Molded Case Circuit Breaker

NM1 Basic Knowledge
Introduction and classification of low voltage electrical appliances

1、Low voltage electrical appliances：It is usually referred to as electrical equipment for communication between 1000V and below with dc 1500V and the following circuit breakers, control, protection and regulation.

2、Classification method：

✓ According to the control object is divided into: low voltage control electrical appliances and low voltage distribution electrical appliances;

✓ According to the working conditions / use environment is divided into: general low-voltage electrical appliances and special low-voltage electrical appliances (including: traction low voltage electrical appliances, marine low voltage electrical appliances, mining low voltage electrical appliances, low voltage electrical appliances, tropical low voltage electrical appliances,

✓ According to the type of points: Knife switch, knife switch, fuse, low voltage circuit breakers, contactors, relays, the main electrical appliances and automatic switch
Molded Case Circuit Breaker profile

1. Molded case circuit breakers (referred to as MCCB): has a shell made of molded insulation material as a circuit breaker integral components of the circuit breaker.

2. Function:
   a. Under normal circumstances, closed or disconnected distribution of electrical energy, control the motor circuit in order to achieve the purpose of power outages, power supply and conversion circuits;
   b. When the grid appears abnormal conditions, such as overload, loss of pressure or voltage, short circuit, etc. automatically disconnect the load from the grid. Because these abnormal conditions will endanger the safety of operators or the normal operation of equipment, and even cause man-made deaths or fires.

3. Switch - in the open state can meet the requirements of the isolation function of the mechanical switching electrical appliances.
   a. Isolation is not limited to isolation requirements.
   b. The isolator can carry current under normal circuit conditions as well as current under abnormal circuit conditions (short-circuit current)
NM1 series circuit breakers are mainly used in distribution network circuits to distribute power and protect circuit and power equipment from damage caused by overload, short circuit and under voltage. At the same time, NM1 series circuit breakers can serve as infrequent starting and overload, short circuit, undervoltage protection.
The structure of MCCB

MCCB is mainly composed of arc extinguishing system, tripping system, conductive system, operating mechanism, insulated shell and insulated operating handle.
Parts of MCCB

Conductive system
- Static contact plate: contact (Contact forms: point contact, line contact, surface contact), arc ignition angle, contact plate...
- Moving contact: silver point, contact plate, usually with a soft link (is to turn flexible)...
- Spindle: a fixed number of moving contact knife of the high-strength thermoset plastic shaft.

Arc extinguishing system
- Arc extinguishing chamber: split and extinguish arc.
- Reflector plate, baffle: steam blowing, cooling arc.

Operating mechanism
- Support
- Trip buckle, hasp, buckle
- Upper and lower connecting rod
- Handle and rocker arm

Tripping system
- Magnetic (transient) system
- Heating system

Shell
- Cover
- Pedestal
Structure and working principle

Breaker connection and breaking action, you must rely on four-bar linkage mechanism to achieve. Four-bar linkage action is divided into "re-buckle", "closing", "sub-gate", "free tripping" four programs.

"Re-buckle" - Pull the trip buckle through the rocker arm to the direction of the hasp, until the trip buckle hooks the hasp, they (trip buckle, hasp, buckle) are overlapped by the buckling force to form another button state, in preparation for the next switch.

"Closing" - When the four-bar linkage is buckled again, the mechanism rotates from the re-buckling position to the stationary contact by the handle, the main pull-spring starts to store energy and the main pull-spring is released after reaching a certain position, Quickly reached the dead center position; At this point, the circuit breaker has closed.

"Open" - by the handle so that the mechanism from the contact closure position to the buckle direction of rotation, the moving contact and the static contact separated, the mechanism again through the dead center position, and then pull the main spring release energy, the circuit breaker has been divided brake.

"Free Tripping" - In the event of a circuit breaker failure, no matter which tripping action, will have a mechanical impact, acting on the four-bar linkage, the contact between the three buckle release, the circuit breaker will also be quickly disconnected.
NM1 Family

NM1-63  NM1-125  NM1-250

NM1-400  NM1-630  NM1-800  NM1-1250
Purpose and conditions of use of NM1

1, Function: NM1 series circuit breaker is used for rated insulation voltage 800V (type 63 is 500V), suitable for AC 50HZ or 60HZ, rated working voltage 690V and current is from 10A to 1250A distribution network circuit for distributing electric energy and protection Circuit and power equipment from overload, short circuit, under voltage fault damage, but also as a motor infrequent start and overload, short circuit, under voltage protection.

2, the use of the environment and conditions:

a. Ambient air temperature -5 ℃ ~ +40 ℃ and 24-hour average can not afford more than +35 ℃;

b. Installation of the altitude does not exceed 2000m;

c. Atmospheric conditions: atmospheric relative humidity at the air temperature of +40 ℃ does not exceed 50%, the wettest month average minimum temperature does not exceed +25 ℃, and taking into account the temperature changes occurred in the product surface condensation;

d. Pollution equivalent: 3;

e. The maximum inclination of the circuit breaker installation is ± 22.5 °

f. Products shipped arc plate, protective cover, before use must be installed arc plate, protective cover.
NM1 model interpretation

NM 1- □ □ □ / □ □ □ □ □

- Derived code: T - transparent cover
- N pole type of a quadrupole breaker
- Use code, distribution with no code, protection motor for 2
- Method of release and attachment code
- Poles
- Operation method code: the electric operation is represented by P, and the rotation handle is represented by Z.
- Dividing capacity code: s-standard type; H- higher type; R - current limiting type
- Rated current of shell bracket rating
- Design Number
- Molded case circuit breaker code
- Enterprise characteristic code
### Example: NM1-250H / 4310Y2BT

- **NM1-250 shelf products**
- **Breaking capacity: H**
- **Four B-type**
- **Assembly prepaid,**
- **Motor protection**
- **Loading transparent cover of the product**

### NM1 model interpretation

#### 附表1 脱扣器方式及附件代号

<table>
<thead>
<tr>
<th>附件名称</th>
<th>脱扣器型式及附件代号</th>
<th>电磁式脱扣器</th>
<th>热磁脱扣器</th>
</tr>
</thead>
<tbody>
<tr>
<td>无附件</td>
<td>200</td>
<td>300</td>
<td></td>
</tr>
<tr>
<td>报警触头</td>
<td>208</td>
<td>308</td>
<td></td>
</tr>
<tr>
<td>分励脱扣器</td>
<td>210 (210Y)</td>
<td>310 (310Y)</td>
<td></td>
</tr>
<tr>
<td>辅助触头</td>
<td>220</td>
<td>320</td>
<td></td>
</tr>
<tr>
<td>欠压脱扣器</td>
<td>230</td>
<td>330</td>
<td></td>
</tr>
<tr>
<td>分励脱扣器、辅助触头</td>
<td>240 (240Y)</td>
<td>340 (340Y)</td>
<td></td>
</tr>
<tr>
<td>分励脱扣器、欠压脱扣器</td>
<td>250 (250Y)</td>
<td>350 (350Y)</td>
<td></td>
</tr>
<tr>
<td>二组辅助触头</td>
<td>260</td>
<td>360</td>
<td></td>
</tr>
<tr>
<td>辅助触头、欠压脱扣器</td>
<td>270</td>
<td>370</td>
<td></td>
</tr>
<tr>
<td>分励脱扣器、报警触头</td>
<td>218 (218Y)</td>
<td>318 (318Y)</td>
<td></td>
</tr>
<tr>
<td>辅助触头、报警触头</td>
<td>225</td>
<td>325</td>
<td></td>
</tr>
<tr>
<td>欠压脱扣器、报警触头</td>
<td>235</td>
<td>335</td>
<td></td>
</tr>
<tr>
<td>分励脱扣器、辅助触头、报警触头</td>
<td>248 (248Y)</td>
<td>348 (348Y)</td>
<td></td>
</tr>
<tr>
<td>二组辅助触头、报警触头</td>
<td>265</td>
<td>365</td>
<td></td>
</tr>
<tr>
<td>辅助触头、欠压脱扣器、报警触头</td>
<td>275</td>
<td>375</td>
<td></td>
</tr>
</tbody>
</table>

**注：**
- 200 表示瞬时脱扣器（仅有效磁脱扣器的断路器本体）。
- 300 表示热磁和电磁脱扣器本体。
- 000 表示无过电流保护要求的断路器（不带脱扣器及内部附件的断路器本体）。
- **括号内带 Y 的代号（如 210Y）表示预付费电表专用分励脱扣器，动作延时时间 0.5s～2s，控制电压 AC220V。**

**四极产品中性极 (N) 的型式分为 2 种：**

- **A 型：** N 极不安装过电流脱扣元件，且 N 极始终接通，不与其它三极一起合分；
- **B 型：** N 极不安装过电流脱扣元件，且 N 极与其它三极一起合分 (N 极先合后分)；
NM1 model interpretation
Nameplate parameter interpretation

- **In --- Rated current:** Shelf class. The rated current represents the size of the circuit breaker, the rated current of the release means that the current of the circuit breaker is guaranteed under the specified conditions.

- **Ue --- rated working voltage:** indicating the normal operating voltage circuit breaker effective value, under the conditions specified, to ensure the normal working voltage electrical appliances. 200V / 230V, 380V / 415V, 660V/690V.

- **Ui --- rated insulation voltage:** Under specified conditions, used to measure the electrical parts of different parts of the electrical insulation strength, electrical clearance and creepage distance of the standard voltage value, unless otherwise specified, the value of the maximum electrical Rated operating voltage NM1-63: 500V, NM1-125 ~ NM1-1250: 800V.

- **Uimp --- rated impulse withstand voltage:** appliances under specified test conditions can withstand the peak voltage surge with the specified waveform and characteristics without fault. Rated impulse withstand voltage and clearance and so on. The rated impulse withstand voltage of the appliance shall be equal to or greater than the transient overvoltage rating that may be generated in the circuit in which the appliance is located.

  NM1-63: 6kV  \hspace{1cm} NM1-125~NM1-1250: 8kV
Nameplate parameter explanation

- f --- rated frequency: used to design electrical appliances and other characteristics of the value of the power frequency.

  Note: The same appliance can have a set of rated frequency or rated frequency range, but also AC and DC. 50Hz / 60Hz

- Icu-ultimate short-circuit breaking capacity: According to the provisions of the test procedures prescribed conditions, does not include the circuit breaker continuous carrying capacity of its rated current breaking capacity.

- Ics-Operational short-circuit breaking capacity: According to the provisions of the test procedure under the conditions, including the circuit breaker continuous carrying capacity of its rated current breaking capacity.
NM1 product parameters

1, open distance: refers to the contact in the fully open position, the shortest distance between moving and static contact. The size of the distance should ensure that the contacts can be reliably broken arc, and can ensure that the dynamic and static contact between the insulation gap. (Related to breaking capacity)

2, Overtravel: Refers to the contact is completely closed state, the static contact removed when the moving contact occurred in the contact displacement. The size of the overtravel should ensure reliable contact even after the contact is worn during its life. (Related to life expectancy)

3, the initial contact pressure: refers to the moving contact with the static contact just contact, each contact (for double break point refers to each contact) on the pressure. When the contact is closed, bouncing occurs due to the mechanical impact. At this moment, short arc will occur between the contacts, causing the wear of the contact to be aggravated or even welding occurs. The contact has a certain initial pressure to reduce the bouncing time of the contact, Reduce the contact wear and improve the anti-welding ability, greatly improve product life.
NM1 product parameters

4, the final contact pressure: the final contact pressure is the moving contact and the static contact is completely closed, the pressure on each contact. The contact has a certain final pressure can limit the contact resistance between contacts to prevent overheating contact, and to ensure that the contact through the maximum short-circuit current will not be repelled by the role of electric force. (Related to temperature rise)

5, the contact area: closing state, each phase, static contact contact effective area, ≥ 85% of the contact area can reduce the contact resistance between contacts to ensure product temperature rise.

6, synchronization: closing, the three-phase contact with the static contact contact consistency; asynchronous> 0.5, resulting in three-phase contact with the static contact can not touch at the same time, causing instantaneous phase failure, serious Will cause the device to burn
NM1 product parameters

7, the tripping force: Tripping components push (pull) tripping rod caused by the three deduction buckle to exert the maximum force. Tripping force over the General Assembly led to product thermal overload tripping difficulties; too small, the product body instability instability point, easy to slide.

8, Clearance: The shortest distance between the two conductive parts in the shortest way to tension the rope in the air. The minimum clearance is based on the impact voltage, the applicable altitude is less than or equal to 2000m.

9, creepage distance: the shortest distance between the two conductive parts along the surface of the insulating material. The minimum creepage distance is related to the rated insulation voltage (or actual working voltage) of the electrical equipment, pollution level and insulation material group.
Features of the NM1

1. Tripping characteristics

Overcurrent release can be divided into long delay, short delay and instantaneous three overcurrent release.

Most current molded case circuit breakers only have long delay and instantaneous two-stage protection (Class A, non-selective).

NM8S products with long delay, short delay and instantaneous three-stage protection (Class B, optional).

a. Instantaneous tripping characteristics: Including the solenoid type, take the type

- Instantaneous setting value Distribution protection: \( I_i = 10I_n \)
- Motor protection: \( I_i = 12I_n \)

The instantaneous tripping characteristics meet the bipolar tripping in the range of \( I_i (1 \pm 20\%) \) Tripping, in order to meet the characteristic requirements with a 0.8\( I_i \) non-action, 1.2\( I_i \) action within 0.2s

GB 14048.2 also pointed out that the product unipolar multiplier by the manufacturer's own regulation, there is 1.2\( I_i \), 1.3\( I_i \), 1.4\( I_i \) and other current regulations, NM1 products are now in accordance with 1.2\( I_i \) products

b. Long delay tripping characteristics: to ensure the reliability of thermal overload protection. With a long delay release can be divided into thermal magnetic [Direct thermal (20A below), next to the thermal (32A and above)], damping (DZ15) and electronic.

- Action principle: double gold heated bending, double gold

The factory production process, this feature is full detection; in order to ensure the production efficiency, the use of equivalent delay detection method, the product is usually 2\( I_n \) and 2.5\( I_n \) current equivalent verification. The equivalent delay is not equal to the result of the long delay, the equivalent time of different temperature is different.
Features of the NM1

Bimetal presentation:

1. Bimetallic sheet is composed of two kinds of two or more layers of different thermal expansion coefficient of the metal or alloy material formed by the strong combination of composite metal materials.

2. It has the general metal does not have the special properties ---- thermal sensitivity, that is, with the temperature changes have different bending deformation;

3. NM1 major row number has FPA206-78, FPA721-110, 5J20110 (5J20110 ---- 5J is the row number, 20 that ratio of curvature, 110 said resistivity), 5J1580.
Features of the NM1

Distribution protection with the tripping characteristics

<table>
<thead>
<tr>
<th>Rated current</th>
<th>Thermal trip (ambient temperature + 40 °C)</th>
<th>The setting current of the tripper</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.05In(cold) no action time</td>
<td>1.3In(hot state) action time</td>
</tr>
<tr>
<td>10≤In≤63</td>
<td>1h</td>
<td>1h</td>
</tr>
<tr>
<td>63&lt;In≤100</td>
<td>2h</td>
<td>2h</td>
</tr>
<tr>
<td>100&lt;In≤800</td>
<td>2h</td>
<td>2h</td>
</tr>
</tbody>
</table>

Motor protection with the tripping characteristics (NM1)

<table>
<thead>
<tr>
<th>Rated current</th>
<th>Thermal trip (ambient temperature + 40 °C)</th>
<th>The setting current of the tripper</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.0In(cold) no action time</td>
<td>1.2In(hot state) action time</td>
</tr>
<tr>
<td>10≤In≤250</td>
<td>2h</td>
<td>2h</td>
</tr>
<tr>
<td>250&lt;In≤630</td>
<td>2h</td>
<td>2h</td>
</tr>
</tbody>
</table>

Special Market: There are also benchmark temperature is 50 °C - 55 °C, such as Saudi Arabia, Egypt and so on
Features of the NM1

2. the temperature rise

Stable temperature rise: it takes 4h or 5h to establish a steady state heating process.

Circuit breaker of the temperature rise test at room temperature, air flow environment, product rated current, general electric start measuring after 4 h, 1 hour/time measurement frequency, for any measurement point, two measuring the temperature rise of difference can determine to reach stable temperature rise of less than 1 k.

<table>
<thead>
<tr>
<th>部位</th>
<th>温升极限（K）</th>
</tr>
</thead>
<tbody>
<tr>
<td>手柄</td>
<td>25</td>
</tr>
<tr>
<td>盖</td>
<td>40</td>
</tr>
<tr>
<td>基座</td>
<td>50</td>
</tr>
<tr>
<td>联接板</td>
<td>70K（镀银） 65（镀锡）</td>
</tr>
</tbody>
</table>
Features of the NM1

3, life expectancy

(1) Mechanical life: The product is not loaded with the opening and closing operations, but also with the shunt for re-buckle-closing - tripping operation, assessment of product reliability agencies to ensure that the customer's life.

(2) Electrical life: the product with the load of sub-closing operation, assess the reliability of the product bodies and contacts; to ensure that the customer's term of use; electrical life mainly burning static contact.

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated current</td>
<td>Number of cycles per hour</td>
<td>Operation cycle</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td></td>
<td>No current</td>
<td>Electricity flow</td>
<td>total</td>
</tr>
<tr>
<td>In≤100</td>
<td>120</td>
<td>8 500</td>
<td>1 500</td>
<td>10 000</td>
</tr>
<tr>
<td>100&lt;In≤315</td>
<td>120</td>
<td>7 000</td>
<td>1 000</td>
<td>8 000</td>
</tr>
<tr>
<td>315&lt;In≤630</td>
<td>60</td>
<td>4 000</td>
<td>1 000</td>
<td>5 000</td>
</tr>
<tr>
<td>630&lt;In≤2 500</td>
<td>20</td>
<td>2 500</td>
<td>500</td>
<td>3 000</td>
</tr>
<tr>
<td>2 500&lt;In</td>
<td>10</td>
<td>1 500</td>
<td>500</td>
<td>2 000</td>
</tr>
</tbody>
</table>

1) The maximum rated current for a given shelf rating.
2) The second column shows the minimum operating frequency. The operating frequency may be increased if agreed by the manufacturer, in which case the operating frequency used shall be stated in the test report.
3) The circuit-breaker shall be kept closed for each operating cycle - sufficient time to ensure full current but not more than 2s.
Features of the NM1

4. Insulation voltage:

Insulation dielectric performance test: the relative phase, relatively, into the line end of the outlet should be tested.

1. Power-frequency withstand voltage test: It belongs to the routine test, and corresponds to the dielectric test voltage of rated insulation voltage, see table. There should be no destructive discharge phenomenon such as insulation breakdown or flashover during the test to ensure the safe value of leakage current.

2. Impact pressure test: a type test. Ensure product clearances, creepage distances and related dielectric properties of solid electrical insulation. The higher the relative voltage, the higher the installation category, the higher the Uimp, the greater the clearance.

<table>
<thead>
<tr>
<th>额定绝缘电压 U₁ (V)</th>
<th>交流试验电压 (r. m. s.) (V)</th>
<th>直流试验电压 b-c (V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>U₁ ≤ 60</td>
<td>1 000</td>
<td>1 415</td>
</tr>
<tr>
<td>60 &lt; U₁ ≤ 300</td>
<td>1 500</td>
<td>2 120</td>
</tr>
<tr>
<td>300 &lt; U₁ ≤ 690</td>
<td>1 890</td>
<td>2 570</td>
</tr>
<tr>
<td>690 &lt; U₁ ≤ 800</td>
<td>2 000</td>
<td>2 830</td>
</tr>
<tr>
<td>800 &lt; U₁ ≤ 1 000</td>
<td>2 200</td>
<td>3 110</td>
</tr>
<tr>
<td>1 000 &lt; U₁ ≤ 1 500</td>
<td>—</td>
<td>3 820</td>
</tr>
</tbody>
</table>

NM1 products are tested on the production line: nm1-63: 1280V nm1-125 ~ nm1-1250: 1700V 1s.

Test sampling: nm1-63: 1890V nm1-125 ~ nm1-1250: 2000V 5s.
Attachment of NM1 products

NM1 Series Accessories: Machine Accessories and Machine Accessories

1. Annex within the machine incentive, auxiliary, under voltage, alarm;
   Divide and under voltage points AC and DC in two forms, a variety of current specifications.

2. Outside the annex there are electric operating mechanism, manual operating mechanism, plug-in, backplane wiring and institutional interlocks.
Attachment of NM1 products

- Under voltage release
- Auxiliary contact
- Alarm contacts
- Shunt trip
Attachment of NM1 products

Extended handle
Hand-operated institutions
Electromechanical institutions
Protecting mask

The circuit breaker of the nm1-400 and above can be equipped with an extended handle.
Attachment of NM1 products

Wiring in front of the plate

Cage terminals

After the board wiring

plug-in

Draw out type
Attachment of NM1 products

NM1 series lock assembly function

When the product is locked, the operator will not be able to buckle and close the product again. This function is mainly used to prevent non-professionals from mis-operating during equipment blackout maintenance and to ensure the safety of equipment maintenance personnel.
Attachment of NM1 products

1) The difference between auxiliary contact and alarm contact is:

Auxiliary contacts are mainly used for the circuit breaker status display, through the circuit breaker on the other related to the implementation of electrical control or interlock;

The alarm contact is mainly used for the status display when the circuit breaker is disconnected due to the fault, and the control or interlocking is implemented to other related electrical appliances in time when the circuit breaker load fails.

2) Under voltage release is a protective accessory

When the power supply voltage drops to 35% ~ 70% of the under voltage release rated voltage, the under voltage release enables the circuit breaker to trip;

When the power supply voltage is less than 35% of the under voltage release rated voltage, the under voltage release can ensure that the circuit breaker does not close;

When the power supply voltage is higher than 85% of the under voltage release rated voltage, the under voltage release can ensure the normal operation of the circuit breaker.
Attachment of NM1 products

3) Shunt tripod is a kind of accessories to realize long-distance opening of circuit breaker. It is usually used for remote opening operation of circuit breaker in emergency state and as the execution component of protection electric appliance such as leakage relay. When the shunt release coil voltage at rated voltage 70% ~ 110%, the circuit breaker can be reliably disconnected;

4) The electromotive mechanism is an extra-machine attachment of the remote operated circuit breaker, which can be used to realize the long-distance opening operation of the circuit breaker as well as the closing operation of the circuit breaker.

5) Hand-operated mechanism for manual opening and closing operation;
   The external operating handle is an external accessory that converts the up and down operation of the circuit breaker into a rotary operation.
Attachment of NM1 products

NM1 series prepaid meter special release

NM1 series prepaid meter special release device is suitable for supporting the use of IC card prepaid meter, when there is no balance in the user IC card, prepaid meter dedicated tripping device will open the breaker to open the circuit so that the user cannot normally use electricity and prevent the circuit breaker from closing again. Only when the user charges the IC card again for a certain amount of time can the circuit breaker normally close. This attachment reduces the labor intensity of the power supply personnel.
Selection of circuit breakers and applicable environment

14.1, the use of selection Reference:

1) rated current of circuit breaker $I_{n} \geq$ line rated current $I_{L}$; circuit breaker rated short-circuit breaking capacity $I_{cs} \geq$ line expected short-circuit current.

2) Installation of dual power switch place, because the system of all the neutral line (N line) is connected, in order to ensure the switched power switch (circuit breaker) overhaul security, you must use B, C (N pole and Other three with the same points) type quadrupole circuit breaker.

3) into the residential single-phase main switch, should use a pole with a N pole circuit breaker (for the use of isolator for maintenance).

4) Residual Current Protector (Leakage Circuit Breaker) for 380 / 220V system, the neutral line must pass through the zero-sequence current transformer (core) of the protector to prevent no neutral line from passing, so that the 220V load Leakage current and malfunction, this time should be used quadrupole or with a neutral residual current protection device.

5) known three-phase AC motor power and voltage, circuit breaker rated current can be calculated according to empirical formula: $(kW / kV) * 0.76$
Selection of circuit breakers and applicable environment

14.2, the use of the environment:

§ Do not install in an atmosphere containing explosive gas, because the product with open and close, will have an arc, and our Molded Case circuit breaker non-explosion-proof electrical appliances, so there is the risk of explosion;

§ Do not install the gas medium can corrode the metal and damage the insulation of the place; And the corrosion of the product components.

§ Atmospheric conditions: the relative humidity of the air does not exceed 50% at the air temperature of +40 ℃, the average minimum temperature of the wettest month does not exceed +25 ℃, taking into account the condensation on the surface of the product due to temperature changes;

§ pollution level: 3; (minimum width of groove: 1.5)

§ Degree of protection: IP30; (Prevent foreign bodies > 2.5 in diameter from entering the product)

§ installed at the altitude of not more than 2000m;

In the plateau environment, the air pressure and air density decreased, the air temperature decreases, the larger the temperature difference, air absolute humidity and other factors have reduced the normal use of low-voltage electrical equipment has had a negative impact. With the deepening of the development of the western region and the needs of the development of the western region, the performance requirements for low-voltage electrical appliances are also increasingly being raised. Here we give a brief introduction of the influence of plateau environment on LV circuit breakers.
Plateau Environmental Impact:

1) Temperature rise. As the elevation increases, the density of air decreases, the convection effect of heat dissipation decreases, and the temperature rise increases. However, the temperature in the plateau decreases with the altitude increasing. The decreasing rate is $100\text{m} / 0.5^\circ\text{C}$ above sea level, and can be partly compensated. The effect of altitude increase on temperature rise of electrical appliances. After 100A molded case circuit breaker test verification: temperature rise was linearly increased, significantly affected by altitude. The maximum temperature exceeds the national standard value. Different products increase the temperature rise value is different, the average growth value of $0.24\text{K} / 100\text{m}$, up to $0.5\text{K} / 100\text{m}$. The following figure shows the molded case circuit breaker and the elevation of the corresponding map.
Plateau Environmental Impact:

2) Insulation performance. As the altitude increases, the air density decreases, the dielectric strength decreases, the outer surface of the insulation and charged potential gap is relatively easy to breakdown, especially for the clearance and creepage distance has a greater impact. In general, the electrical clearance is determined by the electrical withstand voltage required by the impulse withstand voltage. The creepage distance is determined by the effective value of the long-term voltage acting across the creepage distance. The dielectric strength test method according to the existing national standards should be revised.

After the frequency withstand voltage test at different altitudes shows that: the dielectric properties of low voltage electrical products by the altitude changes in the presence of but not obvious. In the current technical level, the low-voltage electrical products used in the plateau of the dielectric properties of the test still need to be amended. In addition to the factors that affect the electrical insulation strength of circuit breakers in the plateau environment, there are also complex factors. The IEC standard also clearly stipulates that clearances should be revised as altitude increases.
3) Turn on and breaking capacity. Air pressure and air density decreased, resulting in the air medium arc extinguishing switch arc extinguishing performance, this effect comes from two aspects, one is the elevation, pressure drop, the air density decreases, will cause the switch electrical arc Extended time, contact burning serious. Thus reducing the ability to switch on and off. On the other hand, the altitude increases, the pressure decreases, and the air density decreases, which may be conducive to the switch arc extinguishing. After a series of tests at different altitudes, the arcing and breaking tests show that the arcing times at different altitudes are not significantly different, but increase slightly with the elevation above 4 km but decrease slightly, as shown below. Moving contact electric wear trend is gradually increased, but not sure, see figure. (Turn-on and break-off test main burning moving contact) In summary, the altitude of the arc arcing time has an impact, but the arc can not be modified, but to consider the impact of temperature rise.

![Graph showing arcing times at different altitudes.](image-url)
4) Action characteristics. With the elevation increasing, the density of air decreases and the convection effect of heat dissipation weakened. Moreover, the lowest temperature in the plateau region and the large daily temperature difference will bring a certain impact on the operating characteristics of some low-voltage electrical products. Such as thermal magnetic low-voltage circuit breaker operating characteristics will have some changes.

After the operation at different altitudes characteristic tests show that: a. Thermal magnetic trip circuit breaker. As the altitude increases, the air is thin, convection cooling capacity weakened, leading to thermal elements of the action faster, so that the product of the tripping time ahead of schedule. Thermal magnetic trip characteristics and the relationship between altitude (100A molded case circuit breaker) As shown:

b, electronic trip circuit breaker. Experiments show that the plateau environment has little effect on the trip performance of electronic trip circuit breakers. Electronic tripping characteristics and elevation (100A Molded Case Circuit Breaker) as shown.
5) Electrical life. Due to the extreme low temperature in high altitude area and the combined effect of product temperature rise and interrupting time, the plateau environment will have an impact on the electrical life of low voltage electrical products. Electrical life is a product of a comprehensive parameter, by the product off performance, circuit breaking performance, frequency and frequency of operation, interrupter performance, temperature rise performance and other factors does exist. At present, the application of low voltage electrical products in our country to the plateau area is appropriate, and the derating method is suitable according to the altitude. The derating value is different due to the product structure and performance index.

6) Due to the lower plateau temperature, the low-voltage electrical products used on the plateau should be tested at low temperature according to the severity of low temperature in use.
The maximum inclination of the circuit breaker installation is ±22.5°.

The circuit breaker can be mounted vertically (vertical installation), but also horizontal (horizontal installation), the circuit breaker complies with IEC60947-2, GB14048.2 standards. Some products (NM1, NM6, NM8) have the isolation function. The supplementary requirements for circuit-breakers with isolation function apply to 7.1.6 of IEC 60384-1 and the following additional requirements: If the tripping position is not the indicated open position, the tripping position must be clearly indicated. The indicated open position only refers to the position that ensures that the contacts have reached the specified separation distance. Circuit breakers with isolation shall be marked with the product panel.

Circuit breakers are used for AC 50Hz.
14.3 use of cautions:

§ When the product is manufactured with the arc plate and the protective cover, the spacer and the protective cover must be installed before use.

§ Do not operate the circuit breaker with wet hands, otherwise electric shock may occur.

§ Circuit breakers do not install in a particularly humid place.

§ Circuit breakers do not install outside the magnetic field is greater than 5 times the magnetic field.

§ Circuit breakers do not install in the vibration greater than 5g.

§ Circuit breakers do not install in the rain and snow invasion.

§ Circuit breakers can not be reversed, that is, only 1, 3, 5 then power lines, 2, 4, 6 then the load line. (NM8 products can be poured line)

§ Circuit breaker equipped with under voltage release, must first under-voltage release power, then the circuit breaker closing, or it will damage the circuit breaker.
### Common failures and troubleshooting of circuit breakers

<table>
<thead>
<tr>
<th>NO.</th>
<th>the fault phenomenon</th>
<th>the cause of the problem</th>
<th>Elimination method</th>
</tr>
</thead>
</table>
| 1   | Circuit breaker can not be switch on manually | 1. Under voltage release without voltage or coil damage (with under voltage)  
2. The deformation of the storage spring causes the closing force to decrease  
3. The agency can not reset and buckle | 1. Check the wiring, apply voltage or change the coil  
2. Replace the spring parts  
3. Replace and then buckle and other related parts |
| 2   | Circuit breaker cannot be switch on by electric operation | 1. Operation power voltage does not match  
2. The power capacity is not enough  
Electromagnet rod stroke is not enough  
4. Motor Operation Positioning switch displacement  
5. The rectifier or capacitor in the controller is damaged | 1. Exchange power supply  
2. Increase the operating power capacity  
3. Readjust or replace the lever  
4. Re-adjust  
5. Replace damaged components |
| 3   | Shunt trip can not break the circuit breaker | 1. The coil is short-circuited  
2. The supply voltage is too low  
3. Re-contact interface is too large  
4. Loose screws | 1. Replace the coil  
2. Adjust the power supply voltage.  
3. Readjustment  
4. Tighten the screws |
## Common failures and troubleshooting of circuit breakers

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<tbody>
<tr>
<td>4</td>
<td>The circuit breaker is immediately disconnected when the motor starts</td>
<td>Overcurrent trip instantaneous setting value is too small or improper selection</td>
<td>Adjust instantaneous setting</td>
</tr>
</tbody>
</table>
| 5   | Circuit breaker temperature rise is too high             | 1. The contact surface is too worn or poorly connected  
2. The two conductive parts are loose  
3. Contact surface contamination | 1. Replace  
2. Tighten the screw  
3. Remove oil or oxide |
| 6   | Circuit breaker closed after a certain period of time to break itself | 1. Over-current trip long delay setting value is incorrect  
2. Thermal components or semiconductor delay electrical components have changed | 1. Re-adjust  
2. Replace the product |
Parts that are easily damaged during the use of a circuit breaker

<table>
<thead>
<tr>
<th>No.</th>
<th>damageable parts</th>
<th>the failure reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Into the outlet of the terminal</td>
<td>damaged terminal thread</td>
</tr>
<tr>
<td>2</td>
<td>handle</td>
<td>broken</td>
</tr>
</tbody>
</table>
## Tools used in fault detection

<table>
<thead>
<tr>
<th>No.</th>
<th>names</th>
<th>picture</th>
<th>use</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>multimeter</td>
<td><img src="image1.png" alt="Multimeter" /></td>
<td>For resistance, voltage and current measurements</td>
</tr>
<tr>
<td>2</td>
<td>megger</td>
<td><img src="image2.png" alt="Megger" /></td>
<td>Measure the insulation resistance between phases (or relative position)</td>
</tr>
<tr>
<td>3</td>
<td>point temperature meter</td>
<td><img src="image3.png" alt="Temperature Meter" /></td>
<td>The temperature used to measure the local location of the product when in use</td>
</tr>
</tbody>
</table>
## Tools used in fault detection

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</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Nested tables</td>
<td><img src="image1.png" alt="Nested tables" /></td>
<td>Used to measure the current in the line</td>
</tr>
<tr>
<td>5</td>
<td>portable power supply</td>
<td><img src="image2.png" alt="portable power supply" /></td>
<td>Used as shunt, under voltage and other accessories test power</td>
</tr>
<tr>
<td>6</td>
<td>torque wrench</td>
<td><img src="image3.png" alt="torque wrench" /></td>
<td>Used to measure the tightening torque of the screw</td>
</tr>
</tbody>
</table>
Thanks!