

JIS

JAPANESE INDUSTRIAL STANDARD

**Molded case circuit breakers
(MCCB)**

JIS C 8370—1996

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Molded case circuit breakers (MCCB)

C 8370-1996

1. **Scope** This Japanese Industrial Standard specifies molded case circuit breakers, with a rated current not exceeding 5000 A, a rated breaking capacity not exceeding 200000 A a.c. or 100000 A d.c. to be used for protection of electric circuits at a voltage not exceeding 600 V a.c. of frequency 50 Hz or 60 Hz or 500 V d.c. (hereafter referred to as "circuit breakers").

Circuit breakers specified in this Standard include the ones given below. However, for the circuit breakers of (1) to (5), the requirements different from general technical requirements specified in this text, are specified in Annexes 1 to 5 respectively.

- (1) Molded case circuit breakers which also serve as protection of induction motors
- (2) Molded case circuit breakers for residential distribution boards
- (3) Instantaneous breaking molded case circuit breakers (circuit breaker exclusively used for short circuit protection)
- (4) Four-pole molded case circuit breakers
- (5) Conventional molded case circuit breakers for lamp distribution boards
- (6) Molded case circuit breakers with short-time delay release
- (7) Molded case circuit breakers for d.c. circuits

Remarks 1. The circuit breaker specified in this Standard means an apparatus which consists of a switching mechanism, a release, etc. assembled as an integral unit in one case of insulating materials, which is able to close or open the circuit under normal service conditions by manual operation, or by dependent electrical operating device mounted on the outside of the case, etc. and which breaks the circuit automatically at overload or short circuit. However, this Standard is not applicable to overload protective switches, circuit protectors, and current limiters, which are protected by fuses or circuit breakers for branch circuit.

2. The following Standards are cited in this Standard:

- | | |
|------------|---|
| JIS C 0911 | Vibration testing procedure for electric machines and equipment |
| JIS C 0912 | Shock testing procedure for electric machines and equipment |
| JIS C 3306 | Polyvinyl chloride insulated flexible cords |
| JIS C 3307 | 600 V Polyvinyl chloride insulated wires |
| JIS C 4004 | General rules for rotating electrical machines |
| JIS C 8306 | Testing methods for wiring devices |
| JIS K 2435 | Benzene•toluene•xylene |
| JIS K 8116 | Ammonium chloride |

JIS K 8576 Sodium hydroxide

JIS R 3503 Glass apparatus for chemical analysis

IEC 947-2 (1989) Low-voltage switchgear and controlgear
Part 2: Circuit-breakers

3. The International Standard corresponding to this Standard is given below.

IEC 947-2 (1989) Low-voltage switchgear and controlgear
Part 2: Circuit-breakers

4. The units and numerical values given in { } in this Standard are based on the traditional unit system and are appended for informative reference.

2. Definitions For the purpose of this Standard, the following definitions apply:

(1) Classification of circuit breakers

- (a) front-connection circuit breaker A circuit breaker of such construction that connection of the external wiring to the terminals is made at its front.
- (b) rear-connection circuit breaker A circuit breaker of such construction that connection of the external wiring to the terminals is made at its rear side by means of rear connection studs or the like.
- (c) plug-in circuit breaker A circuit breaker of such construction that disconnecting contacts are provided so that the breaker can be plugged in or out without removing the external wiring.
- (d) flush-type circuit breaker A circuit breaker of such construction that the greater parts are placed inside of the panel surface.
- (e) draw-out circuit breaker A circuit breaker which has the same disconnecting contacts as those of plug-in type and an exclusive supporting mechanism which can support the circuit breaker in disconnected state.
- (f) circuit breaker with short time-delay release A circuit breaker equipped with an overcurrent release having a function of short time-delay operation to obtain the cooperation in operating time with the circuit breaker in the load side circuit.
- (g) MCCB which also serves as protection of induction motor A circuit breaker which also serves as overload protection of a motor, and rated current of which is adjusted to the full load current of the motor.
- (h) MCCB for residential distribution board A circuit breaker generally named as a safety breaker and used near the service entrance for the branch circuit, etc. of a residence.
- (i) instantaneous breaking MCCB (MCCB exclusively used for short circuit protection) A circuit breaker equipped with an instantaneous trip element only and without long time-delay trip element.

- (j) 4 pole MCCB A circuit breaker equipped with four poles one of which is exclusively used for neutral line in 3-phase 4-line circuit.
- (k) conventional circuit breaker for lamp distribution board A circuit breaker for branch circuit of lamp distribution board having the agreed (between electric utilities, related industries and users) dimensions shown in Annex 5.

(2) General terms

- (a) frame size This is the size of a case expressed in the maximum rated current of the circuit breaker mechanism which can be accommodated in the case, while the said mechanism has relation with such functions of circuit breaker as rated working voltage, insulation performance, temperature rise and rated breaking capacity. The frame size is called ampere frame.
- (b) main circuit This means the conductive path of a circuit breaker for passing main current including main contacts.
- (c) control circuit This means the conductive path of a circuit breaker for closing or opening the circuit breaker, excluding the main circuits.
- (d) auxiliary circuit This means conductive path of a circuit breaker used for such functions as signaling of the operated state of the circuit breaker, and interlocking between circuit breakers, excluding the main and control circuits.
- (e) pole This means an electrically insulated conductive path in main circuits.
- (f) open state (position) This means the state (position) of a circuit breaker in which the pre-determined clearance between contacts in the main circuit of the circuit breaker is secured.
- (g) closed state (position) This means the state (position) of a circuit breaker in which the pre-determined continuity of the main circuit of the circuit breaker is secured.
- (h) tripped state (position) This means the open state (position) of a circuit breaker caused by the operation of the trip mechanism of the circuit breaker.
- (i) overcurrent This means a current exceeding the rated current of a circuit breaker, and is the generic term of overload current and short-circuit current.
- (j) overload This means the running state of a circuit in which a overcurrent is flowing through the circuit without electrical damage.
- (k) overload current This means the overcurrent passing through a circuit breaker in the state of overload.
- (l) overshoot This means the momentary flow of current exceeding the steady state current when an incandescent lamp is put into operation.
- (m) short-circuit current This means the overcurrent caused by short-circuit due to failure or mis-connection.

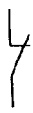
- (n) prospective short-circuit current This means the short-circuit current that would flow if each pole of the circuit breaker were replaced by a conductor of negligible impedance.
- (o) reference ambient temperature This is the ambient temperature employed as the reference to determine performance of an overcurrent release.
- (p) insulation distance This means the distance between the parts to be insulated from each other, and is composed of clearance and creepage distance.
- (q) clearance This is the shortest distance through air between two bare live parts insulated from each other.
- (r) creepage distance This is the shortest distance between two bare live parts from each other along the surface of insulation which is in contact with the live parts.
- (s) arc space This is the space necessary for insulation to avoid secondary accidents due to exhaust gas from a circuit breaker at the time of breaking short-circuit current.
- (t) self-pressurized contact A contact of such construction that the contact pressure is produced by elastic materials forming a part of its conductive parts.
- (u) separately-pressurized contact A contact of such construction that the contact pressure is produced by elastic materials other than its conductive parts.

(3) Components

- (a) main contact A contact provided in the main circuit of a circuit breaker.
- (b) arcing contact An additionally provided contact to decrease the arcing of the main contact by transferring the arcing at make or break of the current thereon.
- (c) conductive part This means an electrical path of a circuit breaker to carry current.
- (d) live part This means a part which is directly charged when a voltage is applied to a circuit breaker.
- (e) terminal A conductive part provided for electrical connection of external wiring with a circuit breaker.
- (f) release This is a device to open a circuit breaker by releasing the switch mechanism.
- (g) overcurrent release A release which permits a circuit breaker to open when an overload or short-circuit current flows.
- (h) trip element (overcurrent release) This means a unit component which has the function of detecting overcurrent for each pole in a overcurrent release.

- (i) electronic (semiconductor) overcurrent release An overcurrent release in which, main functions such as overcurrent detection, calculation, control and release instruction are performed by an electronic circuit.
- (j) replaceable overcurrent release An overcurrent release of such a construction that it is standardized for circuit breakers of the same frame size, so that a circuit breaker of a different rated current can be obtained by replacing only the overcurrent release when change of the rated current is necessary.
- (k) adjustable type This means that the operating time or current of the overcurrent release can be adjusted to meet the conditions of use by the user over the designated range.
- (l) auxiliary switch A switch which operates interlocked with the main-circuit switching mechanism of a circuit breaker. The contacts of an auxiliary switch are indicated by the symbols shown in Table 1.

Table 1. Contacts of auxiliary switch

Symbol	Graphic symbol	State of contacts of auxiliary switch
a		A contact which opens when the main contact opens and closes when the main contact closes.
b		A contact which closes when the main contact opens and opens when the main contact closes.
c		A pair of a, b contacts having a common contact and terminal.

- (m) alarm switch A switch which operates only when a circuit breaker breaks the circuit due to operation of the release. The contacts of alarm switch are indicated by the symbols shown in Table 2.

Table 2. Contacts of alarm switch

Symbol	Graphic symbol	State of contacts of alarm switch
a		A contact which closes when the main contact is opened due to operation of a release of a circuit breaker.
b		A contact which opens when the main contact is opened due to operation of a release of a circuit breaker.
c		A pair of a, b contacts having a common contact and terminal.

(4) Operation and action

- (a) closing operation An operation to transfer the main contacts of a circuit breaker from the open position to the closed position.
- (b) opening operation An operation to transfer the main contacts of a circuit breaker from the closed position to the open position.
- (c) resetting operation An operation to transfer a circuit breaker from the tripped state to the state ready to close again.
- (d) dependent manual operation An operation executed solely by manual energy for closing, opening or resetting a circuit breaker.
- (e) dependent electric power operation An operating system where the operating power necessary for closing, opening, tripping or resetting operation is supplied by electric energy of electric motors, electromagnetic solenoids, etc.
- (f) trip free This means the ability of a circuit breaker to be tripped by operation of the release even if the circuit breaker is in closing operation or the closing command is maintained.
- (g) overcurrent trip This means an action to open a circuit breaker automatically by releasing the switching mechanism when an overcurrent flows.
- (h) long time-delay trip (inverse time-delay trip) This means an action to trip a circuit breaker in such a way that the operating time becomes shorter when the overcurrent increases.
- (i) instantaneous trip This means an action to trip a circuit breaker by overcurrent without an intentional time delay when relatively large overcurrent such as short-circuit current flows.
- (j) short time-delay trip This means an action to trip a circuit breaker by overcurrent with a short time delay to coordinate with the operation of the downstream circuit breaker.

- (k) voltage trip This means an action to trip a circuit breaker by applying the control voltage to the shunt release.
- (l) under-voltage trip This means an action to trip a circuit breaker when the control voltage of under-voltage release decrease below a specified value.

(5) Ratings and characteristics

- (a) rated insulation voltage (U_i) This is the voltage used as the reference for the design to guarantee the dielectric withstand voltage under the specified conditions.
- (b) rated operational voltage (U_e) This is the upper limit of operational voltage at which the switching and breaking performances are guaranteed under the specified conditions and which is not exceeding the rated insulation voltage.
- (c) rated insulation voltage of operation circuits (U_{is}) This is the voltage used as the reference for the design to guarantee the dielectric withstand voltage of the electrical operating device under the specified conditions.
- (d) rated operational voltage of operation circuit (U_s) This means the rated operational voltage applied to electrical operating device, and it is called the rated closing operation voltage in the case of closing, the rated opening operation voltage in the case of opening and the rated trip operation voltage in the case of tripping.
- (e) power frequency recovery voltage This is the voltage of working frequency appearing across the terminals of pole of a circuit breaker after the breaking.
- (f) rated current (I_n) This is the current which can be carried continuously without exceeding the specified limit of temperature rise.
- (g) rated breaking capacity (I_{cn}) This means the limit of current which can be broken under the specified conditions, and is expressed by the effective value of symmetrical components of the prospective short-circuit current at $\frac{1}{2}$ cycle after the initiation of short circuit, in the case of a.c. and by the maximum value of the prospective short circuit current in the case of d.c.
- (h) rated short-time current (I_{cw}) This means a current which can be passed through a circuit breaker for a specified period without any abnormality under the specified conditions. In the case of a.c. this is expressed by the effective value of symmetrical components.
- (i) rated short time-delay breaking capacity This means a current which can be broken smoothly after passing the current for a short time at the longest time-delay setting under the specified conditions. In the case of a.c. this is expressed by the effective value of symmetrical components.
- (j) opening time This is the time period from the instant when the trip command is given to the release of a circuit breaker in closed position to the instant when the arcing contacts (main contacts if there is no arcing contacts) have separated in all poles.

- (k) closing time This is the time period from the instant when the electrical closing device of a circuit breaker in open state is energized to the instant when the arcing contacts (main contacts if there is no arcing contacts) touch in all poles.
- (l) arcing time This is the time period from the instant when the first separation of arcing contacts (main contacts if there is no arcing contacts) to the instant when the current is broken in all poles.
- (m) (total) break time This is the time period from the instant when the trip command is given to the release of a circuit breaker in closed position to the instant of final arc extinction in all poles. It is equal to the sum of the opening time and the arcing time.
- (n) instantaneous trip time This is the time period used as the reference for an instantaneous release.
- (o) continuous rating This means such a rating that the values of temperature rise when the rated operational voltage or rated current is continuously applied until the temperature rise is stabilized, do not exceed the respective specified values at every part.
- (p) short-time rating This is a rating which defines an apparatus which serves under such conditions that the apparatus does not reach thermal equilibrium due to the short current duration and that there is enough rest time to cool the current carrying parts. It means such a rating that, the temperature rise of each part does not exceed the specified value when the rated operational voltage or rated current is applied for the specified duration.
- (q) operating duty This means a series of operations assigned to a circuit breaker for closing (C), opening (O) and/or closing then opening (CO) under the prescribed conditions.

3. Standard service conditions The standard service conditions are the conditions given below. Unless otherwise specified circuit breakers shall be used under those conditions.

- (1) The ambient temperature is in the range of 40°C at highest and -5°C at lowest. However, the mean value for 24 h does not exceed 35°C.
- (2) The altitude does not exceed 2000 m.
- (3) The relative humidity is within the range of 45% to 85%.
- (4) The circuit breaker does not receive abnormal vibrations and mechanical shocks.
- (5) The atmosphere does not including excess water vapour, oil vapour, smoke, dust, salt, corrosive materials and others.

4. Classification Circuit breakers are classified as follows:

- (1) Classification by intended protection
 - (a) For wiring protection (Abbreviation is not prepared)
 - (b) For protection of both wiring and electric motor (Abbreviation: M)

(2) Classification by number of poles and number of trip elements

- (a) Single pole, 1 element
- (b) 2 poles, 1 element
- (c) 2 poles, 2 elements
- (d) 3 poles, 2 elements
- (e) 3 poles, 3 elements
- (f) 4 poles, 3 elements

(3) Classification by overcurrent release

- (a) With long time-delay release
- (b) With combined release of long time-delay and instantaneous release
- (c) With combined release of long time-delay, short time-delay and instantaneous release
- (d) With instantaneous release

(4) Classification by mounting and connecting methods

- (a) Surface type
- (b) Rear type
- (c) Plug-in type
- (d) Flush type
- (e) Draw-out type

5. Ratings

5.1 Frame sizes and rated currents The frame sizes and rated currents shall be as shown in Table 3.

Table 3. Frame sizes and rated currents

Frame size	30	50	60	100	225	400	600	800	1 000	1 200	1 600	2 000	2 500	3 000	3 200	4 000	5 000
(AF)																	
Rated current	3	3	3	15	100	225	400	600	800	1 000	1 200	1 600	2 000	2 500	2 500	3 600	5 000
(I_n)	5	5	5	20	125	250	500	700	1 000	1 200	1 400	1 800	2 500	2 800	2 800	4 000	
A	6	6	6	30	150	300	600	800			1 600	2 000		3 000	3 000		
	10	10	10	40	175	350									3 200		
	15	15	15	50	200	400											
	20	20	20	60	225												
	30	30	30	75													
		40	40	100													
		50	50														
		60	60														

5.2 Rated operational voltages of main circuit The rated operational voltages of main circuit shall be as given in Table 4.

Table 4. Rated operational voltages of main circuit

Unit: V

Rated operational voltage of main circuit (U_o)	
a.c.	d.c.
110	
110/220 ⁽¹⁾	125
220	
265	250
265/460 ⁽²⁾	
460	500
550	

Notes (1) This shows a circuit breaker for single-phase three-line circuit, the rated operational voltage between voltage lines is 220 V, and between voltage line and neutral earthed line is 110 V. As for number of poles and trip elements, there are single pole one element, two poles two elements, three poles two elements, and three poles three elements.

(2) This shows a circuit breaker for three-phase four-line circuit, the rated operational voltage between voltage lines is 460 V, and between voltage line and neutral earthed line is 265 V. As for number of poles and trip elements, there are two poles and two elements.

5.3 Rated insulation voltages of main circuit The rated insulation voltages of main circuit shall be as shown in Table 5.

Table 5. Rated insulation voltages of main circuit

Unit: V

Rated insulation voltage of main circuit (U_i)				
125	250	300	500	600

5.4 Rated operational voltages of operation circuits The rated operational voltages of operation circuits shall be as shown in Table 6.

Table 6. Rated operational voltages of operation circuits

Unit: V

Classification	Rated operational voltage of operation circuit (U_s)				
A.C.	24	100	200	240	415
D.C.	24	48	100	200	

5.5 Rated insulation voltages of operation circuits The rated insulation voltages of operation circuits shall be as shown in Table 7.

Table 7. Rated insulation voltages of operation circuits

Unit: V				
Rated insulation voltage of operation circuit (U_{is})				
125	250	300	500	600

5.6 Rated frequencies The rated frequencies shall be 50 Hz, 60 Hz, or 50/60 Hz (in common).

5.7 Rated breaking capacities The standard values of rated breaking capacity shall be as shown in Table 8.

Table 8. Rated breaking capacities

Unit: A			
Rated breaking capacity (I_m)			
a.c. circuit breaker		d.c. circuit breaker	
1 000 ⁽³⁾	30 000	700	30 000
1 500	35 000	1 000	35 000
2 500	42 000	1 500	40 000
5 000	50 000	2 500	50 000
7 500	65 000	5 000	60 000
10 000	85 000	7 500	75 000
14 000	100 000	10 000	100 000
18 000	125 000	15 000	
22 000	150 000	20 000	
25 000	200 000	25 000	

Note (3) This is applicable to molded case circuit breakers which also serve as protection of induction motors specified in Annex 1.

5.8 Reference ambient temperature The reference ambient temperature shall be 40°C. The ambient temperature at the long time-delay trip test is 40°C as a rule, but if the test is carried out at a room temperature different from 40°C, the current or time shall be corrected to that at 40°C, by means of a temperature correction curve certified by the maker.

5.9 Rated short-time current and current duration

5.9.1 Rated short-time current For the standard values of rated short-time current, the numerical values given in Table 8 shall apply.

5.9.2 Current durations The current durations shall be as follows:

0.03 s, 0.05 s, 0.1 s, 0.3 s

5.10 Rated short time-delay breaking capacities For the standard values of this capacity, the numerical values given in Table 8 shall apply.

6. Performances6.1 Operating performances

6.1.1 Dependent manual operation The circuit breaker shall be smooth in operation and reliable in closing and opening operations when subjected to the test specified in 8.3.1.

6.1.2 Dependent electric power operation The performance of dependent electric power operation system shall satisfy the following items:

- (1) Closing operation The circuit breaker with dependent electric power closing device can be closed without difficulty, through the range from 85% to 110% of the rated operational voltage of operation circuit, at the test specified in 8.3.2 (1).
- (2) Opening operation The circuit breaker with dependent electric power opening and resetting device can be opened and reset without difficulty through the range from 85% to 110% of the rated operational voltage of operation circuit, at the test specified in 8.3.2 (2).
- (3) Voltage trip The circuit breaker with shunt release can be tripped without difficulty, at all voltages of operation circuit in the range shown in Table 9, at the test specified in 8.3.2 (3).

Table 9. Trip voltages

Operating system	Trip voltage
A.C. type	85% (incl.) to 110% (incl.) of the rated operational voltage of operation circuit
D.C. type	75% (incl.) to 125% (incl.) of the rated operational voltage of operation circuit

- (4) Under-voltage trip The circuit breaker with under-voltage release shall satisfy the following conditions, at the test specified in 8.3.2 (4).
 - (a) The closing operation can be accomplished at a voltage not less than 85% of the rated operational voltage of the operation circuit.
 - (b) The circuit breaker in closed position shall not be tripped at a voltage exceeding 70% of rated operational voltage of the operation circuit.
 - (c) The circuit breaker shall be tripped at a voltage in the range of 20% to 70% of the rated operational voltage of the operation circuit.
 - (d) The circuit breaker shall not remain in closed position if the closing operation is carried out at a voltage below 20% of the rated operational voltage of the operation circuit.
 - (e) The circuit breaker which has been closed at 110% of the rated operational voltage of the operation circuit, can be tripped without difficulty when the voltage is decreased to zero.
- (5) Trip free The mechanism of the release of circuit breaker shall trip certainly the circuit breaker when tested in accordance with 8.3.2 (5).

6.2 Robustness of terminals

6.2.1 Tensile strength When the test is carried out in accordance with 8.4 (1), no abnormality such as coming out of conductors, shall occur.

6.2.2 Tightening of wire As the results of test specified in 8.4 (2), no loosening of terminals, breakage of screws, nor damage of slit, screw thread, washer or cramping plate shall appear.

6.3 Current carrying and long time-delay trip

6.3.1 Trip at 200% current The overcurrent release shall operate within the operating time specified in Table 10, at the test specified in 8.5.2.

6.3.2 Trip at 125% current The overcurrent release shall operate within the operating time specified in Table 10, at the test specified in 8.5.3.

Table 10. Operating times of overcurrent release

Rated current of circuit breaker (I_n) (A)	Operating time (min)	
	Current equal to 200% of rated current	Current equal to 125% of rated current
$I_n \leq 30$	Within 2	Within 60
$30 < I_n \leq 50$	Within 4	
$50 < I_n \leq 100$	Within 6	Within 120
$100 < I_n \leq 225$	Within 8	
$225 < I_n \leq 400$	Within 10	
$400 < I_n \leq 600$	Within 12	
$600 < I_n \leq 800$	Within 14	
$800 < I_n \leq 1\,000$	Within 16	
$1\,000 < I_n \leq 1\,200$	Within 18	
$1\,200 < I_n \leq 1\,600$	Within 20	
$1\,600 < I_n \leq 2\,000$	Within 22	
$2\,000 < I_n$	Within 24	

6.3.3 Carrying of 100% current The overcurrent release shall not operate at the test specified in 8.5.4.

6.4 Instantaneous trip The circuit breaker with a frame size of 225 AF or larger shall not operate when the lower limit current guaranteed by the manufacturer is passed, at the test specified in 8.6.

Also it shall operate within a opening time (instantaneous trip time) of not more than 0.1 s when the upper limit current is passed.

6.5 Short time-delay trip The circuit breaker with short time-delay release shall operate within the specified time guaranteed by the manufacturer, at the test specified in 8.7.

6.6 Make and break of overload When a circuit breaker is tested in accordance with 8.8, there shall be no electrical and/or mechanical trouble such as remarkable damage, burning or welding of the contacts.

6.7 Overshoot The circuit breaker with a rated operational voltage of 110 V or 110/220 V and a rated current not exceeding 50 A, shall not open automatically and not show welding of contacts, at the test specified in 8.9.

6.8 Temperature rise When the test is carried out in accordance with 8.10, the values of temperature rise shall not exceed the following values i.e. the appropriate value shown in Table 11 for each part of the circuit breaker, the appropriate value shown in the column of thermometer method of Table 12 for the insulation of current coil in main circuit, and the appropriate value shown in the column of resistance method of Table 12, for the insulation of under-voltage release coil.

Table 11. Limits of temperature rise at each part of circuit breaker

Unit: °C

Place and materials composed			Limit of temperature rise (Thermometer method)
Contact	Self pressurized contact		40
	Separately pressurized contact	Silver, silver plating ⁽⁴⁾ , silver alloy	— ⁽⁵⁾
		Others	40
Joints ⁽⁶⁾		Silver, silver plating, silver alloy	— ⁽⁵⁾
		Between tin, solder or nickel plating mutually	60 ⁽⁷⁾
		Others	40
Insulation		Synthetic resin products	— ⁽⁸⁾
Terminal			60 ⁽⁹⁾
Filling compounds			— ⁽¹⁰⁾
Manually operated parts		Metal parts	20 ⁽¹¹⁾
		Insulated parts	35 ⁽¹¹⁾

Notes ⁽⁴⁾ Applicable to the main contacts of a circuit breaker with arcing contacts.

⁽⁵⁾ This means that the temperature rise of the contacts, the supporting conductors or connection parts is harmless to the neighbouring insulating materials. However, the temperature rise limit of the circuit breaker with a rated insulation voltage not exceeding 300 V and a rated current not exceeding 100 A, shall be 100°C.

- (⁶) Applicable to intermediate joints to the terminal of surface type, rear type, flush type, plug-in type and draw-out type circuit breakers excluding inside of the circuit breaker itself.
- (⁷) Applicable only for the joints which are clamped with screws.
- (⁸) It means that the temperature rise shall be harmless to each synthetic resin.
- (⁹) The temperature rise limit shall be 65°C, when the test is carried out with copper bars connected.
- (¹⁰) The compounds shall not flow out at a temperature not exceeding 75°C.
- (¹¹) The measuring point of temperature rise on the manually operated parts shall be approximate center of projected part from the enclosure.

Remarks: The limit of reference ambient temperature shall be 40°C.

Table 12. Limits of temperature rise of coil insulation

Unit: °C

Classification		Limit of temperature rise	
		Thermometer method	Resistance method
Class of coil insulation	Class Y insulation	50	70
	Class A insulation	65	85
	Class E insulation	80	100
	Class B insulation	90	110
	Class F insulation	115	135
	Class H insulation	140	160
Single layer winding of enameled wire		90	—
Double layer winding of enameled wire		80	—

Remarks: Limit of reference ambient temperature shall be 40°C.

6.9 Endurance to operation (closing and opening) The circuit breaker shall not show any electrical and/or mechanical trouble when tested in accordance with 8.11.

6.10 Insulation resistance When a circuit breaker is tested in accordance with 8.12, the insulation resistance of each part shall be not less than 5 MΩ. However, this value is not applied in the case of 8.12 (2) (a).

6.11 Dielectric withstand voltage Each part of the circuit breaker shall withstand the appropriate test voltage for 1 min, at the test specified in 8.13.

6.12 Short-circuit breaking The circuit breaker shall satisfy each of items (1) to (4), at the tests specified in 8.14 (1) to 8.14 (6), and after these tests, shall satisfy each of the items (5) to (8) at the verification after test specified in 8.14 (7).

- (1) Neither electrical nor mechanical trouble shall occur.
- (2) The insulation covering of the connecting wire (W_1 and W_2 in Fig. 1) shall not be injured.
- (3) The fuse for inspection shall not melt down.
- (4) In the case of a circuit breaker with a rated insulation voltage not exceeding 300 V, and a rated current not exceeding 100 A, the cotton cambric shall not be ignited.
- (5) The insulation resistance shall be 0.5 M Ω or more at each part.
- (6) Each part shall withstand the test voltage for 1 min.
- (7) The overcurrent release shall operate within the operating time for 200% of rated current specified in Table 10.
- (8) Making and breaking of the rated current under the rated voltage can be done without any practical trouble.

6.13 Short-time current The circuit breaker with short time-delay release shall show neither electrical nor mechanical trouble, at the test specified in 8.15.

6.14 Short time-delay breaking The circuit breaker with short time-delay release, shall satisfy each of the items (1) to (3) at the tests specified in 8.16 (1) and 8.16 (2), and after these tests, shall satisfy each of the items (4) to (7), at the verification after test specified in 8.16 (3).

- (1) Neither electrical nor mechanical trouble shall occur.
- (2) The insulation covering of the connecting wire (W_1 and W_2 shown in Fig. 1) shall not be injured.
- (3) The fuse used for inspection shall not melt down.
- (4) The insulation resistance shall be 0.5 M Ω or more at each part.
- (5) Each part shall withstand the test voltage for 1 min.
- (6) The overcurrent release shall operate within the operating time for 200% of rated current specified in Table 10.
- (7) Making and breaking of the rated current under the rated operational voltage can be done without any practical trouble.

6.15 Cord protection When a circuit breaker with a rated current not exceeding 30 A and a guaranteed cord protection is tested by passing the cord protective current guaranteed by the manufacturer in accordance with 8.17, the insulation covering of cord shall not be melted and the conductors of cord shall not be broken due to melting.