



Test Report issued under the responsibility of:



TEST REPORT
IEC 60947-2
Low-voltage switchgear and controlgear - Part 2: Circuit-breakers

Report Reference No. : 2168756.51

Date of issue : 2014-11-25

Total number of pages : 39

CB Testing Laboratory : DEKRA Certification B.V.

Address : Meander 1051, 6825 MJ Arnhem, The Netherlands

Applicant's name : LSIS Co. Ltd.

Address : 127, LS-ro, Dongan-gu, Anyang-si, Gyeonggi-do, Korea

Test specification:

Standard..... : IEC/EN 60947-2:2006 (Fourth Edition) + A1: 2009 + A2: 2013

Test procedure : CB scheme

Non-standard test method..... : N/A

Test Report Form No. : IEC60947_2G

Test Report Form(s) Originator : DEKRA Certification BV

Master TRF : Dated 2013-11

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Test item description : Moulded-case circuit-breaker

Trade Mark..... : LS

Manufacturer : LSIS Co., Ltd.

Model/Type reference : TD100 E, TD100 N, TD100 S, TD100 H, TD100 P, TD100 L
TD160 E, TD160 N, TD160 S, TD160 H, TD160 P, TD160 L

Ratings : TD100 E/N/S/H/P/L : 16, 20, 25, 32, 40, 50, 63, 80, 100 A
TD160 E/N/S/H/P/L : 16, 20, 25, 32, 40, 50, 63, 80, 100, 125, 160 A

Testing procedure and testing location:		
<input type="checkbox"/>	CB Testing Laboratory:	
Testing location/ address..... :		
Tested by (name + signature)		
Approved by (name + signature)		
<input type="checkbox"/>	Testing procedure: TMP	
Testing location/ address..... :		
Tested by (name + signature)		
Approved by (name + signature)		
<input checked="" type="checkbox"/>	Testing procedure: WMT	
Testing location/ address..... :		LSIS Co., Ltd. CheongJu Plant, 95, Baekbong-ro, Heungdeok-gu, Cheongju-si, Chungcheongbukdo, Korea,
Tested by (name + signature)		Mr.Oh Jun-Sik
Witnessed by (name + signature)		H.G.M. Kormelink
Approved by (name + signature)		H.L. Schendstok
<input type="checkbox"/>	Testing procedure: SMT	
Testing location/ address..... :		
Tested by (name + signature)		
Approved by (name + signature)		
Supervised by (name + signature)....		

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

Summary of testing:

The product has been certified under CB certificate number NL-11135 dated 2006-9-14. A spot check has been performed on the 3 pole device according the latest standard.

Sequence II and sequence III has been performed according amendment A2 of the standard.

In case of alternative test programs for circuit breakers with a different number of poles, the following program is used:

- ☐ Programme 1 (three pole fully tested)
☐ Programme 2 (four pole fully tested)
☒ Alternative program not applicable

Tests performed (name of test and test clause):

Sequence II&III

Testing location:

LSIS Co., Ltd. CheongJu Plant,
95, Baekbong-ro, Heungdeok-gu,
Cheongju-si, Chungcheongbukdo, Korea, 361-720
Power Testing & Technology Institute (PT&T)

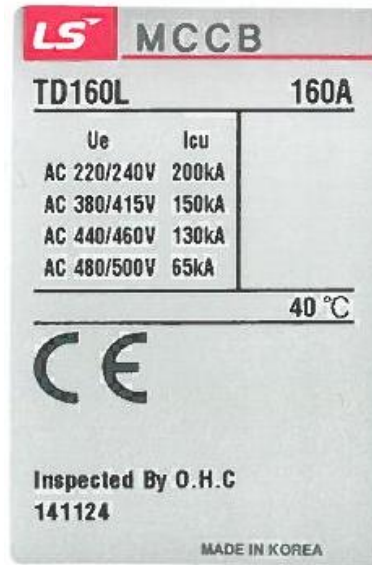
Summary of compliance with National Differences

List of countries addressed: N.A.

Copy of marking plate:

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

Name plate:



Marking plate on product:



Test item particulars: test item vs. test requirements	
3. Classification	
3.1. Utilization category: (A or B).....	A
3.2. Interruption medium: (air, vacuum, gas Break)	Air
3.3. Design: (open construction, moulded case)	Moulded case
3.4. Method of controlling the operation mechanism: (dependent manual, independent manual, dependent power, independent power).....	Independent manual operation
3.5. Suitability for insulation: (suitable, not -suitable)	Suitable
3.6. Provision for maintenance: (maintainable, non- maintainable).....	Maintainable
3.7. Method of installation: (fixed, plug in, withdrawable	Fixed
3.8. Degree of protection: (IP code)	IP20
4.7. Type of release (thermo-magnetic / electronic)	Thermo-magnetic
4.8. Integral fuses (integrally fused circuit-breakers) Type and characteristics of SCPD	N/A
7.3 Electromagnetic compatibility (EMC) Environment A or B.....	N/A
Circuit-breaker for use on phase-earthed systems	N/A
Circuit-breaker for use in IT systems	P
Rated and limiting values, main circuit	
- rated operational voltage: Ue (V)	AC 220, 240, 380, 415, 440, 460, 480 and 500 V
- rated insulation voltage: Ui (V)	AC 750 V
- rated impulse withstand voltage: Uimp (kV)	8 kV
- rated operational current: Ie (A)	16,20,25,32,40,50,63,80,100,125 and 160 A
- kind of current	A.C.
- conventional free air thermal current: Ith (A)	16,20,25,32,40,50,63,80,100,125 and 160 A
- conventional enclosed thermal current: Ithe (A).....	N/A
- current rating for four-pole circuit-breakers: (A)	N/A
- number of poles.....	3
- rated frequency: (Hz).....	50/60 Hz
- integral fuses (rated values).....	N/A
Rated duty :	
- eight-hour duty.....	N/A
- uninterrupted duty: Iu (A).....	160 A
Short-circuit characteristic :	

rated short-time making capacity: I_{cm} (kA)	440 kA
rated ultimate short-circuit breaking capacity: I_{cu} (kA).	200 kA-220&240V, 150 kA-380&415 V, 130 kA-440&460V, 65 kA-480&500 V
rated service short-circuit breaking capacity: I_{cs} (kA)	100% I_{cu}
rated short-time withstand current: I_{cw} (kA/s)	N/A
Control circuits :	
Electrical control circuits :	
- kind of current: (AC, DC)	N/A
- rated frequency: (Hz)	N/A
- rated control circuit voltage: U_c (nature, frequency, V) ...	N/A
- rated control supply voltage: U_s (nature, frequency V) ...	N/A
Air supply control circuits: (pneumatic or electro-pneumatic) :	
- rated pressure and its limit	N/A
- volumes of air, at atmospheric pressure, required for each closing and each opening operation	N/A
Auxiliary circuits :	
Rated and limiting values, auxiliary circuits	
- rated operational voltage U_e (V)	N/A
- rated insulation voltage: U_i (V)	N/A
- rated operational current: I_e (A)	N/A
- kind of current	N/A
- rated frequency: (Hz)	N/A
- number of circuits	N/A
- number and kind of contact elements	N/A
- rated uninterrupted current: I_u (A)	N/A
- utilization category: (AC, DC, current and voltage)	N/A
Short-circuit characteristic :	
- Rated conditional short-circuit current (kA)	N/A
- kind of protective device	N/A

Releases :	
1) shunt release	N/A
2) Over-current release	See Remarks
a) instantaneous	P
b) definite time delay.....	N/A
c) inverse time delay.....	P
- independent of previous load.....	N/A
- dependent on previous load; (for example thermal type release)	P
3) Undervoltage release (for opening)	N/A
4) Other releases	N/A
Characteristics :	
1) Shunt release and undervoltage release (for opening)....:	
- rated control circuit voltage: U_c (nature, frequency, V)	N/A
- kind of current	N/A
- rated frequency: (if AC)	N/A
2) Over-current release	
- rated current.....	16,20,25,32,40,50,63,80,100,125 and 160 A
- kind of current	AC
- rated frequency: (if AC)	50/60 Hz
- current setting (or range of settings)	0,8 ~ 1,0 I_n
- time settings (or range of settings).....	N/A

Classification of installation and use..... :

Supply Connection :

..... :

..... :

Possible test case verdicts:

- test case does not apply to the test object..... : N/A

- test object does meet the requirement..... : P (Pass)

- test object does not meet the requirement..... : F (Fail)

Testing

Date of receipt of test item : January 5th, 2014

Date (s) of performance of tests : February 3rd, 2014 ~ July 28th, 2014

General remarks:

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

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

"(See Enclosure #)" refers to additional information appended to the report.

"(See appended table)" refers to a table appended to the report.

Throughout this report a ☒ comma / ☐ point is used as the decimal separator.

Manufacturer's Declaration per sub-clause 4.2.5 of IEC60947-2:

The application for obtaining a CB Test Certificate ☐ Yes
includes more than one factory location and a ☒ Not applicable
declaration from the Manufacturer stating that the
sample(s) submitted for evaluation is (are)
representative of the products from each factory
has been provided..... :



When differences exist; they shall be identified in the General product information section.

Name and address of factory (ies)..... : LSIS Co., Ltd. Cheongju Plant
95, Baekbong-ro, Heungdeok-gu, Cheongju-si,
Chungcheongbuk-do, Korea, Republic

General product information:


See report 2086029.50

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5.2	MARKING	
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.	
	- rated current:	16, 20, 25, 32, 40, 50, 63, 80, 100, 125 and 160 A
	- suitability for isolation, if applicable, with the symbol 	Compliance
	- indication of the open and closed position: with \bigcirc and I respectively, if symbols are used	Compliance
b)	Marking on equipment not needed to be visible after mounting:	
	- manufacturer's name or trademark	LS
	- type designation or serial number	TD100 E, TD100 N, TD100 S, TD100 H, TD100 P, TD100 L, TD160 E, TD160 N, TD160 S, TD160 H, TD160 P, TD160 L
	- IEC 60947-2 if the manufacturer claims compliance with this standard.	IEC 60947-2
	- utilization category	A
	- rated operational voltage(s) U_e	500V
	- 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	Compliance
	- value (or range) of the rated frequency and/or the indication DC (or symbol)	50/60 Hz
	- rated service short-circuit breaking capacity. I_{cs}	200 kA
	- rated ultimate short-circuit breaking capacity. I_{cu}	200 kA
	- rated short-time withstand current, (I_{cw}) and associated short-time delay, for utilization category B	-
	- line and load terminals, unless their connection is immaterial	-
	- neutral pole terminals, if applicable, by the letter N	-
	- protective earth terminal, where applicable, by the symbol acc. 7.1.9.3 of part 1	-

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	- ref. temperature for non-compensated thermal releases, if different from 30°C	40 °C	P
	- range of the current setting (I _r) of adjustable overload release	Compliance	P
	- value / range of the rated instantaneous short-circuit current setting (I _i), fixed or adjustable	Compliance	P
c)	Marked on the circuit-breaker as specified in item b), or shall be made available in the manufacturer's published information:		
	- rated short-circuit making capacity (I _{cm}) (if higher than specified in 4.3.5.1)	440 kA	P
	- rated insulation voltage. (U _i) if higher than the maximum rated operational voltage)	750 V	P
	- rated impulse withstand voltage (U _{imp}), when declared.	8 kV	P
	- pollution degree if other than 3	-	N/A
	- conventional enclosed thermal current (I _{the}) if different from the rated current:	-	N/A
	- IP Code, where applicable:	IP20	P
	- minimum enclosure size and ventilation data (if any) to which marked ratings apply:	-	N/A
	- details of minimum distance between circuit-breaker and earthed metal parts for circuit-breaker intended for use without enclosure:	Compliance	P
	- r.m.s sensing if applicable, according to F.4.1.1	-	N/A
	- suitability for environment A or B	A	P
	- minimum cable cross-section, if different from Table 9 of IEC 60947-1, for ratings ≤ 20 A according to rated ultimate short-circuit breaking capacity I _{cu} ;	-	N/A
	- values of tightening torque for the circuit-breaker terminals.	Compliance	P
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:		
	- rated control circuit voltage of the closing device, and rated frequency for AC:	-	N/A
	- rated control circuit voltage of the shunt release and/or of the under-voltage release, and rated frequency:	-	N/A
	- rated current of indirect over-current releases:	-	N/A

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	- 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.	-	N/A
e)	Terminal shall be clearly and permanently identified in acc. with IEC 60445 and annex L :		
	- line terminal	-	N/A
	- load terminal	-	N/A
	- neutral pole terminal "N"	-	N/A
	- protective earth terminal 	-	N/A
	- terminal of coils (A/B)	-	N/A
	- terminal of shunt release (B)	-	N/A
	- terminals of under-voltage release (D)	-	N/A
	- terminals of interlocking electromagnets (E)	-	N/A
	- terminals of indicated light devices (X)	-	N/A
	- terminals of contact elements for switching devices (no)	-	N/A

7.1	CONSTRUCTION		
7.1.1	Withdrawable circuit-breaker	-	N/A
	In the disconnected position (main- and auxiliary circuits)		
	Isolating distances for circuit-breaker suitable for isolating warranted:	-	N/A
	Mechanism fitted with a reliable indicating device with indicates the position of the isolating contacts.	-	N/A
	Mechanism fitted with interlocks which only permit the isolating contacts to be separate or re-closed when main contacts are open	-	N/A
	Mechanism fitted with interlock, which only permit the main contacts to be closed when the isolating contacts are fully closed.	-	N/A
	Mechanism fitted with interlock, which only permit the main contacts to be closed when in disconnected position.	-	N/A
	The isolating distances between the isolating contacts cannot be inadvertently reduced.	-	N/A
7.1.2.1 part 1	Resistance to abnormal heat and fire	650 °C 960 °C	P


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7.1.3 part 1	Current-carrying parts and their connection	Compliance	P
7.1.4	Clearances and creepage distances:		
	For circuit-breakers for which the manufacturer has declared a value of rated impulse withstand voltage. (Uimp.)		
	Clearances distances:		
	- Uimp is given as:	8 kV	
	- max. value of rated operational voltage to earth	289 V	
	- nominal voltage of supply system:	500 V	
	- overvoltage category:	IV	
	- pollution degree:	3	
	- field-in or homogeneous:	Inhomogeneous	
	- minimum clearances (mm):	8 mm	
	- measured clearances (mm):	8,5 mm	P
	Creepage distances:		
	- rated insulation voltage Ui (V)	750 V	
	- pollution degree	3	
	- comparative tracking index (V)	≥ 600 V	
	- material group	IIIa	
	- minimum creepage distances (mm)	12,5 mm	
	- measured creepage distances (mm)	13,1 mm	P
7.1.5 part 1	Actuator		
7.1.5.1 part 1	Insulation		
	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	Compliance	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/A
	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	Compliance	P
7.1.5.2	Direction of movement		
	The direction of operation for actuators of devices shall normally conform to IEC 60447.	Compliance	P

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	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	Compliance	P
7.1.6 part 1	Indication of contact position		
7.1.6.1 part 1	Indicating means		
	When an equipment is provided with means for indicating the closed and open positions, these positions shall be unambiguous and clearly indicated	Compliance	P
	This is done by means of a position indicating device (see 2.3.18)	Compliance	P
	If symbols are used, they shall indicate the closed and open position respectively, in accordance with IEC 60417-2:		
	- 60417-2-IEC-5007 I On (power)	Compliance	P
	- 60417-2-IEC-5007 O Off (power)	Compliance	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"	-	N/A
	Red colour shall not be used for any other push-button	-	N/A
	The colours of other push-buttons, illuminated push-buttons and indicator lights shall be in accordance with IEC 60073	-	N/A
7.1.6.2 part 1	Indication by the actuator		
	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	On position Off position Trip position	P
7.1.7	Additional safety requirements for equipment suitable for isolation		
7.1.7.1	Additional constructional requirements for equipment suitable for isolation (U _e > 50 V):		
	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:		
	- the position of the actuator	Compliance	P

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	- a separate mechanical indicator	-	N/A
	- visibility of the moving contacts	-	N/A
	When means are provided or to lock the equipment in the open position, locking only be possible when contacts are in the open position	-	N/A
	Actuator front-plate fitted to the equipment in a manner which ensures correct contact position indication and locking	-	N/A
	The indicated open position is the only position in which the specified isolation distances between the contacts is ensured.	Compliance	P
	- minimum clearances across open contacts (see Table XIII, Part 1) (mm) :	8 mm	
	- measured clearances (mm) :	8,5 mm	P
	- test Uimp across gap (kV) :	12,3 kV	P
7.1.7.2	Supplementary requirements for equipment with provision for electrical interlocking with contactors or circuit-breakers:		
	auxiliary switch shall be rated according to IEC 60 947-5-1	-	N/A
	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/A
	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/A
	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/A
	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/A
	During the closing operation the contacts of the auxiliary switch shall close after or simultaneously with the contacts of the main poles	-	N/A

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	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	-	N/A
7.1.7.3	Supplementary requirements for equipment provided with means for padlocking the open position:		
	the locking means shall be designed in such a way that it cannot be removed with the appropriate padlock(s) installed	-	N/A
	Alternatively, the design may provide padlockable means to prevent access to the actuator	-	N/A
	test force F applied to the actuator in an attempt to operate to the closed position (N) :	-	N/A
	rated impulse withstand voltage (kV) :	-	N/A
	test Uimp on open main contacts at the test force	-	N/A
7.1.8	Terminals		
7.1.8.1	All parts of terminals which maintain contact and carry current shall be of metal having adequate mechanical strength	Compliance	P
	Terminal connections shall be such that necessary contact pressure is maintained	Compliance	P
	Terminals shall be so constructed that the conductor is clamped between suitable surfaces without damage to the conductor and terminal	Compliance	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	Compliance	P
7.1.8.2	Connection capacity		
	type of conductors :	Flexible and stranded type	P
	minimum cross-sectional area of conductor (mm ²) :	2,5mm ² or 12AWG [16A]	P
	maximum cross-sectional area of conductor (mm ²) :	70mm ² or 2/0AWG [160A]	P
	number of conductors simultaneously connectable to the terminal :	1	P
7.1.8.3	Connection		
	terminals for connection to external conductors shall be readily accessible during installation	Compliance	P
	clamping screws and nuts shall not serve to fix any other component	Compliance	P

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7.1.8.4	Terminal identification and marking		
	terminal intended exclusively for the neutral conductor	-	N/A
	protective earth terminal	-	N/A
	other terminals	-	N/A
7.1.9 part 1	Additional requirements for equipment provided with a neutral pole		
	When 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.).	-	N/A
	A switched neutral pole shall break not before and shall make not after the other poles	-	N/A
	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	-	N/A
	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	-	N/A
	if a pole with an appropriate making and breaking capacity is used as a neutral pole, then all poles, incl. the neutral pole, shall operate substantially together.	-	N/A
7.1.10	Provisions for protective earthing		
7.1.10.1	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/A
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	-	N/A
	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 50 mm x 50 mm) or are so located as to exclude any contact with live parts	-	N/A

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7.1.10.2 part 1	Protective earth terminal		
	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/A
	The protective earth terminal shall be suitably protected against corrosion	-	N/A
	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/A
	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/A
7.1.10.3	Protective earth terminal marking and identification		
	The protective earth terminal shall be clearly and permanently identified by its marking	-	N/A
	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/A
	Graphical symbol to be used: 60417-2-IEC-5019  Protective earth (ground) in accordance with IEC 60417-2	-	N/A
7.1.11	Enclosure for equipment		
7.1.11.1	Design		
	The enclosure, when it is opened: all parts requiring access for installation and maintenance are readily accessible	-	N/A
	Sufficient space shall be provided inside the enclosure	-	N/A
	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	-	N/A

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	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	-	N/A
	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/A
	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	-	N/A
	If the enclosure is used for mounting push-buttons, it shall not be possible to remove the buttons from the outside of the enclosure	-	N/A
7.1.11.2	Insulation		
	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	-	N/A
7.1.12	Degree of protection of enclosed equipment		
	Degree of protection.	IP20	
	Test for first characteristic.	IPXX	
	Test for first numeral :	1 2 3 4 5 6	N/A
	Test for second characteristic	IPXX	
	Test for second numeral :	1 2 3 4 5 6 7 8	N/A
7.1.13 part 1	Conduit pull-out, torque and bending with metallic conduits		
	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/A

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7.2	Performance requirements		
7.2.1	Operating condition		
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	Compliance	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	-	N/A
	Such a circuit-breaker should not be used in circuits having a prospective peak making current exceeding 10 kA	-	N/A
	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	-	N/A
7.2.1.1.2	Independent manual closing		
	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	Compliance	P
7.2.1.1.3	Dependent power closing		
	At 110% of the rated control supply voltage, the closing operation performed on no-load shall not cause any damage to the circuit-breaker.	-	N/A
	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.	-	N/A

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7.2.1.1.4	Independent power closing		
	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	-	N/A
	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/A
7.2.1.1.5	Stored energy closing		
	Capable ensuring closing of the circuit-breaker in any condition between no-load and its rated making capacity	-	N/A
	- when the stored energy is retained within the circuit-breaker, a device is provided which indicates when the storing mechanism is fully charged.	-	N/A
	- 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/A
	- 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/A
	- by manually operated circuit-breaker is the direction of operation indicated. (not for circuit-breaker with an independent manual closing operation.)	-	N/A
	- 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/A
7.2.1.2	Opening		
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		
7.2.1.2.2	Opening by undervoltage releases		
7.2.1.3. a part 1	Operating voltage		
	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	-	N/A

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	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	-	N/A
	Unless otherwise stated in the relevant product standard, the upper limit of the supply voltage shall be 110% of its rated value	-	N/A
7.2.1.3. b part 1	Operating time		
	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	-	N/A
7.2.1.2.3	Opening by shunt releases	-	N/A
7.2.1.4 part 1	Limits of operation of shunt releases		
	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/A
7.2.1.5 part 1	Limits of operation of current operated relays and released		
	Limits of operation of current operated relays and releases shall be stated in the relevant product standard	-	N/A
7.2.1.2.4	Opening by over-current releases		
a)	Opening under short-circuit conditions		
	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	Compliance	P
	Where necessary for over-current co-ordination the manufacturer shall provide information (usually curves) showing	Compliance	P
	- maximum cut-off (let-through) peak current as a function of prospective current (r.m.s. symmetrical)	Compliance	P
	- I_t characteristics for circuit-breakers of utilization category A and, if applicable, B for circuit-breakers with instantaneous override (see note to 8.3.5)	Compliance	P

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b)	Opening under overload conditions		
1)	Instantaneous or definite time-delay operation	-	N/A
	The release shall cause tripping of the circuit-breaker with an accuracy of $\pm 10\%$ of the tripping current value of the current setting for all values of current setting of the overload release	-	N/A
2)	Inverse time-delay operation		
	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	Compliance	P
	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	Compliance	P
	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	Compliance	P
	The width of the temperature band shall be at least 10 K on either side of the reference temperature	Compliance	P
7.2.4.2	Operational performance capability		
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/A
	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	Compliance	P

8	TESTS		
8.2.4	Mechanical properties of terminals		
	Mechanical strength of terminals		
	maximum cross-sectional area of conductor (mm ²) :		

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	diameter of thread (mm) :	8	
	torque (Nm) :	6	
	5 times on 2 separate clamping units	6, 6	p
	Testing for damage to and accidental loosening of conductor (flexion test)		
	conductor of the smallest cross-sectional area (mm ²) :	-	
	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	-	N/A
	Pull-out test		
	force (N) :	-	
	1 min, the conductor shall neither slip out of the terminal nor break near the clamping unit	-	N/A
	conductor of the largest cross-sectional area (mm ²) :	-	
	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	-	N/A
	Pull-out test		
	force (N) :	-	
	1 min, the conductor shall neither slip out of the terminal nor break near the clamping unit	-	N/A
	conductor of the largest and smallest cross-sectional area (mm ²) :	-	
	number of conductors of the smallest cross section, 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) :	-	

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	135 continuous revolutions: the conductor shall neither slip out of the terminal nor break near the clamping unit	-	N/A
	Pull-out test		
	force (N) :	-	
	1 min, the conductor shall neither slip out of the terminal nor break near the clamping unit	-	N/A

8.3.3	TEST SEQUENCE I: GENERAL PERFORMANCE CHARACTERISTICS	N/A
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8.3.4	TEST SEQUENCE II (lcs):	N/A
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8.3.4	TEST SEQUENCE II/III (lcs=lcu):	
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	TD160L 3P
	Sample no:	S2-1
	Rated current: In (A)	160 A
	Rated operational voltage: Ue (V)	415 V
	Rated service short-circuit breaking capacity: (kA)	150 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.	Compliance
	closing mechanism energized with 85% at the rated Uc: (V)	-
	The circuit-breaker is mounted complete on its own support or an equivalent support.	Compliance
	Test made in free air:	Compliance
	Distances of the metallic screen's: (all sides)	130(W) x 210(H) x 86(D)
	The characteristics of the metallic screen:	
	- woven wire mesh	-
	- perforated metal	Compliance

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	- expanded metal	-	N/A
	- ratio hole area/total area: 0,45-0,65	0,5	P
	- size of hole: <30mm ²	<30mm ²	P
	- finish: bare or conductive plating	Compliance	P
	Test made in specified individual enclosure: Details of these tests, including the dimensions of the enclosure:	-	N/A
	Fuse "F": copper wire: diameter 0,8 mm, 50 mm long	Compliance	P
	Circuit is earthed at: (load-star- or supply-star point)	Load-star point	P
	Conductor cross-sectional area (mm ²) :	70 mm ²	P
	If terminals unmarked: line connected at: (underside/upside)	-	N/A
	Tightening torques: (Nm)	6,0 Nm	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.		
	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.		
	Time specified by the manufacturer:	60~600 s	P
	- Operation time: (s) L1: L2: L3: N :	L1: 369 s L2: 443 s L3: 376 s	P
8.3.4.1	Test of rated service short-circuit breaking capacity		
	Test sequence of operation: O – t – CO – t – CO		
	- test voltage U/U _e = 1,05 (V) L1: L2: L3:	L1: 442,7 V L2: 441,5 V L3: 445,2 V	P
	- r.m.s. test current AC/DC: (A) L1: L2: L3:	L1: 76,2 kA (50%) L2: 76,2 kA (50%) L3: 75,5 kA (50%)	P
	power factor/time constant :	0,19	P
	- Factor "n"	2.2	P
	- peak test current (A) :	167,4 kA (50%)	P
	Test sequence "O"		
	- max. let-through current: (kA _{peak}) L1: L2: L3:	L1: 24,5 kA _{peak} L2: 24,6 kA _{peak} L3: 22,6 kA _{peak}	P

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	- Joule integral I^2dt (A ² s) L1: L2: L3:	L1: 377,5 kA ² s L2: 734,8 kA ² s L3: 256,8 kA ² s	P
	Pause, t: (min)	3 min	P
	Test sequence "CO"		
	- max. let-through current: (kA _{peak}) L1: L2: L3:	L1: 23,5 kA _{peak} L2: 17,6 kA _{peak} L3: 24,3 kA _{peak}	P
	- Joule integral I^2dt (A ² s) L1: L2: L3:	L1: 715,8 kA ² s L2: 254,3 kA ² s L3: 355,6 kA ² s	P
	Pause, t: (min)	4 min	P
	Test sequence "CO"		
	- max. let-through current: (kA _{peak}) L1: L2: L3:	L1: 20,4 kA _{peak} L2: 21,9 kA _{peak} L3: 19,3 kA _{peak}	P
	- Joule integral I^2dt (A ² s) L1: L2: L3:	L1: 293,3 kA ² s L2: 296,0 kA ² s L3: 645,2 kA ² s	P
	Melting of the fusible element	No	P
	Damage to insulation on conductors	No	P
	Holes in the PE-sheet for test sequence "O"	-	N/A
	Cracks observed	No	P
8.3.4.2	Operational performance capability with current.		
	Rated current: I _n (A)	160 A	
	Maximum rated operational voltage: U _e (V)	415 V	
	Conductor cross-sectional area (mm ²) :	70 mm ²	
	Number of operating cycles per hour	120 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 U _c)	50 cycles	P
	Applied voltage: closing mechanism (V)	-	N/A
	For circuit-breaker fitted with adjustable releases, test shall be made with the overload setting at maximum and short-circuit setting at minimum.	Compliance	P
	Conditions, make/break operations:		
	- test voltage U/U _e = 1,0 (V) L1: L2: L3:	L1: 429,7 V L2: 432,0 V L3: 430,4 V	P

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	- test current $I/I_e = 1,0$ (A)..... L1: L2: L3:	L1: 165,4 A L2: 163,9 A L3: 166,6 A	P
	- power factor/time constant:	0,73	P
	- frequency: (Hz)	60 Hz	P
	- on-time (ms):	1 000 ms	P
	- off-time (s):	29 s	P
8.3.4.3	Verification of dielectric withstand		
	- equal to twice the rated operational voltage with a minimum of 1000 V	1 000 V	P
	- no breakdown or flashover	No	p
	- the leaking current for circuit-breaker suitable for isolation: ($<2\text{mA} / 1,1 U_e$)	$\leq 0,03 \text{ mA} / 457 \text{ V}$	P
8.3.4.4	Verification of temperature-rise		
	- the values of temperature-rise do not exceed those specified in tab. 7.	See table	P
	Temperature rise of main circuit terminals. $\leq 80 \text{ K}$ (K) :	66,7 K	P
	conductor cross-sectional area (mm^2) :	70 mm^2	P
	test current I_e (A) :	160 A	P
8.3.4.5	Verification of overload releases		
	Test current: 1,45 times the value of their current setting at the reference temperature: (A)	248,2 A	P
	Conventional tripping time: $<1\text{h}$ when $I_n < 63\text{A}$, $<2\text{h}$ when $I_n > 63 \text{ A}$	224 s	P
8.3.5.4	Verification of overload releases		
	The operation of overload releases shall be verified at 2,5 times the value of their current setting on each pole separately.		
	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.		
	Time specified by the manufacturer:	60~600 s	P
	- Operation time: (s) L1: L2: L3: N :	L1: 178 s L2: 177 s L3: 157 s	P
8.3.5	TEST SEQUENCE III (I_{cu})		N/A

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8.3.6	TEST SEQUENCE IV	N/A
8.3.7	TEST SEQUENCE V	N/A
8.3.8	TEST SEQUENCE VI: Combined test sequence	N/A
Annex B	Circuit-breakers incorporating residual current protection	N/A
Annex C	Individual pole short-circuit test sequence	N/A
Annex F	Additional tests for circuit-breakers with electronic over-current protection	N/A
Annex H	Individual pole short-circuit test sequence	N/A
Annex J	Electromagnetic compatibility (EMC) – Requirements and test methods for circuit-breakers	N/A
Annex L	Circuit-breakers not fulfilling the requirements for overcurrent protection	N/A
Annex M	Modular residual current devices (without integral current breaking device)	N/A
Annex N	Electromagnetic compatibility (EMC) – Additional requirements and test methods for devices not covered by Annexes B, F and M	N/A

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	TABLE: Heating Test			S2-1
	Test voltage (V):			—
	Ambient (°C):	26,2 °C		—
Thermocouple Locations		max. temperature measured, (°C)	max. temperature limit, (°C)	
LINE L1		52,7	80	
LINE L2		59,3	80	
LINE L3		66,7	80	
LOAD L1		46,5	80	
LOAD L2		51,6	80	
LOAD L3		55,1	80	

	TABLE: clearance and creepage distance measurements						
clearance cl and creepage distance dcr at/of:	Up (V)	U r.m.s. (V)	required cl (mm)	cl (mm)	required dcr (mm)	dcr (mm)	
Pole to pole		750	8	17.7	12.5	28.2	
Live part to accessible part		750	8	8.5	12.5	13.1	
Across open contacts		750	8	11.2	12.5	12.9	
supplementary information:							

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Attachment showing test equipment used for TMP and WMT projects
List of test equipment used at the TMP/WMT Laboratory

Clause	Measurement / testing	Testing / measuring equipment / material used (Equipment ID)	Range used	Last Calibration date	Calibration due date
8.3.3.1	Tripping limits and characteristic	MCCB Instant Tester (85-0028)	~ 15 000 A	2013.11.16	2014.11.16
		Thermal Tester (85-0021)	~ 6 000 A	2014.06.09	2015.06.09
		Over Current Tester (85-0030)	~ 2 500 A	2014.04.24	2015.04.24
		Over Current Tester (85-0032)	~ 1300 A	2013.08.26	2014.08.26
		Digital Clamp on Tester (25-0158)	~2000 A	2013.10.07	2014.10.07
		Digital Power Meter (25-0087)	~ 600 V ~ 20 A	2014.06.30	2015.06.30
		CT (68-0207)	~ 5000 A	2014.07.07	2015.07.07
		CT (68-0208)	~ 5000 A	2014.07.07	2015.07.07
		CT (68-0209)	~ 5000 A	2014.07.07	2015.07.07
		Rogowski Coil & Integrator (62-0117)	2.5 kA/V, 5 kA/V 10 kA/V, 25 kA/V 50 kA/V	2013.01.16	2019.01.16
8.3.3.2	Dielectric properties	Lightening Impulse generator (46-0225)	~ 15 kV	2013.12.27	2014.12.27
8.3.3.3	Mechanical operation and operational performance	Digital Power Meter (25-0087)	~ 600 V ~ 20 A	2014.06.30	2015.06.30
		CT (68-0207)	~ 5000 A	2014.07.07	2015.07.07
		CT (68-0208)	~ 5000 A	2014.07.07	2015.07.07
		CT (68-0209)	~ 5000 A	2014.07.07	2015.07.07
8.3.3.4	Overload performance	Digital Power Meter (25-0087)	~ 600 V ~ 20 A	2014.06.30	2015.06.30
		CT (68-0207)	~ 5000 A	2014.07.07	2015.07.07
		CT (68-0208)	~ 5000 A	2014.07.07	2015.07.07
		CT (68-0209)	~ 5000 A	2014.07.07	2015.07.07
		PT (68-0181)	660 V : 5 V	2013.05.20	2014.05.20
		PT (68-0182)	660 V : 5 V	2013.05.20	2014.05.20
		PT (68-0183)	660 V : 5 V	2013.05.20	2014.05.20
		PT (68-0184)	660 V : 5 V	2013.05.20	2014.05.20
		PT (68-0185)	660 V : 5 V	2013.05.20	2014.05.20
		PT (68-0186)	660 V : 5 V	2013.05.20	2014.05.20
		R-Coil (62-0133)	~ 6 000 A	2013.06.18	2014.06.18

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8.3.3.5	Verification of dielectric withstand	Dielectric Tester (31-0068)	~ 5 kV ~ 110 mA	2014.08.14	2015.08.14
8.3.3.6	Verification of temperature-rise	Over Current Tester (85-0030)	~ 2 500 A	2014.04.24	2015.04.24
		Over Current Tester (85-0032)	~ 1300 A	2013.08.26	2014.08.26
		Recorder DR130 (70-0301)	-40 ~ 200 °C	2014.05.19	2015.05.19
		CT (68-0102)	~ 5000 A	2013.06.13	2016.06.13
		AC V-A Meter (24-0038)	~ 750 V ~ 30 A	2014.02.28	2015.02.28
		Recorder (70-0254)	60 CH	2013.11.23	2014.11.23
8.3.3.7	Verification of overload release	Thermal Tester (85-0021)	~ 6 000 A	2014.06.09	2015.06.09
		Over Current Tester (85-0030)	~ 2 500 A	2014.04.24	2015.04.24
		Over Current Tester (85-0032)	~ 1300 A	2013.08.26	2014.08.26
		Digital Clamp on Tester (25-0158)	~2000 A	2013.10.07	2014.10.07
		Digital Power Meter (25-0087)	~ 600 V ~ 20 A	2014.06.30	2015.06.30
		CT (68-0207)	~ 5000 A	2014.07.07	2015.07.07
		CT (68-0208)	~ 5000 A	2014.07.07	2015.07.07
		CT (68-0209)	~ 5000 A	2014.07.07	2015.07.07
8.3.3.9	Verification of main contact position	Push Pull Gage (18-0381)	490 N	2013.09.17	2014.09.17
8.3.4.1	Rated service short-circuit breaking capacity	Low Voltage Divider (33-0126)	~ 1000 Vrms	2013.06.26	2015.06.26
		Isolation Amplifier (46-0033)	62.5 mV, 125 mV 250 mV, 500 mV 1 V	2014.05.14	2015.05.14
		Isolation Amplifier (46-0034)	62.5 mV, 125 mV 250 mV, 500 mV 1 V	2014.04.30	2015.04.30
		Isolation Amplifier (46-0049)	62.5 mV, 125 mV 250 mV, 500 mV 1 V	2013.10.22	2014.10.22
		Recorder (55-0028)	1 S/s ~ 10 MS/s	2014.05.27	2015.05.27
		Rogowski Coil & Integrator (62-0117)	2.5 kA/V, 5 kA/V 10 kA/V, 25 kA/V 50 kA/V	2013.01.16	2019.01.16
		Potential Transformer (68-0194)	660 V/5 V	2012.08.28	2014.08.28
		Potential Transformer (68-0195)	660 V/5 V	2012.08.28	2014.08.28
		Potential Transformer (68-0196)	660 V/5 V	2012.08.28	2014.08.28

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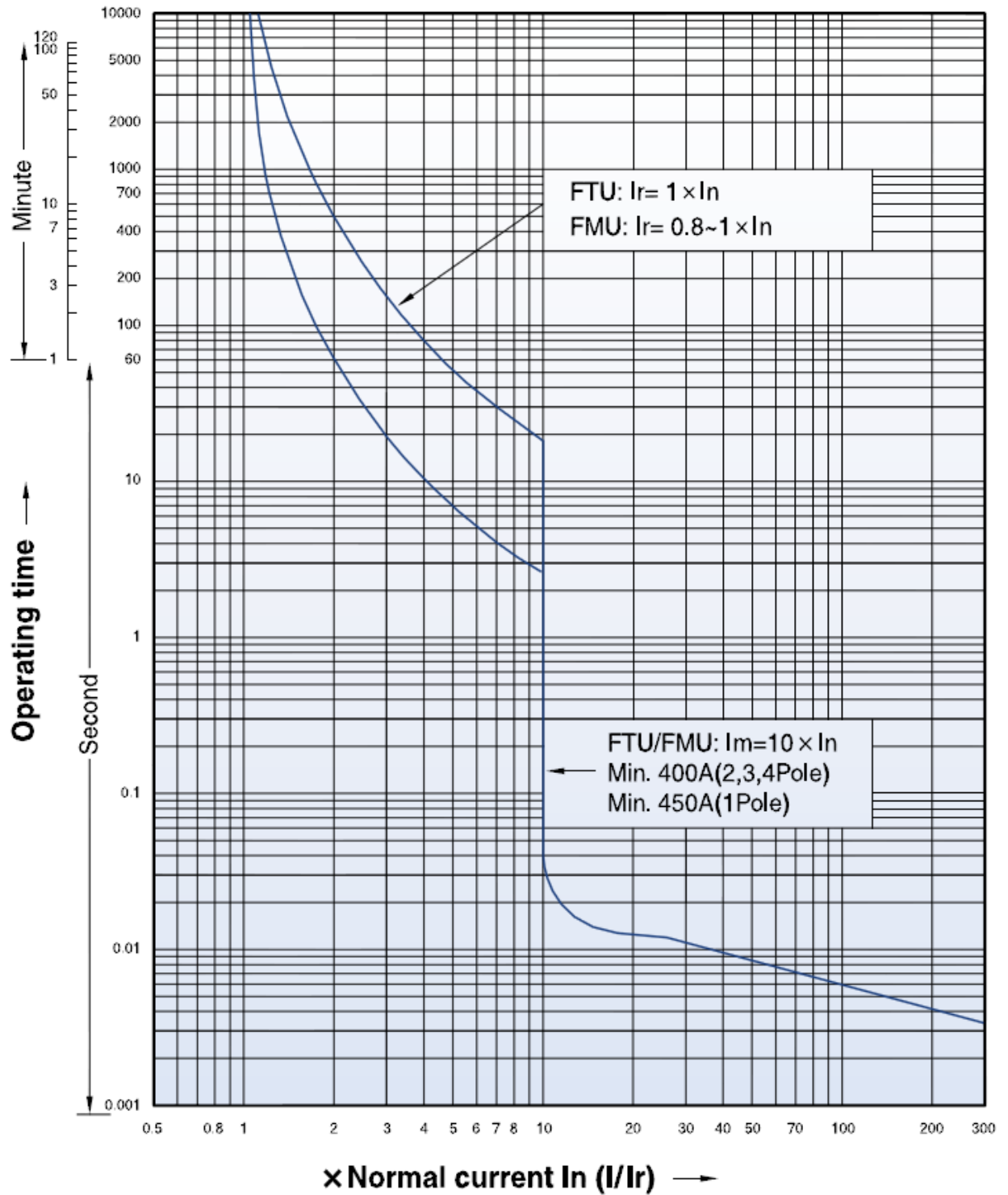
8.3.4.2	Verification of operational performance	Refer to Clause.8.3.3.3			
8.3.4.3	Verification of dielectric withstand	Refer to Clause.8.3.3.5			
8.3.4.4	Verification of temperature-rise	Refer to Clause.8.3.3.6			
8.3.4.5	Verification of overload release	Refer to Clause.8.3.3.7			
8.3.5.1	Verification of overload release	Refer to Clause.8.3.3.7			
8.3.5.2	Rated ultimate short-circuit breaking capacity	Refer to Clause.8.3.4.1			
8.3.5.3	Verification of dielectric withstand	Refer to Clause.8.3.3.5			
8.3.5.4	Verification of overload release	Refer to Clause.8.3.3.7			
8.3.6.1	Verification of overload release	Refer to Clause.8.3.3.7			
8.3.6.2	Rated short-time withstand current	Refer to Clause.8.3.4.1			
8.3.6.3	Verification of temperature-rise	Refer to Clause.8.3.3.6			
8.3.6.4	Short-circuit breaking capacity at maximum short-time withstand current	Refer to Clause.8.3.4.1			
8.3.6.5	Verification of dielectric withstand	Refer to Clause.8.3.3.5			
8.3.6.6	Verification of overload release	Refer to Clause.8.3.3.7			
	Time Measurement	Stop Watch (18-0744)	~ 1 000 s	2013.06.22	2014.06.22
	Length Measurement	Dial Caliper (04-0352)	~150 mm	2014.05.08	2015.05.08
		Standard tape rule (04-0064)	~ 5,5 m	2014.01.13	2015.01.13
	Tourque Measurent	Tourque Wrench (13-0984)	2,4 N.m ~ 11,8 N.m	2014.03.14	2015.03.14
		Tourque Wrench (13-1153)	19,6 N.m ~ 88,3 N.m	2014.03.14	2015.03.14

Note 3: *If the TMP/WMT procedure was used, the above list of test equipment is required.*

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Time current characteristics

TD160 (16A~160A)



Photographs



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TD160 maximum current inside



TD160 maximum current outside

TRF No. IEC60947_2G

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TD160 minimum current inside

TRF No. IEC60947_2G

IEC 60947-2



TD160 minimum current outside

TRF No. IEC60947_2G

IEC 60947-2

