Information materials

Medium/Low voltage detector and its correct use

To prevent accidents during electrical work, extensive research has been carried out to improve facilities/equipment, working methods, and mechanical tools. Among those, the voltage detector for checking final charging status and electric power outages of circuits and apparatus onsite is an indispensable device for preventing electrical accidents.

During electrical work, it is not uncommon for electric shock accidents to occur due to mistaking live lines for lines with a power stoppage. It is important for workers to confirm without fail, that electricity lines do not have electricity flowing through them using a voltage detector before touching them. Their use is also required by OSH Regulations (Article 339).

A voltage detector is a device that detects whether electricity is flowing in a circuit or not. Various types of detector have been manufactured and are widely used. But, there was no official standard for the structure and performance of voltage detectors, and they were mainly manufactured according to the in-house specifications of users, such as electric power companies. However, since the electronic circuit voltage detector with a built-in battery was developed in recent years, detectors with complicated structures and unique modes of operating performance have been manufactured by various companies. Accordingly, the National Institute of Industrial Safety in Labor Ministry (at that time) released the Safety Guideline on the structure, performance, test method, and use of these voltage detectors, in order to make their selection and correct use well known.

The following explains the structure, performance, and correct use, mainly of high/low voltage detectors for AC circuits, which are in general use.

1. Structure and operating principle of voltage detector

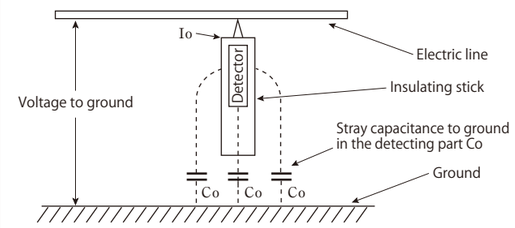
1.1 Voltage detection of AC circuit

In general, voltage detectors have a structure with a detector built into a casing of insulation material. When the contact tip of the voltage detector makes contact with a cableway (electric circuit) as shown in Fig. 1, it detects minute electric currents Io flowing in the Electric line → Detector → Stray capacitance to ground in the detecting part Co of the detector → Ground, and is activated. Then, it identifies the charging or electric power outage status of the circuit, indicating the result by lighting a lamp or sounding an alarm.

There are various types of voltage detector, depending on the working voltage, such as low voltage, high voltage, and special high voltage detectors, and according to the targeted application, such as for overhead lines and substations. There are many types of voltage detector including, for example, low voltage driver type or pencil type voltage detectors, which can easily check whether or not a voltage is applied to a household plug socket and to the cable terminals of electric appliances, as well as voltage detectors used for construction work, inspecting electric power supply equipment, etc.

Among commonly used voltage detectors, the neon light emission type, which has the merits of a simple structure and not requiring a power supply, has been widely used. However, its weak luminance is a drawback when checking if its lamp is lit, which is a vital point. Accordingly, a better indication of detection than that provided by the discharge light emission from a neon tube has been required by users. Today, a voltage detector that can detect a voltage through an insulated cable and indicate it has been developed, with battery and amplifier circuit built in. This has become a commonly used type.

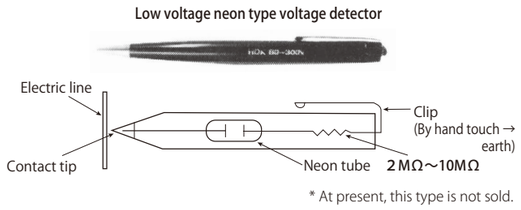
Fig. 1 Principle of voltage detector



◇Neon light emission type voltage detector (Fig. 2)

This made use of the feature whereby if a discharge voltage is applied to a neon discharge tube, it glows a brilliant orange color, even in the case of a minute current. It has been widely used for low, high, and special high voltage detectors, because its structure is very simple and it is easy to handle. Its drawback is that the weak light emitted is difficult to verify in well-lit areas, and voltage detection is not possible through the covering of an insulated cable.

Fig. 2 Neon light emission type voltage detector



◇Electronic circuit type voltage detector (Fig. 3) (Fig. 4)

This device identifies charging or electric power outage status by incorporating a battery and an electronic amplifier circuit with semiconductors inside the voltage detector. These amplify the minute detection current to light an easy-to-see indication lamp, and convert the current into an audio frequency to generate an easy-to-hear sound using the switching circuit and oscillating circuit.

The great advantage is that by designing an amplifier circuit it is possible to manufacture voltage detectors with various characteristics and to have the common type for high/low voltages, as well as to detect a voltage through an insulating sheath. Furthermore, because electronic circuit type voltage detectors are provided with a button for easily checking the battery and built-in circuit, it is easy to confirm a voltage detector's functions.

Fig. 3 Audio signaling and light emitting type low voltage detector (example)

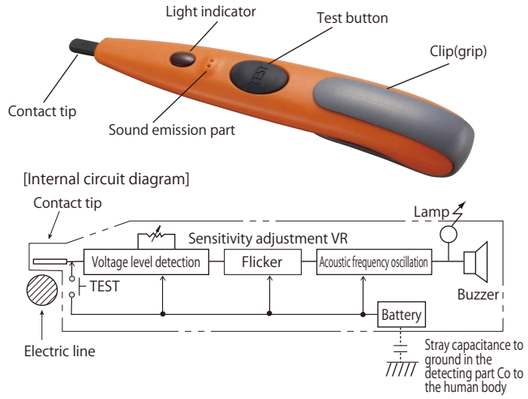
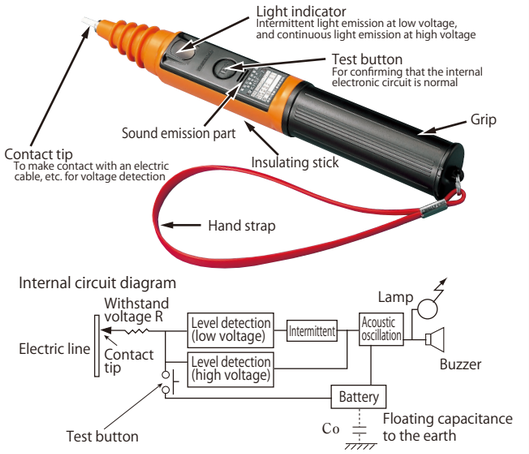


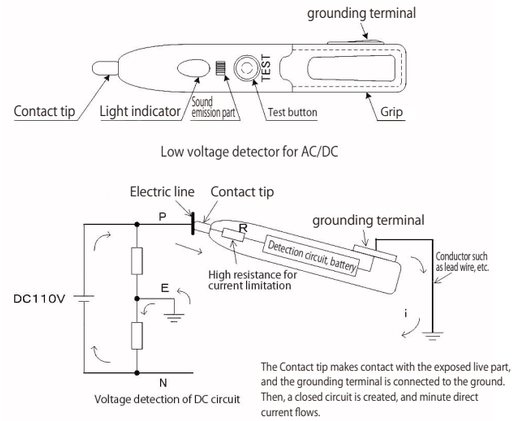
Fig. 4 Audio signaling and light emitting type high/low voltage detector (example)



1.2 Voltage detection of DC circuit

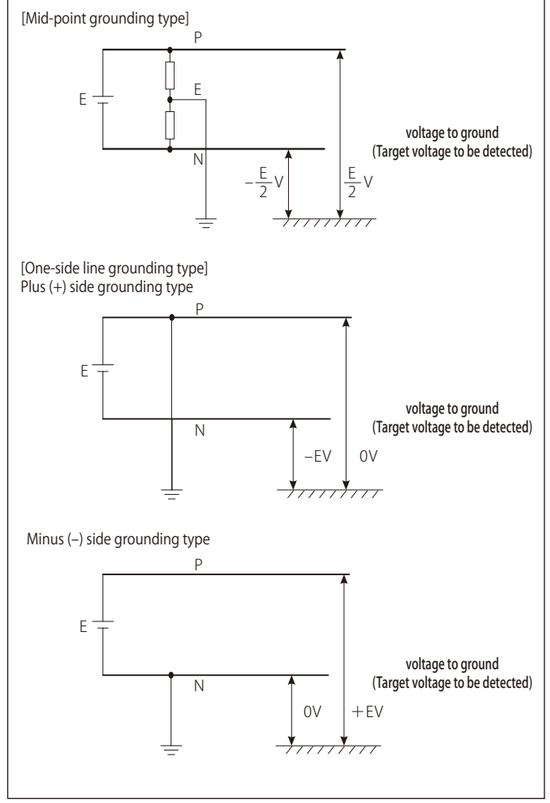
When detecting the voltage of a DC circuit, it is possible to have the contact tip make contact with an exposed live part of a electric line then create a closed circuit by connecting the earth terminal to the ground, and flow a direct current (**Fig. 5**), because the current does not flow via capacitance, unlike the case of AC. Therefore, voltage detection through a covering (sheath) is not possible in the case of a DC circuit. Furthermore, a voltage detector exclusively for AC use cannot detect a DC voltage. Moreover, voltage detection in a DC circuit with the cableway not grounded is impossible, because there is no return route for the current. The grounding system and voltage to the earth of the low voltage DC circuit are shown in **Fig. 6**.

Fig. 5 Voltage detection of DC circuit



As described above, because the voltage to the ground (target voltage to be detected) differs depending on the type of voltage, wiring, and grounding system, and the detection method also differs between AC and DC, a basic task of voltage detection is to identify the kind of Electric line (electric circuit) in which the voltage is to be detected, then select a suitable voltage detector, and execute voltage detection with the correct method.

Fig. 6 Grounding system and voltage to the earth of DC circuit



2. Performance required of voltage detectors

The first main performance priority from the viewpoint of a voltage detector's intended use is voltage detection sensitivity (operation starting voltage). It tends to be considered that as sensitivity increases, performance increases. However, as sensitivity increases, there are concerns that false-positive indications increase due to noise and/or induction. Other important things to consider are withstand voltage in terms of the safety of users, and indication method from the viewpoint of certainty.

2.1 Operation starting voltage (detectable minimum voltage)

In normal cases, a user of a voltage detector holds the main body or one end of the insulating stick connected to the main body with a hand(s), then makes contact between the detector and one line of the cableway, detecting the voltage flowing in the conductive cableway to the earth (voltage to the earth). Therefore, the operation starting voltage is indicated by the voltage to the earth.

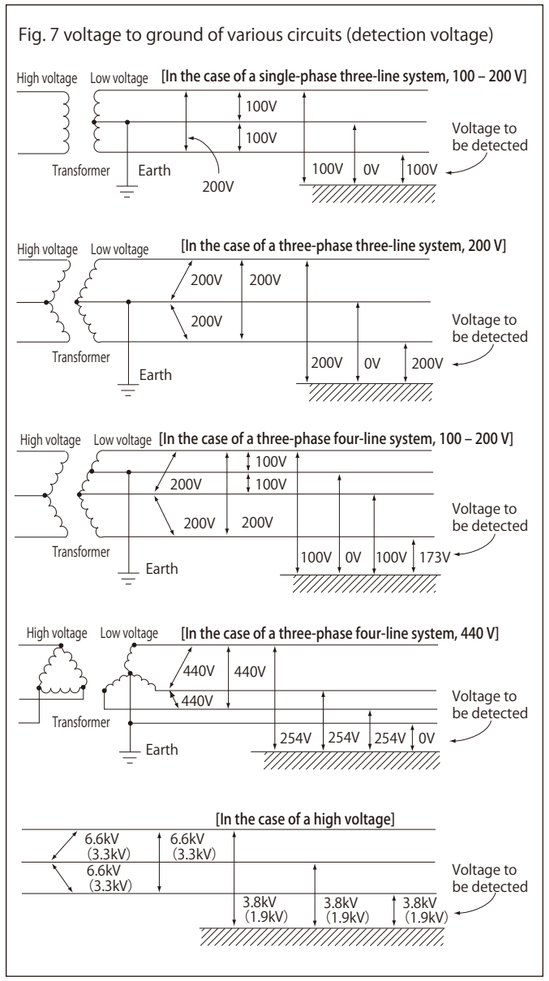
The target voltage to be detected in a low voltage circuit and a high voltage circuit is the voltage to the earth, as shown in **Fig. 7**, which is lower than the line voltage. In addition, voltage detection in a grounded cableway (line) is naturally impossible, because the voltage to earth is zero.

(1) The low voltage detector generally targets the minimum circuit voltage, which is 100 V (95 to 107 V), and the operation starting voltage is set at 65 V ± 15 V, or not to exceed 80 V. In a voltage detector dedicated to low voltages, there is also a detector in which the voltage to the earth is set at 50 V or lower as the target (limit) under the OSH Regulations, because there is no need to consider the influence of induction from a high voltage.

(2) Regarding a high voltage detector, there are cases where a working voltage of 300 V or higher is specified as a high voltage, because the voltage to the earth is 254 V, with regard to a 440 V three-phase four-wire system, which is the highest voltage of a low voltage circuit. Furthermore, there is also a case where 600 V or higher can be detected, based on the regulation: "High voltage of AC denotes the range of higher than 600 V to 7,000 V or lower;" specified in Technical Standards (ministerial ordinance).

In addition, in the case of a voltage detector dedicated to high voltages, there are various types depending on target cableways and applications, such as the case in which the voltage to earth of 1,900 V for a 3,300 V circuit is set at 1,000 V (almost 1/2) considering the margin for voltage detection, in order to prevent miss-operation due to induction from the live wire, as far as possible, and the case in which the working voltage is set at 3,300 V against the voltage to earth of 3,800 V for a 6,600 V circuit, considering the margin, and to enable voltage detection through a sheathed wire. In general, the value that enables detection of the voltage to earth for the targeted circuit's voltage, through a sheathed wire and with a margin considered appropriate for safety, is used for voltage detection.

Fig. 7 voltage to ground of various circuits (detection voltage)



For comparison, **Table 1** shows a partial quoted example of an apparatus and supplies material standard for Japanese electric power companies.

Table 1 Partial example of the apparatus and supplies material for a voltage detector

	Operation starting voltage [V]		Remark
	Bare wire (a)	Coated wire (b)	
Company A	250 ± 50	(2,900 or less)	audio signaling and light emitting type
Company B	300 ± 50	(3,300 or less)	〃
Company C	1,000 or less	3,300 or less	〃
Company D	1000 ± 200	2800 ± 500	〃

(Note) (1) The reason why the ratios in column (a) and column (b) differ significantly between companies A, B and companies C, D is due to structural differences in the voltage detector.
(2) Although the values in ( ) of column (b) are not described in the apparatus and supplies material standard, they are used as practical standard values.
(3) That of company A is a common type for 50/60 Hz, and the others are dedicated to a designated frequency.
(4) The table above describes only the high voltage range of a high/low voltage detector.
(The low voltage range is specified as 65 ± 15 V by every company.)

2.2 Non-operation distance

When a voltage detector approaches a high voltage circuit, it is activated from a certain distance. However, if operation starts too far away, a phenomenon is generated whereby discriminating between live lines and non-energized lines among plural targets becomes impossible. Then, it is considered that, not only can the primary purpose of the voltage detector not be achieved, but it is also dangerous. Accordingly, it is common to specify a minimum distance for a system, beyond which operation is not started when the voltage detector approaches (called the non-operating distance), and in the case of a high voltage, the non-operating distance is usually 3 to 5 cm.

2.3 Withstand voltage

A high voltage detector is classified from the viewpoint of actual use for defective (porcelain) insulators, etc. among apparatus for live-line work, as described in the Public Notice of the Ministry of Labour No. 33, Article 9. Generally, it shall withstand an AC test voltage corresponding to two times the voltage of the target cableway to be used, for one minute. Regarding voltage detectors with a built-in battery, detectors having a withstand voltage performance of not only 14,000 V (6,900 V × 2), but also 20,000 V are manufactured,

2.4 Representation of the result of detection (light and sound)

It is specified that detection by voltage detectors shall be indicated by either light emission or sound generation (Safety guideline for voltage detectors).

Regarding indication by light emission, it is generally possible for light emissions to be identified if the luminance is 8,000 lux on a practical basis in shadow in sunlight (place without direct sunlight).

Regarding sound indication, it is also necessary to consider locations with high ambient noise of 80 dB, such as in the vicinity of roads in urban areas, when reviewing the usage environment of a voltage detector. However, a sound volume of 50 dB or more is deemed sufficient in practice, using sound generated at around 3,000 Hz, to which the sensitivity of a human's auditory sense is high, because ambient noise is generally in low frequency bands, which corresponds to the low tone range.

3. How to use voltage detectors correctly

3.1 Check carefully before use.

Because a voltage detector is an important device for protecting the lives of workers, it must always be stored and handled carefully. External appearance as well as lighting should also be check before use. Defective products must be replaced immediately.

(1) Confirm whether the working voltage range of the voltage detector conforms to electric line or not.

(2) Visually check for the presence or absence of breakages, dirt, flaws, cracks, etc. in the voltage detector.

(3) Confirm that the detecting function of the voltage detector is normal, using a known power supply, voltage detector checker (**Fig. 8**), etc.

(4) For a the voltage detector with a built-in battery, confirm that the internal circuit and battery voltage are normal by checking the mechanism (test button).

Fig. 8 Voltage detector checker

■Point to be noted about contact tip made of conductive rubber

Insulation materials such as oil shall not adhere to the conductive rubber part (detector). In particular, if gasoline, alcohol, etc. adhere, conductive properties can be lost.

Do not wipe it with chemicals, etc. When cleaning, use a soft and clean dry cloth.

3.2 Points to be noted for voltage detection

(1) Before voltage detection, confirm that the voltage detector corresponds to a suitable working voltage range that conforms to the target cableway; (Example: A low voltage detector cannot detect high voltages). Also confirm the status of the cableway, with switches, indication lamps, and circuit diagrams, etc.

(2) Set the insulating stick to the normal state by extending and/or tightening it, depending on the type of voltage detector.

(3) During voltage detection, do not touch parts other than the grip of the voltage detector, because this may be dangerous.

(4) When detecting a high voltage, wear insulated rubber gloves when a hand approaches within a distance of 60 cm from the high-voltage part. If an ordinary voltage detector with a length of 25 cm is used, be sure to wear insulated rubber gloves. In the case of an inspection tour, and if protective equipment and/or protective guard are not carried, it is convenient to use a long voltage detector with an insulating stick.

(5) When there is a risk of a surge voltage being generated, such as when a lightning strike occurs or when opening/closing a circuit breaker, switch, etc., stop using the voltage detector.

(6) Voltage detection in the rain should be avoided, in principle. When it is performed from sheer necessity, pay attention to the wet condition of the voltage detector, and whether operation in the rain is reliable or not. It is also necessary to investigate and confirm whether there is a risk of electric shock or not.

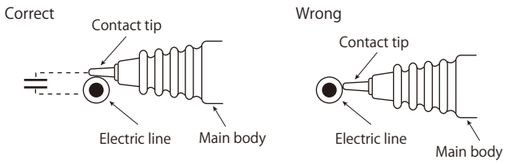
(7) Perform voltage detection for each phase, sequentially.

(8) Perform voltage detection by moving the voltage detector closer from the earth side to the electric line.

3.3 How to make contact with a voltage detector

Hold the grip of a the voltage detector firmly, and have it make contact with the part targeted for voltage detection. When detecting voltage through a covered (sheathed) wire, ensure sufficient contact between the detector and the wire as shown in **Fig. 9**. Otherwise, capacitance between the core wire and detection metal fitting changes, and operating sensitivity decreases.

Fig. 9 How to make contact with the contact tip of the surface of coated wire

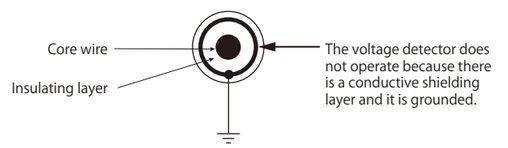


3.4 Voltage detection for a high voltage electric line is not possible.

Voltage detection for the high voltage power cable is not possible because the conductor is shielded and grounded with conductive tape. (**Fig. 10**)

Perform voltage detection at the terminal that is specially provided at the cable end for detection, using a dedicated voltage detector. Furthermore, there are also cases of using a current detector for detecting a current that flows in a cable.

Fig. 10 Voltage detection for a high voltage electric line is not possible.

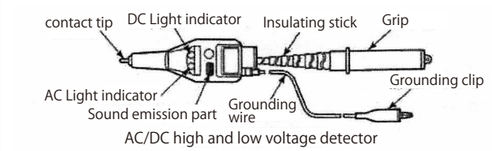


3.5 Electric discharge of residual charge

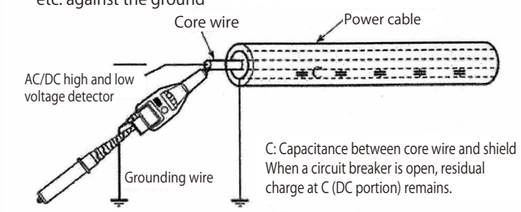
When there are electric power cables, power capacitor, etc. on the cableway, it can be hazardous even with an AC cableway, because a residual DC charge remains after an electric power outage. In the OSH Regulations No. 339 Article 2, it is specified that "Regarding a cableway where its open-circuit has power cables, power capacitor, etc. and there is a risk of danger due to residual charge, the corresponding residual charge must be securely discharged with a safe method," and it is necessary to completely discharge the residual charge with a discharge bar or similar means. At this time, there are cases of a charge remaining between the cableway and the earth, and cases of it remaining between lines. So, discharge all residual charges with care. In addition, it is necessary to take sufficient time when discharging, because there are also cases in which it takes a long time for discharging, depending on the resistance value of a discharge resistor and capacity of a condenser.

Moreover, when the residual charge is checked, use a voltage detector for dual AC/DC use, and perform voltage detection for the electric potential at both ends where the electric charge remains (**Fig. 11**).

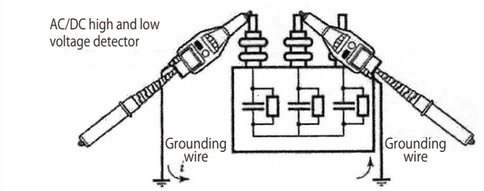
Fig. 11 Method of detecting a residual charge



(1) Voltage detection method for residual charge in power cables, etc. against the ground



(2) Voltage detection method of residual charge between terminals of a phase-advanced capacitor, etc.



Using two DC voltage detectors, it is possible to detect the residual charge between lines.

3.6 Precautions for carrying and storage

(1) Handle voltage detectors carefully, and pay attention not to apply a shock or strong force, caused by dropping, placing a heavy object on top, etc.

(2) Pay attention not to leave it on a road or at a place that is subject to high temperatures, such as inside a car in summer.

(3) In winter, when a voltage detector is suddenly brought out from a hot room to the cold outdoors or the reverse, dew condensation can be generated at the volt-

age detector, and its operating functions may be affected. So, attention is required.

(4) For storage, select a dry, clean dust-free location inside a room, which is not exposed to direct sunlight.

3.7 Don't forget to conduct periodic inspections

Voltage detectors are excluded from periodic self-inspections as determined by the law (Ordinance on Industrial Safety and Health). However, unlike work tools such as pliers and screwdrivers, voltage detectors are important safety equipment used to prevent electric shock disasters for workers in electric-related activities. As such, it is preferable to periodically check the voltage-resistance performance of voltage detectors. (Voltage Detector Safety Guidelines)

(1) For high and extra-high voltage detectors, the following periodic self-inspections are recommended according to the product.

- Short-type voltage detectors for high/low voltage (HSF-7, HSE-7T1, HSE-7G)

Please conduct a voltage-resistance test for 1 minute at a test voltage of 10 kV or higher once a year. (Voltage Detector Safety Guidelines RIIS-TR-85-2)

- Other models not included above (including phase testers)

Please conduct a voltage-resistance test for 1 minute at 2x the maximum working voltage once every six months. (In conformance with Article 351 of the Ordinance on Industrial Safety and Health (Periodical Self-Inspection of Personal Insulating Protective Equipment, etc.) and Article 9 of the Standards for Personal Insulating Protective Equipment, etc. (Voltage Resistance Performance of Live Line Work Equipment)) *For testing methods, refer to P. 72 and P. 74.

(2) When conducting a periodic inspection, check and change the batteries that have been included with the voltage detector, as the individual batteries experience natural discharge even if the voltage detector is not used.

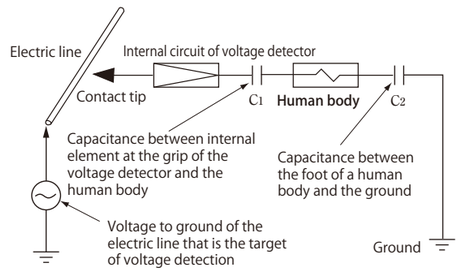
4. Influence of unique usage conditions

The site environments where voltage detectors are used are not always the same, and detection performance sometimes changes depending on usage conditions. The conditions with notable influences are as follows.

4.1 When the correct position of the grip is not identified:

If the grip of a commonly used short voltage detector is not held firmly, and when it is used in a state in which it is only held by finger tips, the operation starting voltage increases because the value of capacitance C1, as shown in the equivalent circuit of **Fig. 12**, decreases.

Fig. 12 Equivalent circuit using a voltage detector

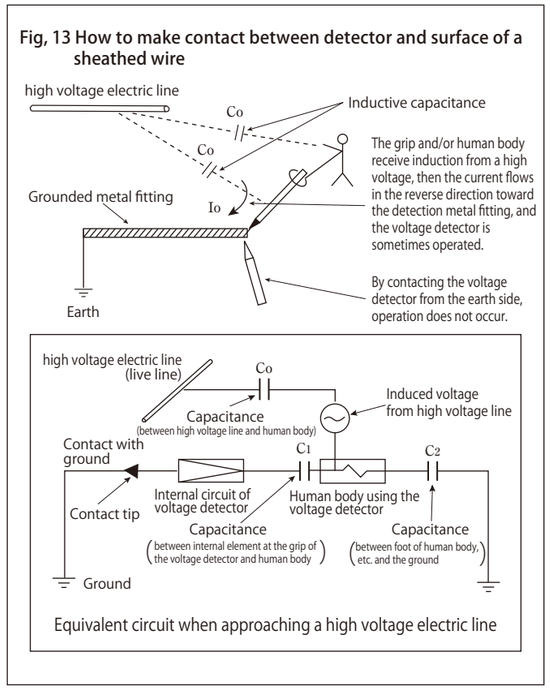


4.2 When voltage detection is performed near a high voltage electric line:

When the detector of a high/low voltage detector (with built-in battery) makes contact with an earth wire or grounded metal while approaching a high voltage live part on a pillar or inside an electric utility room, the voltage detector sometimes displays "Voltage is applied," in the range of low voltage use.

This phenomenon is explained, as shown in **Fig. 13**, as the human body and/or grip of the voltage detector that approaches the high voltage line having a voltage that flows to the earth due to induction from the live line, and an induction current flows in the reverse direction from the grip of the voltage detector to the detector, causing it to operate. In such a case, abnormal operation can be prevented by keeping it as far as possible from the high voltage line, or carrying the voltage detector from the earth side, because induction is decreased.

Fig, 13 How to make contact between detector and surface of a sheathed wire

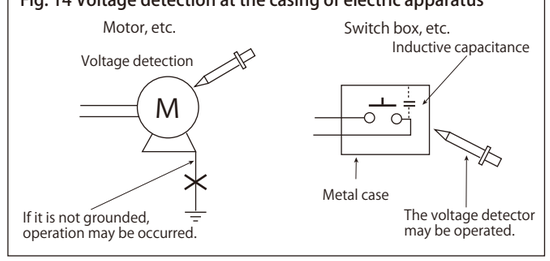


4.3 In the case of apparatus that is not grounded:

To reduce the inflowing current to the human body to a very small value, the impedance between the detector and the human body is increased to a very large value. Accordingly, when the casing of the apparatus is not grounded as shown in **Fig. 14**, the voltage detector sometimes gives an indication when the inductive capacitance of the apparatus is large, even if the insulation of the target apparatus is normal.

In such a case, it is necessary to confirm whether the grounding of the apparatus is perfect or not. Furthermore, in the case of apparatus that is not grounded, measure the voltage to verify if it is in a safe range or not using a meter with a relatively low impedance, such as an analog tester.

Fig. 14 Voltage detection at the casing of electric apparatus



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A comprehensive explanation of high/low voltage detectors has been provided above. Again, because voltage detectors are important items for ensuring safety during electrical work, correct use with sufficient recognition of the system/mechanism is naturally required. We hope this document helps ensure correct use of voltage detectors. For details of quoted regulations, etc., refer to the following.

- OSH Regulations No.339 (Work following an electric power outage)
- OSH Regulations No.342 (Work in proximity to a high voltage)
- OSH Regulations No.348 (Electrical insulating protectors, etc.)
- OSH Regulations No.352 (Inspection before use, etc.)
- OSH Regulations No.354 (Exclusion from application)
- Public Notice of the Ministry of Labour No.33 (revised version), 1975 (Standard of protectors for insulation, etc.)
- Technical guideline of National Institute of Industrial Safety in Labor Ministry
  RIIS ～ TR ～85～2
  (Safety guideline for portable voltage detector for high voltage wiring cableway)

Product Warranty, Maintenance

■Warranty period

- Product warranty period is one year after purchase. If any failure, trouble, etc. is caused during normal use in the course of the warranty period, we will repair or replace it free of charge.

■Scope of warrantee

- If disassembly, modification, etc. is performed by customers, the product becomes outside the scope of warranty.
- Consumable parts such as batteries attached to products, etc. are outside the scope of warranty. Furthermore, because attached batteries are provided for the purpose of confirming operation, early replacement is recommended.

■Repair

- If the product malfunctions, please inquire at a sales office of our company or a sales agent. Requests for repair will be received through sales agents.
- When an estimate before repair is needed, please request it when asking for the repair. When declining repair after submission of the "estimate before repair," the cost of diagnosis will be requested.
- Warranty period after repair is six months. Scope of warranty is limited to the corresponding portion(s) repaired, and even within that warranty period, any new problem arising is outside the scope of warranty.

[Period for repair]

Materials and components for repair are kept for a minimum of five years after stopping manufacture of a product. However, please note that there are cases in which repair can become impossible before that period has expired.

■Recommended period for replacement

(voltage detector, phase tester, auxiliary device for voltage detection, etc.)

Products can be used for a long period if they are handled with sufficient care. However, it is inevitable that functional deterioration occurs to the strength of components, insulation performance, etc. due to aging, micro-cracks caused by shocks when handling resin parts, etc. For safety, please use the product until the recommended time for replacement under product control. The table to the right summarizes recommended replacement periods.

For a detailed table, please inquire at our company's homepage (URL is given on the back cover of the catalog) or a sales office.

Product classification	Recommended period for replacement
Low voltage detector	3 to 5 years
High voltage detector	5 to 7 years
High voltage & special high voltage detector	
High voltage & special high voltage detector (Non-extendable type)	5 to 10 years

■Periodic inspection, calibration test

- For high voltage and special high voltage detectors, we recommend periodic inspection at least once a year. For requests, please inquire at a sales office of our company, or a sales agent.
- After the calibration test, we will issue a test report, calibration certificate, and traceability certificate.
- If calibration documents are required when purchasing a new product, please request them when placing an order.

■Consigned testing

Taking advantage of being a leading maker of domestic test equipment and many years of experience, we will execute withstand voltage tests for products even made by other companies.

Voltage detector test equipment

Simulated power pole for electricity distribution line

■ISO management system Acquiring certification of ISO9001, ISO14001

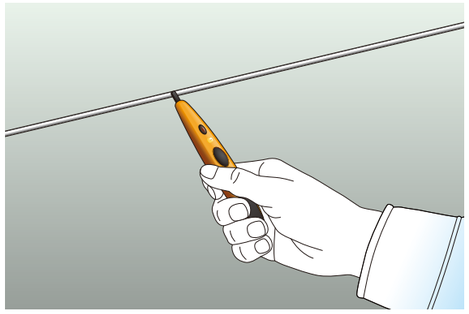
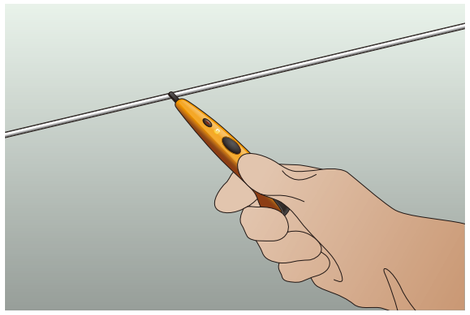
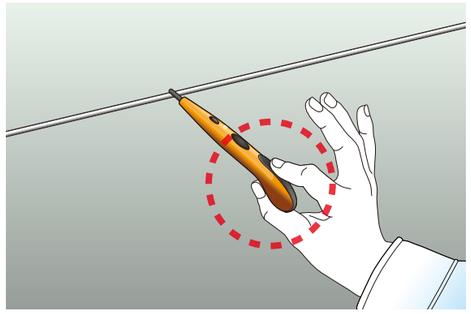
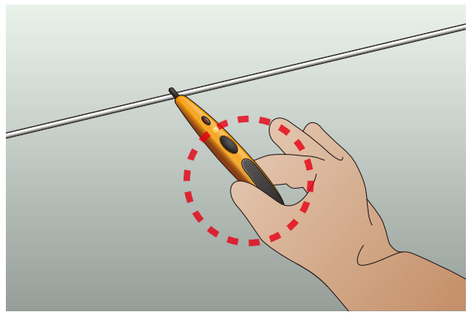
Hasegawa Electric Co., Ltd. has acquired certification of "ISO9001," which is the international standard of the Quality management system, and certification of "ISO14001," which is the international standard of the Environment management system.

ISO9001 Registration No.: 0921
ISO14001 Registration No.: E635

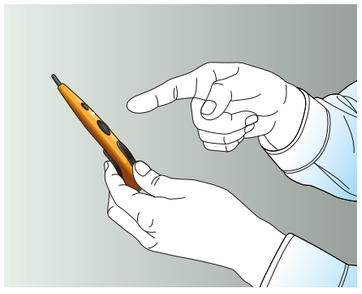
Low voltage use (For AC)

The contact area with the hand affects the sensitivity of the voltage detector. So, appropriate sensitivity cannot be obtained unless it is held firmly. Also, it is not possible to use rubber gloves for high voltages or gloves made from thick fabric.

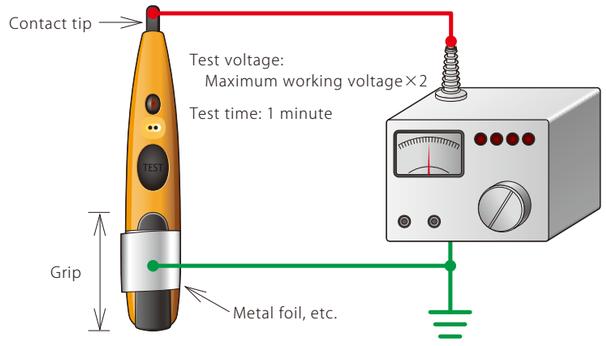
■Holding the voltage detector correctly

○ Good	× Bad
 	 
●Hold the grip firmly.	●It is not possible to detect the voltage correctly if the grip is held with the tips of the fingers.

■Visual inspection



■Withstand voltage testing



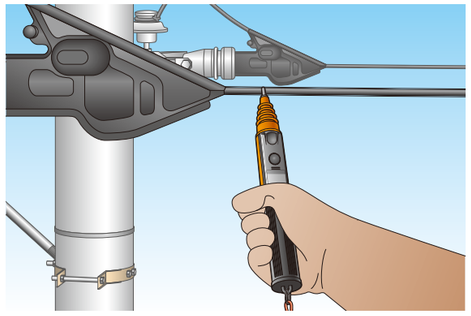
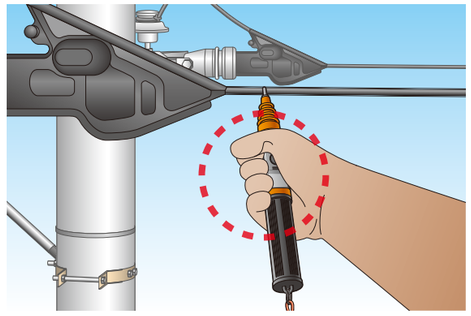
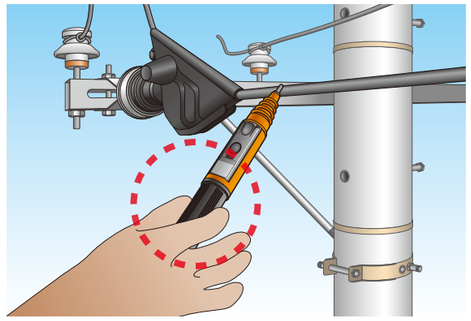
Visual inspection items

- ●Press the test button for about five seconds and check that there is no change in the lamp or the sound.
- ●Check that there are no problems such as damage, dirt, scratches or cracks.
- ●Apply a voltage between the contact tip and the grip (at a position near the contact tip).

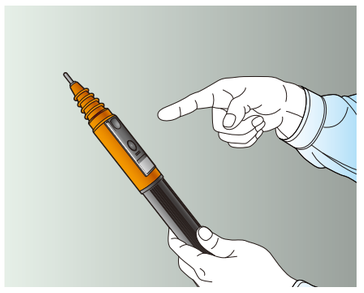
Medium and Low voltage use (For AC)

The contact area with the hand affects the sensitivity of the voltage detector. So, appropriate sensitivity cannot be obtained unless it is held firmly.

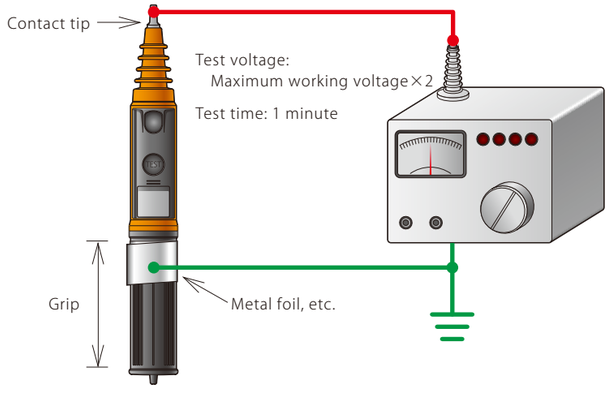
■Holding the voltage detector correctly

○ Good	× Bad
	 
●Hold the grip firmly.	●Never hold a part other than the grip when detecting voltages. This is extremely dangerous. ●It is not possible to detect the voltage correctly if the grip is held with the tips of the fingers.

■Visual inspection



■Withstand voltage testing

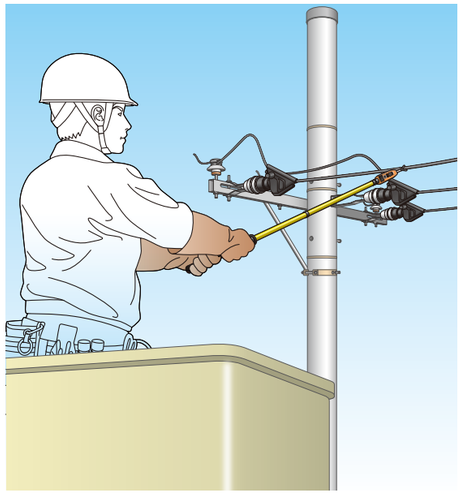
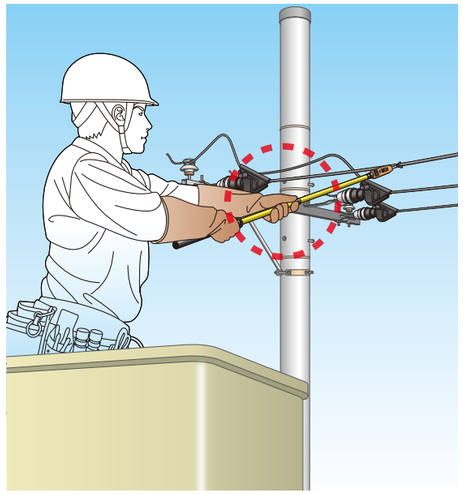
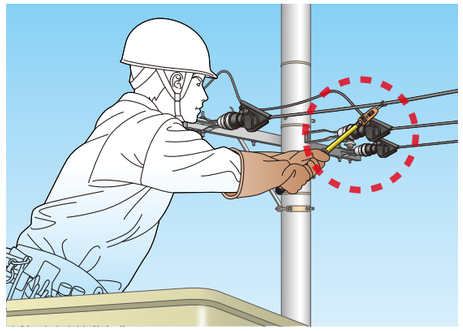


Visual inspection items

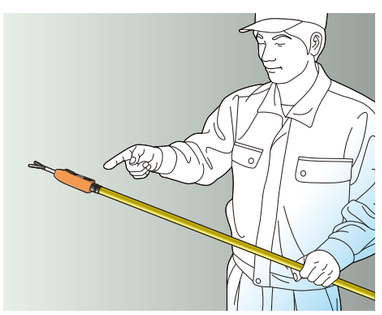
- ●Press the test button for about five seconds and check that there is no change in the lamp or the sound.
- ●Check that there are no problems such as damage, dirt, scratches or cracks.
- ●Apply a voltage between the contact tip and the grip (at a position near the contact tip).

Medium voltage & High voltage detector use

■Holding the voltage detector correctly

Good	Bad
	
■During storage  ■During use  Extend as far as possible	
●Hold the grip firmly. ●Telescopic type voltage detectors should be extended as far as possible for use.	●Never hold a part other than the grip when detecting voltages. ●Do not use a telescopic type voltage detector to detect voltages in its shortened state.

■Visual inspection

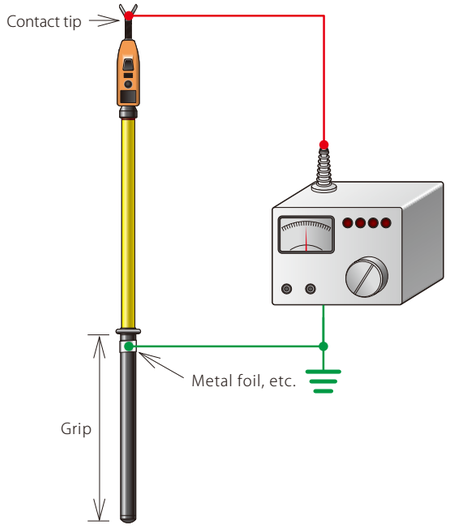


Visual inspection items

- ●Press the test button for about five seconds and check that there is no change in the lamp or the sound.
- ●Check that there are no problems such as damage, dirt, scratches or cracks.

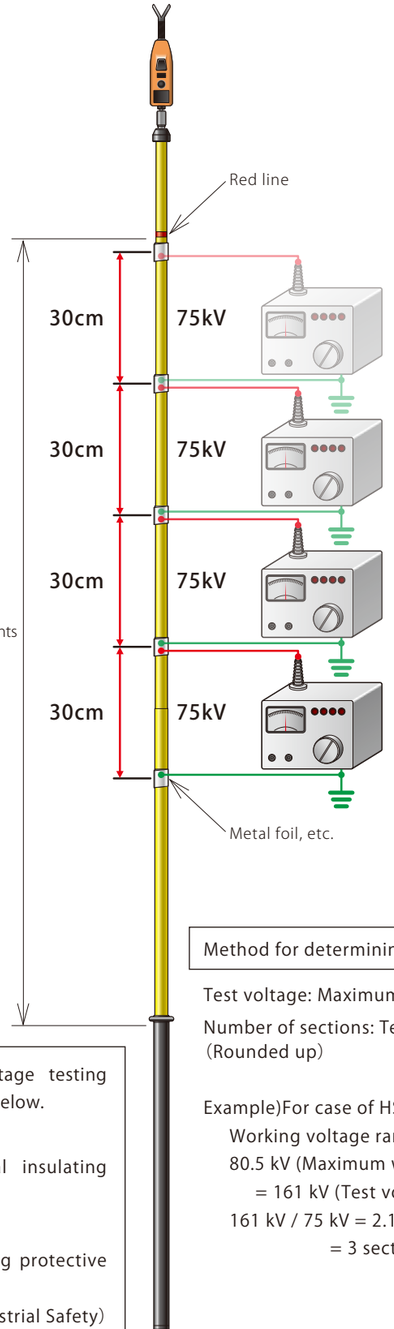
■Withstand voltage testing

■When using a withstand voltage tester output voltage (MAX 75 kV)



Test voltage: Maximum working voltage×2
Test time: 1 minute

■When the test voltage exceeds 75 kV
Divide the test points into parts 30 cm long and apply the test voltage across each of those parts



Method for determining the number of sections

Test voltage: Maximum working voltage×2

Number of sections: Test voltage / 75 kV (Rounded up)

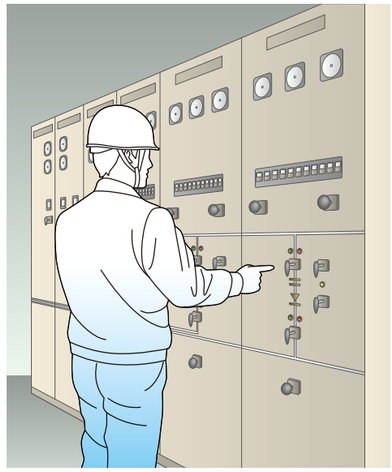
Example)For case of HST-70
Working voltage range: 20 kV to 80.5 kV
80.5 kV (Maximum working voltage) × 2
= 161 kV (Test voltage)
161 kV / 75 kV = 2.15 (Number of sections)
= 3 sections (rounded up)

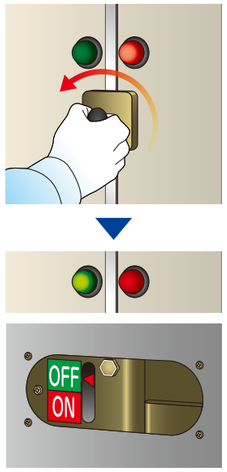
Hasegawa Electric has defined the withstand voltage testing methods by quoting the regulations and others listed below.

- ●March 28, 1961 LSB Notification No. 247
  "Regulations on the performance of personal insulating protective equipment"
  (Ministry of Health, Labour and Welfare)
- ●4th Edition Test standards for personal insulating protective equipment, etc.
  (Issued by: The Expert Group of Expertise on Industrial Safety)
- ●JIS C 4510-1991 Hook bars for disconnecting switch operation

Confirming dead-line work

①Visual inspection of appearance and structure
Battery check by pushing the test button

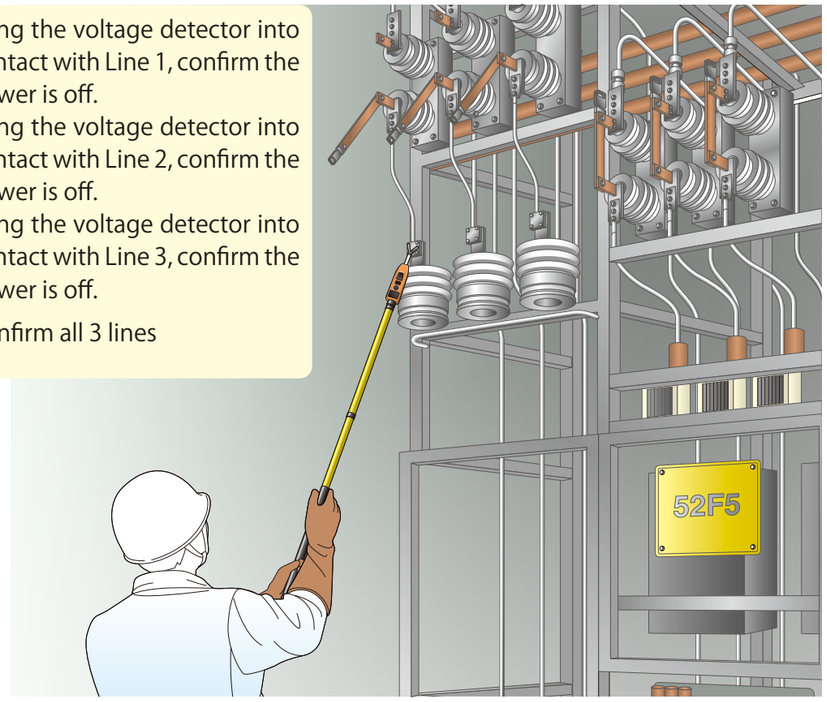


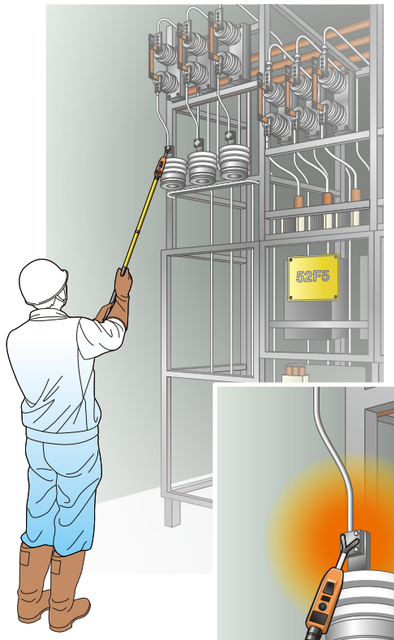


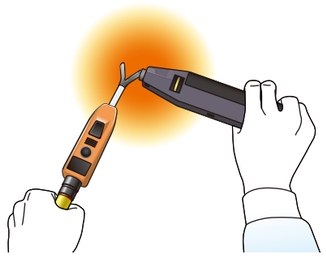
③Turn off the Circuit Breaker
Turn off the disconnector switch

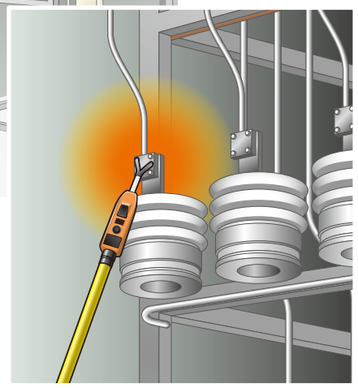
④Bring the voltage detector into contact with Line 1, confirm the power is off.
Bring the voltage detector into contact with Line 2, confirm the power is off.
Bring the voltage detector into contact with Line 3, confirm the power is off.

＊Confirm all 3 lines

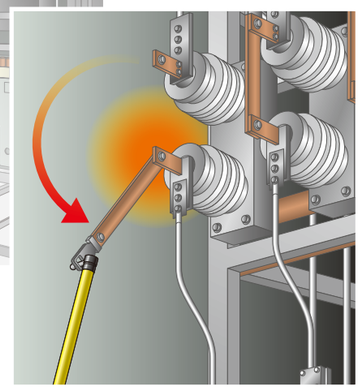




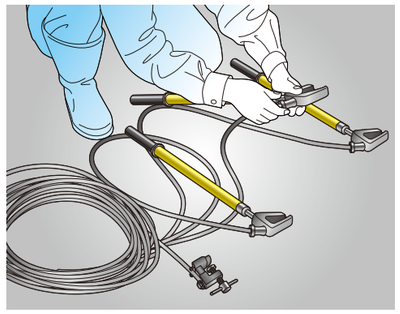


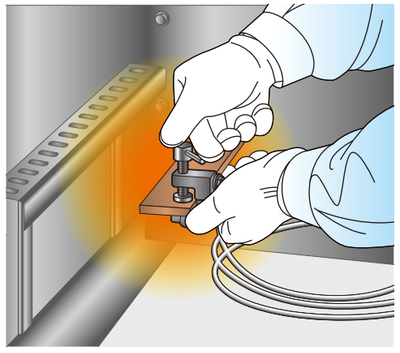


②Confirm normal operation of voltage detector contacting any charged conductor already known

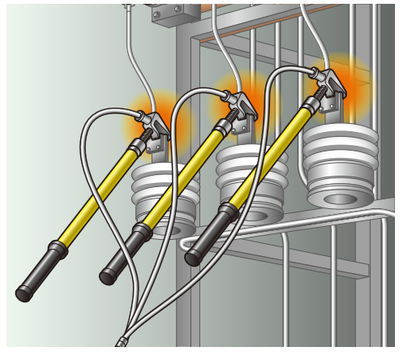


⑤Visual check of grounding hook set.
Appearance and construction check





⑥Connect the grounding device to earth terminal



⑦Connect the contact clamp to Line 1
Connect the contact clamp to Line 2
Connect the contact clamp to Line 3

＊Connect all 3 lines