and 9.1 4.		P

EN 60898-1&EN 60898-2			
Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
8.1.4.2	For screws in engagement with a thread of insulating material and which are operated when mounting the circuit-breaker during installation, correct introduction of the screw into the screw hole or nut shall be ensured. Compliance is checked by inspection and by manual test. The requirement with regard to correct introduction is met, if introduction of the screw in a slanting manner is prevented, for example by guiding the screw by the part to be fixed by a recess in the female thread, or by the use of a screw with the leading thread removed.		P
8.1.4.3	Electrical connections shall be so designed that contact pressure is not transmitted through insulating material other than ceramic, pure mica or other material with characteristics no less suitable, unless there is sufficient resilience in the metallic parts to compensate for any possible shrinkage or yielding of the insulating material. Compliance is checked by inspection. NOTE The suitability of the material is considered in respect of the stability of the dimensions.		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.EXAMPLE Examples of suitable materials are given below: – copper; – an alloy containing at least 58 % copper for parts worked cold, or at least 50 % copper for other parts; – other metal or suitably coated metal, no less resistant to corrosion than copper and having mechanical properties no less suitable. 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 9.1 6). The requirements of this subclause do not apply to contacts, magnetic circuits, heater elements, bimetals, shunts, electronic parts, including circuit boards, or to screws, nuts, wash- ers, clamping plates, similar parts of terminals and parts of the test circuit. Compliance is checked by inspection in accordance with manufacturer's declaration.		P
8.1.5	**Terminals for external conductors**		P
8.1.5.1	Terminals for external conductors shall be such that the conductors may be connected so as to ensure that the necessary contact pressure is maintained permanently.		P

EN 60898-1&EN 60898-2			
Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	Connection arrangements intended for busbar connection are admissible, provided they are not used for the connection of cables. Such arrangements may be either of the plug-in or of the bolt-on type. The terminals shall be readily accessible under the intended conditions of use. Compliance is checked by inspection, by the tests of 9.5 for screw-type terminals, by specific tests for plug-in or bolt-on circuit-breakers included in the standard, or by the tests of Annex J or K, as relevant for the type of connection.		P
8.1.5.2	Circuit breakers shall be provided with: – either terminals which shall allow the connection of copper conductors having nominal cross-sectional areas as shown in Table 5; NOTE Examples of possible designs of screw-type terminals are given in Annex F. – 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. Compliance is checked by inspection, by measurement and by fitting, in turn, one conductor of the smallest and one of the largest cross-sectional area as specified. Text deleted **Table 5 – Connectable cross-sections of copper conductors for screw-type terminals** (see table below)		P
8.1.5.3	The means for clamping the conductors in the terminals shall not serve to fix any other component, although they may hold the terminals in place or prevent them from turning. Compliance is checked by inspection and by the tests of 9.5.		P

Rated current [b] A		Range of nominal cross-section to be clamped [a] mm²	
Greater than	Up to and including	Rigid (solid or stranded [c]) 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	25 to 50	25 to 35

[a] 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.

[b] A range of CBs having the same fundamental design and having the same design and construction of terminals, the terminals are fitted with copper conductors of the smallest cross-section for the minimum rated current and largest cross-section for the maximum rated current, as specified, solid and stranded, as applicable.

[c] Rigid stranded conductors shall be used for conductors having cross-sections from 1,5 mm² up to 50 mm² and shall be in compliance with class 2 of IEC 60228:2004, related to stranded conductors for single-core.

EN 60898-1&EN 60898-2			
Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
8.1.5.4	Terminals for rated currents up to and including 32 A shall allow the conductors to be connected without special preparation. Compliance is checked by inspection. NOTE The term "special preparation" covers soldering of the wire of the conductor, use of cable lugs, formation of eyelets, etc., but not the reshaping of the conductor before its introduction into the terminal or the twisting of a flexible conductor to consolidate the end.		P
8.1.5.5	Terminals shall have adequate mechanical strength. Screws and nuts for clamping the conductors shall have a metric ISO thread or a thread comparable in pitch and mechanical strength. Compliance is checked by inspection and by the tests of 9.4 and 9.5.2. NOTE Provisionally, Sl, BA and UN threads can be used as they are virtually equivalent in pitch and mechanical strength to metric ISO threads.		P
8.1.5.6	Terminals shall be so designed that they clamp the conductor without undue damage to the conductor. Compliance is checked by inspection and by the test of 9.5.3.		P
8.1.5.7	Terminals shall be so designed that they clamp the conductor reliably and between metal surfaces. Compliance is checked by inspection and by the tests of 9.4 and 9.5.2.		P
8.1.5.8	Terminals shall be so designed or positioned that neither a rigid solid conductor nor a wire of a stranded conductor can slip out while the clamping screws or nuts are tightened. This requirement does not apply to lug terminals. Compliance is checked by the test of 9.5.4.		P
8.1.5.9	Terminals shall be so fixed or located that, when the clamping screws or nuts are tightened or loosened, the terminals shall not work loose from their fixings to circuit-breakers. NOTE 1 These requirements do not imply that the terminals are so designed that their rotation or displacement is prevented, but any movement is to be sufficiently limited so as to prevent non-compliance with the requirements of this standard. NOTE 2 The use of sealing compound or resin is		P

EN 60898-1&EN 60898-2			
Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	considered to be sufficient for preventing a terminal from working loose, provided that – the sealing compound or resin is not subject to stress during normal use, and – the effectiveness of the sealing compound or resin is not impaired by temperatures attained by the terminal under the most unfavourable conditions specified in this standard. Compliance is checked by inspection, by measurement and by the test of 9.4.		P
8.1.5.10	Clamping screws or nuts of terminals intended for the connection of protective conductors shall be adequately secured against accidental loosening. Compliance is checked by manual test. NOTE In general, the designs of terminals (examples of which are shown in Annex F) can provide sufficient esilience to comply with this requirement; for other designs, special provisions, such as the use of an adequately resilient part which is not likely to be removed inadvertently, can be necessary.		P
8.1.5.11	Pillar terminals shall allow full insertion and reliable clamping of the conductor. Compliance is checked by inspection after a rigid conductor of the largest cross-sectional area specified for the relevant rated current in Table 5 has been fully inserted and fully clamped by applying the torques according to Table 11.		P
8.1.5.12	Screws and nuts of terminals intended for the connection of external conductors shall be in engagement with a metal thread and the screws shall not be of the tapping screw type. Compliance is checked by inspection.		P
8.1.6	Non-interchangeability		P
	For circuit-breakers intended to be mounted on bases forming a unit therewith (plug-in type or screw-in type) it shall not be possible, without the aid of a tool, to replace a circuit-breaker when mounted and wired as for normal use by another of the same make having a higher rated current. Compliance is checked by inspection. NOTE The expression "as for normal use" implies that the circuit-breaker is installed according to the manufacturer's instructions.		P

EN 60898-1&EN 60898-2			
Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
8.1.7	Mechanical mounting of plug-in type circuit-breakers		P
8.1.7.1	**General**		P
	The mechanical mounting of plug-in type circuit-breakers shall be reliable and have adequate stability.		P
8.1.7.2	**Plug-in type circuit-breakers, the holding in position of which does not depend solely on their plug-in connection(s)**		P
	Compliance of the mechanical mounting is checked by the relevant tests of 9.13.		P
8.1.7.3	**Plug-in type circuit-breakers, the holding in position of which depends solely on their plug-in connection(s)**		P
	Compliance of the mechanical mounting is checked by the relevant tests of 9.13.		P
8.2	**Protection against electric shock**		P
	Circuit-breakers shall be so designed that, when they are mounted and wired as for normal use (see note in 8.1 .6), live parts are not accessible.A part is considered to be "accessible" if it can be touched by the test finger (see 9.6). For circuit-breakers other than those of the plug-in type, external parts, other than screws or other means for fixing covers and labels, which are accessible when the circuit-breakers are mounted and wired as for normal use, shall either be of insulating material or be lined throughout with insulating material, unless the live parts are within an internal enclosure of insulating material.Linings shall be fixed in such a way that they are not likely to be lost during installation of the circuit-breakers. They shall have adequate thickness and mechanical strength and shall provide adequate protection at places where sharp edges occur.Inlet openings for cables or conduits shall either be of insulating material or be provided with bushings or similar devices of insulating material.Such devices shall be reliably fixed and shall have adequate mechanical strength. For plug-in circuit-breakers, external parts other than screws or other means for fixing covers, which are accessible in normal conditions of use, shall be of insulating material.		P

EN 60898-1&EN 60898-2			
Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	Metallic operating means shall be insulated from live parts and their exposed conductive parts shall be covered by insulating material. This requirement does not apply to means for coupling insulated operating means of several poles. It shall be possible to replace plug-in circuit-breakers easily without touching live parts. Lacquer or enamel are not considered to provide adequate insulation for the purpose of this subclause. Compliance is checked by inspection and by the test of 9.6.		P
8.3	**Dielectric properties and isolating capability**		P
8.3.1	**General**		P
	Circuit-breakers shall have adequate dielectric properties and shall ensure isolation.		P
8.3.2	**Dielectric strength at power frequency**		P
	Circuit-breakers shall have adequate dielectric properties at power frequency. Compliance is checked by the tests of 9.7.1, 9.7.2 and 9.7.3 on the circuit-breaker in new condition. Moreover, after the endurance tests of 9.11 and after the short-circuit tests of 9.12, the circuit-breakers shall withstand the test of 9.7.3 but at the reduced test voltage specified in 9.11.3 and 9.12.12.2 respectively and without the previous humidity treatment of 9.7.1.		P
8.3.3	**Isolating capability**		P
	Circuit-breakers shall be suitable for isolation. Compliance is checked by the verification of compliance with the minimum clearances and creepage distances of item 1 of Table 4 and by the tests of 9.7.5.1 and 9.7.5.3.		P
8.3.4	**Dielectric strength at rated impulse withstand voltage (U imp)**		P
	Circuit-breakers shall adequately withstand impulse voltages. Compliance is checked by the tests of 9.7.5.2.		P
8.4	**Temperature-rise**		P
8.4.1	**Temperature-rise limits**		P

<table>
<tr><th colspan="4">EN 60898-1&EN 60898-2</th></tr>
<tr><th>Clause</th><th>Requirement-Test</th><th>Result-Remark</th><th>Verdict</th></tr>
<tr><td></td><td>The temperature rises of the parts of a circuit-breaker specified in Table 6, measured under the conditions specified in 9.8.2, shall not exceed the limiting values stated in that table.

The circuit-breaker shall not suffer damage impairing its functions and its safe use.

Table 6 – Temperature-rise values
<table><tr><th>Parts [a] [b]</th><th>Temperature-rise K</th></tr><tr><td>Terminals for external connections [c]</td><td>60</td></tr><tr><td>External parts liable to be touched during manual operation of the circuit-breaker, including operating means of insulating material and metallic means for coupling insulated operating means of several poles</td><td>40</td></tr><tr><td>External metallic parts of operating means</td><td>25</td></tr><tr><td>Other external parts, including that face of the circuit-breaker in direct contact with the mounting surface</td><td>60</td></tr><tr><td colspan="2">[a] No value is specified for the contacts, since the design of most circuit-breakers is such that a direct measurement of the temperature of those parts cannot be made without the risk of causing alterations or displacements of parts likely to affect the reproducibility of the tests. The 28-day test (see 9.9) is considered to be sufficient for checking indirectly the behaviour of the contacts with respect to undue overheating in service.
[b] No value is specified for parts other than those listed, but no damage shall be caused to adjacent parts of insulating materials, and the operation of the circuit-breaker shall not be impaired.
[c] For plug-in type circuit-breakers, the terminals of the base on which they are installed.</td></tr></table></td><td></td><td>P</td></tr>
<tr><td>8.4.2</td><td>Ambient air temperature</td><td></td><td>P</td></tr>
<tr><td></td><td>The temperature-rise limits given in Table 6 are applicable only if the ambient air temperatures remain between the limits given in 7.2.</td><td></td><td>P</td></tr>
<tr><td>8.5</td><td>Uninterrupted duty</td><td></td><td>P</td></tr>
<tr><td></td><td>Circuit-breakers shall operate reliably even after long service.
Compliance is checked by the test of 9.9.</td><td></td><td>P</td></tr>
<tr><td>8.6</td><td>Automatic operation</td><td></td><td>P</td></tr>
<tr><td>8.6.1</td><td>Standard time-current zone</td><td></td><td>P</td></tr>
<tr><td></td><td>The tripping characteristic of circuit-breakers shall be such that they ensure adequate protection of the circuit, without premature operation.

The zone of the time-current characteristic (tripping characteristic) of a circuit-breaker is defined by the conditions and the values stated in Table 7.

This table refers to a circuit-breaker mounted in accordance with the reference conditions (see 9.2) operating at the reference calibration temperature of 30 °C, with a tolerance of $^{+5}_{0}$ °C.

Compliance is checked by the tests specified in 9.10.

The test may be made at any convenient temperature, the results being referred to 30 °C, using the information given by the manufacturer.

In any case the variation from the test current of Table 7 shall not exceed 1,2 %/ per K of calibration temperature variation.

If the circuit-breakers are marked for a calibration temperature different from 30 °C, they are tested for that different temperature.

The manufacturer shall be prepared to give information on the variation of the tripping characteristic for calibration temperatures differing from the reference value.</td><td></td><td>P</td></tr>
</table>

<table>
<tr><th colspan="4">EN 60898-1&EN 60898-2</th></tr>
<tr><th>Clause</th><th>Requirement-Test</th><th>Result-Remark</th><th>Verdict</th></tr>
<tr><td></td><td>
Table 7 – Time-current operating characteristics
<table>
<tr><th>Test</th><th>Type</th><th>Test current</th><th>Initial condition</th><th>Limits of tripping or non-tripping time</th><th>Result to be obtained</th><th>Remarks</th></tr>
<tr><td>a</td><td>B, C, D</td><td>1,13 I_n</td><td>Cold [a]</td><td>$t \le 1$ h (for $I_n \le 63$ A)
$t \le 2$ h (for $I_n > 63$ A)</td><td>No tripping</td><td></td></tr>
<tr><td>b</td><td>B, C, D</td><td>1,45 I_n</td><td>Immediately following test a</td><td>$t < 1$ h (for $I_n \le 63$ A)
$t < 2$ h (for $I_n > 63$ A)</td><td>Tripping</td><td>Current steadily increased within 5 s</td></tr>
<tr><td>c</td><td>B, C, D</td><td>2,55 I_n</td><td>Cold [a]</td><td>1 s $< t <$ 60 s (for $I_n \le 32$ A)
1 s $< t <$ 120 s (for $I_n > 32$ A)</td><td>Tripping</td><td></td></tr>
<tr><td>d</td><td>B
C
D</td><td>3 I_n
5 I_n
10 I_n</td><td>Cold [a]</td><td>0,1 s $< t <$ 45 s (for $In \le 32$ A)
0,1 s $< t <$ 90 s (for $In > 32$ A)
0,1 s $< t <$ 15 s (for $In \le 32$ A)
0,1 s $< t <$ 30 s (for $In > 32$ A)
0,1 s $< t <$ 4 s [b] (for $In \le 32$ A)
0,1 s $< t <$ 8 s (for $In > 32$ A)</td><td>Tripping</td><td>Current established by closing an auxiliary switch</td></tr>
<tr><td>e</td><td>B
C
D</td><td>5 I_n
10 I_n
20 I_n</td><td>Cold [a]</td><td>$t <$ 0,1 s</td><td>Tripping</td><td>Current established by closing an auxiliary switch</td></tr>
</table>
[D] Text deleted [E]
[a] The term "cold" means without previous loading.
[b] [D] For $In \le 10$ A, $t < 8$ s is permissible. [E]
</td><td></td><td>P</td></tr>
<tr><td>8.6.2</td><td>Conventional quantities</td><td></td><td>P</td></tr>
<tr><td>8.6.2.1</td><td>Conventional time</td><td></td><td>P</td></tr>
<tr><td></td><td>The conventional time is 1 h for circuit-breakers of rated current up to and including 63 A, and 2 h for circuit-breakers of rated current above 63 A.</td><td></td><td>P</td></tr>
<tr><td>8.6.2.2</td><td>Conventional non-tripping current (I nt)</td><td></td><td>P</td></tr>
<tr><td></td><td>The conventional non-tripping current of a circuit-breaker is 1 ,1 3 times its rated current.</td><td></td><td>P</td></tr>
<tr><td>8.6.2.3</td><td>Conventional tripping current (I t)</td><td></td><td>P</td></tr>
<tr><td></td><td>The conventional tripping current of a circuit-breaker is 1 ,45 times its rated current.</td><td></td><td>P</td></tr>
<tr><td>8.6.3</td><td>Tripping characteristic</td><td></td><td>P</td></tr>
<tr><td>8.6.3.1</td><td>General</td><td></td><td>P</td></tr>
<tr><td></td><td>The tripping characteristic of circuit-breakers shall be contained within the zone defined in 8.6.1 .NOTE Conditions of temperature and mounting different from those specified in 9.2 (e.g. mounting in a special enclosure, grouping of several circuit-breakers in the same enclosure) can affect the tripping</td><td></td><td>P</td></tr>
</table>

EN 60898-1&EN 60898-2			
Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	characteristic of circuit-breakers. The manufacturer shall be prepared to give information on the variation of the tripping characteristic for ambient temperatures differing from the reference value, within the limits of 7.2.		P
8.6.3.2	**Effect of single-pole loading of multipole circuit-breakers on the tripping Characteristic**		P
	When circuit-breakers having more than one protected pole are loaded on only one of the protected poles, starting from cold, with a current equal to • 1 ,1 times the conventional tripping current, for two-pole circuit-breakers with two protected poles, • 1 ,2 times the conventional tripping current, for three-pole and four-pole circuit-breakers, the circuit-breakers shall trip within the conventional time specified in 8.6.2.1 . Compliance is checked by the test of 9.10.4.		P
8.6.3.3	**Effect of the ambient air temperature on the tripping characteristic**		P
	Ambient air temperatures other than the reference temperature, within the limits of –5 °C and +40 °C, shall not unacceptably afect the tripping characteristic of circuit-breakers. Compliance is checked by the tests of 9.10.5.		P
8.7	**Mechanical and electrical endurance**		P
	Circuit-breakers shall be capable of performing an adequate number of cycles with rated current. Compliance is checked by the test of 9.11.		P
8.8	**Performance at short-circuit currents**		P
	Circuit-breakers shall be capable of performing a specified number of short-circuit operations, during which they shall neither endanger the operator nor initiate a flashover between live conductive parts or between live conductive parts and earth. Compliance is checked by the tests of 9.12.It is required that circuit-breakers be able to make and to break any value of current up to and including the value corresponding to the rated short-circuit capacity at rated frequency, at a power-frequency recovery voltage equal to 1 05 % (±5 %) of the rated voltage and at any power factor not less than the appropriate lower limit of the range stated in 9.1 2.5; it is also		P

<table>
<tr><th colspan="4">EN 60898-1&EN 60898-2</th></tr>
<tr><th>Clause</th><th>Requirement-Test</th><th>Result-Remark</th><th>Verdict</th></tr>
<tr><td></td><td>required that the corresponding values of I 2 t lie below the I 2 t characteristic (see 3.5.1 3).</td><td></td><td>P</td></tr>
<tr><td>8.9</td><td>Resistance to mechanical shock and impact</td><td></td><td>P</td></tr>
<tr><td></td><td>Circuit-breakers shall have adequate mechanical behaviour so as to withstand the stresses imposed during installation and use. Compliance is checked by the tests of 9.13.</td><td></td><td>P</td></tr>
<tr><td>8.10</td><td>Resistance to heat</td><td></td><td>P</td></tr>
<tr><td></td><td>Circuit-breakers shall be sufficiently resistant to heat. Compliance is checked by the test of 9.14.</td><td></td><td>P</td></tr>
<tr><td>8.11</td><td>Resistance to abnormal heat and to fire</td><td></td><td>P</td></tr>
<tr><td></td><td>Circuit-breaker parts made of insulating material shall not be likely to ignite and to spread fire if current-carrying parts in their vicinity attain a high temperature under fault or overload conditions.Compliance is checked
— for external parts made of insulating material, by the test of 9.15;
— for all other parts made of insulating material, by the test sequences, no additional test being required.</td><td></td><td>P</td></tr>
<tr><td>8.12</td><td>Resistance to rusting</td><td></td><td>P</td></tr>
<tr><td></td><td>Ferrous parts shall be adequately protected against rusting. Compliance is checked by the test of 9.16.</td><td></td><td>P</td></tr>
<tr><td>8.13</td><td>Power loss</td><td></td><td>P</td></tr>
<tr><td></td><td>Circuit-breakers shall not have excessive power loss. The maximum permissible values per pole are indicated in Table 8.
Compliance is checked by the test of 9.8.5.
Table 8 – Maximum power loss per pole
<table>
<tr><th>Range of rated current I_n
A</th><th>Maximum power loss per pole
W</th></tr>
<tr><td>$I_n \leq 10$</td><td>3</td></tr>
<tr><td>$10 < I_n \leq 16$</td><td>3,5</td></tr>
<tr><td>$16 < I_n \leq 25$</td><td>4,5</td></tr>
<tr><td>$25 < I_n \leq 32$</td><td>6</td></tr>
<tr><td>$32 < I_n \leq 40$</td><td>7,5</td></tr>
<tr><td>$40 < I_n \leq 50$</td><td>9</td></tr>
<tr><td>$50 < I_n \leq 63$</td><td>13</td></tr>
<tr><td>$63 < I_n \leq 100$</td><td>15</td></tr>
<tr><td>$100 < I_n \leq 125$</td><td>20</td></tr>
</table></td><td></td><td>P</td></tr>
<tr><td>8.14</td><td>Electromagnetic immunity</td><td></td><td>P</td></tr>
<tr><td></td><td>Circuit-breakers for overcurrent protection for household and similar installations are not</td><td></td><td>P</td></tr>
</table>

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	sensitive to normal electromagnetic disturbances and therefore no immunity tests are required.		P
8.15	**Electromagnetic emission**		P
	Electromagnetic disturbances can only be generated by circuit-breakers for overcurrent protection for household and similar installations during occasional switching or automatic breaking operations. The duration of the disturbances is of the order of milliseconds. The frequency, the level and the consequences of these emissions are considered as part of the normal electromagnetic environment of low voltage installations. Therefore the requirements for electromagnetic emissions are deemed to be satis ied and no veri ication is necessary.		P
9	**Tests**		P
9.1	**Type tests and test sequences**		P
	The characteristics of circuit-breakers are verified by means of type tests. Type tests required by this standard are listed in Table 9. **Table 9 – List of type tests** Test / Subclause: Indelibility of marking 9.3 Reliability of screws, current-carrying parts and connections 9.4 Reliability of terminals for external conductors 9.5 Protection against electric shock 9.6 Dielectric properties and isolating capability 9.7 Temperature-rise 9.8 28-day test 9.9 Tripping characteristic 9.10 Mechanical and electrical endurance 9.11 Short-circuit 9.12 Resistance to mechanical shock and impact 9.13 Resistance to heat 9.14 Resistance to abnormal heat and to fire 9.15 Resistance to rusting 9.16 *For the purpose of verification of conformity with the standard, type tests are carried out in test sequences.* *The test sequences and the number of samples to be submitted are stated in Annex C.* *Unless otherwise specified, each type test (or sequence of type tests) is carried out on circuit-breakers in a clean and new condition.* NOTE Test to verify compliance of additional marking to 6.2, if any, are carried out according to the relevant standard.		P
9.2	**Test conditions**		P
	The circuit-breaker is mounted individually, vertically and in free air at an ambient tempe- rature between 20 °C and 25 °C, unless otherwise specified, and is protected against undue external heating or cooling. Circuit-breakers designed for installation in an individual enclosure are tested in		P

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Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	the smallest of such enclosures specified by the manufacturer. Unless otherwise specified, the circuit-breakers are wired with the appropriate cable specified in Table 10 and are fixed on a dull, black-painted plywood board of about 20 mm thickness, the method of fixing complying with any requirements relating to the means of mounting recommended by the manufacturer. Where a tolerance is not specifically specified, type tests are carried out at values not less severe than those specified in this standard. Unless otherwise specified, tests are carried out at the rated frequency ± 5 Hz and at any convenient voltage. During the tests, no maintenance or dismantling of the samples is allowed. For the tests of 9.8, 9.9, 9.10 and 9.11 the circuit-breaker is connected as follows. a) The connections are made by means of single-core, PVC insulated copper cables, according to IEC 60227 series. b) Unless otherwise specified, the tests are carried out with single-phase current. c) The connections are in free air and spaced not less than the distance between the terminals. d) The minimum length of each temporary connection from terminal to terminal is: – 1 m for cross-sections up to and including 10 mm 2 ; – 2 m for cross-sections larger than 10 mm 2 . The tightening torques to be applied to the terminal screws are two-thirds of those specified in Table 11. Text deleted **Table 10 – Cross-sectional areas (*S*) of test copper conductors corresponding to the rated currents** *S* mm²: 1 / 1,5 / 2,5 / 4 / 6 / 10 / 16 / 25 / 35 / 50 Values of the rated current I_n A: $I_n \le 6$ / $6 < I_n \le 13$ / $13 < I_n \le 20$ / $20 < I_n \le 25$ / $25 < I_n \le 32$ / $32 < I_n \le 50$ / $50 < I_n \le 63$ / $63 < I_n \le 80$ / $80 < I_n \le 100$ / $100 < I_n \le 125$		P
9.3	**Test of indelibility of marking**		P
	The test is made by rubbing the marking by hand for 15 s with a piece of cotton soaked with water and again for 15 s with a piece of cotton soaked with aliphatic solvent hexane with a content of aromatics of maximum 0,1 % by volume, a kauributanol value of 29, an initial boiling-point approximately 65 °C, a dry-point of approximately 69 °C and a density of approximately 0,68 g/cm 3 . Marking made by impression, moulding, or engraving is not subjected to this test.		P

<table>
<tr><th colspan="4">EN 60898-1&EN 60898-2</th></tr>
<tr><th>Clause</th><th>Requirement-Test</th><th>Result-Remark</th><th>Verdict</th></tr>
<tr><td></td><td>After this test, the marking shall be easily legible. The marking shall also remain easily legible after all the tests of this standard.
It shall not be easily possible to remove labels and they shall show no curling.</td><td></td><td>P</td></tr>
<tr><td>9.4</td><td>Test of reliability of screws, current-carrying parts and connections</td><td></td><td>P</td></tr>
<tr><td></td><td>Compliance with the requirements of 8.1.4 is checked by inspection and, for screws and nuts which are operated when mounting and connecting up the circuit-breaker, by the following test.
The screws or nuts are tightened and loosened
– ten times for screws in engagement with a thread of insulating material;
– five times in all other cases.
Screws or nuts in engagement with a thread of insulating material are completely removed and reinserted each time.
The test is made by means of a suitable test screwdriver or spanner applying a torque as shown in Table 11.
The screws and nuts shall not be tightened in jerks.
The conductor is moved each time the screw or nut is loosened.
Plug-in connections are tested by plugging the circuit-breaker in and pulling it out five times.After the test the connections shall not have become loose nor shall their electrical function be impaired.During the test, the screwed connections shall not work loose and there shall be no damage,such as breakage of screws or damage to the head slots, threads, washers or stirrups, that will impair the further use of the circuit-breaker.

Table 11 – Screw thread diameters and applied torques
<table><tr><th rowspan="2">Nominal diameter of thread
mm</th><th colspan="3">Torque
Nm</th></tr><tr><th>I</th><th>II</th><th>III</th></tr><tr><td>Up to and including 2,8</td><td>0,2</td><td>0,4</td><td>0,4</td></tr><tr><td>over 2,8 up to and including 3,0</td><td>0,25</td><td>0,5</td><td>0,5</td></tr><tr><td>over 3,0 up to and including 3,2</td><td>0,3</td><td>0,6</td><td>0,6</td></tr><tr><td>over 3,2 up to and including 3,6</td><td>0,4</td><td>0,8</td><td>0,8</td></tr><tr><td>over 3,6 up to and including 4,1</td><td>0,7</td><td>1,2</td><td>1,2</td></tr><tr><td>over 4,1 up to and including 4,7</td><td>0,8</td><td>1,8</td><td>1,8</td></tr><tr><td>over 4,7 up to and including 5,3</td><td>0,8</td><td>2,0</td><td>2,0</td></tr><tr><td>over 5,3 up to and including 6,0</td><td>1,2</td><td>2,5</td><td>3,0</td></tr><tr><td>over 6,0 up to and including 8,0</td><td>2,5</td><td>3,5</td><td>6,0</td></tr><tr><td>over 8,0 up to and including 10,0</td><td>3,5</td><td>4,0</td><td>10,0</td></tr><tr><td colspan="4">Column I applies to screws without heads if the screw, when tightened, does not protrude from the hole, and to other screws which cannot be tightened by means of a screwdriver with a blade wider than the diameter of the screw.

Column II applies to other screws which are tightened by means of a screwdriver.

Column III applies to screws and nuts which are tightened by means other than a screwdriver.

Where a screw has a hexagonal head with a slot for tightening with a screwdriver and the values in columns II and III are different, the test is made twice, first applying to the hexagonal head the torque specified in column III and then, on another sample, applying the torque specified in column II by means of a screwdriver. If the values in columns II and III are the same, only the test with the screwdriver is made.</td></tr></table></td><td>P</td></tr>
</table>

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Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	Moreover, enclosures and covers shall not be damaged. Plug-in connections are tested by plugging the circuit-breaker in and pulling it out five times.After the test the connections shall not have become loose nor shall their electrical function be impaired.		P
9.5	**Tests of reliability of screw-type terminals for external copper conductors**		P
9.5.1	Compliance with the requirements of 8.1.5 is checked by inspection, by the test of 9.4, for which a rigid copper conductor having the largest cross-section specified in Table 5 is placed in the terminal (for nominal cross-sections exceeding 6 mm², a rigid stranded conductor is used; for other nominal cross-sections, a solid conductor is used), and by the tests of 9.5.2, 9.5.3 and 9.5.4. These last tests are made using a suitable test screwdriver or spanner.		P
9.5.2	The terminals are fitted with copper conductors of the same type (rigid solid or rigid stranded or flexible) of the smallest and largest cross-sectional as specified in Table 5. The terminal shall be suitable for all types of conductors of the same type (rigid – solid or stranded – or flexible), unless otherwise specified by the manufacturer. The terminal shall be suitable for all types of conductors: rigid (solid or stranded) and flexible,unless otherwise specified by the manufacturer. Terminals shall be tested with the minimum and maximum cross-section of each type of conductors on new terminals as follows: – Tests for solid conductors shall use conductors having cross-sections from 1 mm 2 up to 6 mm 2 , as applicable. – Tests for stranded conductors shall use conductors having cross-sections from 1 ,5 mm 2 up to 50 mm 2 , as applicable. – Tests for flexible conductors shall use conductors having cross-sections from 1 mm 2 up to 35 mm 2 , as applicable. The conductor is inserted into the terminal for the minimum distance prescribed or, where nodistance is prescribed, until it just projects from the far side, and in the position most likely to assist the wire to escape. The clamping screws are then tightened with a torque equal to two-thirds of that		P

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	have escaped outside the retaining device.		P
9.6	**Test of protection against electric shock**		P
	This verification is applicable to those parts of circuit breakers which are exposed to the operator when mounted as for normal use. The test is made with the standard test finger shown in Figure 8, on the sample mounted as for normal use (see note in 8.1.6) and fitted with the conductors of the smallest and largest cross-sectional areas specified in Table 5.The standard test finger shall be so designed that each of the jointed sections can be turned through an angle of 90° with respect to the axis of the finger, in the same direction only.The test finger is applied in every possible bending position of a real finger, an electrical contact indicator being used to show contact with live parts.It is recommended that a lamp be used for the indication of contact and that the voltage be not less than 40 V.Circuit-breakers with enclosures or covers of thermoplastic material are subjected to the following additional test, which is carried out at an ambient temperature of 35 °C ± 2 °C, the circuit-breakers being at this temperature. The circuit-breakers are subjected for 1 min to a force of 75 N, applied through the tip of a straight unjointed test finger of the same dimensions as the standard test finger. This finger is applied to all places where yielding of insulating material could impair the safety of the circuit-breaker; in the case of knockouts it is applied with a force of 10 N. Unenclosed circuit-breakers having parts not intended to be covered by an enclosure are submitted to the test with a metal front panel, and mounted as for normal use (see 8.1.6).		P
9.7	**Test of dielectric properties**		P
9.7.1	**Resistance to humidity**		P
9.7.1.1	**Preparation of the circuit-breaker for test**		P
	Parts which can be removed without the aid of a tool are removed and subjected to the humidity treat-ment with the main part; spring lids are kept open during this treatment. Inlet openings, if any, are left open; if knockouts are provided, one of them is opened.		P
9.7.1.2	**Test conditions**		P

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Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	The humidity treatment is carried out in a humidity cabinet containing air with a relative humidity maintained between 91 % and 95 %. The temperature of the air in which the sample is placed is maintained within ± 1 °C of any convenient value T between 20 °C and 30 °C. Before being placed in the humidity cabinet, the sample is brought to a temperature between T and T +4 °C.		P
9.7.1.3	**Test procedure**		P
	The sample is kept in the cabinet for 48 h. NOTE 1 A relative humidity between 91 % and 95 % can be obtained by placing in the humidity cabinet a saturated solution of sodium sulphate (Na 2 SO 4) or potassium nitrate (KNO 3) in water having a sufciently large contact surface with the air. NOTE 2 In order to achieve the specifed conditions within the cabinet it is necessary to ensure constant circulation of the air within and, in general, to use a cabinet which is thermally insulated.		P
9.7.1.4	**Condition of the circuit-breaker after the test**		P
	After this treatment, the sample shall show no damage within the meaning of this standard and shall withstand the tests of 9.7.2, 9.7.3, 9.7.4, and 9.7.5.2.		P
9.7.2	**Insulation resistance of the main circuit**		P
	The circuit-breaker having been treated as specifed in 9.7.1 is then removed from the cabinet. After an interval between 30 min and 60 min following this treatment, the insulation resistance is meas- ured 5 s after application of a d.c. voltage of approximately 500 V, in the following order: a) with the circuit-breaker in the open position, between each pair of the terminals which are electrically connected together when the circuit-breaker is in the closed position, in turn on each pole; b) with the circuit-breaker in the closed position, between each pole and the others connected together; c) with the circuit-breaker in the closed position,		P

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Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	between all poles connected together and the frame, including a metal foil or part in contact with the outer surface of the housing of insulating material but with the terminal areas kept completely free to avoid fashover between terminals and the metal foil; d) for circuit-breakers with a metal enclosure having an internal lining of insulating material, between the frame and a metal foil in contact with the inner surface of the lining of insulating material, includ-ing bushings and similar devices. The measurements a), b) and c) are carried out after having connected all auxiliary circuits to the frame. The term "frame" includes: — all accessible metal parts and a metal foil in contact with the surfaces of insulating material which are accessible after installation as for normal use; — the surface on which the base of the circuit-breaker is mounted, covered, if necessary, with a metal foil; — screws and other devices for fxing the base to its support; — screws for fxing covers which have to be removed when mounting the circuit-breaker, — metal parts of operating means referred to in 8.2. If the circuit-breaker is provided with a terminal intended for the interconnection of protective conductors, this terminal is connected to the frame. For the measurements according to b), c) and d), the metal foil is applied in such a way that the sealing compound, if any, is efectively tested. The insulation resistance shall be not less than — 2 MΩ for the measurements according to items a) and b); — 5 MΩ for the other measurements.		P
9.7.3	**Dielectric strength of the main circuit**		P
	After the circuit-breaker has passed the tests of 9.7.2 the test voltage specifed is applied for 1 min be-		P

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Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	tween the parts indicated in 9.7.2. The test voltage shall have practically sinusoidal waveform, and a frequency between 45 Hz and 65 Hz. The source of the test voltage shall be capable of supplying a short-circuit current of at least 0,2 A. No overcurrent tripping device of the transformer shall operate when the current in the output circuit is lower than 100 mA. The values of the test voltage shall be as follows: — 2 000 V for items a) to c) of 9.7.2; — 2 500 V for item d) of 9.7.2; Initially, not more than half the prescribed voltage is applied, then it is raised to the full value within 5 s. No fashover or breakdown shall occur during the test. Glow discharges without drop in the voltage are neglected.		P
9.7.4	**Insulation resistance and dielectric strength of auxiliary circuits**		P
	Insulation resistance and dielectric strength shall be verifed according to a, b and c. a) The measurement of the insulation resistance and the dielectric strength tests for the auxiliary cir- cuits are carried out immediately after the measurement of the insulation resistance and the dielec- tric strength tests for the main circuit, under the conditions given in b) and c) below. b) The measurements of the insulation resistance are carried out: — between the auxiliary circuits connected to each other and to the frame; — between each of the parts of the auxiliary circuits which might be isolated from the other parts in normal service and the whole of the other parts connected together, at a voltage of approxi- mately 500 V d.c., after this voltage has been applied for 1 min. The insulation resistance shall be not less than 2 MΩ. c) A substantially sinusoidal voltage at rated frequency is applied for 1 min between the parts listed under b). The voltage values to be applied are specifed in Table 13		P

<table>
<tr><th colspan="4">EN 60898-1&EN 60898-2</th></tr>
<tr><th>Clause</th><th>Requirement-Test</th><th>Result-Remark</th><th>Verdict</th></tr>
<tr><td></td><td>
Table 13 – Test voltage of auxiliary circuits
<table>
<tr><th colspan="2">Rated voltage of auxiliary circuits (a.c. or d.c.)
V</th><th rowspan="2">Test voltage
V</th></tr>
<tr><th>Greater than</th><th>Up to and including</th></tr>
<tr><td>0</td><td>30</td><td>600</td></tr>
<tr><td>30</td><td>50</td><td>1000</td></tr>
<tr><td>50</td><td>110</td><td>1500</td></tr>
<tr><td>110</td><td>250</td><td>2000</td></tr>
<tr><td>250</td><td>500</td><td>2500</td></tr>
</table>
At the beginning of the test the voltage shall not exceed half the value specified. It is then increased steadily to the full value in not less than 5 s, but not more than 20 s.
During the test, there shall be no flashover or perforation.
NOTE 1 Discharges which do not correspond to a voltage drop are disregarded.
NOTE 2 In the case of circuit breakers in which the auxiliary circuit is not accessible for verification of the requirements given in b), the tests can be made on samples specially prepared by the manufacturer or according to his instructions.
NOTE 3 Auxiliary circuits do not include the control circuit of circuit breakers functionally dependent on line voltage.
NOTE 4 Control circuits other than those of secondary circuit of detection transformers and control circuits connected to the main circuit are submitted to the same tests as the auxiliary circuits.
</td><td></td><td>P</td></tr>
<tr><td>9.7.5</td><td>Verifcation of impulse withstand voltag es (across clearances and across solid insulation)and of leakage current across open contacts</td><td></td><td>P</td></tr>
<tr><td>9.7.5.1</td><td>General testing procedure for the impulse withstand voltage tests</td><td></td><td>P</td></tr>
<tr><td></td><td>The impulses are given by a generator producing positive and negative impulses having a front time of 1,2 µs, and a time to half-value of 50 µs, the tolerances being as follow:
— ± 5 % for the peak value;
— ± 30 % for the front time;
— ± 20 % for the time to half-value.
For each test, fve positive impulses and fve negative impulses are applied. The interval between con- secutive impulses being at least 1 s for impulses of the same polarity and being at least 10 s for impulses of the opposite polarity
When performing the impulse voltage test on complete circuit-breaker, the attenuation or amplifcation of the test voltage shall be taken into account. It needs to be ensured that the required value of the test voltage is applied across the terminals of the equipment under test. The surge impedance of the test apparatus shall have a nominal value of 500 Ω. In 9.7.5.2, for the verifcation of clearances within the basic insulation, on complete circuit-breaker,</td><td></td><td>P</td></tr>
</table>

EN 60898-1&EN 60898-2			
Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	a very low impedance of the generator is needed for the test. For this purpose, a hybrid generator with a virtual impedance of 2 ohm is appropriate if internal components are not disconnected before testing. However, in any case, a measurement of the correct test voltage directly at the clearance is required. The shape of the impulses is adjusted with the circuit-breaker under test connected to the impulse gen- erator. For this purpose appropriate voltage dividers and voltage sensors shall be used. Small oscillations in the impulses are allowed provided that their amplitude near the peak of the impulse is less than 5 % of the peak value. For oscillations on the frst half of the front, amplitudes up to 10 % of the peak value are allowed. There shall be no disruptive discharge (sparkover, fashover or puncture) during the tests. Partial discharges in clearances which do not result in breakdown are disregarded. NOTE The use of an oscilloscope can be necessary to observe the impulse voltage in order to detect disruptive discharge.		P
9.7.5.2	**Verifcation of clearances with the imp ulse withstand voltage**		P
	If the measurement of clearances of items 2 and 4 of Table 4 does not show any reduced clearance, this test is not applied. This test may be applied to replace measurement of clearances of items 2 and 4 of Table 4. The test is carried out on a circuit breaker fxed on a metal support and being in the closed position. The test impulse voltage value is given in 5.3.6. This value is corrected for barometric pressure and/or altitude at which the tests are carried out, according to Table 1 4. Tests are made applying the impulse voltage between: a) in turn between each pole and the others connected together b) between all poles connected together and the frame including a metal foil or part in contact with the outer surface of the housing of insulating material but with the terminal areas kept completely free to avoid fashover between terminals and the metal foil; c) for circuit-breakers with a metal enclosure having an internal lining of insulating material, between the frame and a metal foil in contact with the inner surface of the lining of		P

<table>
<tr><th colspan="4">EN 60898-1&EN 60898-2</th></tr>
<tr><th>Clause</th><th>Requirement-Test</th><th>Result-Remark</th><th>Verdict</th></tr>
<tr><td></td><td>insulating material, includ-
ing bushings and similar devices.
NOTE 1 The term "frame" is defned in 9.7.2.
Where applicable, the metal foil is applied in such a way that the sealing compound, if any, is efectively
tested.
There shall be no disruptive discharge. If, however, only one such disruptive discharge occurs, ten addi-
tional impulses having the same polarity as that which caused the disruptive discharge are applied, the
connections being the same as those with which the failure occurred. No further disruptive discharge shall occur.
NOTE 2 The expression "unintentional disruptive discharge" is used to cover the phenomena associated with the
failure of insulation under electric stress, which include a drop in the voltage and the flowing of current.

Table 14 — Test voltage for verification of impulse withstand voltage
<table><tr><th rowspan="2">Rated impulse withstand voltage U_{imp} kV</th><th colspan="5">Test voltages at corresponding altitude $U_{1.2/50}$ a.c. peak kV</th></tr><tr><th>Sea level</th><th>200 m</th><th>500 m</th><th>1 000 m</th><th>2 000 m</th></tr><tr><td>4</td><td>4,9</td><td>4,8</td><td>4,7</td><td>4,4</td><td>4,0</td></tr></table></td><td></td><td>P</td></tr>
<tr><td>9.7.5.3</td><td>Verifcation of leakage currents across open contacts (suitability for isolati on)</td><td></td><td>P</td></tr>
<tr><td></td><td>Each pole of circuit-breakers having been submitted to the tests of 9.12.11.2, or 9.12.11.3, or 9.12.11.4.2 or 9.12.11.4.3 or 9.12.11.4.4 is supplied at a voltage 1,1 times its rated operational voltage, the circuit-breaker being in the open position.
The leakage current fowing across the open contacts is measured and shall not exceed 2 mA.</td><td></td><td>P</td></tr>
<tr><td>9.7.5.4</td><td>Verifcation of resistance of the insulati on of open contacts against an impul se voltage (suitability for isolation)</td><td></td><td>P</td></tr>
<tr><td></td><td>The test impulse voltage value is given in 5.3.6. These values are corrected for barometric pressure and/ or altitude at which the tests are carried out, according to Table 1 5.</td><td></td><td>P</td></tr>
</table>

<table>
<tr><th colspan="4">EN 60898-1&EN 60898-2</th></tr>
<tr><th>Clause</th><th>Requirement-Test</th><th>Result-Remark</th><th>Verdict</th></tr>
<tr><td></td><td>
Table 15 — Test voltage for verifying the suitability for isolation, referred to the rated impulse withstand voltage of the circuit breakers and the altitude where the test is carried out
<table>
<tr><td rowspan="3">Nominal voltage of the installation V</td><td colspan="5">Test voltages at corresponding altitude</td></tr>
<tr><td colspan="5">$U_{1.2/50}$ a.c. peak kV</td></tr>
<tr><td>Sea level</td><td>200 m</td><td>500 m</td><td>1 000 m</td><td>2 000 m</td></tr>
<tr><td>Single and three-phase systems 230/400</td><td>6,2</td><td>6,0</td><td>5,8</td><td>5,6</td><td>5,0</td></tr>
</table>
The series of tests is carried out on a circuit-breaker fixed on a metal support as in normal use and with the contact in open position.
The impulses are applied between:
— the line terminals connected together;
— and the load terminals connected together with the contacts in the open position.
There shall be no disruptive discharges during the test.
</td><td></td><td>P</td></tr>
<tr><td>9.8</td><td>Test of temperature-rise and measurement of power loss</td><td></td><td>P</td></tr>
<tr><td>9.8.1</td><td>Ambient air temperature</td><td></td><td>P</td></tr>
<tr><td></td><td>The ambient air temperature shall be measured during the last quarter of the test period by means of at least two thermometers or thermocouples symmetrically positioned around the circuit-breaker at about half its height and at a distance of about 1 m from the circuit-breaker. The thermometers or thermocouples shall be protected against draughts and radiant heat.</td><td></td><td>P</td></tr>
<tr><td>9.8.2</td><td>Test procedure</td><td></td><td>P</td></tr>
<tr><td></td><td>A current equal to In at any convenient voltage is passed simultaneously through all the poles of the circuit-breaker for a period of time sufficient for the temperature-rise to reach the steady-state value or for the conventional time, whichever is the longer.In practice, this condition is reached when the variation of the temperature-rise does not exceed 1 K/h. For four-pole circuit-breakers with three protected poles, the test is first made by passing the specified current through the three protected poles only.The test is then repeated by passing the same current through the pole intended for the connection of the neutral and the adjacent protected pole. With the agreement of the manufacturer, the tests on four-pole circuit-breakers with three protected poles, may also be replaced by a single test with all poles in series including the N-pole.</td><td></td><td>P</td></tr>
</table>

EN 60898-1&EN 60898-2			
Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	During the test, the temperature-rises shall not exceed the values shown in table 6.		P
9.8.3	**Measurement of the temperature of parts**		P
	The temperature of the different parts referred to in Table 6 shall be measured by means of fine wire thermocouples or by equivalent means at the nearest accessible position to the hottest spot. Good heat conductivity between the thermocouple and the surface of the part under test shall be ensured.		P
9.8.4	**Temperature-rise of a part**		P
	The temperature-rise of a part is the difference between the temperature of this part measured in accordance with 9.8.3, and the ambient air temperature measured in accordance with 9.8.1.		P
9.8.5	**Measurement of power loss**		P
	An a.c. current equal to I n , with a supply voltage of a value not less than 30 V, is passed, in a substantially resistive circuit, through each pole of the circuit-breaker. NOTE 1 A test voltage of a value less than 30 V can be used subject to the manufacturer's agreement. The power loss per pole, calculated on the basis of the voltage drop measured under steady state conditions between its terminals, shall not exceed the relevant values given in Table 8. NOTE 2 The voltage drop measurement can be made during the temperature-rise test, provided that the test conditions of this subclause are fulfilled.		P
9.9	**28-day test**		P
	The circuit-breaker is subjected to 28 cycles, each cycle comprising 21 h with a current equal to the rated current at an open circuit voltage of at least 30 V, and 3 h without current under the test conditions of 9.2. NOTE A test voltage of a value less than 30 V can be used subject to the manufacturer's agreement. The circuit-breaker is in the closed position, the current being established and interrupted by an auxiliary switch. During this test the circuit-breaker shall not trip. NOTE A test voltage of a value less than 30 V can be used subject to the manufacturer's agreement.		P

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Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	During the last period of current flow the temperature-rise of the terminals shall be measured. This temperature-rise shall not exceed the value measured during the temperature-rise test (see 9.8) by more than 15 K. Immediately after this measurement of the temperature-rise, the current is steadily increased within 5 s to the conventional tripping current. The circuit-breaker shall trip within the conventional time, the conventional tripping current being referred to calibration temperature, using the information given by the manufacturer.		P
9.10	**Test of tripping characteristic**		P
9.10.1	**General**		P
	This test is made to verify that the circuit-breaker complies with the requirements of 8.6.1. If the test is made in a test chamber, it shall be made in still air; the volume of the test chamber shall be such as not to afect the test results.		P
9.10.2	**Test of time-current characteristic**		P
9.10.2.1	A current equal to 1,13 I n (conventional non-tripping current) is passed for the conventional time (see 8.6.1 and 8.6.2.1) through all poles, starting from cold (see Table 7). The circuit-breaker shall not trip. The current is then steadily increased within 5 s, to 1,45 I n (conventional tripping current). The circuit-breaker shall trip within the conventional time.		P
9.10.2.2	A current equal to 2,55 I n is passed through all poles, starting from cold.The opening time shall not be less than 1 s and shall not be more than – 60 s for rated currents up to and including 32 A; – 120 s for rated currents greater than 32 A.		P
9.10.3	**Test of instantaneous tripping, of correct opening of the contacts and of the trip-free function**		P
9.10.3.1	**General test conditions**		P
	For the lower values of the test current of 9.10.3.2, 9.10.3.3 and 9.10.3.4 respectively the test is made once, at any convenient voltage with all poles connected in series. For the upper values of the test current the test is		P

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Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	made, on each protected pole, at rated voltage between phase to neutral with a power factor between 0,95 and 1.". The sequence of operation is O – t – CO – t – CO – t – CO the interval t being as defined in 9.12.11.1. During the whole O operation the operating means is deliberately held in the closed position. The trip free function shall work properly and the tripping time of the O operation is measured. After tripping the blocked position is abandoned. In case of circuit-breakers with dependent manual operation, the circuit-breaker shall be operated with an operating speed, during actuation, of 0,1 m/s ± 25 %, this speed being measured where and when the operating means of the test apparatus touches the operating means of the circuit-breaker under test. For rotary knobs the angular velocity shall correspond substantially to the above conditions, referred to the speed of the operating means (at its extremities) of the circuit-breaker under test. After each operation all the indicating means shall show the open position of the contacts. The test may be performed at a convenient temperature within the range according to 7.1 .		P
9.10.3.2	**For circuit-breakers of the B-type**		P
	A current equal to 3 I n is passed through all poles connected in series starting from cold. The opening time shall be not less than 0,1 s and not more than: — 45 s for rated currents up to and including 32 A, — 90 s for rated currents above 32 A. A current equal to 5 I n is then passed through each pole separately, again starting from cold. The circuit-breaker shall trip in a time less than 0,1 s. Moreover, the circuit-breaker shall perform the test of 9.10.2.2.		P
9.10.3.3	**For circuit-breakers of the C-type**		P
	A current equal to 5 I n is passed through all poles connected in series , starting from cold. The opening time shall be not less than 0,1 s and not more than: — 15 s for rated currents up to and including 32 A,		P

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Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	— 30 s for rated currents above 32 A. A current equal to 10 I n is then passed through each pole separately, again starting from cold. The circuit-breaker shall trip in a time less than 0,1 s. Moreover, the circuit-breaker shall perform the test of 9.10.2.2.		P
9.10.3.4	**For circuit-breakers of the D-type**		P
	A current equal to 10 In is passed through all poles connected in series , starting from cold. The opening time shall be not less than 0,1 s and not more than: — 4 s for rated currents above 10 A up to and including 32 A, — 8 s for rated currents up to an including 10 A and above 32 A. A current equal to 20 I n is then passed through all poles, again starting from cold. The circuit-breaker shall trip in a time less than 0,1 s. Moreover, the circuit-breaker shall perform the test of 9.10.2.2.		P
9.10.4	**Test of efect of single-pole loading on the tripping characteristic of mu ltipole circuit-breakers**		P
	Compliance is checked by testing the circuit-breaker connected in accordance with 9.2, under the conditions specified in 8.6.3.2. The circuit-breaker shall trip within the conventional time (see 8.6.2.1).		P
9.10.5	**Test of efect of ambient temperature on the tripping characteristic**		P
	Compliance is checked by the following tests. a) The circuit-breaker is placed in an ambient temperature of (35 ± 2) K below the ambient air reference temperature until it has attained steady-state temperature. A current equal to 1,13 I n (conventional non-tripping current) is passed through all poles for the conventional time. The current is then steadily increased within 5 s to 1,9 I n . The circuit-breaker shall trip within the conventional time. b) The circuit-breaker is placed in an ambient temperature of (10 ± 2) K above the ambient air reference temperature until it has attained steady-state temperature.		P

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Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	A current equal to I n is passed through all poles. The circuit-breaker shall not trip within the conventional time.		P
9.11	**Verification of mechanical and electrical endurance**		P
9.11.1	**General test conditions**		P
	The circuit-breaker is fixed to a metal support unless it is designed for installation in an individual enclosure, in which case it shall be mounted accordingly, as specified in 9.2. The test is made at rated voltage, at a current adjusted to the rated current by means of resistors and reactors in series, connected to the load terminals. If air-core reactors are used, a resistor taking approximately 0,6 % of the current through the reactors is connected in parallel with each reactor. The current shall have substantially sine-wave form and the power factor shall be between 0,85 and 0,9. For single-pole circuit-breakers and for two-pole circuit-breakers with two protected poles, the metal support is connected to one side of the supply for the first half of the total number of operations and to the other side for the second half. For two-pole circuit-breakers with one protected pole, the metal support is connected to the neutral of the supply. For single-pole circuit-breakers rated 230/400 V the test shall be made at 230 V. For three-pole circuit-breakers, the metal support is connected to one phase of the supply for the first half of the total number of operations and to one of the other phases, chosen at random, for the second half. For four-pole circuit-breakers, the metal support is connected to the neutral of the supply. The circuit-breaker is connected to the circuit with conductors of the appropriate size indicated in Table 10.		P
9.11.2	**Test procedure**		P
	The circuit-breaker is submitted to 4 000 operating cycles with rated current.Each operating cycle consists of a making operation followed by a breaking operation. For circuit-breakers of rated current up to and including 32 A the operating frequency shall be 240 operating cycles per hour. During each operating cycle, the circuit-breaker shall remain		P

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Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	open for at least 13 s. For circuit-breakers of rated current above 32 A the operating frequency shall be 120 operating cycles per hour. During each operating cycle the circuit-breaker shall remain open for at least 28 s. The circuit-breaker shall be operated as in normal conditions of use. For single-pole circuit-breakers rated 230/400 V the test shall be made at 230 V.Care shall be taken that – the test apparatus does not damage the circuit-breaker under test; – the free movement of the operating means of the circuit-breaker under test is not impeded; – the speed of the operating means of the test apparatus is not unduly affected by the operating means of the circuit-breaker under test. In case of circuit-breakers with dependent manual operation, the circuit-breaker shall be operated with an operating speed, during actuation, of 0,1 m/s ± 25 %, this speed being measured at the extremity when and where the operating means of the test apparatus touches the actuating means of the circuit-breaker under test. For rotary knobs the angular velocity shall correspond substantially to the above conditions, referred to the speed of the operating means (at its extremities) of the circuit-breaker under test.		P
9.11.3	**Condition of the circuit-breaker after test**		P
	Following the test of 9.11.2 the sample shall not show – undue wear; – discrepancy between the position of the moving contacts and of the corresponding position of the indicating device; – damage to the enclosure permitting access to live parts by the test finger (see 9.6); – loosening of electrical or mechanical connections; – seepage of sealing compound. Moreover, the circuit-breaker shall comply with the test of 9.10.2.2 and shall withstand the dielectric strength test according to 9.7.3, but at 900 V and without previous humidity treatment.		P
9.12	**Short-circuit tests**		P
9.12.1	**General**		P

<table>
<tr><th colspan="4">EN 60898-1&EN 60898-2</th></tr>
<tr><th>Clause</th><th>Requirement-Test</th><th>Result-Remark</th><th>Verdict</th></tr>
<tr><td></td><td>Standard tests for the verification of the short-circuit performance consist of sequences of
making and breaking operations, appropriate to the performance to be checked, which are
summarized in Table 16.
The short circuit tests shall be performed at a convenient temperature within the range
according to 7.2.
All circuit-breakers are tested at 500 A or 10 I n , whichever is the higher, according to
9.12.11.2 and at 1 500 A according to 9.12.11.3.
All multipole circuit-breakers are tested according to 9.12.11.4.4. Circuit-breakers having a rated short-circuit capacity above 1 500 A are additionally tested

Table 16 – Applicability of short-circuit tests
<table><tr><th>Kind of test</th><th>Circuit-breaker to be tested</th><th>Verification after short-circuit tests according to subclause</th></tr><tr><td>Test at reduced short-circuit currents (9.12.11.2.1)</td><td>All circuit-breakers</td><td rowspan="2">9.12.12.1</td></tr><tr><td>Test to verify suitability for IT systems (9.12.11.2.2)</td><td>All circuit-breakers</td></tr><tr><td>Tests at 1 500 A (9.12.11.3)</td><td>All circuit-breakers</td><td></td></tr><tr><td>Tests at service short-circuit capacity (9.12.11.4.2)</td><td>Circuit-breakers with $I_{cs} > 1\,500$ A</td><td>9.12.12.1</td></tr><tr><td>Tests at rated short-circuit capacity (9.12.11.4.3)</td><td>Circuit-breakers with $I_{cn} > I_{cs}$</td><td>9.12.12.2</td></tr><tr><td>Tests at the making and breaking capacity on an individual pole (9.12.11.4.4)</td><td>Multipole circuit-breakers</td><td>9.12.12.2</td></tr></table>
– at service short-circuit (breaking) capacity (see 3.5.5.2) according to 9.12.11.4.2 and
9.12.12.1; the service short-circuit capacity is obtained by multiplying the rated short-
circuit capacity by a factor k, the values of which are given in Table 18;
– at rated short-circuit capacity (see 5.2.4) according to 9.12.11.4.3 and to 9.12.12.2 if the factor k is less than 1, in which case new samples shall be used.</td><td></td><td>P</td></tr>
<tr><td>9.12.2</td><td>Values of test quantities</td><td></td><td>P</td></tr>
<tr><td></td><td>All the tests concerning the verification of the rated short-circuit capacity shall be performed with the values stated by the manufacturer in accordance with the relevant tables of this standard.
The value of the applied voltage is that which is necessary to produce the specified power frequency recovery voltage.
The value of the power frequency recovery voltage (see 3.5.8.2) shall be equal to 110% of the rated voltage of the circuit-breaker under test.
– For single-pole circuit-breakers having dual rated voltage value (e.g. 230/400 V) the power</td><td></td><td>P</td></tr>
</table>

EN 60898-1&EN 60898-2			
Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	frequency recovery voltage shall be 110% of the upper value (e.g. 400 V) for the tests according to item d) of 9.12.11.4.2 , item b of 9.12.11.4.3 and 9.12.11.2.2; it shall be 110% of the lower value (e.g. 230 V) for the other tests of 9.12. Text deleted NOTE The value of 110 % (0, −5 %) of the rated voltage is deemed to cover the effects of the variations of the system voltage under normal service conditions. The upper limit can be increased with the approval of the manufacturer.		P
9.12.3	**Tolerances on test quantities**		P
	The tests are considered as valid if the r.m.s. values recorded in the test report differ from the values specified within the following tolerances: – current – voltage (including recovery voltage):0,-5% – frequency ± 5 %.		P
9.12.4	**Test circuit for short-circuit performance**		P
	Figure 3 and Figure 4 give the diagrams of the circuits to be used for the tests concerning: – a single-pole circuit-breaker, – a two-pole circuit-breaker with one protected pole,110 % of the upper value (e.g. 400 V) for the tests according to item d) of 9.12.11.4.2 , item b of 9.12.11.4.3 and 9.12.11.2.2; it shall be 110 % of the lower value (e.g. 230 V) for the other tests of 9.12.Text deleted 11 0 % (0, −5 %) of the rated voltage is deemed to cover the effects of the variations of the system voltage under normal service conditions. The upper limit can be increased with the approval of the manufacturer.0, −5 % – a two-pole circuit-breaker with two protected poles, – a three-pole circuit-breaker, – a four-pole circuit-breaker with three protected poles – a four-pole circuit-breaker with four protected		P

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Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	poles. The resistances and reactances of the impedances Z and Z1 (see Figure 5) shall be adjustable to satisfy the specified test conditions. The reactors shall preferably be air-cored. They shall always be connected in series with the resistors and their value shall be obtained by series coupling of individual reactors; parallel connecting of reactors is permitted when these reactors have practically the same time-constant. Since the transient recovery voltage (see 3.5.8.1) characteristics of test circuits including air- cored reactors are not representative of usual service conditions, the air-cored reactor in any phase shall be shunted by a resistor taking approximately 0,6 % of the current through the reactor. If iron-core reactors are used, the iron-core power losses of these reactors shall not exceed the losses that would be absorbed by the resistors connected in parallel with the air-cored reactors. There shall be one and only one point of the test circuit which is earthed; this may be the short-circuit link of the test circuit or the neutral point of the supply or any other convenient point. In any case the earthing method shall be stated in the test report.In each test circuit for testing the rated short-circuit capacity, the impedances Z are inserted between the supply source S and the circuit-breaker under test.When tests are made with current less than the rated short-circuit breaking capacity, the additional impedances Z 1 , shall be inserted on the load side of the circuit-breaker.For the tests at both the rated and the service short-circuit capacities, the circuit-breaker shall be connected with cables (rigid or flexible) having a length of 0,75 m per pole with the maximum cross-section, corresponding to the rated current, according to the rigid conductor column of Table 5.A resistor R2 of about 0,5 Ω is connected in series with the frame and further on with copper wire F to point of connection H: – for testing the single-pole circuit-breaker and two-pole circuit-breaker with one protected		P

<table>
<tr><th colspan="4">EN 60898-1&EN 60898-2</th></tr>
<tr><th>Clause</th><th>Requirement-Test</th><th>Result-Remark</th><th>Verdict</th></tr>
<tr><td></td><td>pole this connection H is linked to the neutral conductor point D, approximately for half number of operations of the circuit-breaker, and is connected for the remaining operations to the corresponding phase either point C or B.
– for testing either two-pole circuit-breaker with two protected poles, three-pole circuit-breaker, or four-pole circuit-breaker, this connection H is for all operations conducted to D.
The copper wire F shall be at least 50 mm in length and
– 0,1 mm in diameter for circuit-breakers to be tested in free air, mounted on a metal support,
– 0,3 mm in diameter for circuit-breakers to be tested in the smallest individual enclosure specified by the manufacturer.
Resistors R 1 drawing a current of 10 A per phase are connected on the supply side of the circuit-breaker, between the impedances for adjusting the prospective current to the rated short-circuit capacity of the circuit-breaker.</td><td></td><td>P</td></tr>
<tr><td>9.12.5</td><td>Power factor of the test circuit</td><td></td><td>P</td></tr>
<tr><td></td><td>The power factor of each phase of the test circuit shall be determined according to a recognized method which shall be stated in the test report.

Two examples are given in Annex A.

The power factor of a polyphase circuit is considered as the mean value of the power factors of each phase.

The power-factor ranges are given in Table 17.

Table 17 – Power factor ranges of the test circuit
<table><tr><th>Test current I_{cc} A</th><th>Corresponding power factor range</th></tr><tr><td>$I_{cc} \leq 1\,500$</td><td>0,93 to 0,98</td></tr><tr><td>$1\,500 < I_{cc} \leq 3\,000$</td><td>0,85 to 0,90</td></tr><tr><td>$3\,000 < I_{cc} \leq 4\,500$</td><td>0,75 to 0,80</td></tr><tr><td>$4\,500 < I_{cc} \leq 6\,000$</td><td>0,65 to 0,70</td></tr><tr><td>$6\,000 < I_{cc} \leq 10\,000$</td><td>0,45 to 0,50</td></tr><tr><td>$10\,000 < I_{cc} \leq 25\,000$</td><td>0,20 to 0,25</td></tr></table></td><td></td><td>P</td></tr>
<tr><td>9.12.6</td><td>Measurement and verification of I 2 t and of the peak current (I p)</td><td></td><td>P</td></tr>
<tr><td></td><td>The I 2 t and I p values shall be measured during the tests of 9.12.11.2, 9.12.11.3 and 9.12.11.4. In the case of tests of circuit-breakers in three-phase circuits, the I 2 t values shall be measured on each pole. The maximum I 2 t values measured shall be</td><td></td><td>P</td></tr>
</table>

EN 60898-1&EN 60898-2			
Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	recorded in the test report and they shall not exceed the corresponding values of the I 2 t characteristic declared by the manufacturer.		P
9.12.7	**Calibration of the test circuit**		P
9.12.7.1	To calibrate the test circuit, links G1, having negligible impedance compared with that of the test circuit, are connected in the positions shown in Figures 3 and 4.		P
9.12.7.2	To obtain a prospective current equal to the rated short-circuit capacity of the circuit-breaker at the corresponding power factor as stated in Table 16 impedances Z are inserted on the supply side of the links G1.		P
9.12.7.3	To obtain a test current lower than the rated short-circuit capacity of the circuit breaker, additional impedances Z1 are inserted on the load side of the links G1, as shown in figures 3 and 4.		P
9.12.8	**Interpretation of records**		P
9.12.8.1	**Determination of the applied and power frequency recovery voltages**		P
	The applied and power frequency recovery voltages are determined from the record corresponding to the opening operation O, (see 9.12.11.1) made with the apparatus under test Text deleted . The voltage on the supply side shall be measured during the first cycle after arc extinction in all poles and after high frequency phenomena have subsided.		P
9.12.8.2	**Determination of the prospective short-circuit current**		P
	The a.c. component of the prospective current is taken as being equal to the r.m.s. value of the a.c. component of the calibration current (values corresponding to A2 of Figure 6). Where applicable, the prospective short-circuit current shall be the average of the prospective currents in all the phases.		P
9.12.9	**Condition of the circuit-breaker for test**		P
9.12.9.1	**General**		P
	Circuit-breakers shall be tested in free air according to 9.12.9.2, unless they are designed for use only in enclosures specified by the manufacturer or they are intended for use in individual enclosures only, in which cases they shall be tested according to 9.12.9.3 or, with the agreement of the manufacturer, according to		P

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Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	9.12.9.2. A circuit-breaker tested according to 9.12.9.2 needs not be tested according to 9.12.9.3. NOTE An individual enclosure is an enclosure designed to accept one device only. The circuit-breaker shall be operated manually or by means of a test apparatus, simulating as closely as possible the normal closing operation. Care shall be taken that – the test apparatus does not damage the circuit-breaker under test; – the free movement of the operating means of the circuit-breaker under test is not impeded; – the speed of the operating means of the test apparatus is not unduly affected by the operating means of the circuit-breaker under test. In case of circuit-breakers with dependent manual operation, the circuit-breaker shall be operated with an operating speed, during actuation, of 0,1 m/s ± 25 %, this speed being measured where and when the operating means of the test apparatus touches the operating means of the circuit-breaker under test. For rotary knobs the angular velocity shall correspond substantially to the above conditions, referred to the speed of the operating means (at its extremities) of the circuit-breaker under test.		P
9.12.9.2	**Test in free air**		P
	The circuit-breaker under test is mounted as shown in Figure H.1. The polyethylene foil and the barrier of insulating material specified in Annex H are placed as shown in Figure H.1 for O operations only. The grid(s) specified in Annex H shall be so positioned that the bulk of the emitted ionized gases passes through the grid(s). The grid(s) shall be placed in the most unfavourable position(s).If the position of the vents is not obvious, or if there are no vents, appropriate information should be provided by the manufacturer. In case no information is available, two grids, one above and one below the circuit-breaker, shall be used. The grid circuit(s) (see Figure H.3) shall be connected to the points B and C according to the test circuit diagrams of Figures 3 or 4, as applicable; for the test of single-pole circuit- breakers having a rated voltage of 230/400 V the grid circuit(s) shall, however, be connected between phases, to the points B and C' according		P

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Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	to the test circuit diagram of Figure 3. The resistor R ′ shall have a resistance of 1,5 Ω . The copper wire F ′ (see Figure H.3) shall have a length of 50 mm and a diameter of 0,12 mm for circuit-breakers having a rated voltage of 230 V and 0,16 mm for circuit-breaker having a rated voltage of 400 V or 230/400 V. Text deleted For test currents up to and including 3 000 A the distance "a" shall be 35 mm. For higher short-circuit currents up to I cn , the distance "a" may be increased, in which case it shall be chosen from the series (40, 45, 50, 55, etc.) mm and stated by the manufacturer. For test currents greater than 1 500 A any additional barriers or insulating means which allow a shorter distance "a" shall also be stated by the manufacturer.		P
9.12.9.3	**Test in enclosures**		P
	The test shall be performed with the circuit-breaker placed in an enclosure having the most unfavourable configuration under the most unfavourable conditions. The grid and the barrier of insulating material shown in Figure H.1 are omitted. NOTE This means that if other circuit-breakers (or other devices) are normally mounted in the direction(s) in which the grid(s) would be placed, these circuit-breakers (or other devices) are installed there. They are supplied as in normal use, but via F′ and R′ as defined in 9.12.9.2, and connected as shown in the appropriate Figure (3 or 4).In accordance with the manufacturer's instructions, barriers or other means, or adequate clearances may be necessary to prevent ionized gases from affecting the installation. The polyethylene foil as described in Annex H is placed as shown in Figure H.1 at a distance of 10 mm from the operating means, for O operations only.		P
9.12.10	**Behaviour of the circuit-breaker during short-circuit tests**		P
	During the operating sequence of 9.12.11.2 or 9.12.11.3 or 9.12.11.4 the circuit-breaker shall not endanger the operator and shall permit reclosing after the time t as specified in 9.12.11.1, without removing it from the test arrangement. The polyethylene foil shall show no holes visible with normal or corrected vision without additional magnification.		P

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Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	Furthermore, there shall be no permanent arcing, no flashover between poles or between poles and frame, no melting of the fuse F and , where applicable, of the fuse F ′ .		P
9.12.11	**Test procedure**		P
9.12.11.1	**General**		P
	The test procedure consists of a sequence of operations. The following symbols are used for defining the sequence of operations: O represents an opening operation; CO represents a closing operation followed by an automatic opening; t represents the time interval between two successive short-circuit operations which shall be 3 min or such longer time as may be required by the thermal overcurrent release in order to permit the reclosing of the circuit-breaker. This longer time shall be indicated by the manufacturer. The actual value of t shall be stated in the test report. If the sample does not allow reclosing after the time indicated by the manufacturer it is considered as having failed the test. After arc extinction, the recovery voltage shall be maintained for a duration not less than 0,1 s.		P
9.12.11.2	**Tests at reduced short-circuit currents**		P
9.12.11.2 .1	**Test on all circuit-breakers**		P
	The additional impedances Z 1 (see 9.12.7.3) are adjusted so as to obtain a current of 500 A or 10 times I n , whichever is the higher, at a power factor between 0,93 and 0,98. Each of the protected poles of the circuit-breaker is subjected separately to a test in a circuit the connections of which are shown in Figure 3. The circuit-breaker is caused to open automatically nine times, the circuit being closed six times by the auxiliary switch A and three times by the circuit-breaker itself.		P

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Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	The sequence of operations shall be O – t – O – t – O – t – O – t – O – t- O – t – CO – t – CO – t – CO For the test the auxiliary switch A is synchronized with respect to the voltage wave so that the six points of initiation for the opening operations are equally distributed over the half-wave with a tolerance of ± 5°.		P
9.12.11.20.2	**Short-circuit test on circuit-breakers rated 230 V, or 240 V or 230/400 V for verifying their suitability for use in IT systems**		P
	The additional impedances Z 1 (see 9.12.7.3) are adjusted so as to obtain a current of 500 A or 1,2 times the upper limit of the standard range of instantaneous tripping given in Table 2, whichever is the higher, but not exceeding 2 500 A, at a power factor between 0,93 and 0,98, at a voltage 105 % of 400 V.For circuit-breakers having an instantaneous tripping value exceeding 20 I n , the impedances are adjusted as to obtain a current 1,2 times the upper limit of instantaneous tripping declared by the manufacturer, the 2 500 A limitation being disregarded. Single-pole circuit-breakers and each protected pole of multipole circuit-breakers are subjected individually to a test in a circuit the connections of which are shown in Figure 4.The sequence of operations shall be O – t – CO For the O operation on the first protected pole the auxiliary switch T is synchronized with respect to the voltage wave so that the circuit is closed on the point 0° ° (with a tolerance of ±5°) on the wave for this operation .For the following O operations on the other protected poles to be tested (see Clause C.2) this point is shifted each time by 30° with respect to the point on wave of the previous test, with a tolerance of ± 5°.		P
9.12.11.3	Test at 1 500 A		P
	For circuit-breakers having a rated short-circuit capacity of 1 500 A, the test circuit is calibrated according to 9.12.7.1 and 9.12.7.2, to obtain a current of 1 500 A at a power factor corresponding to this current according to Table 17. For circuit-breakers having a rated short-circuit capacity exceeding 1 500 A, the test circuit is		P

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Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	calibrated according to 9.12.7.1 and 9.12.7.3, at a power factor corresponding to 1 500 A, according to Table 17. The circuit breakers are tested in a circuit according to Figure 3. For three-pole circuit-breakers, no connection G1 is made between the neutral of the supply and the common point, if any, on the load side of the circuit-breaker. For four-pole circuit-breakers with three protected poles, the neutral of the supply is connected through the unprotected pole or the switched neutral pole to the common point on the load side of the circuit-breaker. If the neutral of a four-pole circuit-breaker is not marked by the manufacturer, the tests are repeated with three new samples, using successively each pole as neutral in turn. For the test of single-pole and two-pole circuit-breakers, the auxiliary switch T is synchronized with respect to the voltage wave so that the six points of initiation are equally distributed over the half-wave with a tolerance of ± 5°. The sequence of operations shall be as specified in 9.12.11.2, except for single-pole circuit breakers of rated voltage 230/400 V. In that case only two CO operations are performed following the six O operations; in addition single-pole circuit-breakers are then tested by performing simultaneously one O operation, one circuit-breaker being inserted in each phase of the test circuit specified for three-pole circuit-breakers (Figure 3), without synchronization of the auxiliary switch establishing the short-circuit. For three-pole and four-pole circuit-breakers, random point-on-wave testing is acceptable.		P
9.12.11.4	**Test above 1 500 A**		P
9.12.11.4 0.1	**Ratio k between service short-circuit capacity and rated short-circuit Capacity**		P
	The ratio k between the service short-circuit capacity and the rated short-circuit capacity shall be in accordance with Table 18.		P

<table>
<tr><th colspan="4">EN 60898-1&EN 60898-2</th></tr>
<tr><th>Clause</th><th>Requirement-Test</th><th>Result-Remark</th><th>Verdict</th></tr>
<tr><td></td><td>
Table 18 – Ratio k between service short-circuit capacity (I_{cs}) and rated short-circuit capacity (I_{cn})
<table>
<tr><th>I_{cn}</th><th>k</th></tr>
<tr><td>$I_{cn} \leq 6\,000$ A</td><td>1</td></tr>
<tr><td>6 000 A $< I_{cn} \leq 10\,000$ A</td><td>0,75 [a]</td></tr>
<tr><td>$I_{cn} > 10\,000$ A</td><td>0,5 [b]</td></tr>
<tr><td colspan="2">[a] Minimum value of I_{cs}: 6 000 A
[b] Minimum value of I_{cs}: 7 500 A</td></tr>
</table>
</td><td></td><td>P</td></tr>
<tr><td>9.12.11.4 .2</td><td>Test at service short-circuit capacity (I cs)</td><td></td><td>P</td></tr>
<tr><td></td><td>
a) The test circuit is calibrated according to 9.12.7.1 and 9.12.7.3, with a power factor in accordance with Table 17.
Three samples are tested in the relevant circuit specified in 9.12.11.3.
When the supply and load terminals of the circuit-breakers under test are not marked, two
of the samples are connected in one direction and the third sample in the reverse direction.
b) For single-pole and two-pole circuit-breakers the sequence of operation is: O – t – O – t – CO
For the O operations, the auxiliary switch A is synchronized with respect to the voltage wave so that the circuit is closed on the point 0° on the wave for the O operation on the first sample.
This point is then shifted by 45° for the second O operation on the first sample; for the second sample, the two O operations shall be synchronized at 15° and 60° and for the third sample at 30° and 75°.
The synchronization tolerance shall be ± 5°.
For two-pole circuit-breakers, the same pole shall be used as reference for the purpose of synchronization.
This test procedure is shown in Table 19.
c) For three-pole and four-pole circuit-breakers the sequence of operations is: O – t – CO – t – CO
For the O operations, the auxiliary switch A is synchronized with respect to the voltage wave so that the circuit is closed on any point (x°) on the wave for the O operation on the first sample.
Table 19 – Test procedure for I_{cs} in the case of single- and two-pole circuit-breakers
<table>
<tr><th rowspan="2">Operation</th><th colspan="3">Sample</th></tr>
<tr><th>1</th><th>2</th><th>3</th></tr>
<tr><td>1</td><td>O (0°)</td><td>O (15°)</td><td>O (30°)</td></tr>
<tr><td>2</td><td>O (45°)</td><td>O (60°)</td><td>O (75°)</td></tr>
<tr><td>3</td><td>CO</td><td>CO</td><td>CO</td></tr>
</table>
</td><td></td><td>P</td></tr>
</table>

<table>
<tr><th colspan="4">EN 60898-1&EN 60898-2</th></tr>
<tr><th>Clause</th><th>Requirement-Test</th><th>Result-Remark</th><th>Verdict</th></tr>
<tr><td></td><td>This point is then shifted by 60° for the O operation on the second sample and by a further
60° for the O operation on the third sample.
The synchronization tolerance shall be ± 5°. The same pole shall be used as reference for the purpose of synchronization for the different samples. This test procedure is shown in Table 20.

Table 20 – Test procedure for I_{cs} in the case of three- and four-pole circuit-breakers
<table><tr><th rowspan="2">Operation</th><th colspan="3">Sample</th></tr><tr><th>1</th><th>2</th><th>3</th></tr><tr><td>1</td><td>O (x°)</td><td>O (x°+60°)</td><td>O (x°+120°)</td></tr><tr><td>2</td><td>CO</td><td>CO</td><td>CO</td></tr><tr><td>3</td><td>CO</td><td>CO</td><td>CO</td></tr></table>
d) For single-pole circuit-breakers of rated voltage 230/400 V an additional set of three samples is tested in a circuit according to Figure 3 without N- connection .
These samples are inserted one in each phase of the test circuit, without synchronization of the auxiliary switch A establishing the short-circuit.
No connection shall be made between the neutral of the supply and the common point on the load side of the circuit-breakers.
The test procedure is shown in Table 21.
During this test the I^2t values need not be measured.

Table 21 – Test procedure for I_{cs} in the case of three-phase tests for single-pole circuit-breakers of rated voltage 230/400 V
<table><tr><th rowspan="2">Operation</th><th colspan="3">Sample</th></tr><tr><th>1</th><th>2</th><th>3</th></tr><tr><td>1</td><td>O</td><td>O</td><td>O</td></tr><tr><td>2</td><td>–</td><td>CO</td><td>O</td></tr><tr><td>3</td><td>O</td><td>–</td><td>CO</td></tr><tr><td>4</td><td>CO</td><td>O</td><td>–</td></tr></table></td><td></td><td>P</td></tr>
<tr><td>9.12.11.4 .3</td><td>Test at rated short-circuit capacity (I cn)</td><td></td><td>P</td></tr>
<tr><td></td><td>a) The test circuit is calibrated according to 9.12.7.1 and 9.12.7.2. Three samples are tested in the relevant circuit specified in 9.12.11.3.
When the supply and load terminals of the circuit-breakers under test are not marked, two
of the samples are connected in one direction and the third sample in the reverse direction.
The sequence of operations is O – t – CO
For the O operations, the auxiliary switch A is synchronized with respect to the voltage
wave so that the circuit is closed on the point 15° on the wave for the O operation on the
first sample.
This point is then shifted by 30° for the O operation of the second sample and by further
30° for the O operation of the third sample. The synchronization tolerance shall be ± 5°.</td><td></td><td>P</td></tr>
</table>

<table>
<tr><th colspan="4">EN 60898-1&EN 60898-2</th></tr>
<tr><th>Clause</th><th>Requirement-Test</th><th>Result-Remark</th><th>Verdict</th></tr>
<tr><td></td><td>For multipole circuit-breakers the same pole shall be used as reference for the purpose of
synchronization.
The test procedure is shown in Table 22.

Table 22 – The test procedure for I_{cn}
<table><tr><th rowspan="2">Operation</th><th colspan="3">Sample</th></tr><tr><th>1</th><th>2</th><th>3</th></tr><tr><td>1</td><td>O (15°)</td><td>O (45°)</td><td>O (75°)</td></tr><tr><td>2</td><td>CO</td><td>CO</td><td>CO</td></tr></table>
b) For single-pole circuit-breakers of rated voltage 230/400 V an additional set of four samples is tested in a circuit according to Figure 3 without N- connection .
Three of these samples are inserted one in each phase of the test circuit, without synchronization of the auxiliary switch A establishing the short-circuit.
No connection shall be made between the neutral of the supply and the common point on the load side of the circuit-breakers.
The test procedure is shown in Table 23.
After the second O operation of the sample shown as number 1 in Table 23 this sample shall be replaced by the fourth sample.
During this test the I^2t values need not be measured.

Table 23 – Test procedure for I_{cn} in the case of three-phase tests for single-pole circuit-breakers of rated voltage 230/400 V
<table><tr><th rowspan="2">Operation</th><th colspan="4">Sample</th></tr><tr><th>1</th><th>2</th><th>3</th><th>4</th></tr><tr><td>1</td><td>O</td><td>O</td><td>O</td><td>–</td></tr><tr><td>2</td><td>O</td><td>CO</td><td>–</td><td>–</td></tr><tr><td>3</td><td>–</td><td>–</td><td>CO</td><td>O</td></tr></table></td><td></td><td>P</td></tr>
<tr><td>9.12.11.4 0.4</td><td>Test at the making and breaking capacity on an individual pole (I cn1) of multipole circuit-breakers</td><td></td><td>P</td></tr>
<tr><td></td><td>The test circuit is calibrated according to 9.12.7.
The test is carried out on one pole taken at random which shall not be the switched neutral.
This pole is connected according to the diagram of Figure 3 , but with the neutral of the supply being connected directly downstream impedance Z1, so as to apply phase to neutral voltage to the tested pole.
In addition phases which do not carry the short-circuit current during this test shall be connected to their supply voltage at the corresponding terminals.
The sequence of operation is:
O – t – CO
For the " O " operations, the auxiliary switch T is synchronized with respect to the voltage wave so that the circuit is closed on the point 15° on the wave for the " O " operation on the first sample.
This point is then shifted by 30° for the " O "</td><td></td><td>P</td></tr>
</table>

EN 60898-1&EN 60898-2			
Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	operation on the second sample and by a further 30° for the " O " operation on the third sample. The synchronization tolerance shall be ± 5°. For the three- and four-pole circuit-breakers, the same pole shall be used as reference for the purpose of synchronization		P
9.12.12	**Verification of the circuit breaker after short circuit tests.:**		P
9.12.12.1	**Verifications after the tests at reduced short-circuit currents, at 1 500 A and at service short-circuit capacity**		P
	After the tests according to 9.12.11.2, 9.12.11.3 or 9.12.11.4.2, the circuit-breakers shall show no damage impairing their further use and shall, without maintenance, withstand the following tests. a) Leakage current across open contacts, according to 9.7.5.3. b) Dielectric strength tests according to 9.7.3, carried out between 2 h and 24 h after the short-circuit tests at a voltage of 500 V less than the value prescribed in 9.7.5 and without previous humidity treatment. After the test carried out under the conditions specified in item a) of 9.7.2, it shall be verified that the indicating means show the open position. During the test carried out under the conditions specified in item b) of 9.7.2 the indicating means shall show the closed position.c) Moreover, after the test of 9.12.11.3 or 9.12.11.4.2, the circuit-breakers shall not trip when a current equal to 0,85 times the conventional non-tripping current is passed through all poles for the conventional time, starting from cold. At the end of this verification the current is steadily increased, within 5 s, to 1,1 times the conventional tripping current. The circuit-breakers shall trip within the conventional time.		P P
9.12.12.2	**Verifications after the short-circuit test at rated short-circuit capacity**		P
	After the tests according to 9.12.11.4.3 and 9.12.11.4.4 the polyethylene foil shall show no holes visible with normal or corrected vision without additional magnification and the circuit-breakers shall show no damage impairing their further use and shall, without maintenance,		P

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Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	withstand the following tests: a) Leakage current across open contacts, according to 9.7.5.3. b) Dielectric strength tests according to 9.7.3, carried out between 2 h and 24 h after the short-circuit tests at a voltage of 900 V and without previous humidity treatment. After the test carried out under the conditions specified in item a) of 9.7.2, it shall be verified that the indicating means show the open position.During the test carried out under the conditions specified in item b) of 9.7.2 the indicating means shall show the closed position.c) Moreover the circuit-breakers shall trip within the time corresponding to the test c of Table 7 when a current equal to 2,8 In is passed through all poles, the lower time limit being 0,1 s instead of 1 s.The sample shown as number 1 in Table 23 is not subjected to the verification of thissubclause, but it shall nevertheless comply with the requirements of 9.12.10.		P
9.13	**Mechanical stresses**		P
9.13.1	**Mechanical shock**		P
	NOTE The mechanical shock test is intended to test the latching means of the circuit-breaker, not its mounting means.		P
9.13.1.1	**Test device**		P
	A wooden base A is fixed to a concrete block and a wooden platform B is hinged to base A. This platform carries a wooden board C, which can be fixed at various distances from the hinge and in two vertical positions. The end of board B bears a metal stop-plate D which rests on a coiled spring having a constant c of 25 N/mm. The circuit-breaker is secured to the vertical board in such a way that the distance of the horizontal axis of the sample is 180 mm from the platform, the vertical board being in turn so fixed that the distance of the mounting surface is 200 mm from the hinge, as shown in the Figure 7.On the surface C, opposite the mounting surface of the circuit-breaker, a supplementary mass is fixed so that the static force on the metal stop-plate is 25 N in order to ensure that the		P

EN 60898-1&EN 60898-2			
Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	moment of inertia of the complete system is substantially constant.		P
9.13.1.2	**Test procedure**		P
	With the circuit-breaker in the closed position, but not connected to any electrical source, the platform is lifted at its free end and then allowed to fall 50 times from a height of 40 mm, the interval between consecutive falls being such that the sample is allowed to come to rest. The circuit-breaker is then secured to the opposite side of the vertical board C and the platform is allowed to fall 50 times as before. After this test, the vertical board is turned through 90° about its vertical axis and, if necessary, repositioned so that the vertical axis of symmetry of the circuit-breaker is 200 mm from the hinge. The platform is then allowed to fall 50 times as before, with the circuit-breaker on one side of the vertical board, and 50 times with the circuit-breaker on the opposite side. Before each change of position, the circuit-breaker is manually opened and closed. During the tests, the circuit-breaker shall not open.		P
9.13.2	**Resistance to mechanical stresses and impact**		P
9.13.2.1	Compliance is checked on those exposed parts of the circuit-breaker mounted as for normal use (see note in 8.1.6), which may be subjected to mechanical impact in normal use, by the test of 9.13.2.2 for all types of circuit-breakers and, in addition, by the tests specified in: – 9.13.2.3 for screw-in type circuit-breakers; – 9.13.2.4 for circuit-breakers intended to be mounted on a rail and for all types of plug-in circuit-breakers designed for surface mounting; – 9.13.2.5 for plug-in type circuit-breakers, the holding in position of which depends solely on their connections. Circuit-breakers only intended to be totally enclosed are not submitted to this test.		P
9.13.2.2	The samples are subjected to blows by means of an impact-test apparatus as shown in Figure 9 to Figure 13. The head of the striking element has a hemispherical face of radius 10 mm and is of polyamide having a Rockwell hardness of HR 100.		P

EN 60898-1&EN 60898-2			
Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	The striking element has a mass of (150 ± 1) g and is rigidly fixed to the lower end of a steel tube with an external diameter of 9 mm and a wall thickness of 0,5 mm, which is pivoted at its upper end in such a way that it swings only in a vertical plane. The axis of the pivot is (1 000 ± 1) mm above the axis of the striking element.For determining the Rockwell hardness of the polyamide of the head of the striking element, the following conditions apply: - diameter of the ball: (12,7 ± 0,0025) mm, - initial load: (100 ± 2) N; - overload: (500 ± 2,5) N. NOTE 1 Additional information concerning the determination of the Rockwell hardness of plastics is given in ISO 2039-2.The design of the test apparatus is such that a force of between 1,9 N and 2,0 N has to be applied to the face of the striking element to maintain the tube in the horizontal position. Surface-type circuit-breakers are mounted on a sheet of plywood, 8 mm thick and 175 mm square, secured at its top and bottom edges to a rigid bracket, which is part of the mounting support, as shown in Figure 11. The mounting support shall have a mass of (10 ± 1) kg and shall be mounted on a rigid frame by means of pivots.The frame is fixed to a solid wall. Flush-type circuit-breakers are mounted in a device as shown in Figure 12, which in turn is fixed to the mounting support shown in Figure 11. Panel board type circuit-breakers are mounted in a device as shown in Figure 13, which in turn is fixed to the mounting support shown in Figure 11.Plug-in type circuit-breakers are mounted complete with the appropriate means for the plug-in connection, which means are fixed on the sheet of plywood for the surface-type, or in the device according to Figure 12 for the flush-type or Figure 13 for the panel-board-type, as applicable. Screw-in type circuit-breakers are mounted in their appropriate base which is fixed to a mounting square plate made of a plywood sheet, 8 mm thick and 175 mm sides.		P

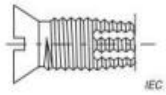
EN 60898-1&EN 60898-2			
Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	Circuit-breakers for screw fixing are fixed by means of screws. Circuit-breakers for rail mounting are mounted on their appropriate rail. Circuit-breakers intended both for screw fixing and for rail mounting shall be fixed with screws for the tests. The design of the test apparatus is such that – the sample can be moved horizontally and turned about an axis perpendicular to the surface of the plywood; – the plywood can be turned about a vertical axis. The circuit-breaker is mounted on the plywood or on the appropriate device as for normal use, with covers, if any, so that the point of impact lies in the vertical plane through the axis of the pivot of the pendulum. Cable entries which are not provided with knock-outs are left open. If they are provided with knock-outs, two of them are opened. Before applying the blows, fixing screws of bases, covers and the like are tightened with a torque equal to two-thirds of that specified in Table 11. The striking element is allowed to fall from a height of 10 cm onto surfaces which are exposed when the circuit-breaker is mounted as for normal use. The height of fall is the vertical distance between the position of a checking point when the pendulum is released and the position of that point at the moment of impact.The checking point is marked on the surface of the striking element where the line through the point of intersection of the axis of the steel tube of the pendulum and that of the striking element, and perpendicular to the plane through both axes, meets the surface. NOTE 2 Theoretically, the centre of gravity of the striking element is the checking point. As the centre of gravity is difficult to determine, the checking point is chosen as specified above. Each circuit-breaker is subjected to ten blows, two of them being applied to the operating means and the remainder being evenly distributed over the parts of the sample likely to be subjected to impacts.		P

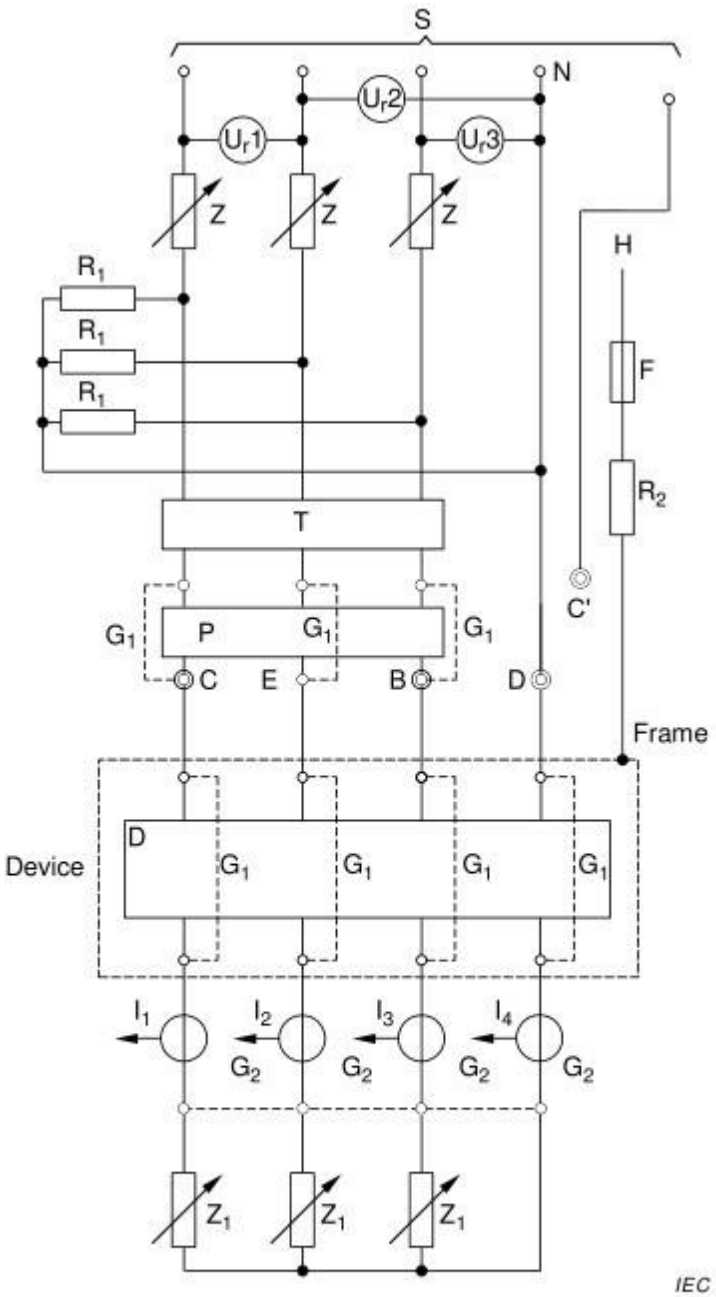
EN 60898-1&EN 60898-2			
Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	The blows are not applied to knock-out areas or to any openings covered by transparent material. In general, one blow is applied on each lateral side of the sample after it has been turned as far as possible, but not through more than 60°, about a vertical axis, and two blows are applied, each approximately midway between the blows on a lateral side and the blows on the operating means. The remaining blows are then applied in the same way, after the sample has been turned through 90° about that of its axes which is perpendicular to the plywood. If cable entries or knock-outs are provided, the sample is so mounted that the two lines of blows are as nearly as possible equidistant from these entries. Two blows shall be applied on the operating means as follows: one when the operating means is in the closed position and the other when it is in the open position. After the test the samples shall show no damage within the meaning of this standard. In particular covers which, when broken, make live parts accessible or impair the further use of the circuit-breaker, operating means, linings and barriers of insulating material and the like, shall not show such damage. In case of doubt, it shall be verified that removal and replacement of external parts, such as enclosures and covers, is possible without these parts or their lining being damaged. NOTE 3 Damage to the appearance, small dents which do not reduce the creepage distances or clearances below the values specified in 8.1 .3 and small chips which do not adversely affect the protection against electric shock are neglected.		P
9.13.2.3	Screw-in type circuit-breakers are screwed home in an appropriate base, a torque of 2,5 Nm being applied for 1 min. After the test the sample shall show no damage impairing its further use.		P
9.13.2.4	Circuit-breakers designed to be mounted on a rail are mounted as for normal use, but without cables being connected and without any cover or coverplate, on a rail rigidly fixed on a vertical rigid wall. Plug-in circuit-breakers designed for surface mounting are mounted complete with the appropriate means for the plug-in connection but without cables being connected and without any cover-plate.		P

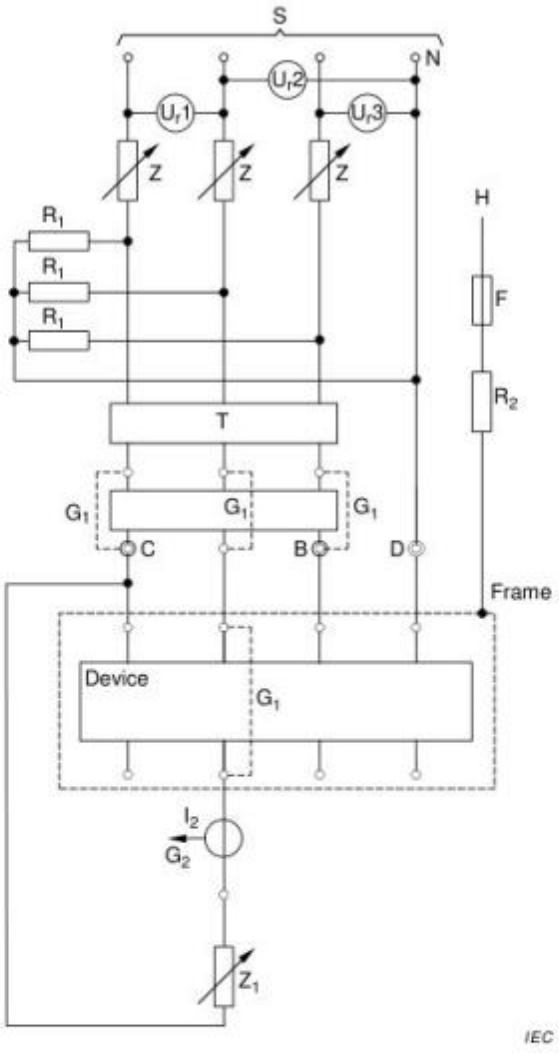
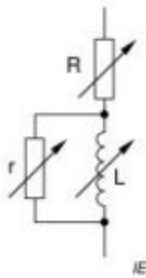
EN 60898-1&EN 60898-2			
Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	A downward vertical force of 50 N is applied without jerks for 1 min on the forward surface of the circuit-breaker, immediately followed by an upward vertical force of 50 N for 1 min (see Figure 14). During this test, the circuit-breaker shall not become loose and after the test the circuit- breaker shall show no damage impairing its further use.		P
9.13.2.5	Plug-in type circuit-breakers, the holding in position of which depends solely on their connections, are mounted, complete with the appropriate plug-in base but without cables being connected and without any cover-plate, on a vertical rigid wall. A force of 20 N is applied to the circuit-breaker portion at a point equidistant between the plug-in connections, without jerks for 1 min (see Figure 16). During this test the circuit-breaker portion shall not become loose and shall not move from the base portion and after the test both portions shall show no damage impairing their further use.		P
9.14	**Test of resistance to heat**		P
9.14.1	The samples, without removable covers, if any, are kept for 1 h in a heating cabinet at a temperature of (100 ± 2) °C; removable covers, if any, are kept for 1 h in the heating cabinet at a temperature of (70 ± 2) °C. During the test the samples shall not undergo any change impairing their further use and sealing compound, if any, shall not flow to such an extent that live parts are exposed. After the test and after the samples have been allowed to cool down to approximately room temperature, there shall be no access to live parts which are normally not accessible when the samples are mounted as for normal use, even if the standard test finger is applied with a force not exceeding 5 N. After the test, markings shall still be legible. Discoloration, blisters or a slight displacement of the sealing compound are disregarded, provided that safety is not impaired within the meaning of this standard.		P

EN 60898-1&EN 60898-2			
Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
9.14.2	External circuit-breaker parts made of insulating material necessary to retain in position current-carrying parts and parts of the protective circuit are subjected to a ball- pressure test by means of the apparatus shown in Figure 15 except that, where applicable, the insulating parts necessary to retain in position the terminals for protective conductors in a box shall be tested as specified in 9.14.3. The part to be tested is placed on a steel support with the appropriate surface in the horizontal position and a steel ball of 5 mm diameter is pressed against this surface with a force of 20 N. The test is made in a heating cabinet at a temperature of (125 ± 2) °C. After 1 h, the ball is removed from the sample which is then cooled down within 10 s to approximately room temperature by immersion in cold water.The diameter of the impression caused by the ball is measured and shall not exceed 2 mm.		P
9.14.3	External circuit-breaker parts made of insulating material not necessary to retain in position current-carrying parts and parts of the protective circuit, even though they are in contact with them, are subjected to a ball-pressure test in accordance with 9.14.2, but the test is made at a temperature of (70 ± 2) °C, or (40 ± 2) °C plus the highest temperature rise, determined for the relevant part during the test of 9.8, whichever is the higher. NOTE 1 Void NOTE 2 The tests of 9.1 4.2 and 9.1 4.3 are not made on parts of ceramic material. NOTE 3 If two or more of the insulating parts referred to in 9.1 4.2 and 9.1 4.3 are made of the same material, the test according to 9.1 4.2 or 9.1 4.3, as applicable, is carried out on only one of these parts.		P
9.15	Resistance to abnormal heat and to fire		P
	The glow-wire test is performed on a complete circuit breaker in accordance with IEC 60695-2-10 under the following conditions: – for external parts of circuit-breakers made of insulating material necessary to retain in position current-carrying parts and parts of the protective circuit, by the test made at a temperature of (960 ± 15) °C; – for all other external parts made of insulating		P

EN 60898-1&EN 60898-2			
Clause	Requirement-Test	Result-Remark	Verdict
	material, by the test made at a temperature of (650 ± 10) °C.Text deleted Small parts, where each surface lies completely within a circle of 15 mm diameter, or where any part of the surface lies outside a 15 mmdiameter circle and it is not possible to fit a circle of 8 mm diameter on any of the surfaces, are not subjected to the test of this subclause (see Figure 17 for diagrammatic representation). If a number of insulating parts is made of the same material, the test is carried out only on one of these parts, according to the appropriate glow-wire test temperature.The test is not made on parts of ceramic material. The glow-wire test is applied to ensure that an electrically heated test wire under defined test conditions does not cause ignition of insulating parts, or to ensure that a part of insulating material, which might be ignited by the heated test wire under defined conditions, has a limited time to burn without spreading fire by flame or burning parts or droplets falling down from the tested part.The test is made on three samples, points of application of glow wire test being different from one sample to another one. The glow wire cannot be applied directly to terminals area or arc chamber or magnetic tripping device area, where the glow-wire cannot protrude far through the outer surface before touching either relatively big metal parts or even ceramics, which will cool down the glow-wire quickly and in addition limit the amount of insulating material ever getting in touch with the glow-wire. In this situation the parts ensure minimum severity of the test by cooling down the glow-wire and limiting access to the insulating material under test.The sample shall be positioned during the test in the most unfavourable position of its intended use (with the surface tested in a vertical position). If an internal part of insulation material influences the test with negative result, it is allowed to remove the relevant identified internal part(s) of insulation material from a new sample. Then, the glow wire test shall be repeated at the same place on this new sample.		P

EN 60898-1&EN 60898-2			
Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	In accordance with the manufacturer, it is acceptable as an alternative method to remove the part under examination in its entirety and test it separately (see IEC 60695-2-11:2000, Clause 4). The sample is regarded as having passed the glow-wire test if – either there is no visible flame and no sustained glowing, – or flames and glowing on the sample extinguish themselves within 30 s after the removal of the glow-wire. There shall be no ignition of the tissue paper or scorching of the pinewood board.		P
9.16	**Test of resistance to rusting**		P
	All grease is removed from the parts to be tested by immersion in a cold chemical degreaser such as methyl-chloroform or refined petrol, for 10 min. The parts are then immersed for 10 min in a 10 % solution of ammonium chloride in water at a temperature of (20 ± 5) °C. *Without drying, but after shaking off any drops, the parts are placed for 10 min in a box containing air saturated with moisture at a temperature of (20 ± 5) °C.* *After the parts have been dried for 10 min in a heating cabinet at a temperature of (100 ± 5) °C, their surfaces shall show no signs of rust.* NOTE Traces of rust on sharp edges and any yellowish film removable by rubbing are ignored. *For small springs and the like and for inaccessible parts exposed to abrasion, a layer of grease may provide sufficient protection against rusting. Such parts are only subjected to the test if there is a doubt as to the effectiveness of the grease film, and in such a case the test is made without previous removal of the grease.*  **Figure 1 – Thread forming tapping screw (3.3.22)**  **Figure 2 – Thread cutting tapping screw (3.3.23)**		P

EN 60898-1&EN 60898-2			
Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	 **Figure 3 – Typical diagram for all short circuit tests except for 9.12.11.2.2)**		P

EN 60898-1&EN 60898-2			
Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	 **Figure 4 – Typical diagram for short circuit tests according to 9.12.11.2.2)**  **Figure 5 – Detail of impedance Z and Z_1**		P

EN 60898-1&EN 60898-2			
Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
			P

Explanation of letter symbols used in Figures 3, 4 and 5

N	=	Neutral conductor
S	=	Supply
R	=	Adjustable resistor(s)
Z	=	Impedance in each phase for the calibration of the rated short-circuit current. The reactors shall preferably be air-cored and connected in series with resistors in order to obtain the required power factor.
Z_1	=	Adjustable impedance to obtain current below the rated short-circuit current
frame	=	All conductive parts normally earthed in service, including FE, if any
G_1	=	Temporary connection(s) for calibration
G_2	=	Connection(s) for the test with rated short-circuit current
T	=	Making switch for the short-circuit
I_1, I_2, I_3, I_4	=	Current sensor(s) May be situated on the supply or on the load side of device under test, but always on the secondary side of the transformer
Ur_1, Ur_2, Ur_3	=	Voltage sensor(s)
F	=	Copper wire for the detection of a fault current
R_1	=	Resistance drawing a current of approximately 10 A per phase
R_2	=	Resistor limiting the current in the device F
r	=	Resistor(s) taking approximately 0,6 % of the current
B, C and C'	=	Points for the connections of the grid(s) shown in Annex C
L	=	Adjustable air cored inductance(s)
P	=	Short circuit protective device for test according to Annex D

NOTE 1 The closing device T can alternatively be situated between the load side terminals of the device under test and current sensors I_1, I_2 and I_3 as applicable.

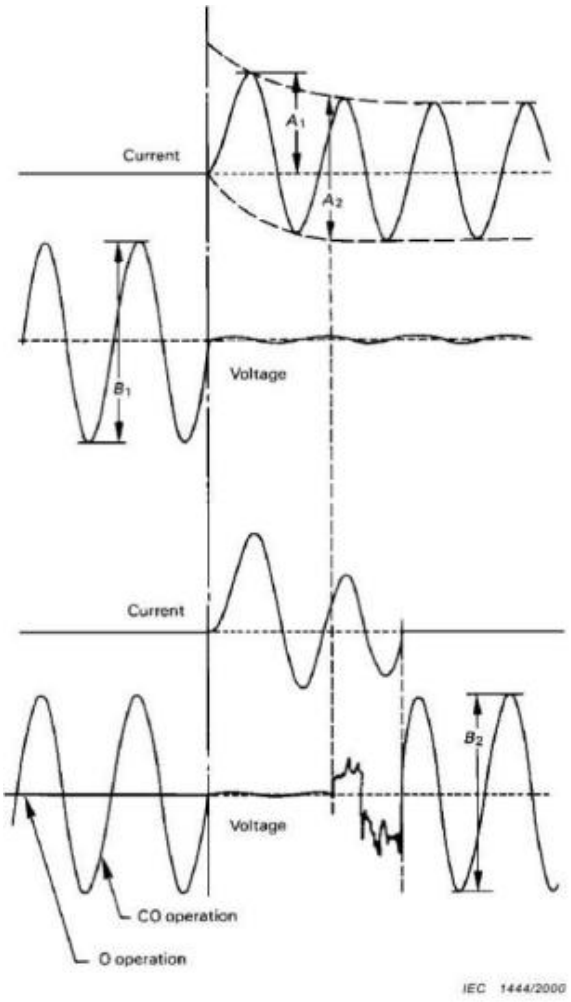
NOTE 2 The voltage sensors Ur_1, Ur_2 and Ur_3 are connected between phase and neutral, as necessary.

NOTE 3 The adjustable load Z can be located at the high-voltage side of the supply circuit.

NOTE 4 Resistances R_1 can be omitted with the agreement of the manufacturer.

NOTE 5 0,5 m are connected on the supply side and 0,25 m on the load side of the circuit-breaker under test.

EN 60898-1&EN 60898-2			
Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
			P



a) = *Calibration of circuit*

A_1 = Prospective peak making current

$\frac{A_2}{2\sqrt{2}}$ = Prospective symmetrical breaking current (r.m.s. value)

$\frac{B_1}{2\sqrt{2}}$ = Applied voltage (r.m.s. value) (see 3.5.7)

b) = *O or CO operation*

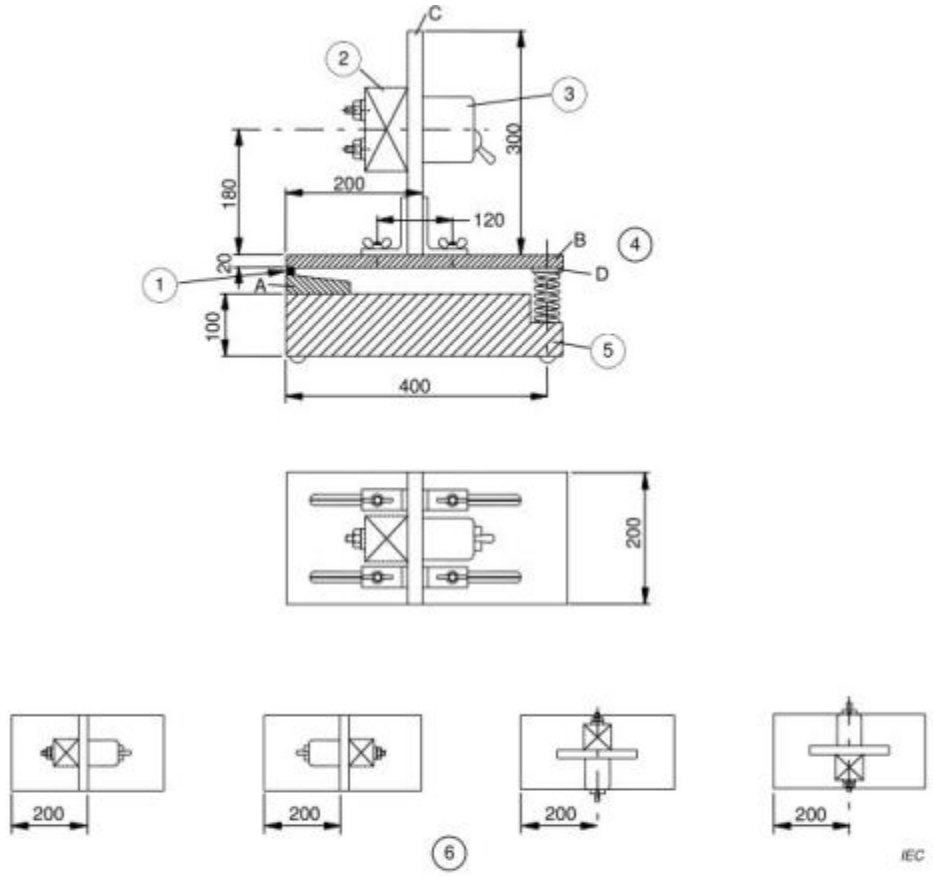
$\frac{A_2}{2\sqrt{2}}$ = Breaking capacity (r.m.s. value)

A_1 = Making capacity (peak value)

$\frac{B_2}{2\sqrt{2}}$ = Recovery voltage (r.m.s. value) (see 3.5.8)

Figure 6 — Calibration of the test circuit

EN 60898-1&EN 60898-2			
Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
			P



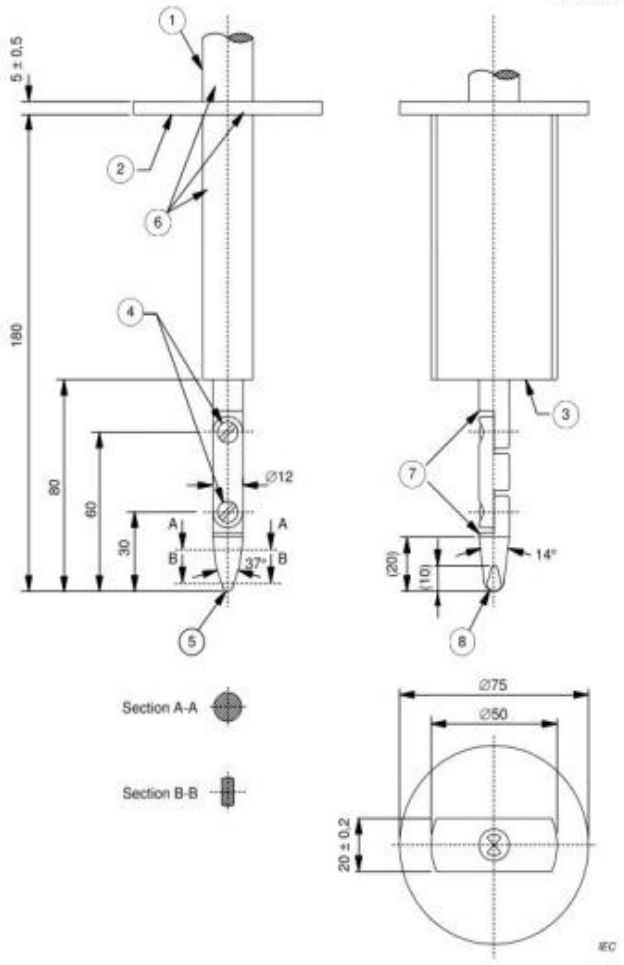
Key

1 Hinge
2 Additional mass
3 Sample
4 Metal stop plate
5 Concrete block
6 Consecutive test positions

Figure 7 – Mechanical shock test apparatus (9.13.1)

EN 60898-1&EN 60898-2			
Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
			P

Dimensions in millimetres



Key

1 Handle
2 Guard
3 Stop face
4 Joints
5 R2 ± 0,05 cylindrical
6 Insulating material
7 Chamfer all edges
8 R4 ± 0,05 spherical

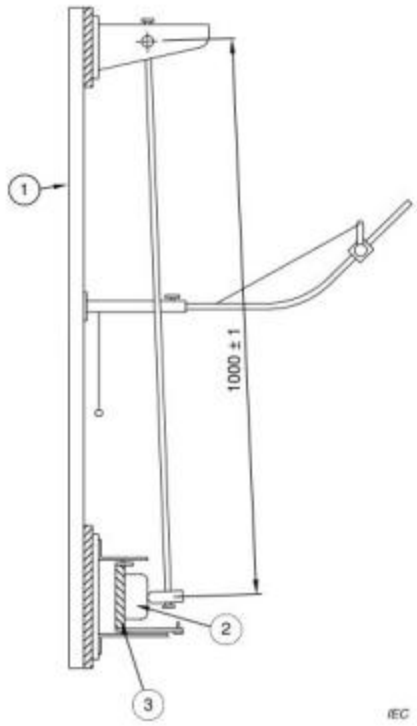
Material : metal, except where otherwise specified
Tolerances on dimensions without specific tolerance:
on angles: $^{0}_{-10}$
on linear dimensions:
up to 25 mm: $^{0}_{-0,05}$
over 25 mm: ±0,2

Both joints shall permit movement in the same plane and the same direction through an angle of 90° with a tolerance of $^{+10}_{0}$°.

Figure 8 – Standard test finger (9.6)

EN 60898-1&EN 60898-2			
Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
			P

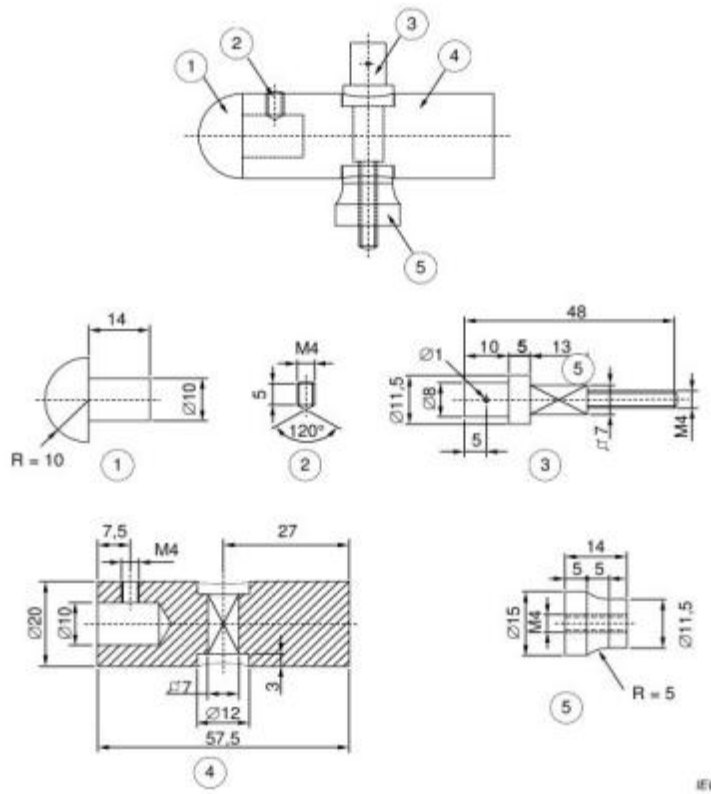
Dimensions in millimetres



Key
1 Frame
2 Sample
3 Mounting support

Figure 9 – Mechanical impact test apparatus (9.13.2)

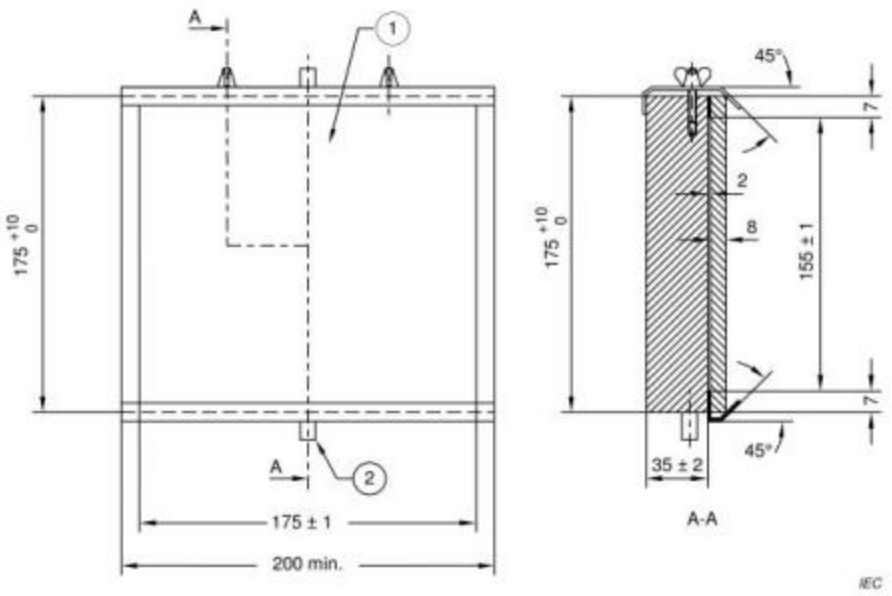
EN 60898-1&EN 60898-2			
Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
			P



Key

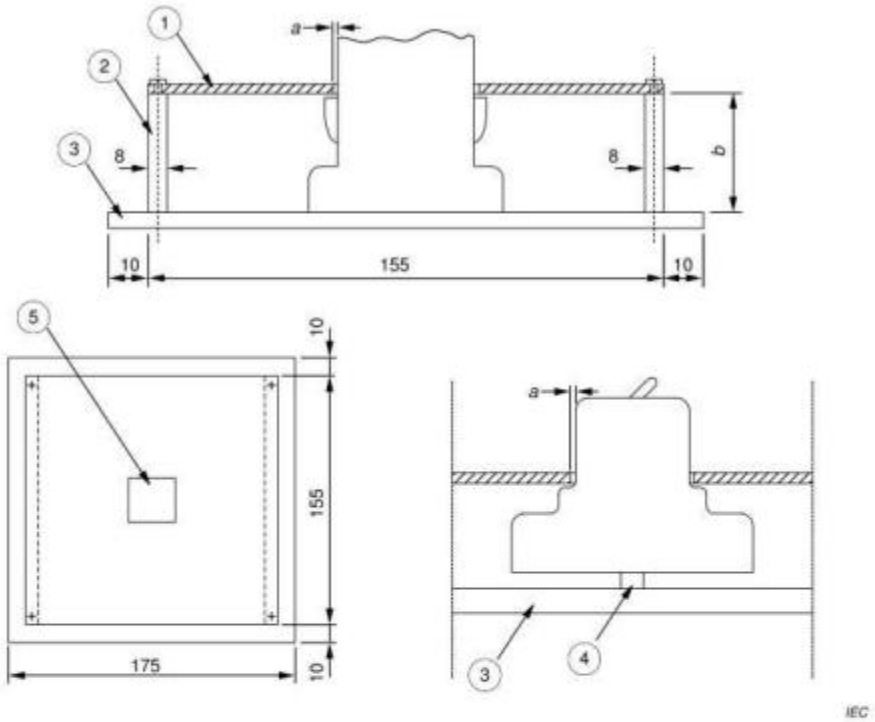
1	Polyamide
2, 3, 4, 5	Steel Fe 360

Figure 10 – Striking element for pendulum for mechanical impact test apparatus (9.13.2)

EN 60898-1&EN 60898-2			
Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
	Dimensions in millimetres  **Key** 1 Sheet of plywood 2 Pivot **Figure 11 – Mounting support for mechanical impact test (9.13.2)**		P

EN 60898-1&EN 60898-2			
Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
			P

Dimensions in millimetres



Key

1 Interchangeable steel plate with a thickness of 1 mm

2 Aluminium plates with a thickness of 8 mm

3 Mounting plate

4 Rail for circuit-breakers designed for rail mounting

5 Cut-out for the circuit-breaker in the steel plate

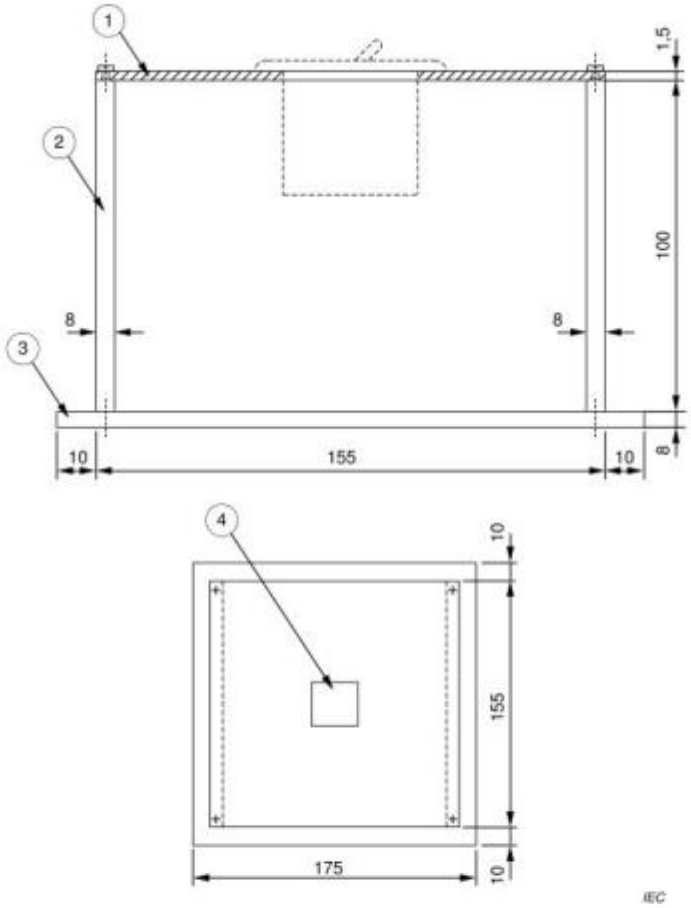
a the distance between the edges of the cut-out and the faces of the circuit-breaker shall be between 1 mm and 2 mm

b the height of the aluminium plates shall be such that the steel plate rests on the supports of the circuit-breaker or, if the circuit-breaker has no such support, the distance from live parts, which are to be protected by an additional cover plate, to be on the underside of the steel, is 8 mm.

Figure 12 – [C] Examples of mounting of a flush type circuit-breaker for mechanical impact test [C]

EN 60898-1&EN 60898-2			
Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
			P

Dimensions in millimetres



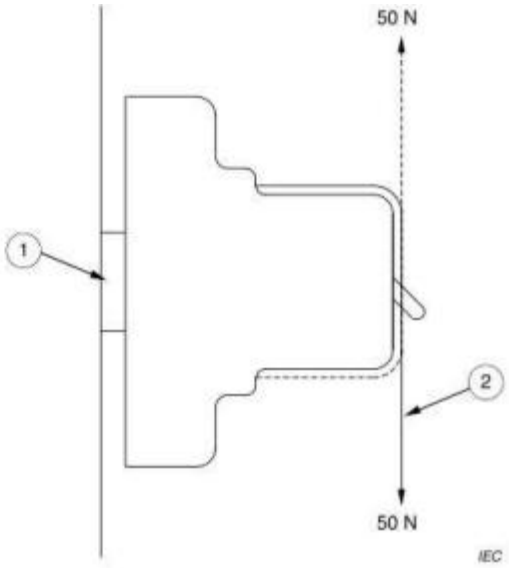
Key

1 Interchangeable steel plate with a thickness of 1,5 mm
2 Aluminium plates with a thickness of 8 mm
3 Mounting plate
4 Cut-out for the circuit-breaker in the steel plate

NOTE In particular cases the dimensions can be increased.

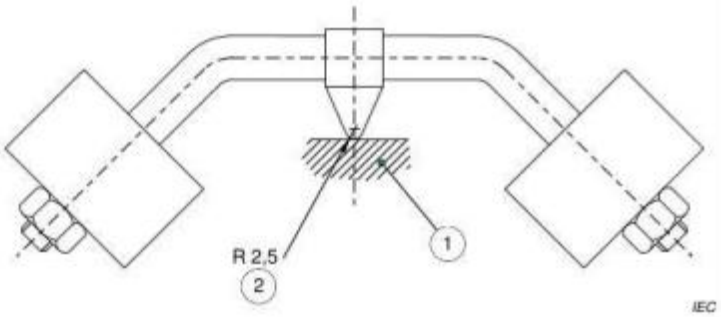
Figure 13 – Example of mounting of a panel board type circuit-breaker for mechanical impact test (9.13.2)

EN 60898-1&EN 60898-2			
Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
			P



Key
1 Rail
2 Cord

Figure 14 – Application of force for mechanical test on a rail-mounted circuit-breaker (9.13.2.4)



Key
1 Sample
2 Spherical

Figure 15 – Ball-pressure test apparatus

EN 60898-1&EN 60898-2			
Clause	**Requirement-Test**	**Result-Remark**	**Verdict**
			P

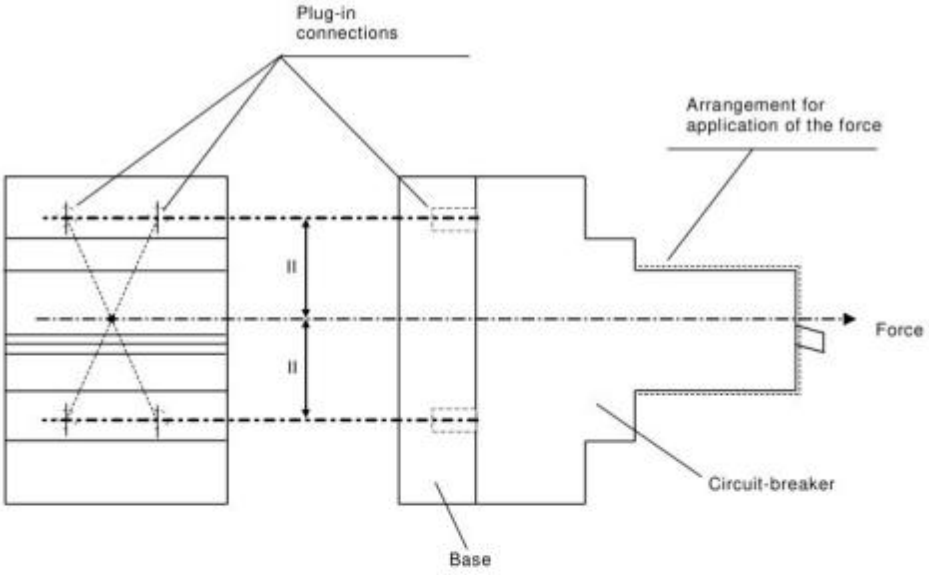
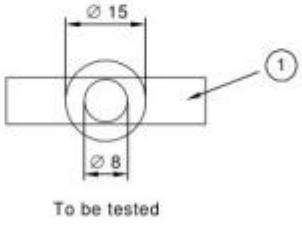
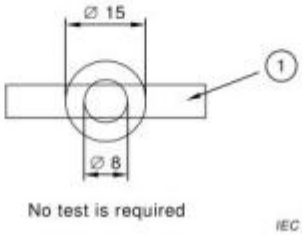


Figure 16 – Example of application of force for mechanical test on two-pole plug-in circuit-breaker, the holding in position of which depends solely on the plug-in connections (9.13.2.5)

Dimensions in millimetres





Key
1 Sample

Figure 17 – Diagrammatic representation (9.15)

Annex 1: Photo docume

Photo 1 General Appearance of the EUT

Photo 2 General Appearance of the EUT

End of the report