Category				Document No.DS27-1
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	7	Transmission and Distribution Facilities (Medium and Low Voltage)	
	Clause	49	Supporting Structures	
		51	Mechanical Strength of Insulators	
Title	Wind Load (1/2)			

Wind load to $1m^2$ of the vertical projected area is calculated by the following formula.

$$P = C \times (1/2\,\delta \times V^2)$$

Where
C = Resistance coefficient
δ = Density of air
V = Wind speed

The values in the following table will be used for wind load that are applied to the calculation of the strength of iron-reinforced concrete poles, wooden poles and iron poles. The value is calculated under the condition of wind speed of 25m/s and the density of air of 0.121, using the resistance coefficient prescribed in the following table. If a wind speed is assumed more than 25m/s, the wind load shall be calculated individually.
When the wind load is fixed based on wind pressure experiments, It is possible to use other values of wind load when it is decided based on other wind pressures experiments.

Wind Pressure

			Wind pressure to $1m^2$ of the vertical projected area (Pa)
Supporting structure	Wooden pole, Iron pole, Iron-reinforced concrete pole	Columnar pole	450
		Square pole	750
		Others	890
Electrical wire and other strung wire			390
Insulation device			520
Cross arm for medium-voltage lines		Used as single material	600
		Others	820

Remarks	Revisions	
	2003/Nov.	Original

Category				Document No.DS27-2
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	7	Transmission and Distribution Facilities (Medium and Low Voltage)	
	Clause	49 51	Supporting Structures Mechanical Strength of Insulators	
Title	Wind Load (2/2)			

Resistance Coefficient

Following resistance coefficient that are decided based on experiments are used for the calculation of the wind pressure.

			Resistance Coefficient
Supporting structure	Wooden pole, Iron pole, Iron-reinforced concrete pole	Columnar pole	1.2
		Square pole	2.0
		Others	2.4
Electrical wire and other strung wire			1.05
Insulation device			1.4
Cross arm for medium-voltage lines		Used as single material	1.6
		Others	2.2

Remarks	Revisions	
	2003/Nov.	Original

Category				Document No.DS28
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	7	Transmission and Distribution Facilities (Medium and Low Voltage)	
	Clause	49	Supporting Structures	
Title	Calculation of Safety Factor of Foundation			

The safety factor of the foundation of supporting structure is calculated as follows;

$$f \leq \frac{KD_0t^4}{120P(H+t_0)^2}$$ (without guy anchor)

Where

f: Safety factor of the foundation of the supporting structure.

D_0: Diameter of the supporting structure at the ground level (m)

t: Embedded depth of the supporting structure (m)

H: Height of the point of action of concentrated loads from the ground surface (m)

P: Load converted into a concentrated load at the top of the supporting structure (N)

t_0: Depth of the center of gyration of the supporting structure from the ground surface (m)

$$t_0 = \frac{2}{3}t(\mathrm{m})$$

K: Soil coefficient taking the value given in following table

Classification of soil		*Soil coefficient (N/m^4)*
Normal soil	[A] Aggregated soil or sand, and soil with plenty of gravel or stone belonging under hard soil	3.9×10^7
	[B] Aggregated soil or sand, and soil with plenty of gravel or stone belonging under soft soil	2.9×10^7
Soft soil	[C] Quicksand (with no soil mixed)	2.0×10^7
	[D] Moist clay, humus, fill and other soft soils (excluding deep rice fields)	0.8×10^7

Remarks	Revisions	
	2003/Nov.	Original

Category				Document No.DS29
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	7	Transmission and Distribution Facilities (Medium and Low Voltage)	
	Clause	49	Supporting Structures	
Title	*Calculation of Strength of Iron-reinforced Concrete Pole and Steel Pole*			

The strength of iron-reinforced concrete pole and steel pole against wind load perpendicular to the distribution line is calculated as follows;

$$\frac{(H-0.25)P}{f} \geq K_1\frac{(2D_1+D_0)H^2}{6}+K_2S(\sum dh)$$

Where

P: Breaking load of the supporting structure (standard design load × 2) (N).
K_1: Wind load per 1 m^2 of vertically projected area of the supporting structure (N/ m^2)
K_2: Wind load per 1 m^2 of vertically projected area of the distribution conductors (N/ m^2)
D_1: Top end diameter of the supporting structure (m)
D_0: Ground-level diameter of the supporting structure (cm)
H: Height of the supporting structure above the ground (m).
S: A half of the sum of the spans on the both sides (m).
d: Diameter of the distribution conductor (mm).
h: Height of the supporting structure of
f: Safety factor of the supporting structure (m).

Remarks	Revisions	
	2003/Nov.	Original

Category				Document No.DS30-1
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	7	Transmission and Distribution Facilities (Medium and Low Voltage)	
	Clause	49	Supporting Structures	
Title	Strength Test for Iron-reinforced Concrete Pole (1/2)			

Iron-reinforced concrete pole shall not have a crack of more than 0.25 mm width after applied the force equivalent to the design load. And it shall not break when it is applied the force equivalent to 2 times of design load.

(Test method)

Strength Test

1 The iron-reinforced concrete pole is fixed by the method like the following figure.
2 The force equivalent to the strength of the design load is inflicted at the load point vertically to the pole at the same speed. In the same way, the force is inflicted to the opposite direction.
3 Then the pole is examined if there are no cracks of more than 0.25 mm width.

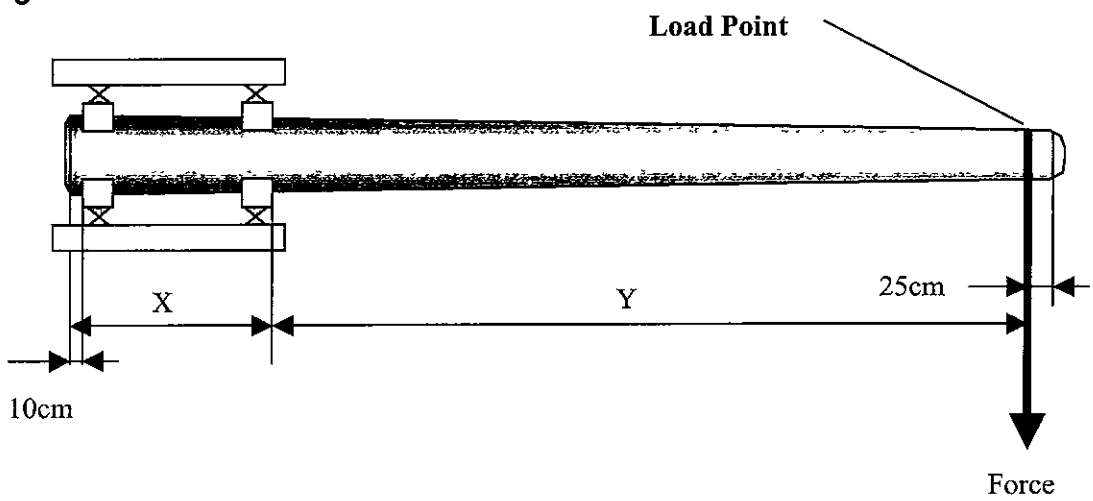
Breakage Test (in succession the Strength Test)

4 The force is inflicted until the pole is broken down.
5 Then the maximum strength measured by a load meter is examined to be equal 2 times of design load or more.
6 If the force 2 times of design load is inflicted and the pole is not broken down, this test may be completed.

Remarks	Revisions	
	2003/Nov.	Original

Category				Document No.DS30-2
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	7	Transmission and Distribution Facilities (Medium and Low Voltage)	
	Clause	49	Supporting Structures	
Title	Strength Test for Iron-reinforced Concrete Pole (2/2)			

Figure: Test Method



(Unit: m)

Remarks	Revisions	
	2003/Nov.	Original

Category				Document No.DS31-1
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	7	Transmission and Distribution Facilities (Medium and Low Voltage)	
	Clause	49	Supporting Structures	
Title	Calculation of Strength of Wooden Pole (1/2)			

The wooden pole shall have the strength to withstand the wind load. The safety factor for low-voltage lines shall be no less than 1.2, and that for medium-voltage shall be no less than 1.5.

The calculation of strength of low-voltage wooden poles against the wind load in a direction at the right angle to the direction of overhead lines is made by the following formulas.

1. Single pole without guys

$$\frac{P}{F} \geqq \frac{390D_0H^2-234H^3+S(\sum 98dh)}{10(D_0')^3}$$

2. Single pole with guys

$$\frac{P}{F} \geqq \frac{195D_0H^2-117H^3+0.5S(\sum 98dh)}{10(D_0')^3}$$

Where
- S: The half of the sum of the span on both sides of the pole (m)
- d: The outer diameter of each wire (mm)
- h: The height of the supporting point of each wire above the ground (m)
- H: The height of the pole above the ground (m)
- D_0: D+0.9H (The diameter of the pole at the surface of the ground) (cm)
- D: The diameter of the pole at the tip of the pole (cm)
- D_0': The diameter of the round of which area is equal to the section area of the pole at the surface of the ground that is excluded the corrosion part. (If there are no corrosion, D_0' equal to D_0)
- P: The breaking strength to the bend of the pole.

Remarks	Revisions	
	2003/Nov.	Original

Category				Document No.DS31-2
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	7	Transmission and Distribution Facilities (Medium and Low Voltage)	
	Clause	49	Supporting Structures	
Title	Calculation of Strength of Wooden Pole (2/2)			

The value will be decided based on the following data.

Type of wood	*Breaking strength*
Cryptomeria	39 N/mm^2
Chestnut tree/ Japanese cypress/	44 N/mm^2
Fir	42 N/mm^2
Oregon pine/ Douglas pine	55 N/mm^2
Others	The values equivalent to the above-mentioned values

F: Safety factor of wooden pole

The calculation of strength for medium-voltage wooden pole is done by the same method. However the wind loads of insulation devices and cross arms will be taken into consideration.

Remarks	Revisions	
	2003/Nov.	Original

Category				Document No.DS32-1
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	7	Transmission and Distribution Facilities (Medium and Low Voltage)	
	Clause	49	Supporting Structures	
Title	Installation of Guy (1/2)			

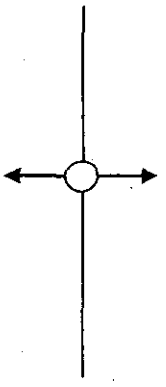
Guys or strut with equal effect shall be installed under the following conditions.

Conditions		*Installation Method*	*Safety Factor*
a. Supporting structures lacking strength against the wind load		When a supporting structure lacks the strength against the wind load, guys shall be installed at right angle to the lines.	2.5 or more
Supporting structures installed in accordance with the table in Clause 49 of Electric Power Technical Standards	b. Supporting structure of which spans on both side are too different	When the difference in spans on both sides of a supporting structure is big, guys that withstand the force caused by unbalanced tension shall be installed on both sides in the direction of line.	1.5 or more
	c. Supporting structure of which lines on both side make an angle more than 5 degrees	When the angle of the lines on both sides of a supporting structure is more than 5 degrees, guys that withstand the force caused by the assumed maximum tension of each line shall be installed.	
	d. Supporting structure supporting the end of a line	When a supporting structure supports the end of a line, guys that withstand the assumed maximum tension of the line shall be installed at the opposite side of the line.	

Remarks	Revisions	
	2003/Nov.	Original

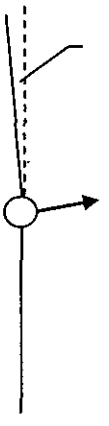
Category				Document No.DS32-2
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	7	Transmission and Distribution Facilities (Medium and Low Voltage)	
	Clause	49	Supporting Structures	
Title	Installation of Guy (2/2)			

a. Supporting structures lacking strength against the wind load



b. Supporting structure of which spans on both side are too different

c. Supporting structure of which lines on both side make an angle more than 5 degrees



d. Supporting structure supporting the end of a line

Remarks	Revisions	
	2003/Nov.	Original

Category				Document No.DS33-1
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	7	Transmission and Distribution Facilities (Medium and Low Voltage)	
	Clause	49	Supporting Structures	
Title	Calculation of Strength of Guy (1/7)			

1. Guys for the wind load lateral to a line (Single Pole)

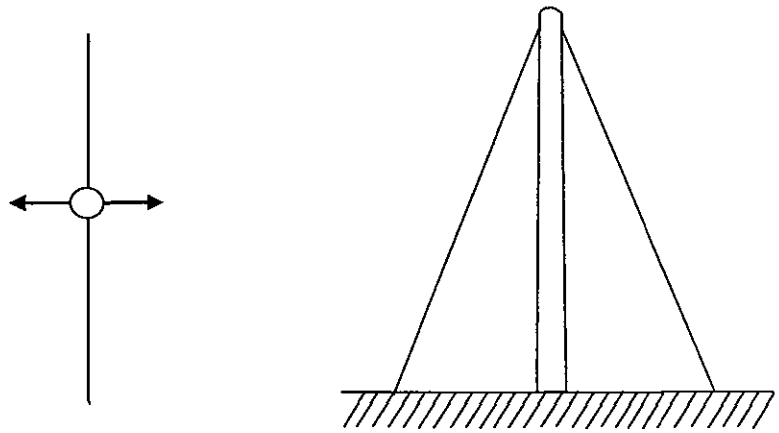
(1)Medium-voltage line

$$P \geqq \frac{K}{h_0}\left\{\frac{12.5}{10^3}(\Sigma 98dh) + 487.5D_0H^2 - \frac{975}{3}kH^3 + 12.5(\Sigma 137c_1h_1) + 125(\Sigma 157c_2h_2)\right\}\operatorname{cosec}\theta$$

(2)Low-voltage line

$$P \geqq \frac{K}{h_0 \times 10^3}\{12.5S\Sigma(98dh) + 4{,}875D_0H^2 - \frac{980}{3} \times 10^3kH^3\}\operatorname{cosec}\theta$$

Explanation Drawing



Remarks	Revisions	
	2003/Nov	Original

Category				Document No.DS33-2
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	7	Transmission and Distribution Facilities (Medium and Low Voltage)	
	Clause	49	Supporting Structures	
Title	Calculation of Strength of Guy (2/7)			

Where
P: Tensile strength of the guy (N)
h_0: Height of the installed point of the guy (m)
θ : Angle of the pole and the guy
S: Span (m) (S is one half of the sum of spans on both sides of the pole If they are not same length.)
c_1: Area of the insulator receiving wind (m^2)
c_2: Area of the cross arm receiving wind (m^2)
d: Diameter of the conductor (mm)
h: Height of the installed point of the conductor (m)
h_1: Height of the installed point of the insulator(m)
h_2: Height of the installed point of the cross arm (m)
H: Height of the pole (m)
D_0: Diameter of the pole at surface of earth (cm)
k: Increasing rate of the diameter of the pole
K: Coefficient for the wind load (K=1 is suitable in Cambodia)

Remarks	Revisions	
	2003/Nov.	Original

Category	Chapter	2	Technical Standards of Electric Power Facilities	Document No.DS33-3
	Paragraph	7	Transmission and Distribution Facilities (Medium and Low Voltage)	
	Clause	49	Supporting Structures	
Title	Calculation of Strength of Guy (3/7)			

2. Guys for the wind load lateral to a line (H Type Pole)

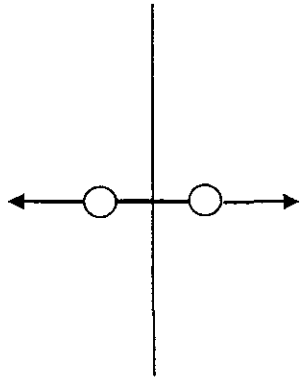
(1)Medium-voltage line

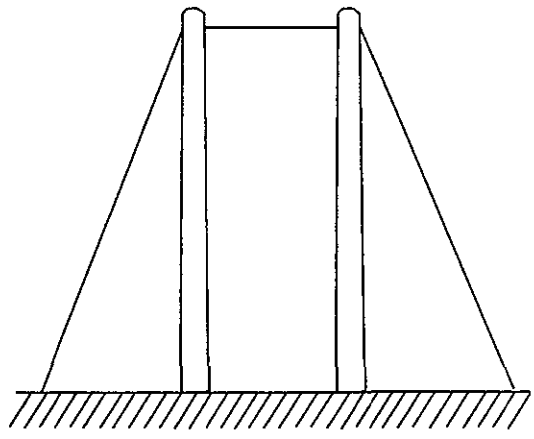
$$P \geqq \frac{K}{h_0}\left\{\frac{12.5}{10^3}(\Sigma 98dh) + 975.0D_0H^2 - \frac{1,950}{3}kH^3 + 12.5(\Sigma 137c_1h_1) + 125(\Sigma 157c_2h_2)\right\}\operatorname{cosec}\theta$$

(2)Low-voltage line

$$P \geqq \frac{K}{h_0 \times 10^3}\{12.5S\Sigma(98dh) + 9,750D_0H^2 - \frac{1,960}{3} \times 10^3kH^3\}\operatorname{cosec}\theta$$

Explanation Drawing





Remarks	Revisions	
	2003/Nov.	Original

Category				Document No.DS33-4
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	7	Transmission and Distribution Facilities (Medium and Low Voltage)	
	Clause	49	Supporting Structures	
Title	Calculation of Strength of Guy (4/7)			

Where
P: Tensile strength of the guy (N)
h_0: Height of the installed point of the guy (m)
θ : Angle of the pole and the guy
S: Span (m) (S is one half of the sum of spans on both sides of the pole If they are not same length.)
c_1: Area of the insulator receiving wind (m^2)
c_2: Area of the cross arm receiving wind (m^2)
d: Diameter of the conductor (mm)
h: Height of the installed point of the conductor (m)
h_1: Height of the installed point of the insulator(m)
h_2: Height of the installed point of the cross arm (m)
H: Height of the pole (m)
D_0: Diameter of the pole at surface of earth (cm)
k: Increasing rate of the diameter of the pole
K: Coefficient for the wind load (K=1 is suitable in Cambodia)

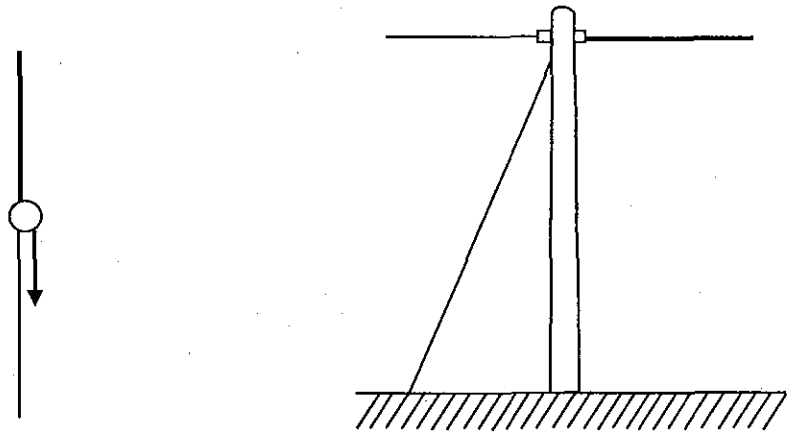
Remarks	Revisions	
	2003/Nov.	Original

Category				Document No.DS33-5
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	7	Transmission and Distribution Facilities (Medium and Low Voltage)	
	Clause	49	Supporting Structures	
Title	Calculation of Strength of Guy (5/7)			

3. Guys for the tension unbalance

$$P \geqq \frac{f}{h_0}(\Sigma Th)\ \mathrm{cosec}\,\theta$$

Explanation Drawing



Where
- P: Tensile strength of the guy (N)
- h_0: Height of the installed point of the guy (m)
- θ : Angle of the pole and the guy
- T: Assumed maximum tension unbalance of a conductor (N)
- S: Span (m) (S is one half of the sum of spans on both sides of the pole If they are not same length.)
- d: Diameter of the conductor (mm)
- h: Height of the installed point of the conductor (m)
- H: Height of the pole (m)
- D_0: Diameter of the pole at surface of earth (cm)
- f: Safety factor
- k: Increasing rate of the diameter of the pole
- K: Coefficient for the wind load (K=1 is suitable in Cambodia)

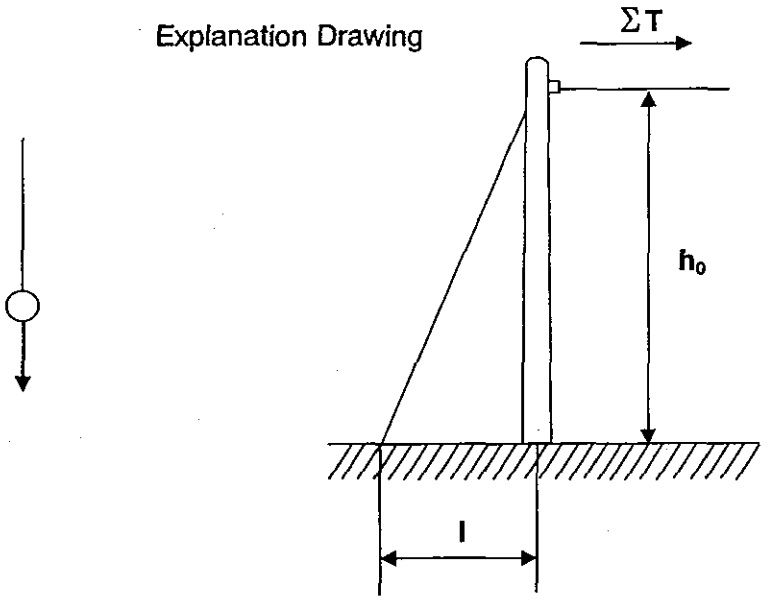
Remarks	Revisions	
	2003/Nov.	Original

Category				Document No.DS33-6
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	7	Transmission and Distribution Facilities (Medium and Low Voltage)	
	Clause	49	Supporting Structures	
Title	Calculation of Strength of Guy (6/7)			

4. Guys for the pole supporting the end of a line (Simplified formula)

$$P \geqq f\Sigma T \sqrt{(h_0/l)^2+1}$$

Explanation Drawing



Where
- P: Tensile strength of the guy (N)
- h_0: Height of the installed point of the guy (m)
- T: Assumed maximum tension unbalance of a conductor (N)
- l: Length between the pole and the guy at the surface of earth (m)
- f: Safety factor

Remarks	Revisions	
	2003/Nov.	Original

Category				Document No.DS33-7
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	7	Transmission and Distribution Facilities (Medium and Low Voltage)	
	Clause	49	Supporting Structures	
Title	Calculation of Strength of Guy (7/7)			

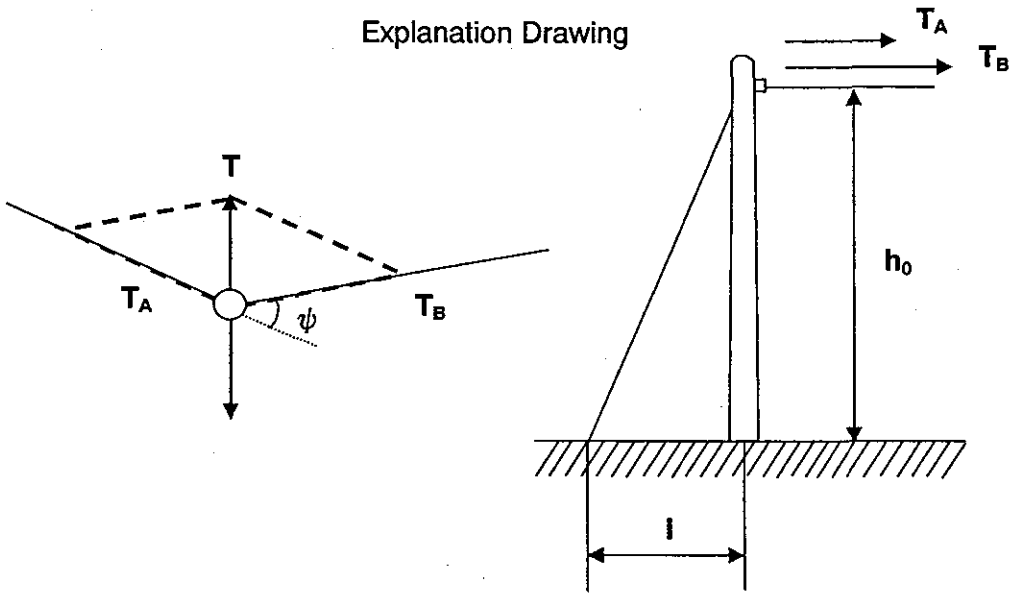
5. Guys for the pole of which line is not strait (Simplified formula)

$$P \geqq f\Sigma T \sqrt{(h_0/l)^2+1}$$

$$T = \sqrt{T_A^2+T_B^2-2T_AT_B\cos\psi}$$

If $T_A=T_B$, then $P \geqq 2f\Sigma T_{As} \sin\frac{\psi}{2}\sqrt{(h_0/l)^2+1}$

Explanation Drawing



Where
- P: Tensile strength of the guy (N)
- h_0: Height of the installed point of the guy (m)
- T: Assumed maximum tension unbalance of a conductor (N)
- l: Length between the pole and the guy at the surface of earth (m)
- f: Safety factor

Remarks	Revisions	
	2003/Nov.	Original

Category				Document No.DS34
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	7	Transmission and Distribution Facilities (Medium and Low Voltage)	
	Clause	50	Overhead Lines	
Title	Types of Conductors for Overhead Line			

Under the Electric Power Technical Standards in Cambodia the conductors for overhead lines shall be cables, insulated conductors or bare conductors. The characteristics of these conductors are as follows,

1. Cable

Cables with excellent insulating performance, though they are more expensive than other conductors, will be most preferable conductors for electrical lines so far as the safety is concerned.

2. Insulated Conductor

Insulated conductors do not have such excellent insulating performance compared with cables and the safety against electrical shock by touching them is not perfectly guaranteed. However their costs will be more reasonable and the danger of electrical shock by coming in touch with them accidentally will be expected to decrease drastically compared with bare conductor.

3. Bare Conductor

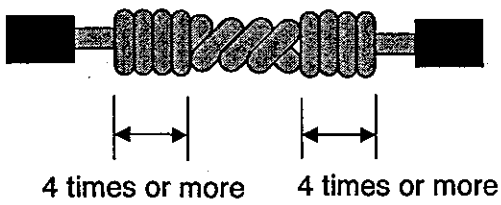
Bare conductors are cheaper compared with other conductors and popular conductors for transmission and distribution lines. However they are inferior to other conductors in safety. Especially it is dangerous to use bare conductors for low-voltage lines, because low-voltage lines will be installed close to houses or buildings and will be supported at the lower position of supporting structures. Therefore under the Electric Power Technical Standards, the use of bare conductors for low-voltage lines is prohibited.

Remarks	Revisions	
	2003/Nov.	Original

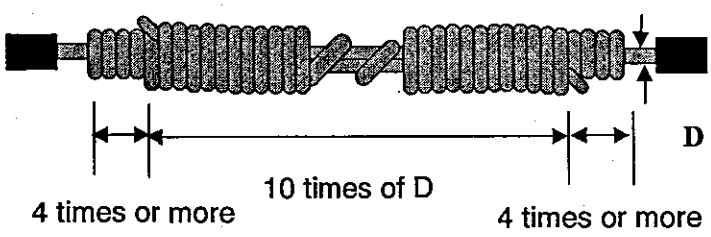
Category				Document No.DS35-1
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	7	Transmission and Distribution Facilities (Medium and Low Voltage)	
	Clause	50	Overhead Lines	
Title	Connecting Methods of Conductors (1/3)			

1.Single Connection

(1)Twist joint



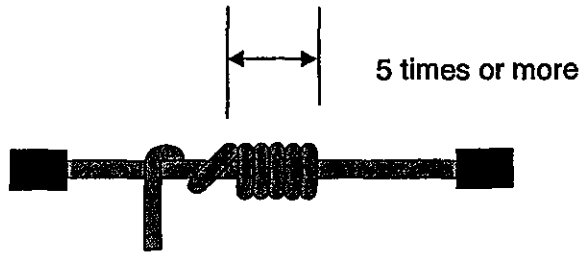
(2)Britania joint



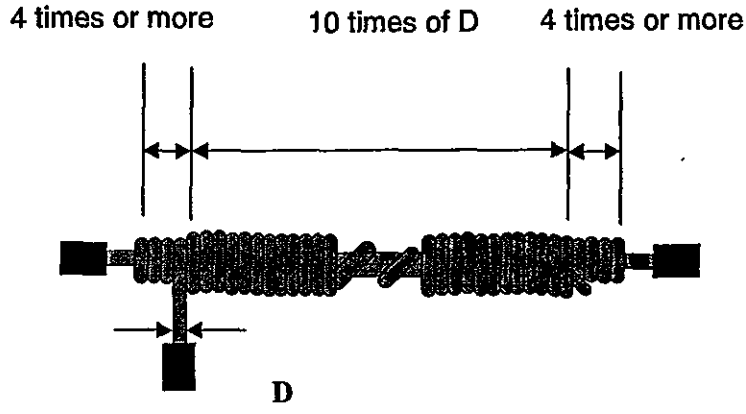
Remarks	Revisions	
	2003/Nov.	Original

Category				Document No.DS35-2
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	7	Transmission and Distribution Facilities (Medium and Low Voltage)	
	Clause	50	Overhead Lines	
Title	Connecting Methods of Conductors (2/3)			

2.Separate Connection
(1)Narrow conductor



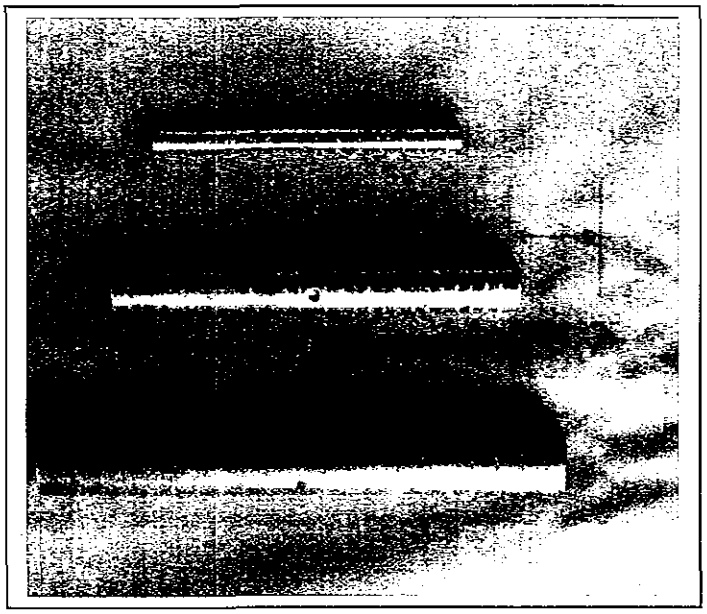
(2)Thick conductor



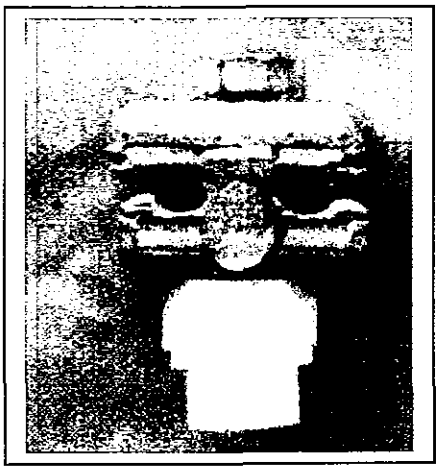
Remarks	Revisions	
	2003/Nov.	Original

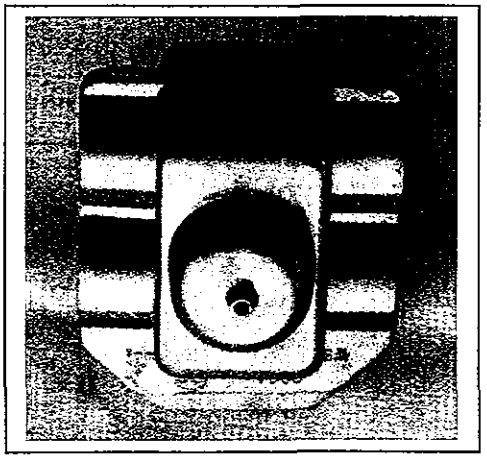
Category				Document No.DS35-3
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	7	Transmission and Distribution Facilities (Medium and Low Voltage)	
	Clause	50	Overhead Lines	
Title	Connecting Methods of Conductors (3/3)			

1. Straight Sleeve



2. Groove Connector & Cover



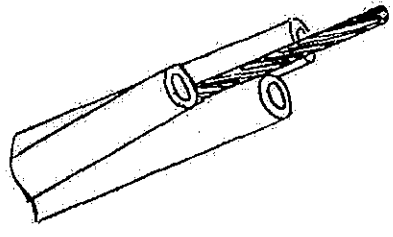


Remarks	Revisions	
	2003/Nov.	Original

Category				Document No.DS36
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	7	Transmission and Distribution Facilities (Medium and Low Voltage)	
	Clause	50	Overhead Lines	
Title	Cables for Overhead Line			

When cables are used for overhead lines, cables shall be installed not to inflict tension to cables directly. Generally, cables are installed hanging on a messenger wire. Aerial Bundled Cable (ABC), a cable with a messenger wire, is often used as an overhead conductor.

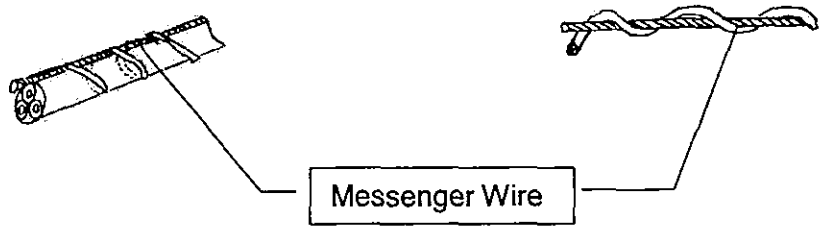
Aerial Bundled Cable (ABC)



Installation Method using a messenger wire

Tying up cable and messenger wire together by metallic tape

Twisting cable around messenger wire

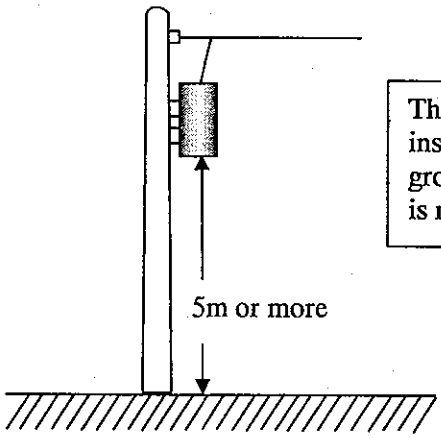


Remarks	Revisions	
	2003/Nov.	Original

Category				Document No.DS37
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	7	Transmission and Distribution Facilities (Medium and Low Voltage)	
	Clause	52	MV/LV Transformers	
Title	Installation Conditions of MV/LV Transformer			

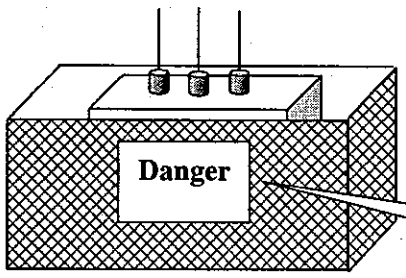
The MV/LV transformers shall be installed in either manner of following method if they are not installed in the exclusive cabin with lock.

Installation on a pole at the height of 5.0m or more



The medium-voltage facilities shall be installed at a height of 5 m or more from the ground level and in such a manner that there is no danger of persons touching them.

Installation with fence



The medium-voltage facilities shall be installed with an appropriate fence around it to eliminate the danger of persons touching them.

A "DANGER" sign shall be posted.

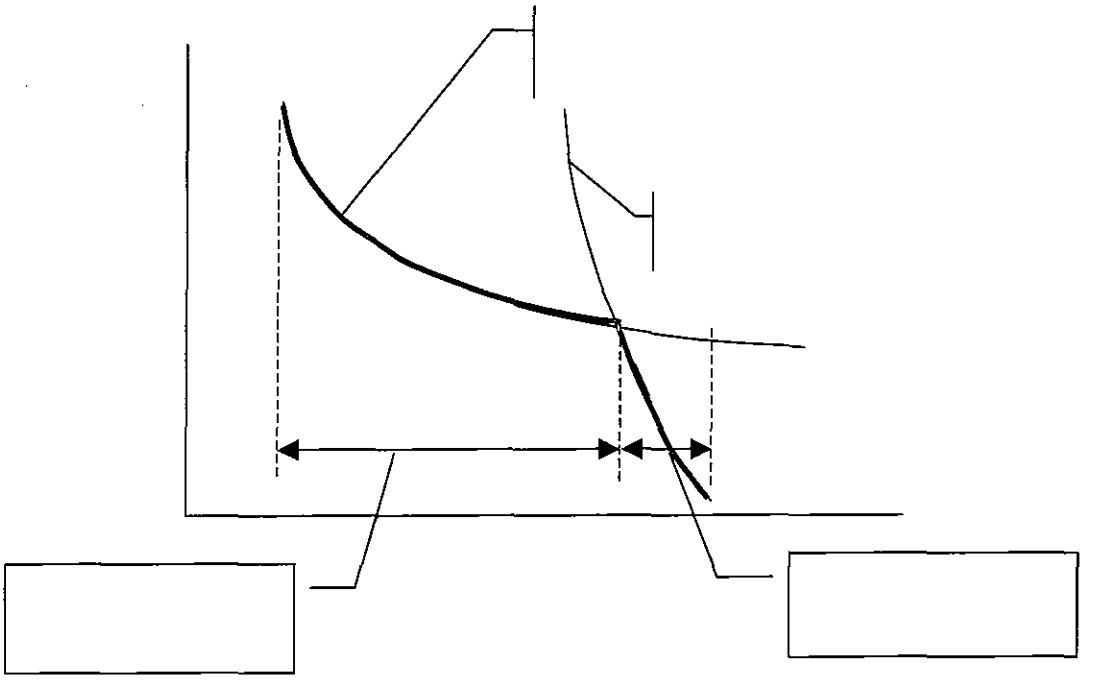
Remarks	Revisions	
	2003/Nov.	Original

Category				Document No.DS38
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	7	Transmission and Distribution Facilities (Medium and Low Voltage)	
	Clause	53	Protective Devices	
Title	Medium-voltage Over Current Circuit Breaker			

The over current circuit breaker is to protect lines and facilities from the overheat damage caused by current or short-circuit current.

When 2 over current circuit breakers are installed for a medium-voltage line, the coordination of 2 breakers shall be considered.

Coordination of 2 breakers



Remarks	Revisions	
	2003/Nov.	Original

Category				Document No.DS39
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	7	Transmission and Distribution Facilities (Medium and Low Voltage)	
	Clause	53	Protective Devices	
Title	Property of Fuses as Medium-voltage Over Current Circuit Breaker			

1. Covered fuses used on a Medium-Voltage electrical circuit shall withstand a current 1.3 times the rated current and melt within 120 minutes at a 2 times the rated current, or shall conform to related IEC.

2. Open fuses used on a Medium-Voltage electrical circuit shall withstand a current 1.25 times the rated current and melt within 2 minutes at a 2 times the rated current.

Remarks	Revisions	
	2003/Nov.	Original

Category				Document No.DS40
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	7	Transmission and Distribution Facilities (Medium and Low Voltage)	
	Clause	53	Protective Devices	
Title	Installation Positions of Switchgear			

It is to be desired to install switchgears at the following positions besides the position regulated in the Electric Power Technical Standards.

1. The regular open position of circuits
2. The connecting point between an overhead line and an underground line
3. The connecting point between a cable and another conductor
4. The boundary position between a licensee's facility and a customer's facility
5. The other position which needs a switchgear for maintenance

Remarks	Revisions	
	2003/Nov.	Original

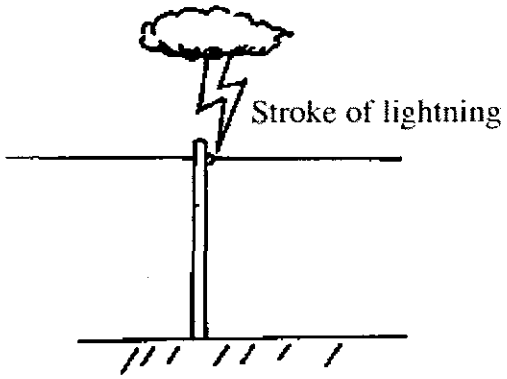
Category				Document No.DS41-1
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	7	Transmission and Distribution Facilities (Medium and Low Voltage)	
	Clause	53	Protective Devices	
Title	Lightening Damage (1/4)			

1. Lightening

Lightening strikes, both direct stroke lightening and induced stroke lightening, cause a current with high voltage into distribution lines and result in the destruction of facilities.

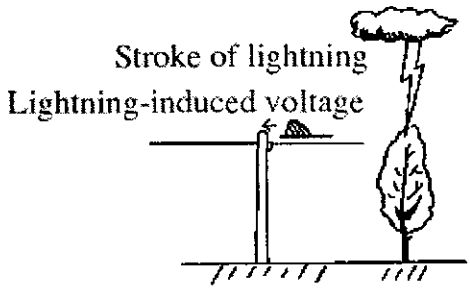
(1) Direct Strike Lightening

Direct strike lightening means lightening that strikes a distribution line directly. Current of 10kA to 120kA with the voltage of several 100kV to several 1000kV flows into medium-voltage lines.



(2)Induced Stroke Lightening

When lightening stroke a tree or a building near distribution lines directly, high voltage is generated at the distribution lines by electromagnet field caused by the lightening current. This is induced lightening and the generated voltage is several 10kV to several 100kV.



Remarks	Revisions	
	2003/Nov.	Original

Category				Document No.DS41-2
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	7	Transmission and Distribution Facilities (Medium and Low Voltage)	
	Clause	53	Protective Devices	
Title	Lightening Damage (2/4)			

2. Damage by Lightening

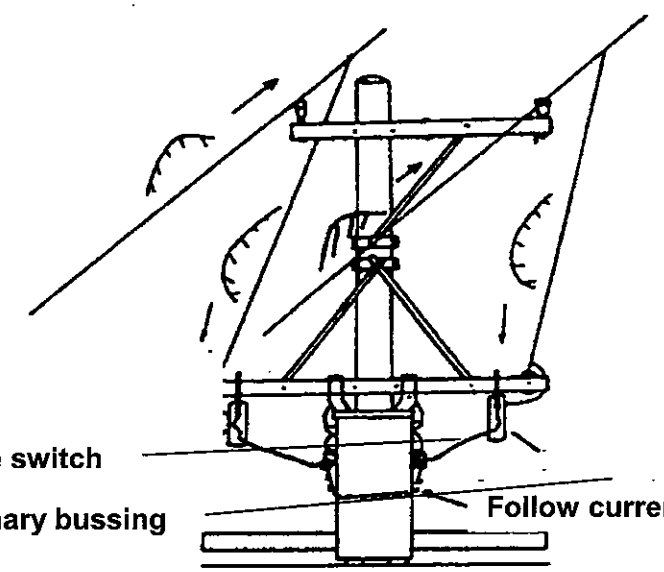
(1) Transformer and Surrounding Facilities

When flashover occurs between primary bushing and case of MV/LV transformer at two phases, a short circuit through the transformer is made and a follow current flows.

In this case, following situation will happen generally.

a. The fuse to protect the transformer will be blown by the follow current.
b. And the transformer and other facilities around the transformers will be protected.

However if the follow current is not shut off, fuse switch or primary bussing of transformer are damaged, and in the worst case, the transformer may be broken.

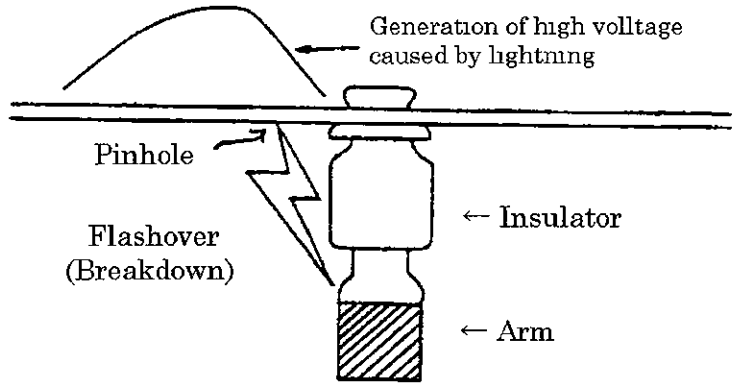


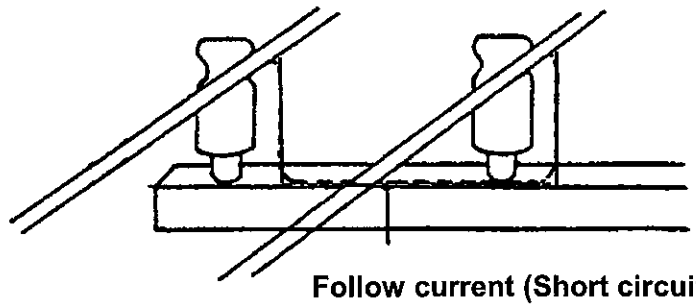
Remarks	Revisions	
	2003/Nov.	Original

Category				Document No.DS41-3
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	7	Transmission and Distribution Facilities (Medium and Low Voltage)	
	Clause	53	Protective Devices	
Title	Lightening Damage (3/4)			

(2) Insulated Conductors

When flashover occurs at a pin insulator a supporting medium-voltage line, a pine hole is made at the insulator covering the conductor.
And if flashovers occur at more than two phases simultaneously, short circuit through a cross arm is made and a follow current flows.
In this case, since the flowing point of follow current at the conductor is fixed to the pine hole, the conductor may be broken by arc heat before the work of an over current breaker.





Follow current (Short circuit current)

Remarks	Revisions	
	2003/Nov.	Original

Category				Document No.DS41-4
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	7	Transmission and Distribution Facilities (Medium and Low Voltage)	
	Clause	53	Protective Devices	
Title	Lightening Damage (4/4)			

3. Counter Measure against Lightening Damage

(1) Arrester

Arrester is the most popular countermeasure against lightening. A line and the earth are insulated by the discharge gap at the normal condition. When the lightening strikes, the induced lightening generated at a medium-voltage line is discharged to the earth through the arrester, and the induced voltage caused by the lightening strike is suppressed. Also the follow current flowing through the arrester is shut off by the current limiting element and the insulation is recovered.

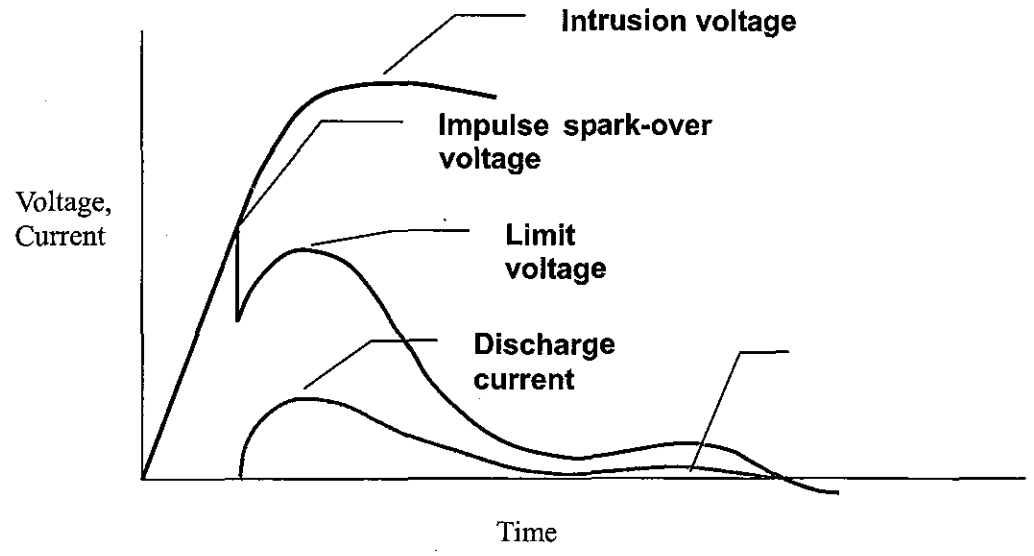
(2) Grounding Wire

Ground wire avoids the direct strike at the medium-voltage line and suppresses the induced strike. Ground wire is installed above the medium-voltage line.

Remarks	Revisions	
	2003/Nov.	Original

Category				Document No.DS42
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	7	Transmission and Distribution Facilities (Medium and Low Voltage)	
	Clause	53	Protective Devices	
Title	Installation of Lightning Arrester			

The lightning arrester is to prevent dielectric breakdown of distribution facilities, attributed to intrusion of lighting voltage,



Impulse spark-over voltage:
The highest instantaneous value of terminal voltage which can be attained prior to initiation of terminal voltage drop due to sufficient formation of discharge current, at the first stage of the lightning arrester discharge by the application of impulse voltage across the terminal.

Limit voltage
The impulse voltage that remains across both terminals, when the over-voltage is limited during discharge of a lightning arrester.

Discharge current
The impulse current that flows through a lightning arrester during discharge.

Follow current
The current that flows through a lightning arrester being supplied from a power-frequency supply circuit successively after a discharge phenomenon has substantially finished.

It is to be desired to install arresters at the following positions besides the position stated in the Electric Power Technical Standards.

1. The end of an overhead line
2. The pole on which a switch gear is installed

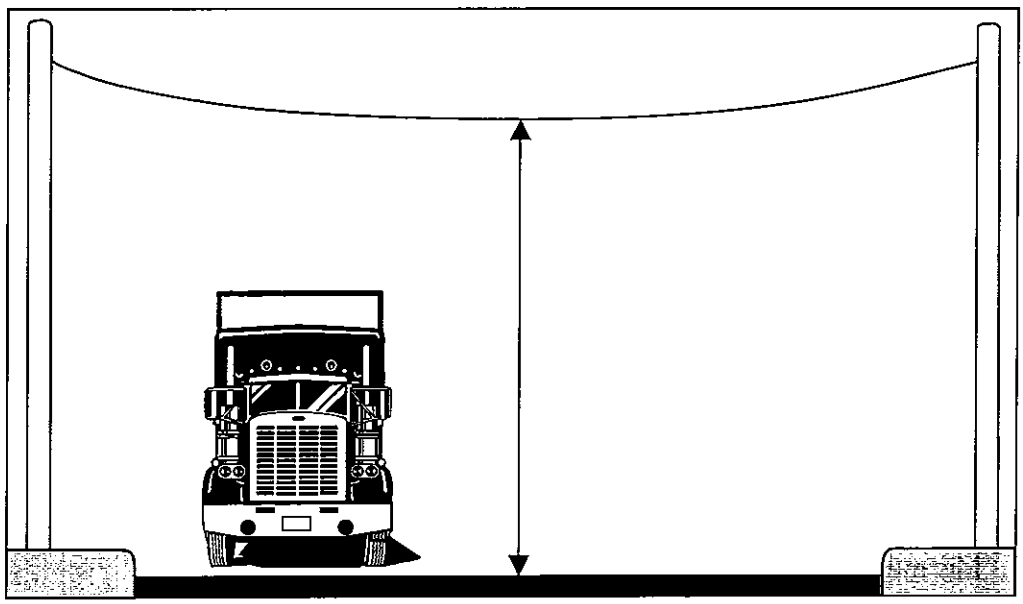
Remarks	Revisions	
	2003/Nov.	Original

Category				Document No.DS43-1
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	7	Transmission and Distribution Facilities (Medium and Low Voltage)	
	Clause	54	Height of Overhead Lines	
Title	Height of Overhead Line (1/2)			

The minimum height of overhead distribution line is as follows;

* The value is decided considering the present situation regarding the installation of overhead lines in Cambodia.

1 Crossing a road



Minimum Height

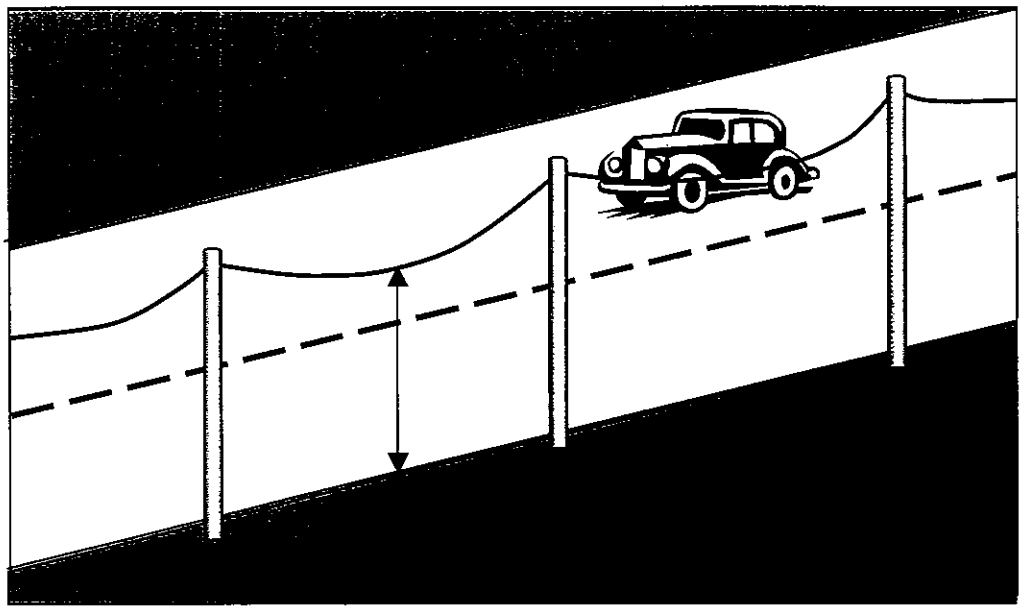
(Unit: m)

Low-voltage	*Medium-voltage*	
	Urban area	*Other area*
6.5	8.0	6.5

Remarks	Revisions	
	2003/Nov.	Original

Category				Document No.DS43-2
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	7	Transmission and Distribution Facilities (Medium and Low Voltage)	
	Clause	54	Height of Overhead Line	
Title	Height of Overhead Line (2/2)			

2 Others



Minimum Height (Unit: m)

Low-voltage	*Medium-voltage*		
	Urban area		*Other area*
	Cable	*Others*	
5.5	5.5	6.5	5.5

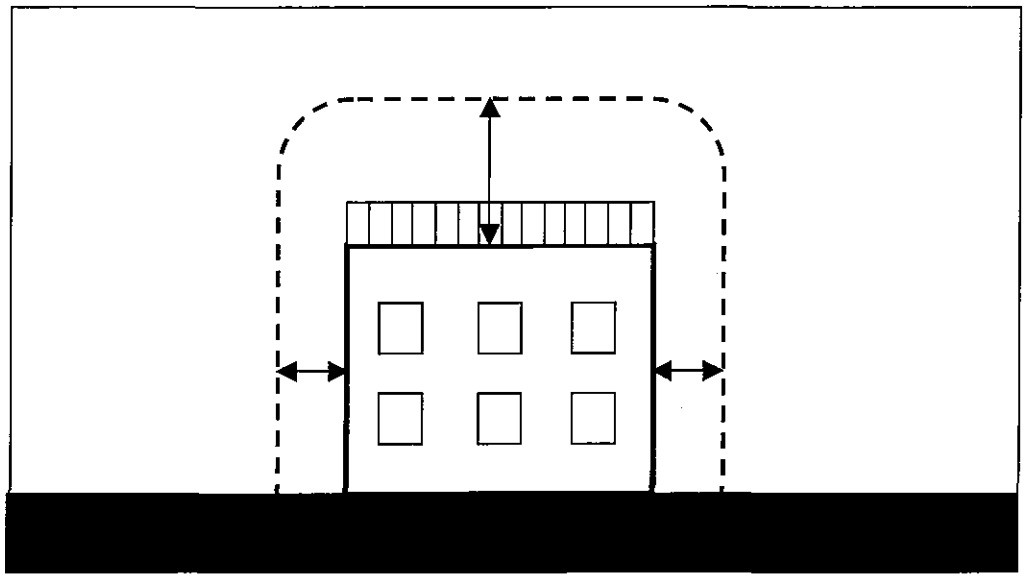
When the medium-voltage line is installed in the urban areas or other areas where many people will gather, the height of the line shall be decided considering the surrounding condition.

Especially it is desired that the height of the line is 10m or more, if bare conductors are used for the medium-voltage line.

Remarks	Revisions	
	2003/Nov.	Original

Category				Document No.DS44-1
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	7	Transmission and Distribution Facilities (Medium and Low Voltage)	
	Clause	55	Clearance between Overhead Lines and Other Objects	
Title	Clearance between Overhead Line and Structure of Building (1/2)			

1 The clearance between overhead line and Structure of building with the possibility for *persons to climb on*



Minimum Clearance

(Unit: m)

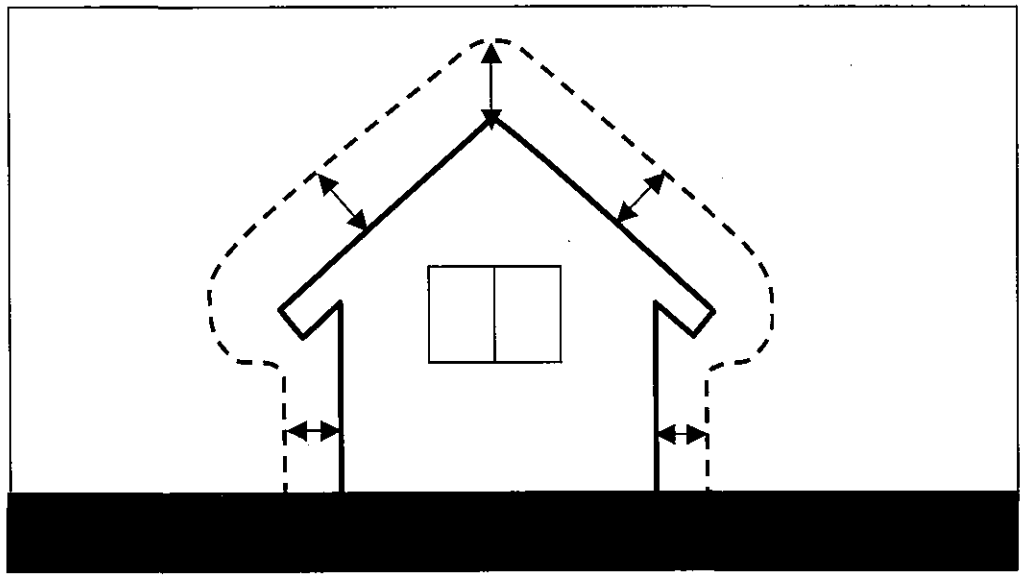
Condition	*Conductor*	*Low-voltage*	*Medium-voltage*
Upside adjacency (A)	Bare Conductor	-	3.0
	Insulated Conductor	2.0	2.5
	Cable	1.0	1.2
Lateral and downside adjacency (B)	Bare Conductor	-	3.0
	Insulated Conductor	1.2	1.5
	Cable	*0.4	0.5

* Except for the special purpose.

Remarks	Revisions	
	2003/Nov.	Original

Category	Chapter	2	Technical Standards of Electric Power Facilities	Document No.DS44-2
	Paragraph	7	Transmission and Distribution Facilities (Medium and Low Voltage)	
	Clause	55	Clearance between Overhead Lines and Other Objects	
Title	Clearance between Overhead Line and Structure of Building (1/2)			

2 The clearance between overhead line and Structure of building with no possibility for persons to climb on



Minimum Clearance

(Unit: m)

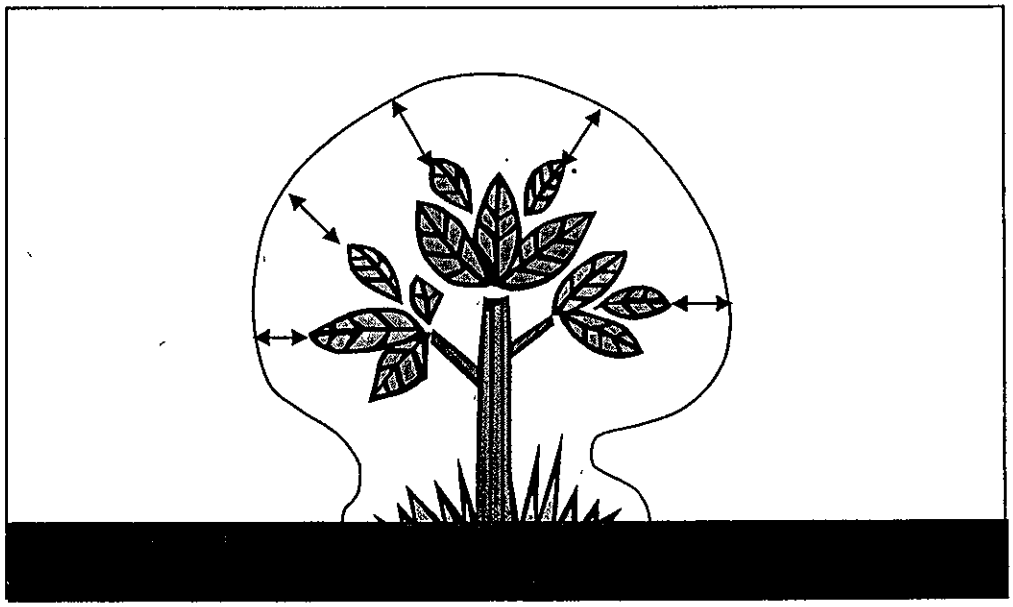
Condition	*Conductor*	*Low-voltage*	*Medium-voltage*
Upside adjacency (A)	Bare Conductor	-	3.0
	Insulated Conductor	1.2	1.5
	Cable	0.4	0.5
Lateral and downside adjacency (B)	Bare Conductor	-	3.0
	Insulated Conductor	1.2	1.5
	Cable	*0.4	0.5

* Except for the special purpose.

The value is decided considering the present situation regarding the installation of overhead lines in Cambodia.

Remarks	Revisions	
	2003/Nov.	Original

Category				Document No.DS45
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	7	Transmission and Distribution Facilities (Medium and Low Voltage)	
	Clause	55	Clearance between Overhead Lines and Other Objects	
Title	Clearance between Overhead Line and Tree			



(Unit: m)

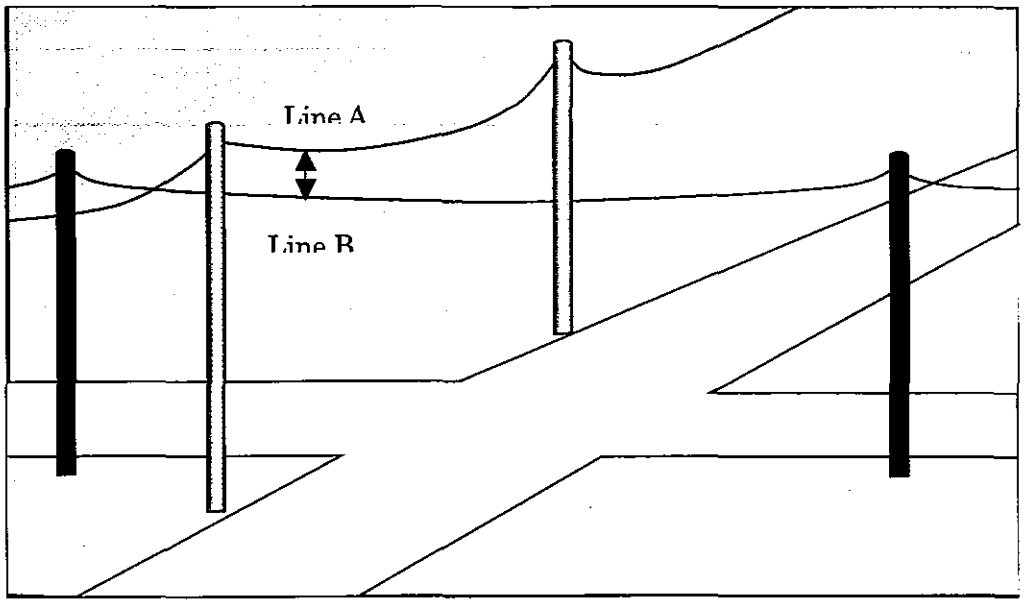
Minimum Clearance

Conductor	*Low-voltage*	*Medium-voltage*
Bare Conductor	-	2.0
Insulated Conductor	Not contact directly	
Cable		

The value is decided considering the present situation regarding the installation of overhead lines in Cambodia.

Remarks	Revisions	
	2003/Nov.	Original

Category				Document No.DS46-1
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	7	Transmission and Distribution Facilities (Medium and Low Voltage)	
	Clause	56	Adjacency and crossing of Overhead Lines	
Title	Adjacency and Crossing of Overhead Lines (1/2)			



Minimum Clearance

(Unit: m)

Line A	*Line B*	*Minimum Clearance*	*Condition*
Medium-voltage Line	Medium-voltage Line	0.5	Line A and B are both cables, or a cable and an insulated conductor.
		2.0	Others
Medium-voltage Line	Low-voltage Line	0.5	Line A is a cable.
		1.0	Line A is an insulated conductor.
		2.0	Line A is a bare conductor.
Low-voltage Line	Low-voltage Line	0.3	Line A and B are both cables, or a cable and an insulated conductor.
		0.6	Others
Medium-voltage Line	Communication Line	0.5	Line A is a cable
		1.0	Line A is an insulated conductor
		2.0	Line A is a bare conductor
Low-voltage Line	Communication Line	0.3	Line A is a cable
		0.6	Line A is an insulated conductor

* The value is decided considering the present situation of overhead lines in Cambodia and the results in other countries.

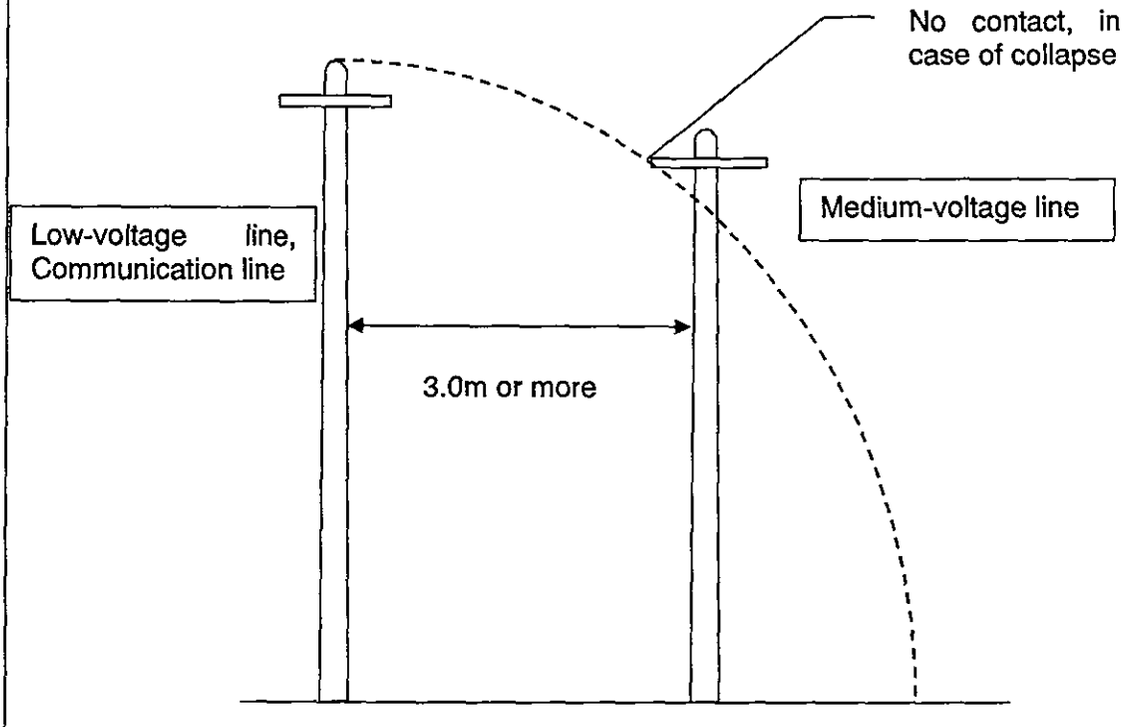
Remarks	Revisions	
	2003/Nov.	Original

Category				Document No.DS46-2
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	7	Transmission and Distribution Facilities (Medium and Low Voltage)	
	Clause	56	Adjacency and Crossing of Overhead Lines	
Title	Adjacency and Crossing of Overhead Lines (2/2)			

As a rule, installation of a low-voltage line or a communication line over a medium-voltage line is prohibited.
If a low-voltage line or a communication line is installed in accordance with the following manners, the installation over a medium-voltage line is permitted.

1. The horizontal clearance between a low-voltage line or communication line and medium-voltage line is 3.0m or more, and

2. The low-voltage line or communication line does not come in contact with the medium-voltage line when the supporting structure of the low-voltage line or communication line collapse.



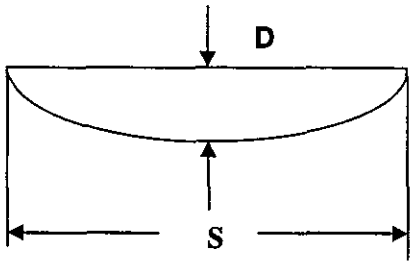
Remarks	Revisions	
	2003/Nov.	Original

Category				Document No.DS47-1
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	7	Transmission and Distribution Facilities (Medium and Low Voltage)	
	Clause	54	Height of Overhead Lines	
		55	Clearance between Overhead Lines and Other Objects	
		56	Adjacency and crossing of Overhead Lines	
Title	Sag of Line (1/2)			

Overhead lines shall be installed with adequate sags in order to keep the safety factors of lines.

Relation between the sag and the tensile strength is given by following formula.

$$D = \frac{W \times g \times S^2}{8T}$$

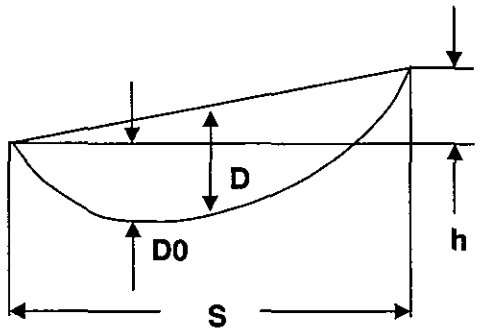


Where
D: Sag of line (m)
W: Unit weight of line (kg/m)
g: G-force (m/s^2)
S: Spam of line (m)
T: Horizontal tensile force of line at the bottom point (N)

Remarks	Revisions	
	2003/Nov.	Original

Category				Document No.DS47-2
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	7	Transmission and Distribution Facilities (Medium and Low Voltage)	
	Clause	54	Height of Overhead Lines	
		55	Clearance between Overhead Lines and Other Objects	
		56	Adjacency and crossing of Overhead Lines	
Title	Sag of Line (2/2)			

$$D0 = D\left(1 - \frac{h}{4D}\right)^2$$



Where
D: Slant sag of line (m)
D0: Sag of line at the center of span (m)
W: Unit weight of line (kg/m)
g: G-force (m/s^2)
S: Spam of line (m)
T: Horizontal tensile force of line at the bottom point (N)

Generally if the sag is larger and the tensile strength is smaller, there will be following advantages.

1. The safety factor will become higher.
2. The required strength of guys or cross arms will be smaller.

On the other hand, there will be following disadvantages.

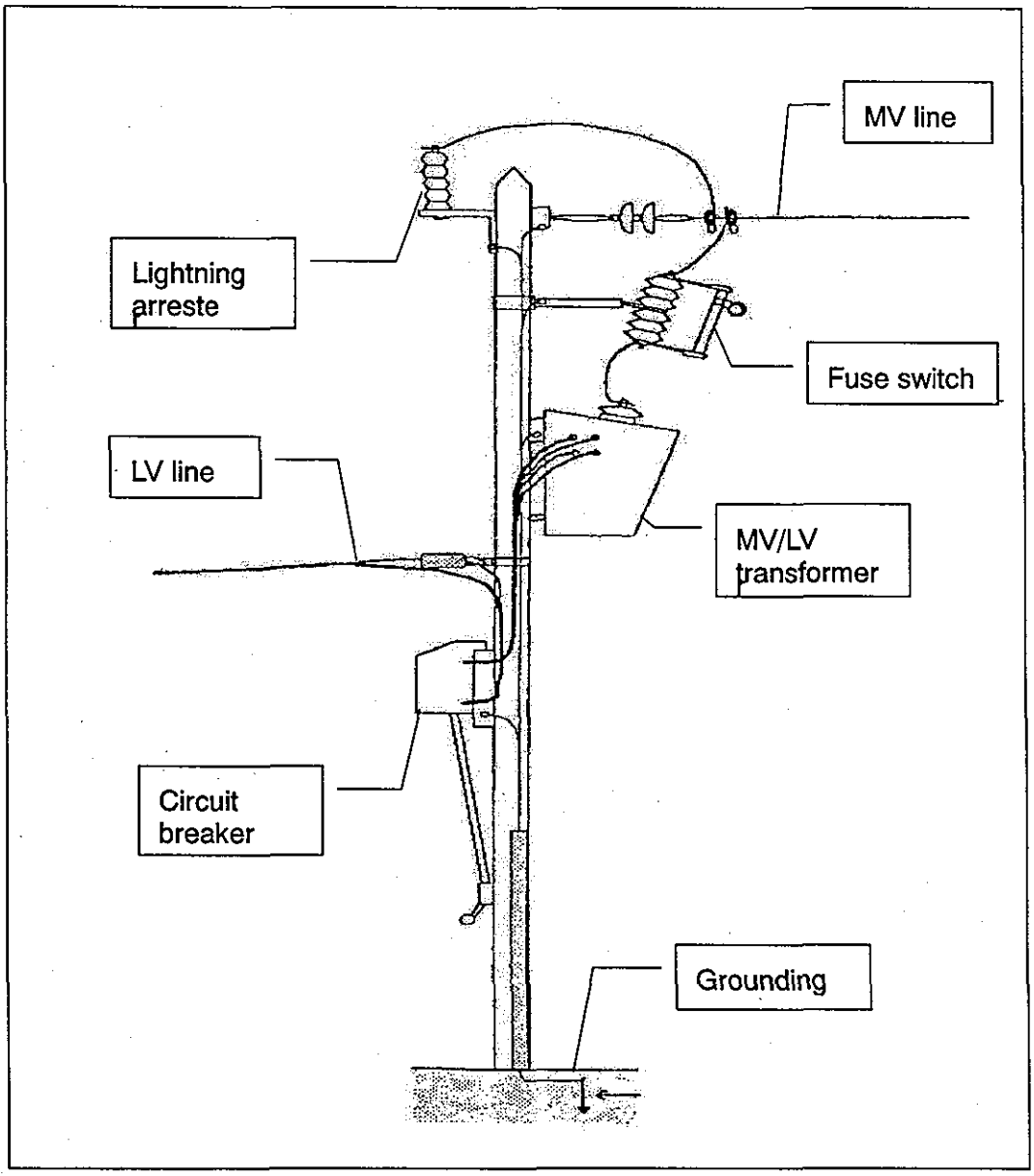
1. The possibility of the entanglement of lines will increase.
2. The height of lines above the ground will become lower.

The sag will be decided taking into consideration these characteristics.
It is desired that the tensile strength on both spans will be equal.

Remarks	Revisions	
	2003/Nov.	Original

Category				Document No.DS48-1
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	7	Transmission and Distribution Facilities (Medium and Low Voltage)	
	Clause	-	Others	
Title	Composition of Overhead Distribution System (1/3)			

Example of Overhead Distribution System (1)

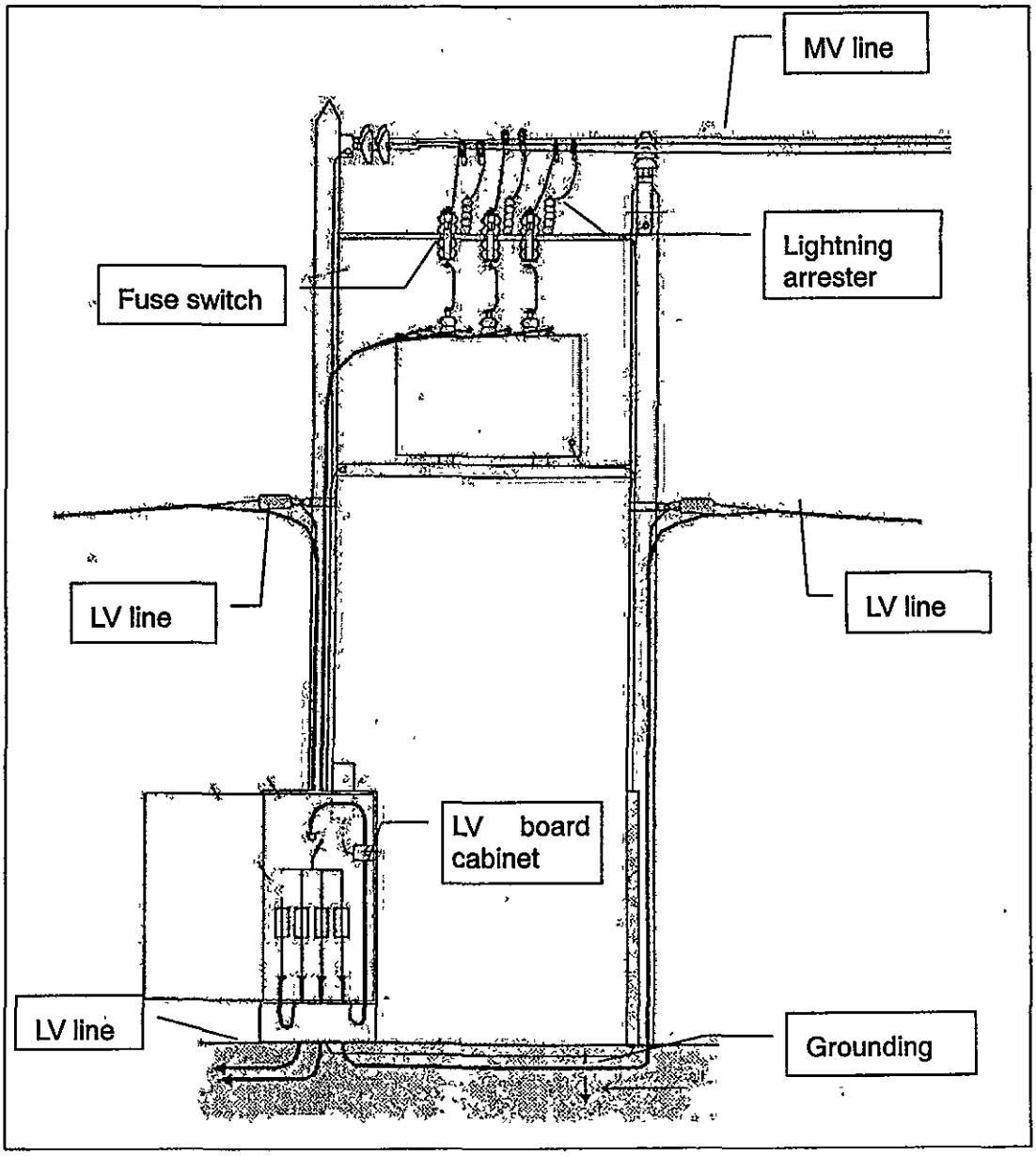


Remarks
Source: EDC Design Standard (July 1996)

Revisions	
2003/Nov.	Original

Category				Document No.DS48-2
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	7	Transmission and Distribution Facilities (Medium and Low Voltage)	
	Clause	-	Others	
Title	Composition of Overhead Distribution System (2/3)			

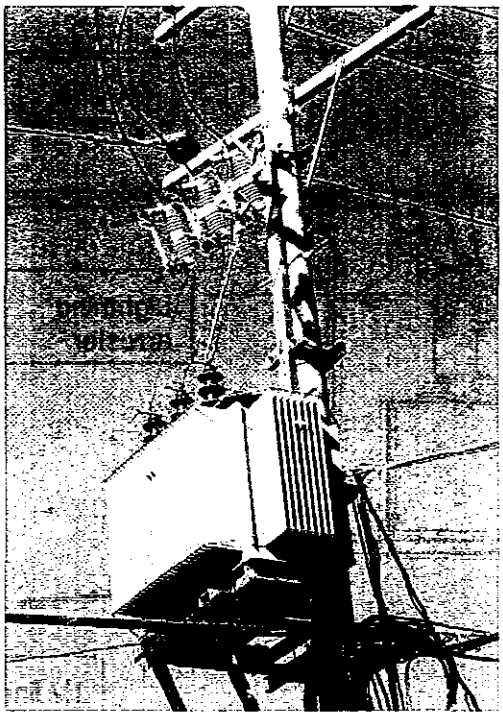
Example of Overhead Distribution System (2)

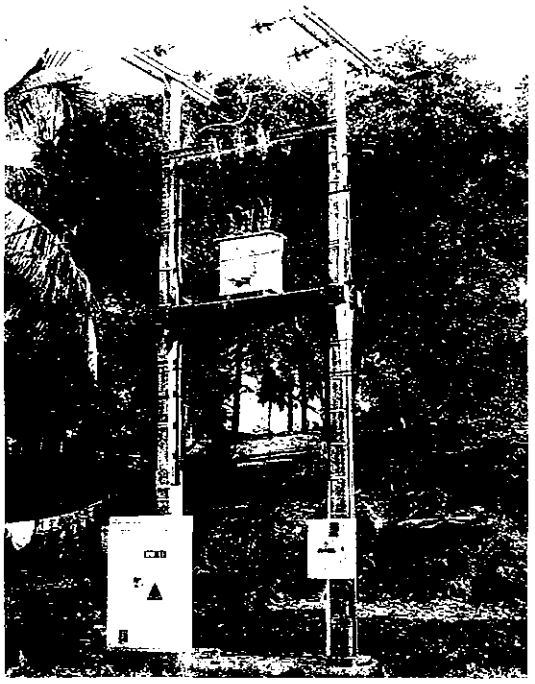


Remarks
Source: EDC Design Standard (July 1996)

Revisions	
2003/Nov.	Original

Category				Document No.DS48-3
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	7	Transmission and Distribution Facilities (Medium and Low Voltage)	
	Clause	-	Others	
Title	Composition of Overhead Distribution System (3/3)			

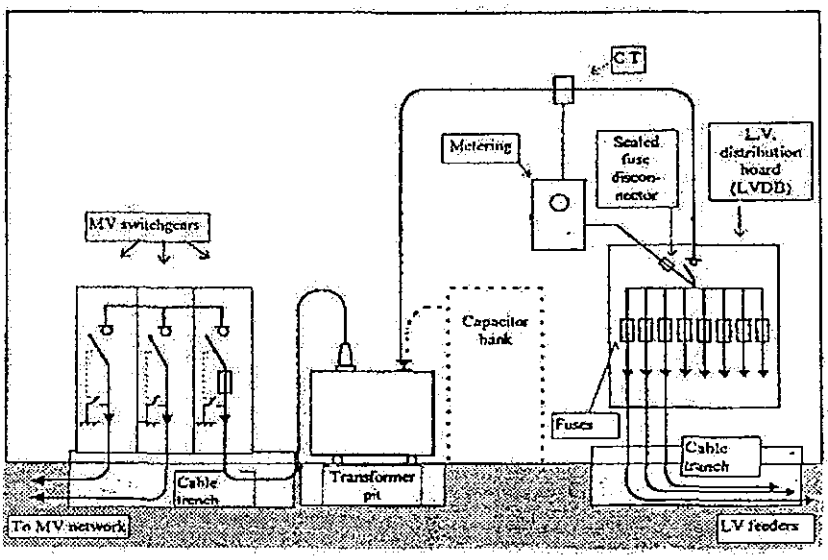




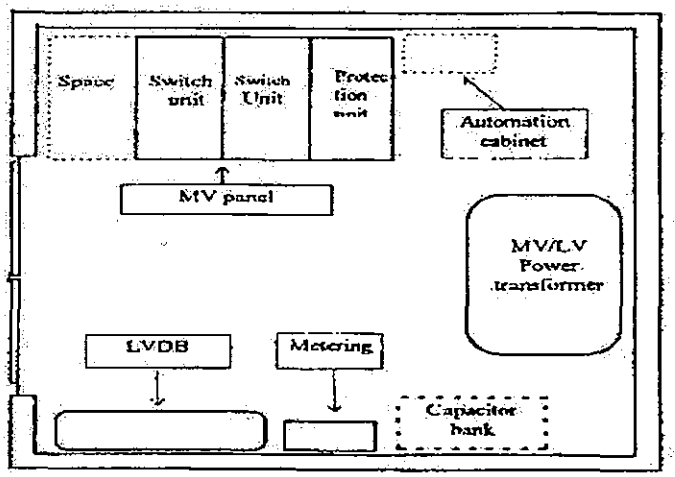
Remarks	Revisions	
	2003/Nov.	Original

Category				Document No.DS49-1
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	7	Transmission and Distribution Facilities (Medium and Low Voltage)	
	Clause	-	Others	
Title	Distribution Substation (1/3)			

Diagram of Distribution Substation with one transformer (Example)



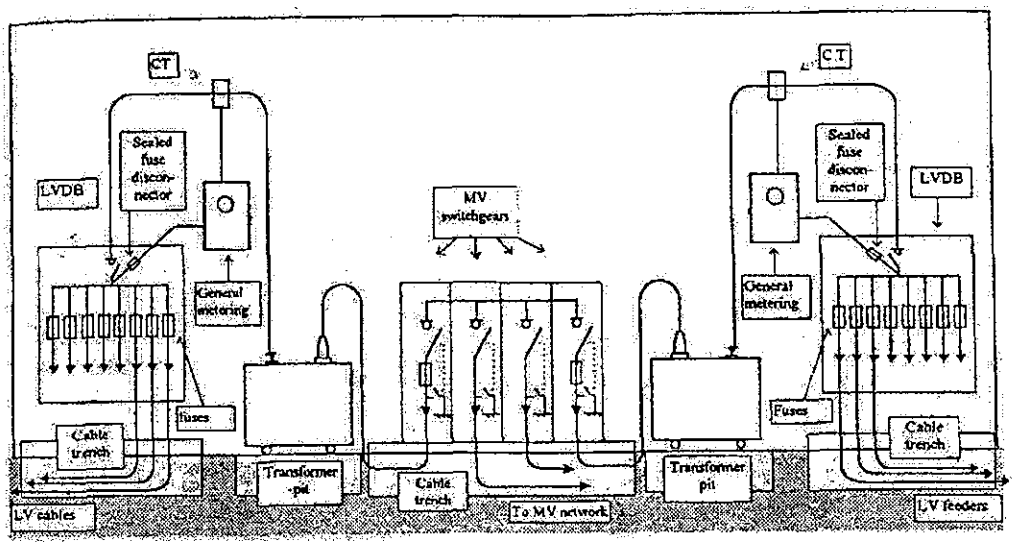
Layout of Distribution Substation with one transformer (Example)



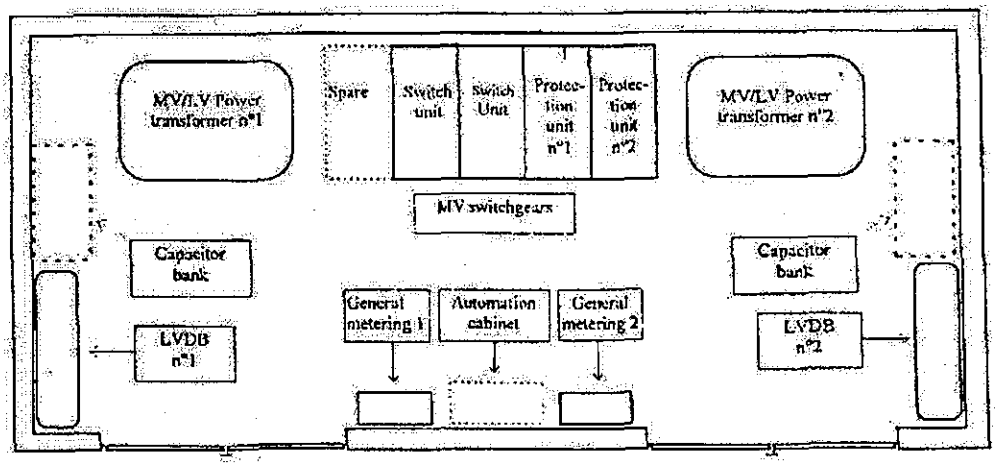
Remarks	Revisions	
	2003/Nov.	Original

Category				Document No.DS49-2
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	7	Transmission and Distribution Facilities (Medium and Low Voltage)	
	Clause	-	Others	
Title	Distribution Substation (2/3)			

Diagram of Distribution Substation with two transformers (Example)



Layout of Distribution Substation with two transformers (Example)

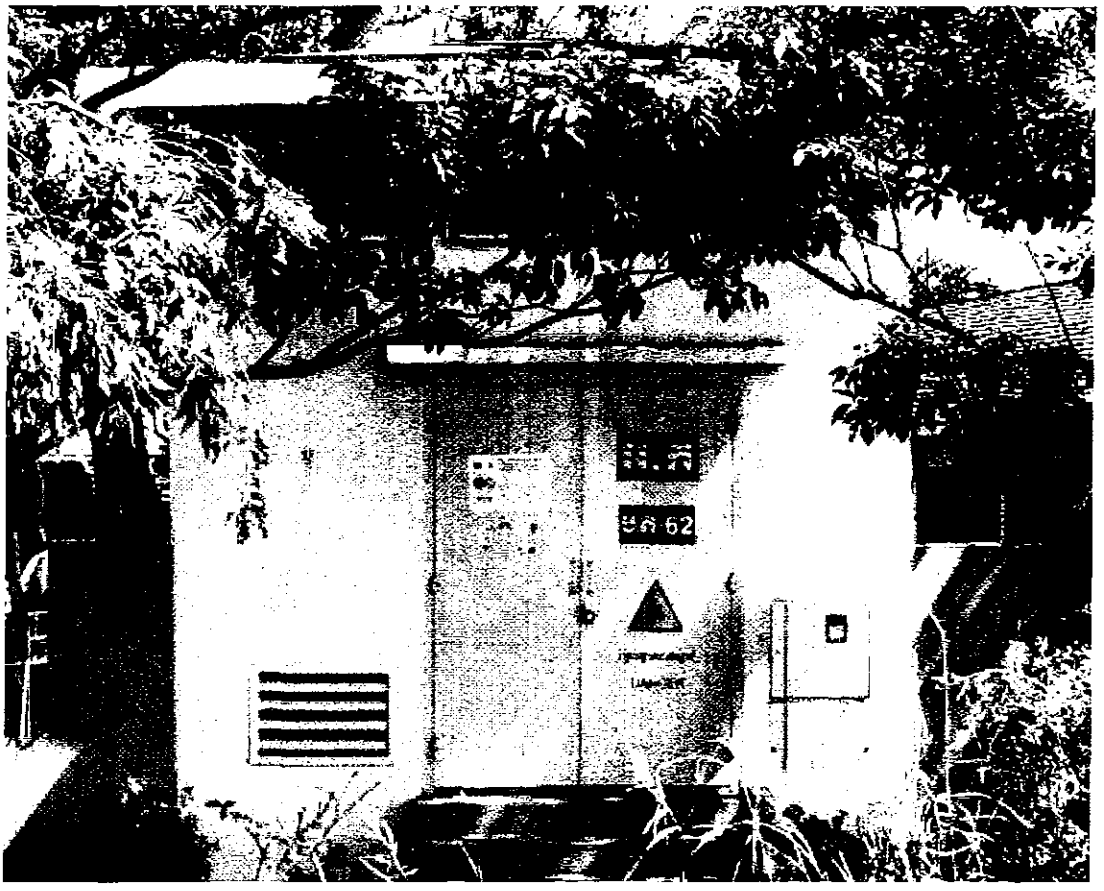


Remarks
Source: EDC Design Standard (July 1996)

Revisions	
2003/Nov.	Original

Category				Document No.DS49-3
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	7	Transmission and Distribution Facilities (Medium and Low Voltage)	
	Clause	-	Others	
Title	Distribution Substation (3/3)			

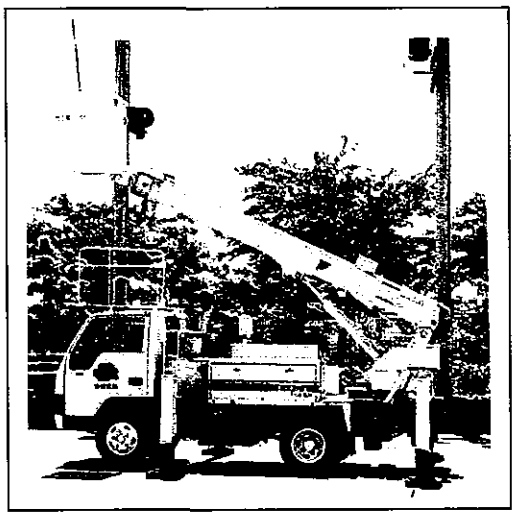
Cabin for Distribution Substation

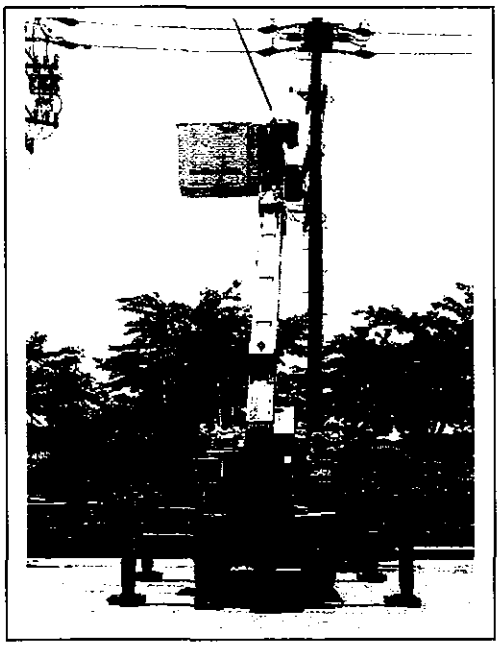


Remarks	Revisions	
	2003/Nov.	Original

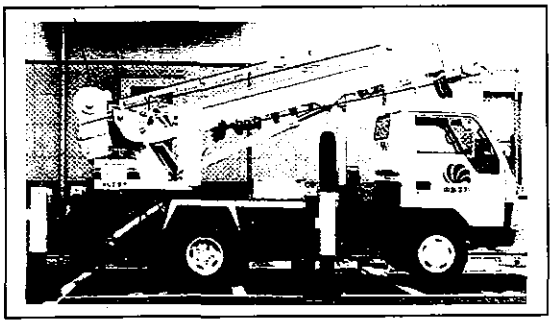
Category				Document No.DS50
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	7	Transmission and Distribution Facilities (Medium and Low Voltage)	
	Clause	-	Others	
Title	Vehicles for Distribution Work			

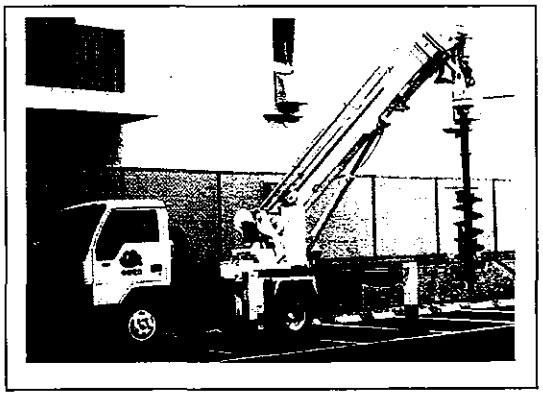
Bucket Vehicle





Pole installation Vehicle





Remarks	Revisions	
Source: Manual of Chubu Electric Power Co., Inc.		
	2003/Nov.	Original

Category	Chapter	2	Technical Standards of Electric Power Facilities	Document No.DS51
	Paragraph	4	Prevention of Electric Power Disasters	
	Clause	9-	Prevention of Electric Power Disasters	
Title	Interconnection of Privately Owned Power Generators			

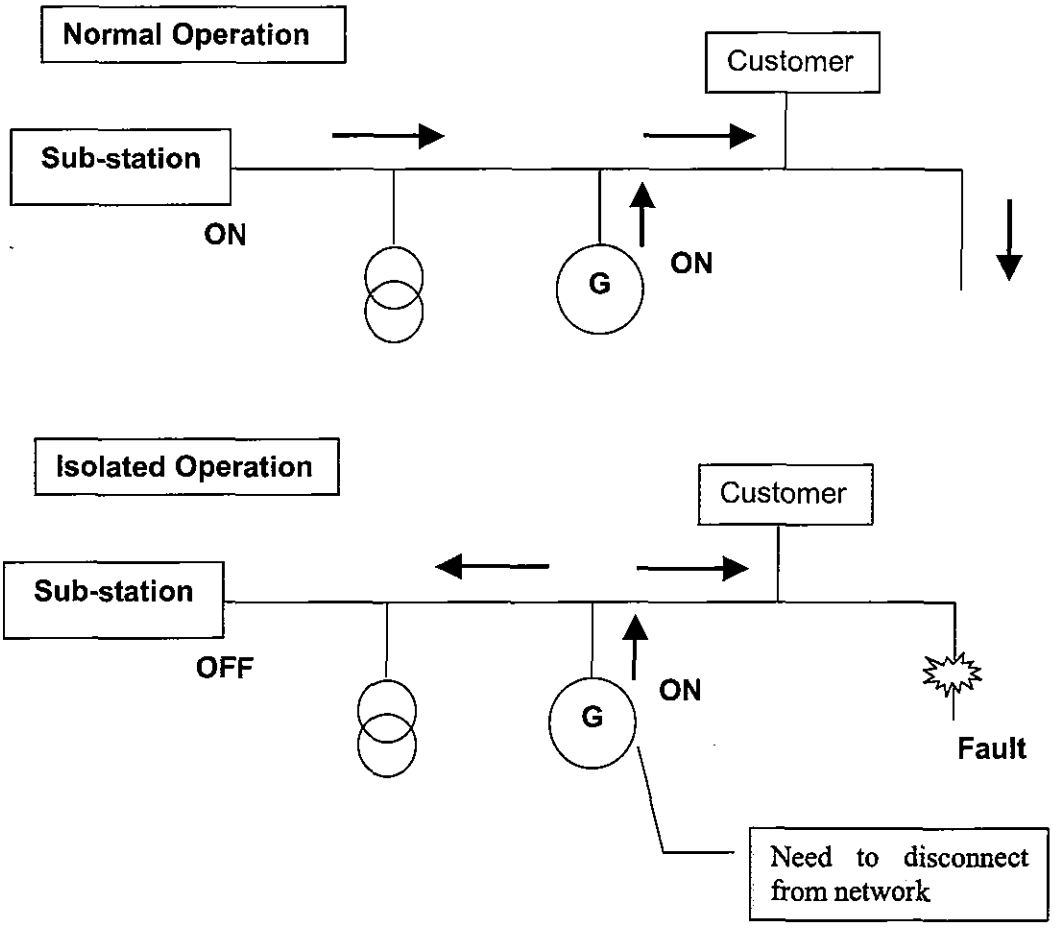
When an privately owned power generator is connected to a distribution network, a licensee has to consider following items to prevent accidents of the third persons or line workers etc..

1. Disconnection of auto-producer from distribution network

When a privately owned power generator breaks down, the generator shall be disconnected from the distribution network quickly.

2. Prevention of isolated operation of auto-producer

When a fault occurs on the distribution line, the privately owned power generator shall be disconnected quickly. In order to prevent the isolated operation, over voltage relay, under voltage relay shall be installed at the generator.



Remarks	Revisions	
	2003/Nov.	Original

JICA

GUIDEBOOK
FOR
POWER ENGINEERS

English Edition

VOL. No.7
LOW VOLTAGE
HOUSE WIRING

Dec. 2003

MINISTRY OF INDUSTRY, MINES AND ENERGY
ELECTRICITY AUTHORITY OF CAMBODIA
ELECTRICITE DU CAMBODGE

GUIDEBOOK FOR POWER ENGINEERS

Contents of House Wiring

Document No.	Title
IW25	Low-voltage Indoor Wiring Work (Flexible Conduit Work)
IW26	Low-voltage Indoor Wiring Work (Metallic Tube Work)
IW27	Low-voltage Indoor Wiring Work (Synthetic Resin Raceway Work)
IW28	Low-voltage Indoor Wiring Work (Metallic Raceway Work)
IW29	Low-voltage Indoor Wiring Work (Insulator Work)
IW30	Low-voltage Indoor Wiring Work (Floor duct work)
IW31	Applications of Work Methods
IW32	Allowable Voltage Drop at Indoor Wiring
IW33	Connection Methods of Indoor Wiring
IW34	Equipment of Indoor Wiring

Category				Document No. IW1-1
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	8	House Wiring	
	Clause	57	Insulation	
Title	Completion Inspection of the Customer's Facilities (1/5)			

For house wiring, which is the customer's facilities, the customers are responsible for its maintenance, but the suppliers have an completion inspection duty according to chapter 3.3.15(in case of small consumer), 3.4.24 (in case of medium consumer) in EAC's regulations to supplement safety of customers' electric equipment.
Completion inspection procedures for house wiring are as follows.

1. Inspection of equipment
Inspectors shall confirm whether they are applied to the technology standard.
At first Inspectors shall confirm the condition of house wiring or electric appliance by means of one's eyes and hands.
Second Inspectors shall measure insulation resistance etc by measurement machine etc.

2. Measurement
After confirming the condition of house wiring or electric appliance by means of one's eyes and hands, Inspectors shall judge good or bad on the basis of results in following measurements.
(1) The insulation resistance
The insulation resistance between conductors of low-voltage wiring and between the electrical circuit and ground shall be no less than the value given in below Table with respect to the nominal circuit voltage for each section into which the electrical circuit can be divided by switching devices or overcurrent circuit breakers.
If insulation resistance measurement is difficult, it is sufficient to keep the leak current 1 mA or less.

Minimum of insulation resistance [IEC 60364-6-61]

Nominal circuit voltage [V]	Test voltage d.c. [V]	Insulation resistance[MO]
500 V or less	500	More than 0.5
Over 500 V	1,000	More than 1.0

*Insulation resistance measurement shall be conducted for each circuit with no equipment attached.
*If electronic equipment is present in the circuit, measurement shall be conducted only between a phase and the ground with the phase connected to the neutral conductor in order to avoid destruction of electronic equipment.

Remarks	Revisions	
	2003/Nov.	Original

Category				Document No. IW1-2
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	8	House Wiring	
	Clause	57	Insulation	
Title	Completion Inspection of the Customer's Facilities (2/5)			

(2) Ground resistance measurement
Inspectors shall measure the ground resistance at the grounding work installed point by means of ground resistance meter, and confirm that those values satisfy regulation.

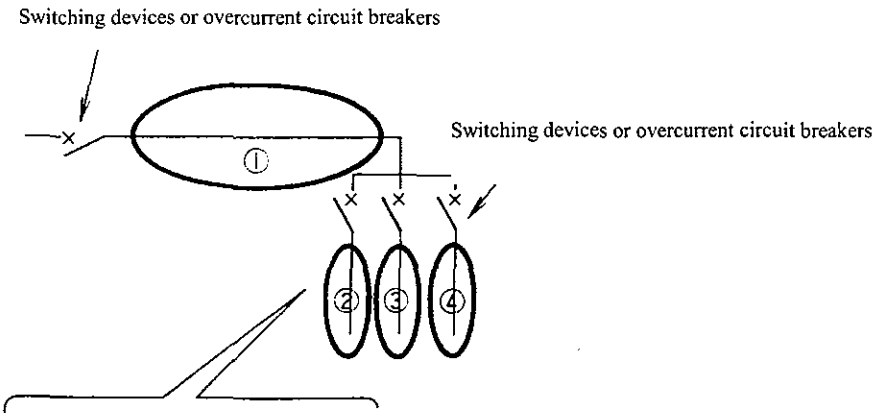
(3) Conductor test
If necessary, inspectors shall perform the conductor test by means of circuit tester etc in order to confirm the [no breaking of house wiring], [correct connection in joint box], [correct connections toward electronic equipment].

3. Switch-on test
Inspectors shall confirm the fault of electric equipment etc by means of switch-on tests after finishing measurements.
Inspectors shall confirm from source side to load side in order.
If any problems are found by the inspection, make a note, and perform re-inspection later.

Remarks	Revisions	
	2003/Nov.	Original

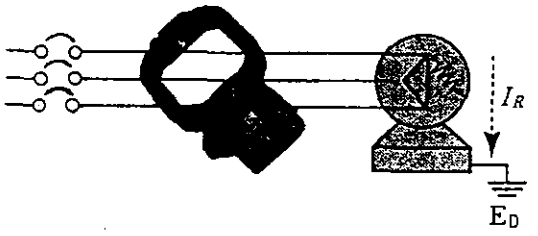
Category				Document No. IW 1-3
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	8	House Wiring	
	Clause	57	Insulation	
Title	Completion Inspection of the Customer's Facilities (3/5)			

Insulation resistance of low-voltage wiring at users' sites



Electrical circuit and ground shall be no less than the value with respect to the nominal circuit voltage for each section into which the electrical circuit can be divided by switching devices or overcurrent circuit breakers.

If insulation resistance measurement is difficult, it is sufficient to keep the leak current 1 mA or less

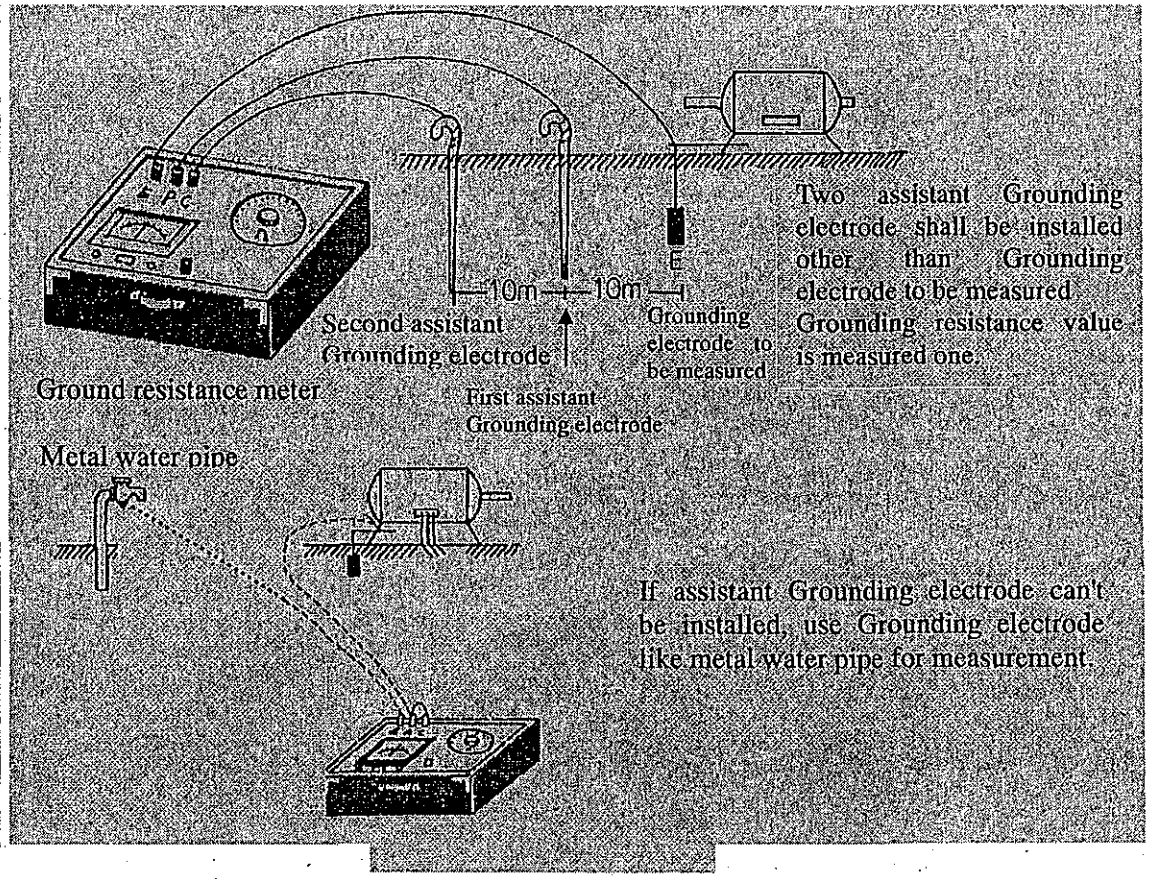


Clamp meter (Leak current meter)

Remarks	Revisions	
	2003/Nov.	Original

Category				Document No. IW 1-4
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	8	House Wiring	
	Clause	57	Insulation	
Title	Completion Inspection of the Customer's Facilities (4/5)			

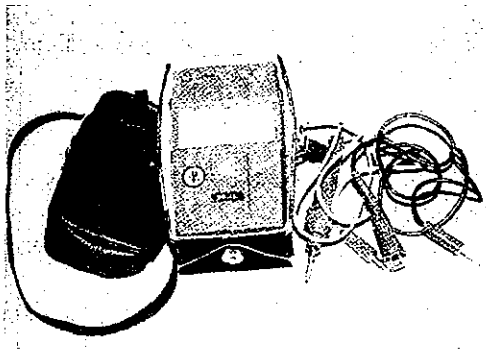
Grounding resistance measurement



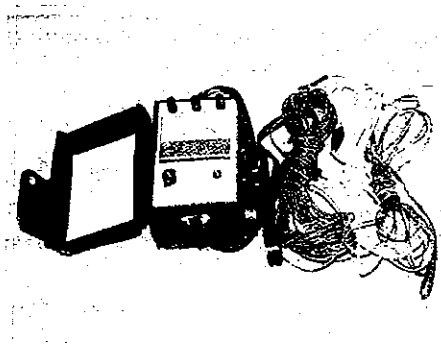
Remarks	Revisions	
	2003/Nov.	Original

Category				Document No. IW 1-5
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	8	House Wiring	
	Clause	57	Insulation	
Title	Completion Inspection of the Customer's Facilities (5/5)			

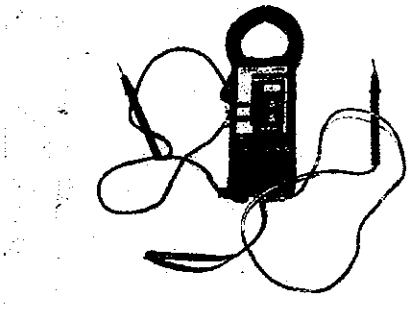
Insulation resistance meter



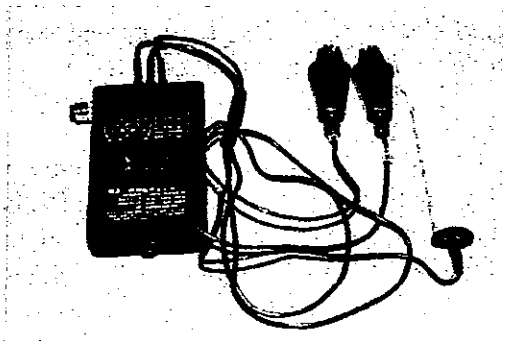
Ground resistance meter



Clamp meter (Leak current meter)



Phase rotation check machine



Remarks	Revisions	
	2003/Nov.	Original

Category				Document No. IW 2-1
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	8	House Wiring	
	Clause	58	Grounding	
Title	Grounding System Types (1/3)			

Grounding systems are classified into three types in IEC, TN system, TT system, IT system, and their details are as follows.

1. TN grounding system

TN grounding systems have one point directly grounded, the exposed-conductive-parts of the installation being connected to that point by protective conductors.
Three types of TN system are considered according to the arrangement of neutral and protective conductors.
These TN grounding systems are suitable in places where we can't separate protective conductors from ground electrodes of the power system electrically, and these TN grounding systems are used generally at buildings or factories etc.

2. TT grounding system

The TT grounding system has one point directly grounded, the exposed-conductive-parts of the installation being connected to ground electrodes electrically independent of the ground electrodes of the power system.
This TT grounding system is suitable in places where we can separate protective conductors from ground electrodes of the power system electrically, and these TN grounding systems are used generally at buildings or factories etc.

3. IT grounding system

The IT grounding system has all live parts isolated from ground or one point connected to ground through an impedance, the exposed-conductive-parts of the electrical installation being grounded independently or collectively or to the grounding of the system.
This IT system is used in such place like hospitals which have important electrical circuit in order to prevent black out, but this IT system is no general use.

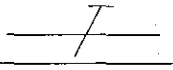
4. Prohibition of using different ground system

If the grounding system is different at same electrical user's site, that is dangerous because the grounding system may not work.
So grounding system at user's sites shall be installed as follows.
(1) If low-voltage electrical equipment are connected to a power utility directly, the grounding methods (TN or TT grounding) shall be the same as methods of the power utility's equipment involved in the supply of low-voltage electricity.
(2) Low-voltage electrical equipment shall not be installed in such a manner of which grounding methods (TN and TT grounding) are different from methods used at the same user's site.

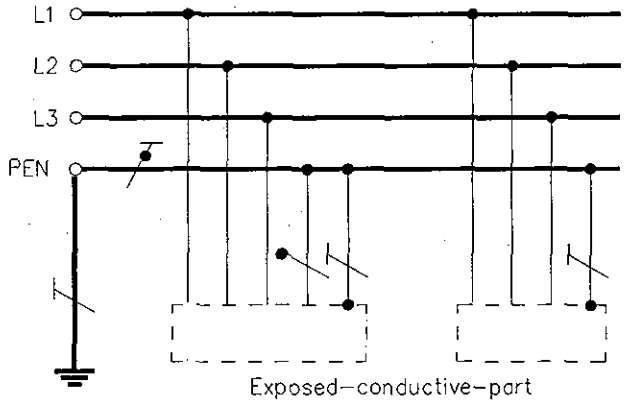
Remarks	Revisions	
	2003/Nov.	Original

Category				Document No. IW 2-2
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	8	House Wiring	
	Clause	58	Grounding	
Title	Grounding System Types (2/3)			

Symbols according to IEC617-11 (1983)

Explanation of symbols according to IEC 617-11 (1983)	
	Nuetral conductor (N)
	Protective conductor (PE)
	*Combined protective and neutral conductor (PEN)*

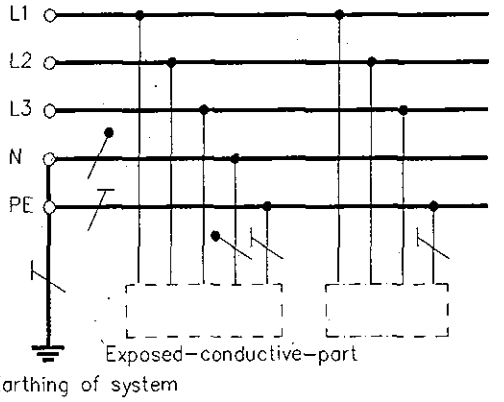
TN-C System



Eathing of system

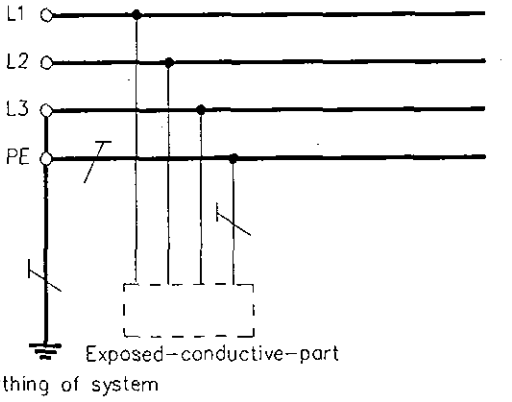
Neutral and protective functions combined in a single conductor throughout the system

TN-S System



Earthing of system

Separate neutral and protective conductors throughout the system



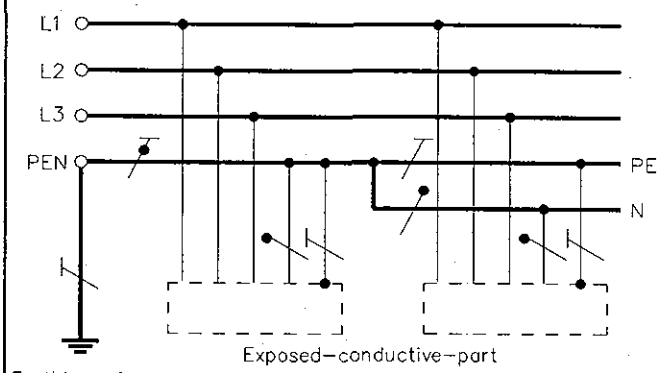
Earthing of system

Separate earthed phase conductors and protective conductors throughout the system

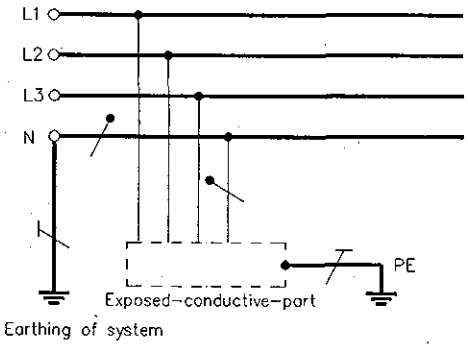
Remarks	Revisions	
	2003/Nov.	Original

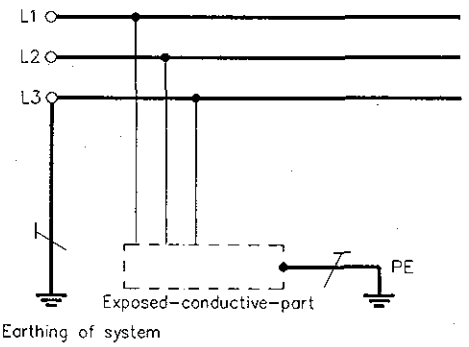
Category				Document No. IW 2-3
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	8	House Wiring	
	Clause	58	Grounding	
Title	Grounding system types (3/3)			

TN-C-S System

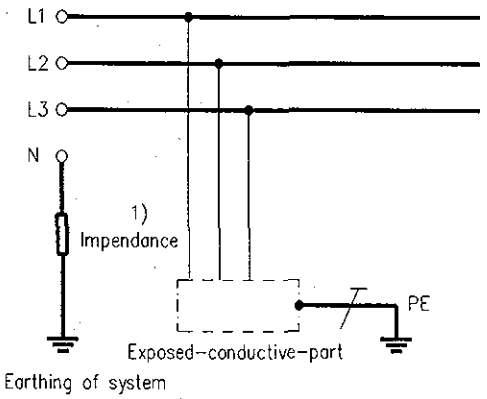


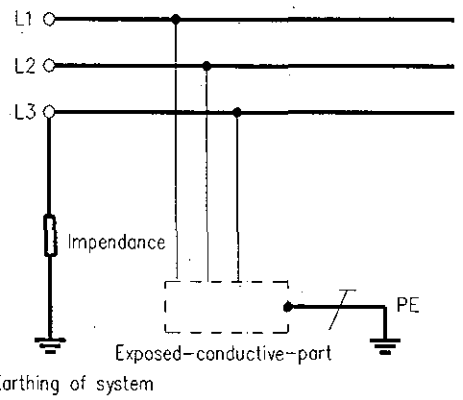
TT-System





IT-System

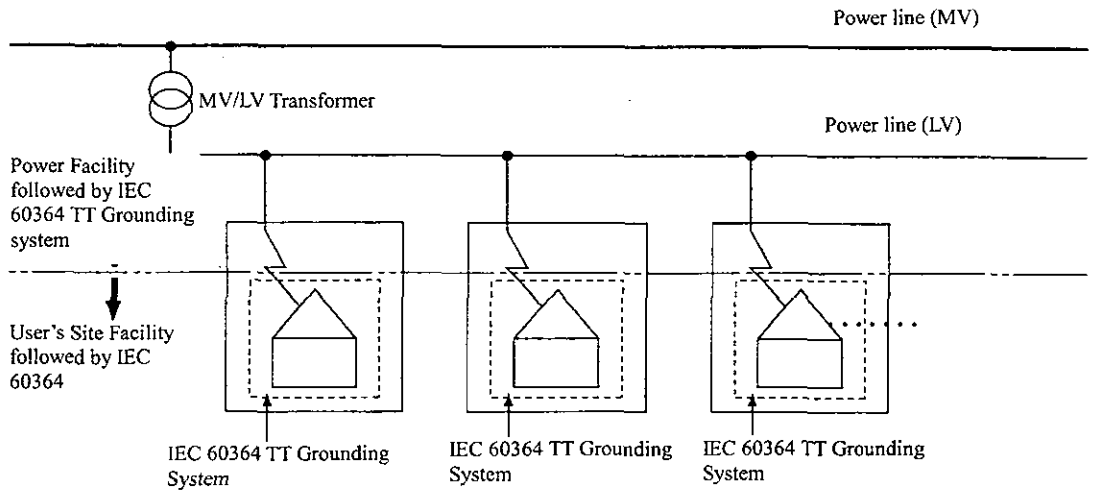




1)
The system may be isolated from earth.
The neutral may or may not be distributed.

Remarks	Revisions	
	2003/Nov.	Original

Category				Document No. IW 3
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	8	House Wiring	
	Clause	58	Grounding	
Title	Prohibition of Using Different Grounding System			



Remarks	Revisions	
	2003/Nov.	Original

Category				Document No.
	Chapter	2	Technical Standards of Electric Power Facilities	IW 4
	Paragraph	8	House Wiring	
	Clause	59	Protection against Overcurrent	
Title	Grounding Arrangements			

The grounding electrode, grounding conductor and protecting grounding conductor shall conform to IEC 60364-5-54 (1980-01) [Electrical installations of buildings. Part 5: Selection and erection of electrical equipment. Chapter 54: Earthing arrangements and protective conductors] as to performance, conductor diameter and diameter of conductor for equal-voltage-bonding.
The minimum diameter of protective grounding conductors shall conform following table according to the sectional area of the phase conductors of the facility.

Minimum sectional areas of protective conductors (Table 54F of IEC 60364-5-54-543.1.2)

Sectional area of phase conductor of facility S [mm^2]	Minimum cross-sectional area of protective conductor Sp [mm^2]
$S \leqq 16$	S
$16 < S \leqq 35$	16
$S > 35$	S / 2

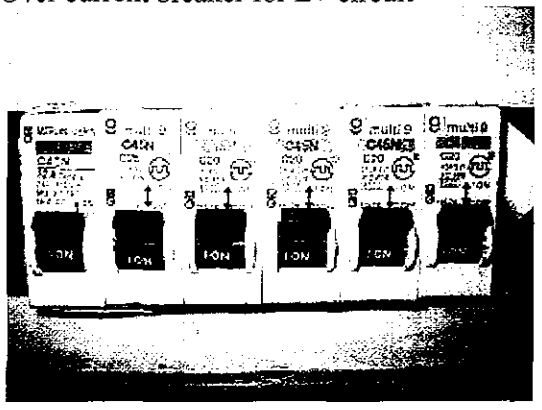
Remarks	Revisions	
	2003/Nov.	Original

Category				Document No. IW 5
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	8	House Wiring	
	Clause	59	Protection against Overcurrent	
Title	Exceptions to Installation of Over Current Protection Devices			

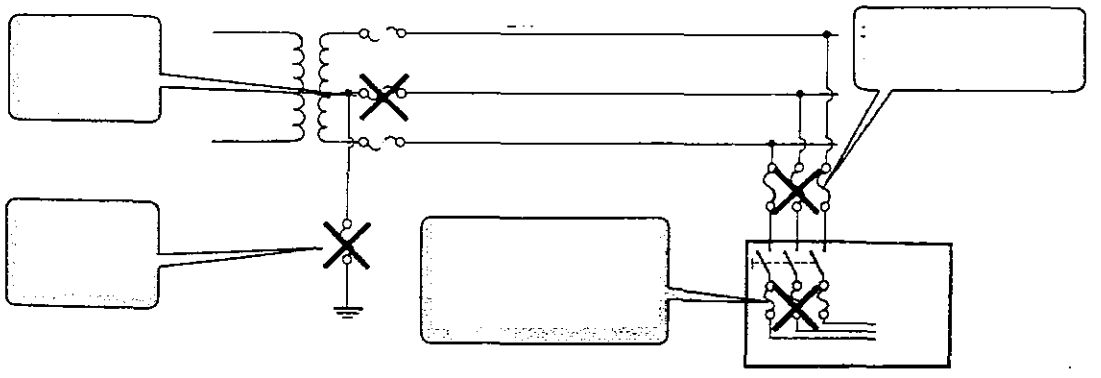
It is desirable to install an overcurrent protection devices at necessary places to protect the equipment and devices and electrical conductor.
But no overcurrent circuit breaker shall be installed at the following places:

1. Grounding conductor of grounding work
2. Neutral conductor of an electrical conductor. However, an overcurrent circuit breaker may be installed if all the poles are shut off simultaneously.
3. The grounded conductor of a low-voltage overhead electrical conductor whose circuit is provided with Class B grounding work in part.

Over current breaker for LV circuit



Exceptions to Installation of an Overcurrent Breaker



Remarks	Revisions	
	2003/Nov.	Original

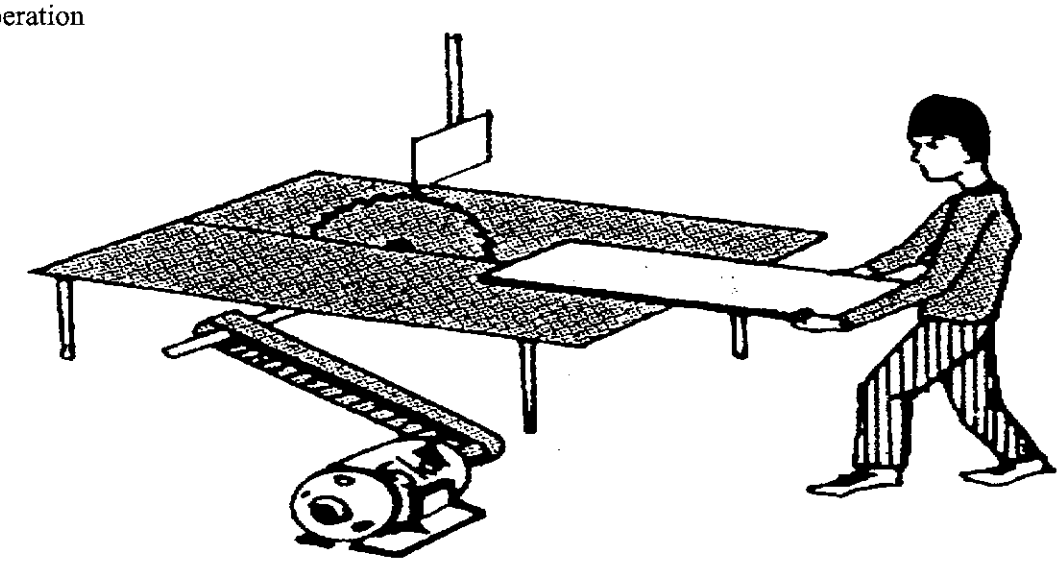
Category				Document No. IW 6
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	8	House Wiring	
	Clause	59	Protection against Overcurrent	
Title	Over Current Protection for Electric Motor			

For an electric motor to be installed indoors with a rated output exceeding 0.2 kW, an appropriate device(like Over current breaker, Buzzer etc) shall be installed to automatically block out, or alert the operator of an overcurrent that may burn out the motor.
This device is not required to be installed if one of the following paragraph is complied with.

1. If the motor is installed at such a position where the operator can normally monitor it while it is in operation.
2. If there is no danger of such an overcurrent that may burn out the motor occurring in the motor winding, because of the structure or load Properties of the motor.
3. If the electric motor is of the single-phase type and the rated current of an overcurrent circuit breaker to be installed on its power supply side is 15 A or less (*1).

(*1) The rated current shall be 20 A or less for distributing circuit breakers.

If the motor is installed at such a position where the operator can normally monitor it while it is in operation



If the motor is installed at such a position where the operator can normally monitor it while it is in operation, this device is not required to be installed.

Remarks	Revisions	
	2003/Nov.	Original

Category				Document No. IW 7
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	8	House Wiring	
	Clause	60	Protection against Ground Fault	
Title	Protection Method against Ground Fault Divided by Grounding Work Type			

It is necessary to install a Ground Fault breaker at necessary places in electrical circuits to protect the electrical shock or fire caused by Ground Fault.

Protection method against ground fault divided by grounding work type

1. TT-grounding system

   Ground Fault Breakers are generally used because ground leakage currents are a little.

2. TN-grounding system

   Ground leakage currents are large because the exposed-conductive-parts of the installation are connected by protective conductors. So both Ground Fault breaker and Over current Breaker can be used against ground fault, but it depends on grounding system.

   In case of using Over current Breaker, those that have suitable current - work time character, that ground fault current is limited by fault loop impedance, shall be used,

3. TN-S

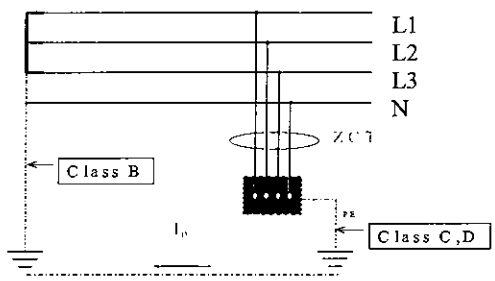
   Ground Fault Breaker and Over current Breaker can be used.

4. TN-C

   Zero-phase-sequence current can't be detected because neutral conductor is combined with protective conductor. For that reason Ground fault breaker can't be used and Over current Breaker shall be used against ground fault.

Ground Fault Breaker for LV Electrical Circuit

Function of Ground Fault Breaker for LV Electrical Circuit



Remarks	Revisions	
	2003/Nov.	Original

Category				Document No. IW 8
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	8	House Wiring	
	Clause	60	Protection against Ground Fault	
Title	Recommended Equipment for Installation of Ground Fault Breaker			

It is desirable to install ground fault breaker in electrical circuit in such cases as using following equipment.

Installed place of leakage circuit breaker

Installed place of equipment and devices	Equipment and devices used
Wet or moist place	Washing machine, clothes dryer (in bathroom), hot water boiler, refrigerator-freezer (kitchen), laundry workshop, filling station's car wash, and others
Under the eaves (exposed to rain)	Well pump, air conditioner, washing machine, boiler, outdoor outlet, automatic vending machine, icebox, showcase, and others
Outdoor	Outdoor unit of air conditioner, well pump, illuminating light around a pond, garden light, outlet installed outdoors, automatic vending machine, showcase, icebox, and others
Used on a 400 V circuit (3-phase,3-wire)	Package, separate or window type air conditioner, large dry cleaning equipment, irrigation and drainage equipment, water supply, drainage, circulatory filtering equipment for swimming pools, and others

Remarks	Revisions	
	2003/Nov.	Original

Category				Document No. IW 9
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	8	House Wiring	
	Clause	60	Protection against Ground Fault	
Title	Leakage Influence on Human Bodies			

About leakage influence on human bodies by alternative voltage, It is said that human bodies have fatal influence when passage current multiplied by passage time exceed 50mA·s. For above reason ground fault breaker to protect electric shock in TT-system is generally used as following performance.

·sensitive current is less than 30mA
·work time is less than 0.1s

An estimate of the amount of current flow through the body under different circumstances when contact is made witIWires at a standard distribution voltage.

Conditions	Body current	Effect
Dry skin	3 mA - 10 mA	Tingling sensation, slight shock.
Damp conditions, sweaty skin	10 mA - 20 mA	Tightening muscles, acute discomfort, and difficulty in separating from electrical contact. Prolonged contact harmful.
Damp conditions, sweaty skin, electrical contact with water	20 mA - 50 mA	Harmful, sometimes severely. Acute tightening of muscles, especially in the chest area.
Damp conditions, sweaty skin, electrical contact with water	50 mA and up	Usually fatal. Irregular contraction of heart muscles (fibrillation).

Remarks	Revisions	
	2003/Nov.	Original

Category				Document No. IW 10
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	8	House Wiring	
	Clause	61	Indoor Wiring	
Title	Sign of Indoor Wiring			

1. The color of sign

The color of sign for neutral conductor shall be black or blue. And the color of sign for protective conductor shall be green or green with white or yellow. In case of TN-C system, both green color and white color can be used for the color of sign for PEN(Combined protective and neutral conductor).

The color of sign for phase conductor is not needed. And that color of sign shall be free except for green or white.

2. The example measures

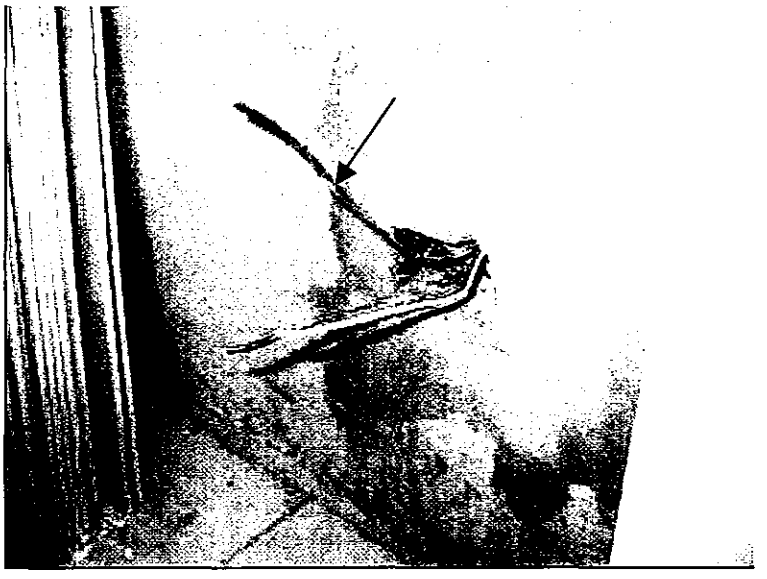
The example measures for color of sign are as follows:

(1) The color of cover of insulated wire

(2) Winding of vinyl tape

(3) In case of multi core cable, the color of sigh of core wire

etc



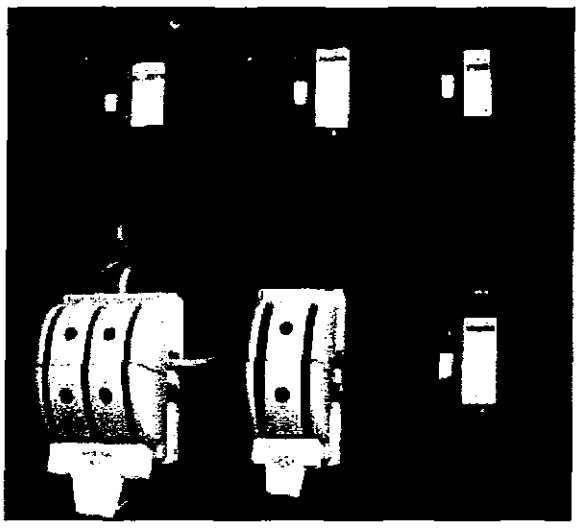
Remarks	Revisions	
	2003/Nov.	Original

Category				Document No. IW 11
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	8	House Wiring	
	Clause	62	Indoor wiring utensils	
Title	Indoor Wiring Utensils			

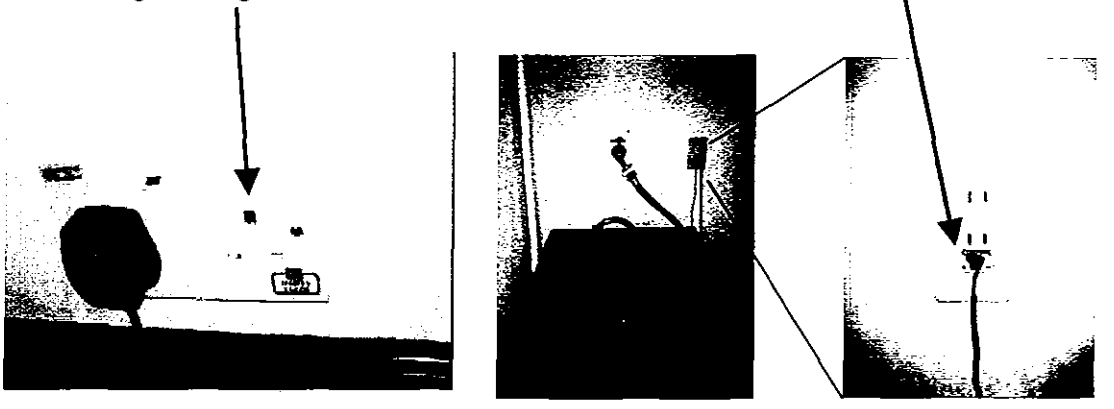
Types of Indoor wiring utensils

Switch, outlets, fuse, circuit breaker, ground fault breaker

No live parts shall not be exposed and connected fast and electrically safely by screw fastening or the like



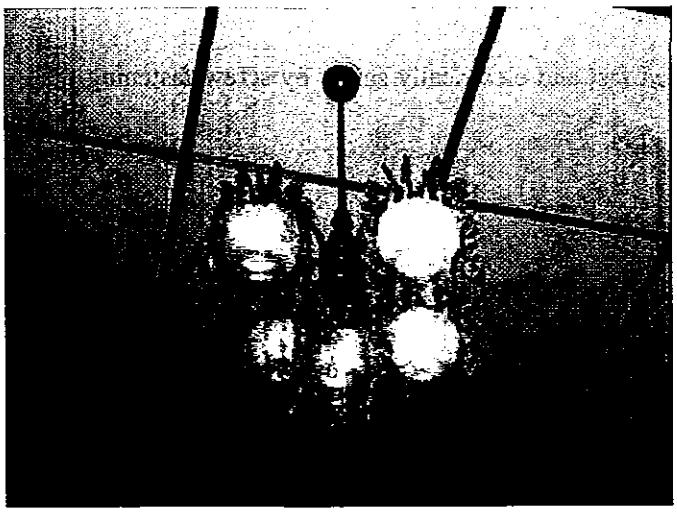
Protective grounding conductors



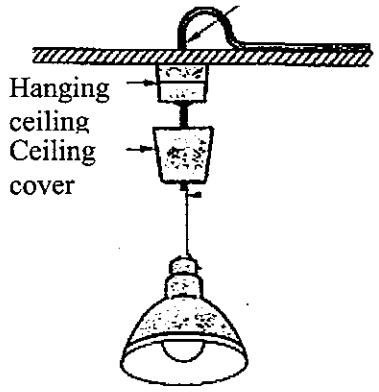
Remarks	Revisions	
	2003/Nov.	Original

Category				Document No. IW 12
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	8	House Wiring	
	Clause	63	Installation Methods of Indoor Electrical Appliances	
Title	Indoor Electrical Appliances			

No live parts of electrical household appliances shall be exposed



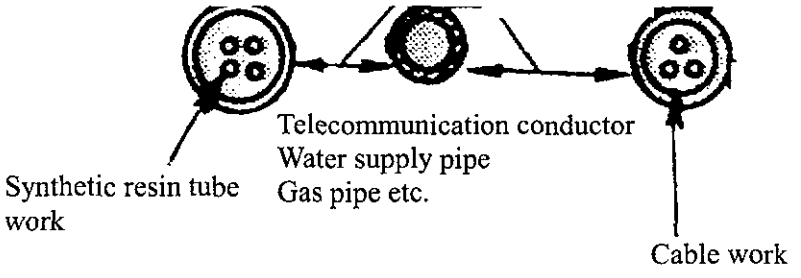
No mechanical tension shall act on the connection point



Remarks	Revisions	
	2003/Nov.	Original

Category	Chapter	2	Technical Standards of Electric Power Facilities	Document No. IW 13
	Paragraph	8	House Wiring	
	Clause	64	Indoor Wiring for Adjacency and Crossing	
Title	Indoor Wiring for Adjacency and Crossing			

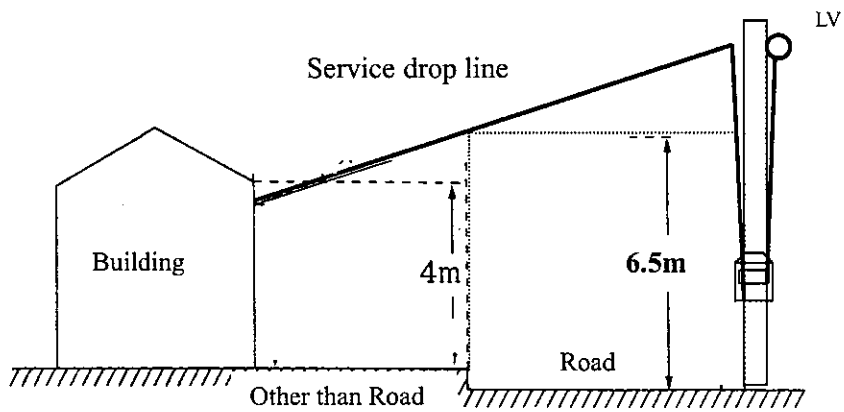
Not to contact Telecommunication conductor, Water supply pipe, Gas pipe etc.



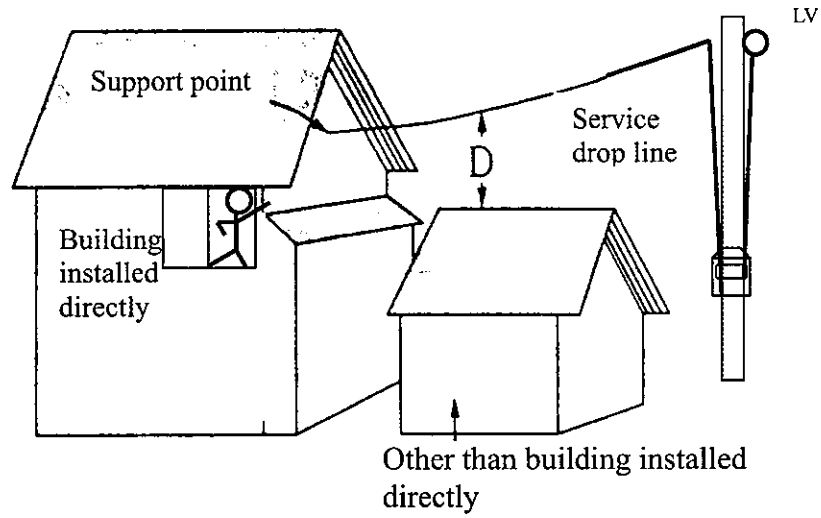
Remarks	Revisions	
	2003/Nov.	Original

Category				Document No. IW 14
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	8	House Wiring	
	Clause	65	Outdoor Installation at user's site	
Title	Overhead Low-voltage Service Drop Lines			

Minimum height from ground



Minimum clearance to other objects (D)

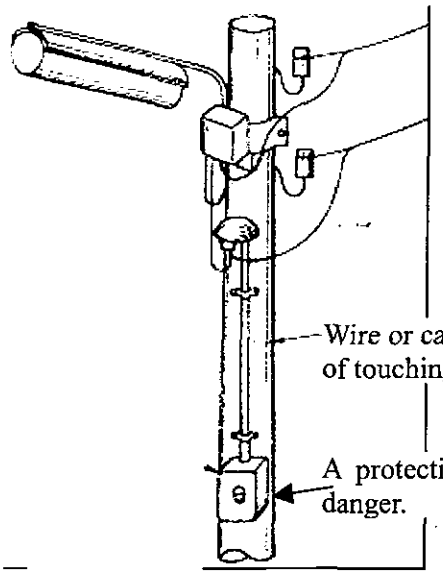


1 (D) is more than 0.4m in case of cable
2 A person cannot reach it even if he or she stretches out his/her hand from a window, corridor, or a passage

Remarks	Revisions	
	2003/Nov.	Original

Category				Document No. IW 15
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	8	House Wiring	
	Clause	65	Outdoor Installation at user's site	
Title	Other Outdoor Installation at User's Site			

Outlets shall be waterproof type if they have possibility of taking rainwater.



Remarks	Revisions	
	2003/Nov.	Original

Category				Document No. IW16-1
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	8	House Wiring	
	Clause			
Title	Allowable Indoor Line Current (1/3)			

The allowable current of PVC-insulated conductor and XLPE-insulated conductor used for low-voltage indoor wiring shall conform to the following paragraphs:

1. Allowable current and current reduction factor of insulated conductor

The allowable current of the conductors given in below Table is the value in this table multiplied by the allowable current correction factor (a) for ambient temperatures of 30°C or less or by the current reduction factor calculated by the formula (b) (θ denotes ambient temperature) of current reduction factor for ambient temperatures exceeding 30°C according to the insulator materials given in Table.

Allowable current of indoor wiring

Conductor			Allowable current (A)		
	Nominal sectional area, mm²	*Diameter, mm*	Copper wire	Aluminum wire	Aluminum alloy wire
Single wire	0.8 or more and under 1.1	1.0 or more and under 1.2	16	12	12
	1.1 or more and under 2.0	1.2 or more and under 1.6	19	15	14
	2.0 or more and under 3.1	1.6 or more and under 2.0	27	21	19
	3.1 or more and under 5.3	2.0 or more and under 2.6	35	27	25
	5.3 or more and under 8.0	2.6 or more and under 3.2	48	37	35
	8.0 or more and under 12.6	3.2 or more and under 4.0	62	48	45
	12.6 or more and under 19.6	4.0 or more and under 5.0	81	63	58
	19.6 or more	5.0 or more	107	83	77
Twisted conductor	0.9 or more and under 1.25		17	13	12
	1.25 or more and under 2		19	15	14
	2 or more and under 3.5		27	21	19
	3.5 or more and under 5.5		37	29	27
	5.5 or more and under 8		49	38	35
	8 or more and under 14		61	48	44
	14 or more and under 22		88	69	63
	22 or more and under 30		115	90	83
	33 or more and under 38		139	108	100
	38 or more and under 50		162	126	117
	50 or more and under 60		190	148	137
	60 or more and under 80		217	169	156
	80 or more and under 100		257	200	185
	100 or more and under 125		298	232	215
	125 or more and under 150		344	268	248
	150 or more and under 200		395	308	284
	200 or more and under 250		469	366	338
	250 or more and under 325		556	434	400
	325 or more and under 400		650	507	468
	400 or more and under 500		745	581	536
	500 or more and under 600		842	657	606
	600 or more and under 800		930	745	690
	800 or more and under 1000		1,080	875	820
	1000		1,260	1,040	980

Remarks	Revisions	
	2003/Nov.	Original

Category				Document No. IW16-2
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	8	House Wiring	
	Clause			
Title	Allowable Indoor Line Current (2/3)			

Current reduction factor

Insulator material	Allowable current correction factor (a)	Formula (b) of current reduction factor
PVC (excluding heat-resistant polymers)	1.00	$\sqrt{\frac{60-\theta}{30}}$
XLPE (limited to cross-linked polymers)	1.41	$\sqrt{\frac{90-\theta}{30}}$

2. Allowable current when put in a conduit

If the insulated conductors in Paragraph 1 are placed in a synthetic resin raceway, synthetic resin tube, metallic raceway, metallic tube or flexible conduit for use, the allowable current of that conductor shall be the allowable current prescribed in Paragraph 1 multiplied by the current reduction factor (c) in Table.

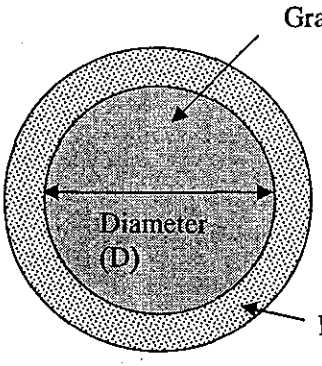
Current reduction factor when put in conduit

Number of electrical conductors in one conduit	Current reduction factor (c)
3 or less	0.70
4 or less	0.63
5 or 6	0.56
7 or over and 15 or less	0.49
16 or over and 40 or less	0.43
41 or over and 60 or less	0.39
61 or over	0.34

Remarks	Revisions	
	2003/Nov.	Original

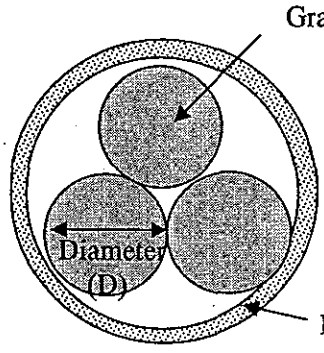
Category	Chapter	2	Technical Standards of Electric Power Facilities	Document No. IW16-3
	Paragraph	8	House Wiring	
	Clause			
Title	Allowable Indoor Line Current (3/3)			

Single wire



Nominal sectional area (mm^2) = $3.14 \times (D/2)^2$

Twisted conductor



Nominal sectional area (mm^2) = $3 \times 3.14 \times (D/2)^2$

Remarks	Revisions	
	2003/Nov.	Original

Category				Document No. IW17
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	8	House Wiring	
	Clause			
Title	Installation of Main Conductors			

In installing the low-voltage indoor mains from the service entrance switch or the switchboard in the receiving room to the branching point of a branch circuit, the mains conductors shall be installed in a place free of danger of damage and an electrical conductor with an allowable current equal to or greater than the value given below shall be used for the mains.
However, if the demand factor, power factor and the like are already known, an alternative electrical conductor with an allowable current equal to or greater than the value given below appropriately modified based on these factors may be used.

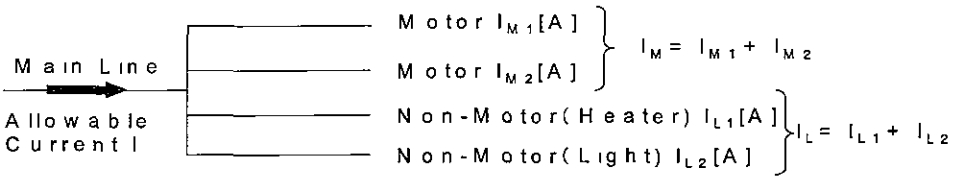
1. If the load on electric motors and the like is 50% or less:
   If the total of rated current of the electric motors and the like (*1) is not greater than the total of rated current of other household appliances, the allowable current shall be the total sum of rated current of the all household appliances supplied from the mains

(*1) "Electric motors and the like" includes electric motors and similar household appliances that require a large starting current.

2. If the load on electric motors and the like exceeds 50%:
   The allowable current shall be the total of rated current of other household appliances to which the following value is added:

a. If the total of rated current of the motors and the like is 50 A or less, the allowable current shall be the value 1.25 times that total of rated current.
b If the total of rated current of the motors and the like exceeds 50 A, the allowable current shall be the value 1.1 times that total of rated current.

Installation of Main Conductors



Condition 1	Condition 2	Allowable Current [A]
$I_M \leqq I_L$	–	$I \geqq I_M + I_L$
$I_M > I_L$	$I_M \leqq 50$	$I \geqq 1.25 \times I_M + I_L$
	$I_M > 50$	$I \geqq 1.1 \times I_M + I_L$

Remarks	Revisions	
	2003/Nov.	Original

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Category				Document No. IW18-1
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	8	House Wiring	
	Clause			
Title	Installation of Overcurrent Circuit Breakers for Main Conductor (1/2)			

On the power supply side of the mains, an overcurrent circuit breaker to protect such mains shall be installed on each pole except the neutral wire according to the following items:

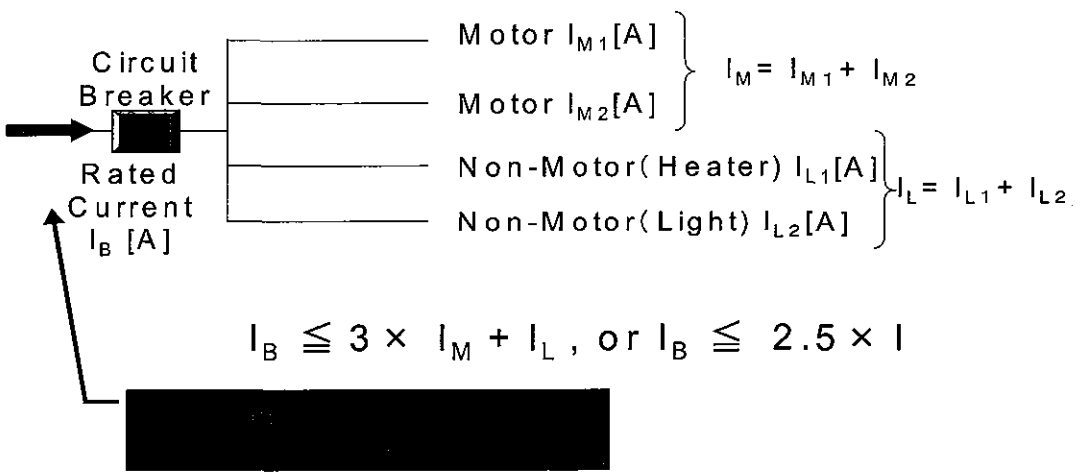
1. If motors and the like are not connected to the overcurrent circuit breakers:
   An overcurrent circuit breaker having a rated current equal to or less than the allowable current of the mains shall be installed.
2. If motors and the like are connected to the overcurrent circuit breakers:
   An overcurrent circuit breaker having a rated current equal to or less than the value 3 times the total of rated current of the motors and the like to which the total of rated current of other household appliances is added shall be installed.
   However, it shall not exceed 2.5 times the allowable current of the mains.
3. Exceptions to installation of overcurrent circuit breakers
   Installation of an overcurrent circuit breaker may be omitted in the following cases:

a. The case where the allowable current of the mains is 55% or more (*1) of the rated current of an overcurrent circuit breaker that protects other mains connected to the power supply side of the mains concerned
   (*1) If the length of such mains is 8 m or less, the rated current shall be 35% or more.
b. The case of which length of mains is 3 m or less and to which no other mains are connected on the load side.

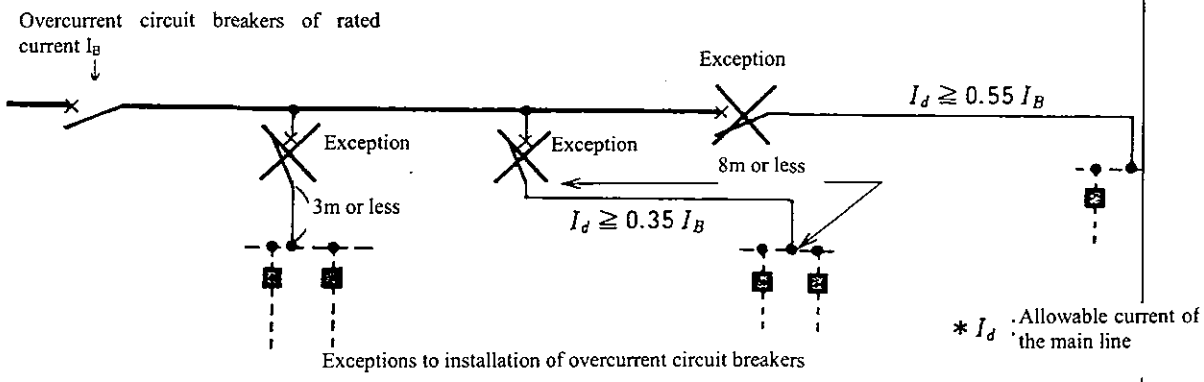
Remarks	Revisions	
	2003/Nov.	Original

Category	Chapter	2	Technical Standards of Electric Power Facilities	Document No. IW18-2
	Paragraph	8	House Wiring	
	Clause			
Title	Installation of Overcurrent Circuit Breakers for Main Conductor (2/2)			

Installation of Overcurrent Circuit Breakers



Exceptions to installation of overcurrent circuit breakers



Exceptions to installation of overcurrent circuit breakers

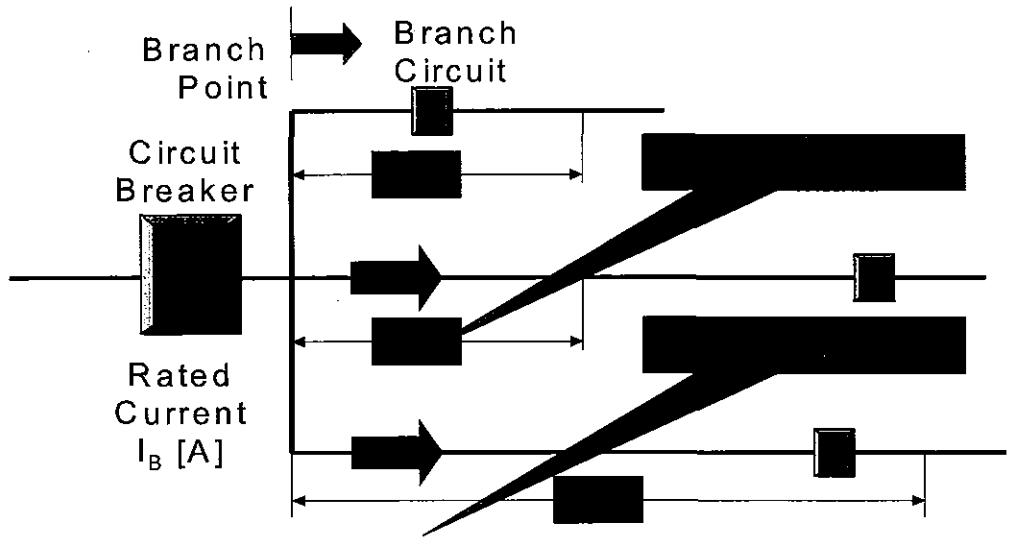
Remarks	Revisions	
	2003/Nov.	Original

J-POWER & CEPCO

Category				Document No. IW19
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	8	House Wiring	
	Clause			
Title	Indoor Branch Circuit (Installation of Switching Devices)			

For a branch circuit, a switching device and overcurrent circuit breaker shall be installed on each pole (*1) at a place within 3 m from the branching point on the mains.
If the allowable current of the electrical conductor from the branching point to the switching device and overcurrent circuit breaker is 55% or more (*2) of the rated current of the overcurrent circuit breaker that protects the mains connecting to that electrical conductor, the switching device and overcurrent circuit breaker may be installed at a place beyond 3 m from the branching point.
(*1) For the overcurrent circuit breaker, the neutral pole is to be excluded.
(*2) If the length of electrical conductor from the branching point to the switching device and overcurrent circuit breaker is 8 m or less, it shall be 35% or more.

Installation of Switching Devices and Overcurent Circuit Breakers



Remarks	Revisions	
	2003/Nov.	Original

Category				Document No. IW20
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	8	House Wiring	
	Clause			
Title	Indoor Branch Circuit (Household Electric Appliance Exceeding 50 A)			

A branch circuit supplying electricity to one household electric appliance, other than a motor, with a rated current exceeding 50 A shall be installed as follows:

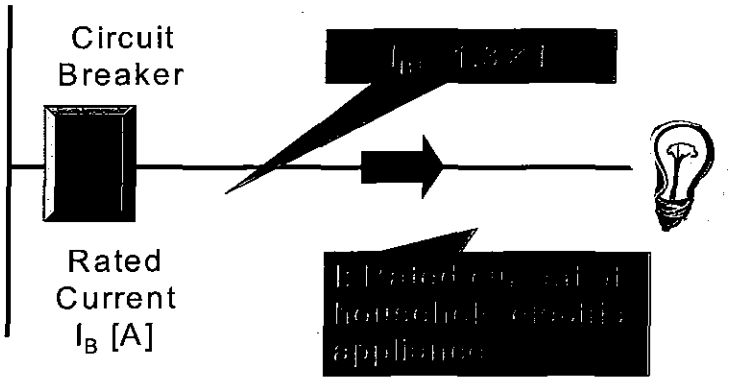
1. No other load than this household electric appliance shall be connected to this branch circuit.
2. The rated current of the overcurrent circuit breaker shall not exceed the value 1.3 times the rated current of that household electric appliance (*1).

(*1) If that value does not fit any standard rating of overcurrent circuit breakers, apply the nearest larger rating.

3. The allowable current of the electrical conductor shall be equal to or greater than the rated current of that household electric appliance and the overcurrent circuit breaker according to b. above.

Installation of Branch Circuits

Branch circuit supplying electricity to lamp load equipment with a rated current exceeding 50A



Remarks	Revisions	
	2003/Nov.	Original

Category				Document No. IW21
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	8	House Wiring	
	Clause			
Title	Indoor Branch Circuit (Electric Motor Alone)			

A branch circuit supplying electricity to an electric motor alone shall be installed as follows:

1. The rated current of the overcurrent circuit breaker shall not exceed the value 2.5 times the allowable current of the electrical conductor connecting to that overcurrent circuit breaker (*1).

(*1) If the rated current of that electrical conductor exceeds 100 A and the said rated current value does not fit any standard rating of overcurrent circuit breakers, employ the nearest rating larger than that value.

2. For each portion of the low-voltage indoor wiring, the allowable value of the electrical conductor of that portion shall be equal to or greater than the value 1.25 times (*2) the total of rated current of the electric motors supplied from that portion of the low-voltage indoor wiring.

(*2) If the total of the rated current of the electric motors concerned exceeds 50 A, the allowable current shall be equal to or greater than 1.1 times that current.

Remarks	Revisions	
	2003/Nov.	Original

Category				Document No. IW22
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	8	House Wiring	
	Clause			
Title	Indoor Branch Circuit (Other Branch Circuits)			

For branch circuits other than described in former clause [household electric appliance exceeding 50 A] and [electric motor alone], the capacity of the electrical conductor, receptacle to such branch circuit shall be installed exceeding the magnitude of the rated current of the overcurrent circuit breaker that protects the branch circuit.

Remarks	Revisions	
	2003/Nov.	Original

Category				Document No. IW23
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	8	House Wiring	
	Clause			
Title	Low-voltage Indoor Wiring Work (Cable Work)			

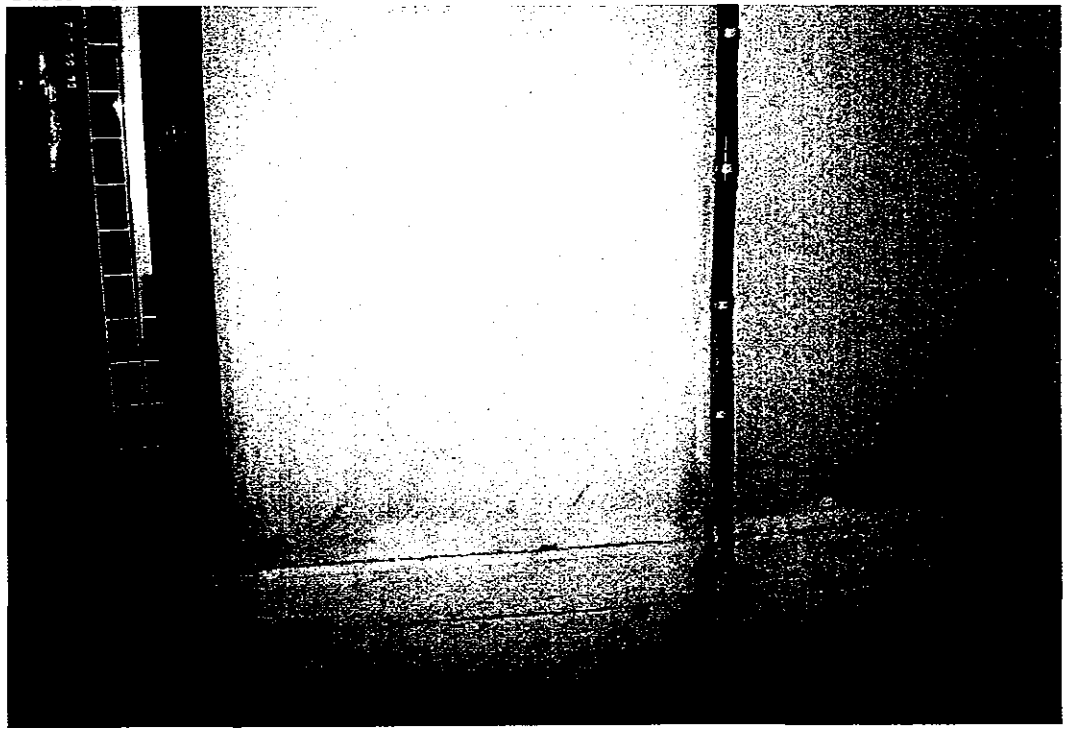
1. Outline

This work uses PVC cable or polyethylene cable for the electrical conductor. This cable can be directly attached to a building and can be used for wiring in a limited installation space.

2. Installation methods

Electrical conductor	grounding work	Installation method
Cable	Class D grounding work shall be applied to the metallic parts of protective devices that accommodate electrical conductors for 300 V or less, and Class C grounding work for more than 300 V.	• Wire supporting clearance shall be 2 m or less (if laid down along the bottom or side of a building part) and 6 m or less (if laid down vertically in an inaccessible place) • Provide an appropriate protective device for electrical conductor installed in a place subject to the pressure of heavy objects or severe mechanical impact.

Cable Work



Remarks	Revisions	
	2003/Nov.	Original

Category	Chapter	2	Technical Standards of Electric Power Facilities	Document No. IW24
	Paragraph	8	House Wiring	
	Clause			
Title	Low-voltage Indoor Wiring Work (Synthetic Resin Tube Work)			

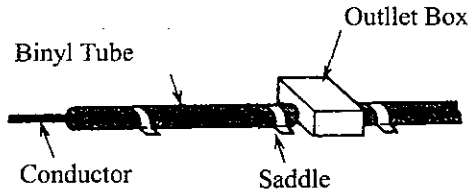
1. Outline

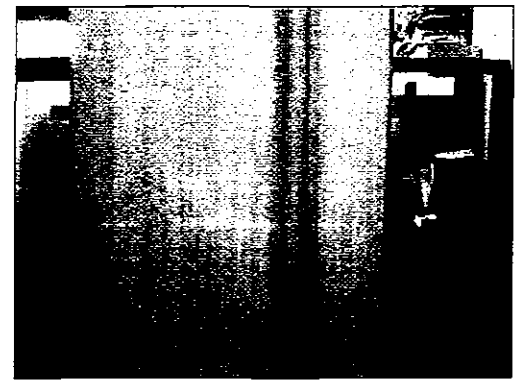
Synthetic resin tube work is executed by drawing the insulated conductor into a synthetic resin tube that mainly uses hard vinyl conduit or flexible synthetic resin conduit. It is less expensive and easier in execution than the execution of metallic tube work, and good at insulating properties and excellent in chemical resistance. It is, however, weaker to mechanical impact and heat than metallic tubes. Therefore, the said work shall be executed in such a manner so that the pressure of heavy objects or severe mechanical impact can be avoided.

2. Installation methods

Electrical conductor	Grounding work	Installation method
Insulated and stranded wire (excluding the case of 3.2 mm or less)	—	・Connection of electrical conductors is not allowed in the tube ・Tube supporting clearance shall be 1.5 m or less

Synthetic resin tube work





Remarks	Revisions	
	2003/Nov.	Original

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Category	Chapter	2	Technical Standards of Electric Power Facilities	Document No. IW25
	Paragraph	8	House Wiring	
	Clause			
Title	Low-voltage Indoor Wiring Work (Flexible Conduit Work)			

1. Outline

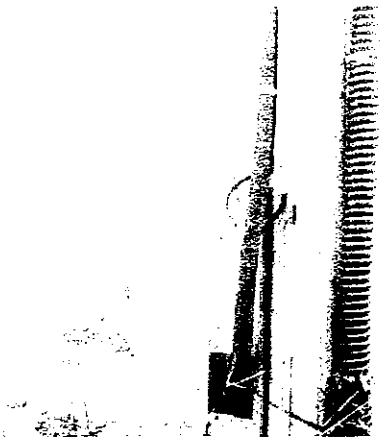
Flexible conduit work is executed by drawing the insulated conductor into a flexible conduit. This work method may be employed for the connection of wiring to vibrating equipment or the joints between structures or other points or places where some positional slippage is foreseeable, or where complex bent may exist.

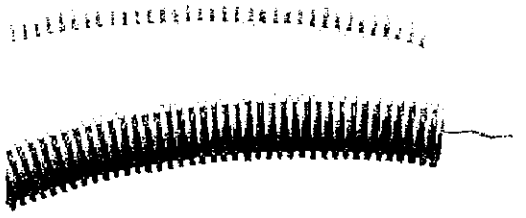
2. Installation methods

Electrical conductor	Grounding work	Installation method
Insulated and stranded wire (excluding the case of 3.2 mm or less)	Class D Grounding work shall be applied to tubes for 300 V or less and Class D for more than 300 V (*1)	• Connection of electrical conductors is not allowed in the tube • Tube and accessories shall be made of metal

(*1) Apply class D grounding work if 300 V is exceeded and there is no danger of a person's touching the duct.

Flexible Conduit Work





Remarks	Revisions	
	2003/Nov.	Original

Category				Document No. IW26
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	8	House Wiring	
	Clause			
Title	Low-voltage Indoor Wiring Work (Metallic Tube Work)			

1. Outline

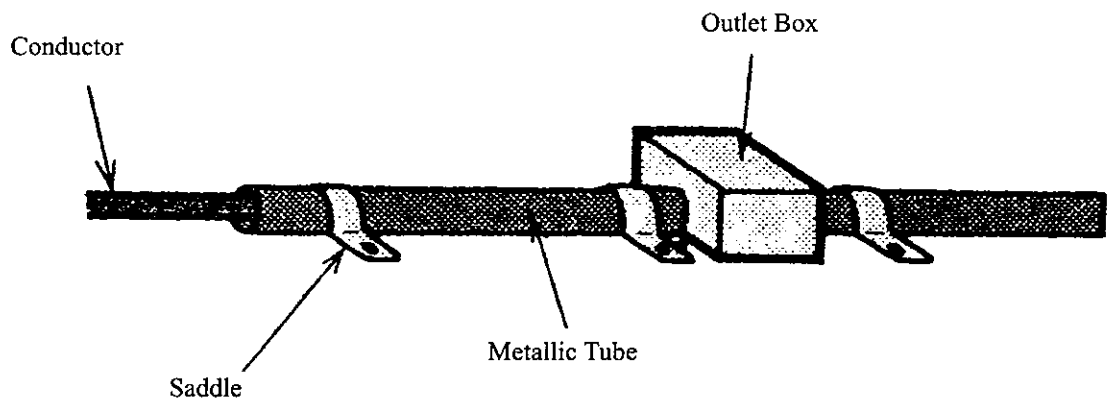
Metallic tube work is executed by drawing the insulated conductor into a steel conduit. This work method is strong against the mechanical impact and, widely used for installation of low-voltage wiring in an office building or factory.

2. Installation methods

Electrical conductor	Grounding work	Installation method
Insulated and stranded wire (excluding the case of 3.2 mm or less)	Class D grounding work shall be applied to tubes for 300 V or less and class C for more than 300 V (*1)	• Connection of electrical conductors is not allowed in the tube • Tube and accessories shall be made of brass or copper • Tube wall thickness shall be 1.2 mm or over for embedment in concrete and 1 mm or over for others

(*1) Apply class D grounding work if 300 V is exceeded and there is no danger of a person's touching the duct.

Metallic Tube Work



Remarks	Revisions	
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Category	Chapter	2	Technical Standards of Electric Power Facilities	Document No. IW27
	Paragraph	8	House Wiring	
	Clause			
Title	Low-voltage Indoor Wiring Work (Synthetic Resin Raceway Work)			

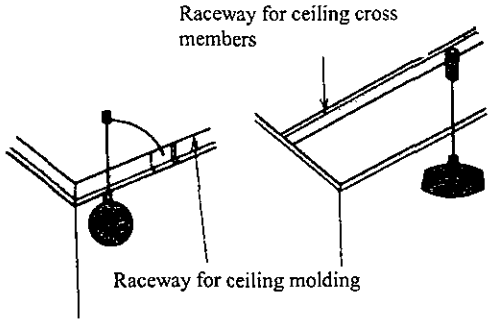
1. Outline

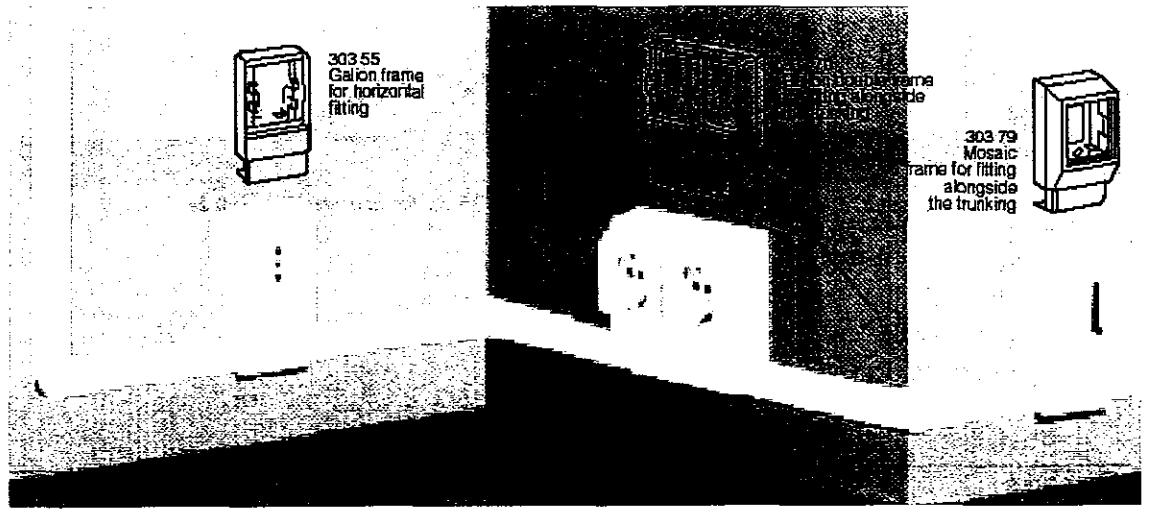
A kind of exposed wiring is employed where buried wiring is difficult, such as, in a concrete prefabricated building. In executing interior finishing of a dwelling house, for example, a synthetic resin raceway is often attached to the ceiling molding, ceiling cross members or baseboard, and insulated conductor can be put in the raceway afterward by removing the raceway lid.

2. Installation methods

Electrical conductor	Grounding work	Installation method
Insulated conductor (excluding PVC-insulated conductor)	-	Connection of electrical conductors is not allowed in the raceway

Synthetic Resin Raceway Work





Remarks	Revisions	
	2003/Nov.	Original

Category	Chapter	2	Technical Standards of Electric Power Facilities	Document No. IW28
	Paragraph	8	House Wiring	
	Clause			
Title	Low-voltage Indoor Wiring Work (Metallic Raceway Work)			

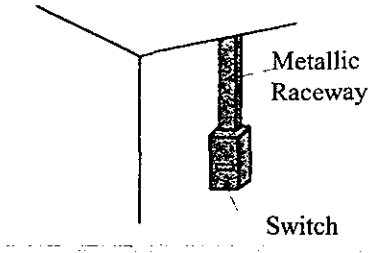
1. Outline

Wiring is installed by laying insulated conductor in a metallic raceway. This work method can be used for indoor wiring where little importance is put on the aesthetics or at the drop section of a switch or receptacle when the switch or receptacle position is changed due to a design change in concrete building.

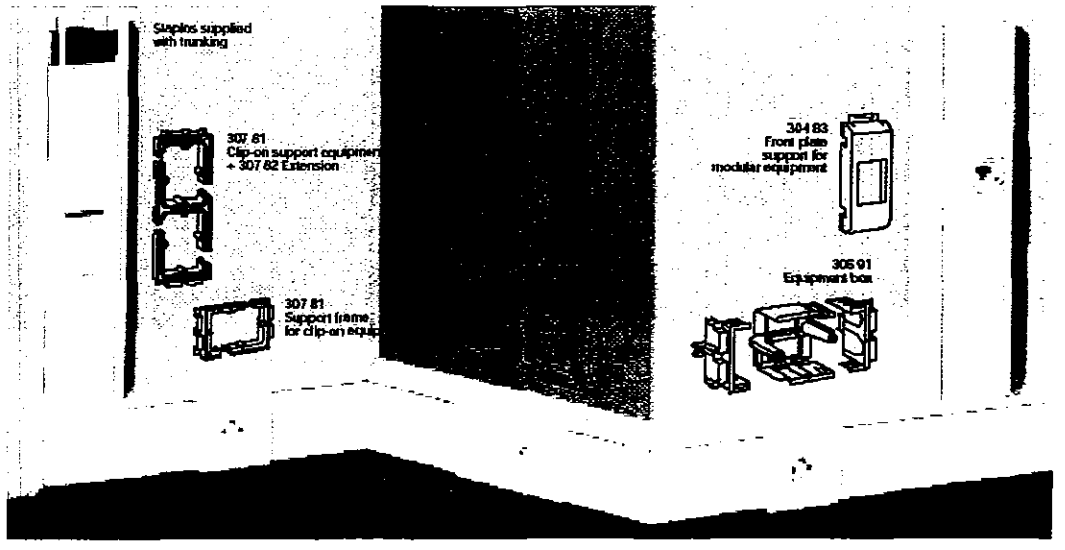
2. Installation methods

Electrical conductor	Grounding work	Installation method
Insulated conductor (excluding PVC-insulated conductor)	Class D Grounding work shall be applied to the raceway.	• Connection of electrical conductors is not allowed in the tube • Tube and accessories shall be made of brass or copper

Metallic raceway work



Switch



Remarks	Revisions	
	2003/Nov.	Original

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Category				Document No. IW29
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	8	House Wiring	
	Clause			
Title	Low-voltage Indoor Wiring Work (Insulator Work)			

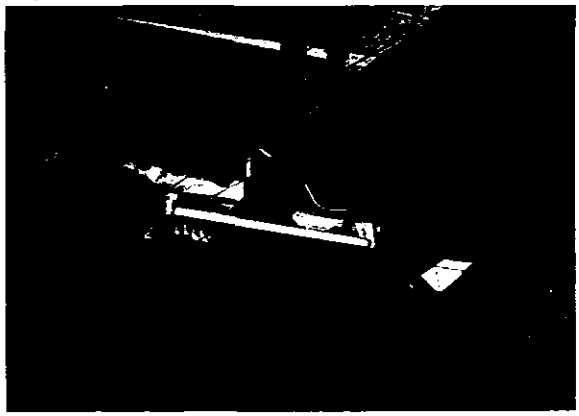
1. Outline

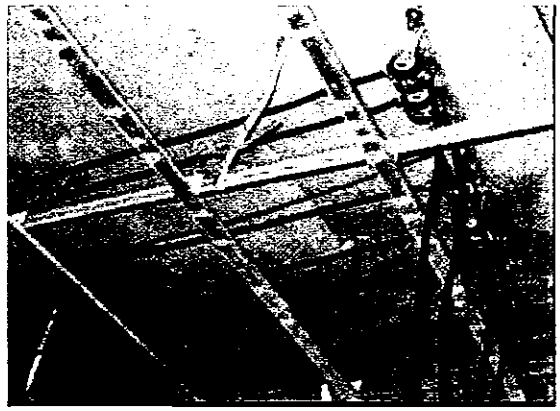
This insulator work is executed by supporting the electrical conductor with insulators. This work method is economical and relatively easy to execute. It can be used for wiring in a place where an ample installation space can be secured.

2. Installation methods

Electrical conductor	Grounding work	Installation method
Insulated conductor (excluding PVC-insulated conductor) (*1)		• Exclude easy access for 300 V or less. • Exclude access for more than 300 V. • Connection of electrical conductors is 6 cm or over • Clearance from electrical conductor to building part shall be 2.5 cm or over for 300 V or less and 4.5 cm or over for more than 300 V (2.5 cm or over in a dry place). • Supporting clearance shall be 2 m or less (for wire laid down along the top or a side of a building part). 6 m or less, however, for voltages exceeding 300 V and electrical conductor laid down otherwise.

Insulator Work





Remarks	Revisions	
	2003/Nov.	Original

Category	Chapter	2	Technical Standards of Electric Power Facilities	Document No. IW30
	Paragraph	8	House Wiring	
	Clause			

Title Low-voltage Indoor Wiring Work (Floor duct work)

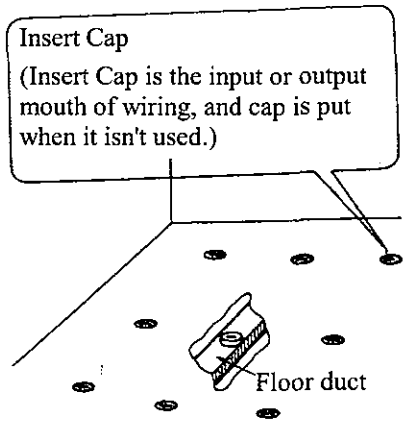
1. Outline

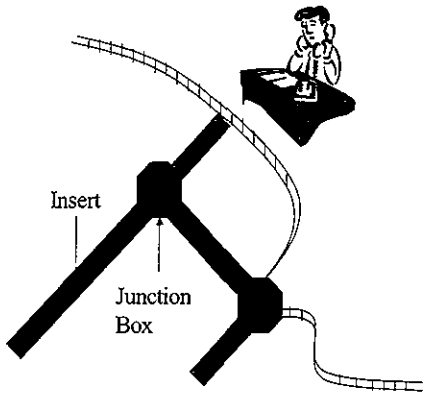
Wiring is made by embedding a metallic duct with a wiring take-off in a dry concrete floor of an office building or the like. For any equipment placement in a large room, a power line or signal line can be taken out from the floor surface near the equipment for connection.

2. Installation methods

Electrical conductor	Grounding work	Installation method
Insulated and stranded wire (excluding the case of 3.2 mm or less)	Class D Grounding work shall be applied to the duct.	• Connection of electrical conductors is not allowed in the duct (wire branching is excluded if that branch is easily accessible.) • Duct shall be 2 mm or over in wall thickness made of steel plate galvanized or coated with enamel or the like

Floor duct Work





Remarks	Revisions	
	2003/7/14	Original

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Category				Document No. IW31
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	8	House Wiring	
	Clause			
Title	Applications of Work Methods			

The work methods of low-voltage indoor wiring shall be applied according to the division of places of installation and operation voltages as shown in following Table.

Application of low-voltage indoor wiring work

Operation voltage / Place of installation / Kinds of work	300 V or less						Greater than 300 V					
	Open place		Accessible concealed place		Inaccessible concealed place		Open place		Accessible concealed place		Inaccessible concealed place	
	Dry place	Other places	Dry place	Other places	Dry place	Other places	Dry place	Other places	Dry place	Other places	Dry place	Other places
Cable work	○	○	○	○	○	○	○	○	○	○	○	○
Synthetic resin tube work	○	○	○	○	○	○	○	○	○	○	○	○
Flexible conduit work	○	○	○	○	○	○	○	○	○	○	○	○
Metallic tube work	○	○	○	○	○	○	○	○	○	○	○	○
Synthetic resin raceway work	○		○									
Metallic raceway work	○		○									
Insulator work	○	○	○	○			○	○	○	○		
Floor duct work					○							

The mark ○ indicates a place where the work concerned can be executed.

Remarks	Revisions	
	2003/Nov.	Original

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Category				Document No. IW32
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	8	House Wiring	
	Clause			
Title	Allowable Voltage Drop at Indoor Wiring			

In case that there are no such equipment like electric motor or ones which have large-start-current, It is desirable that voltage drop between service entrance to electric equipment at indoor wiring shall be no less than 4% of its nominal voltage.
This service entrance means as follows;
Low voltage supply: Attachment place of service drop wire at building
Medium or high voltage supply: Transformer at electrical user's site

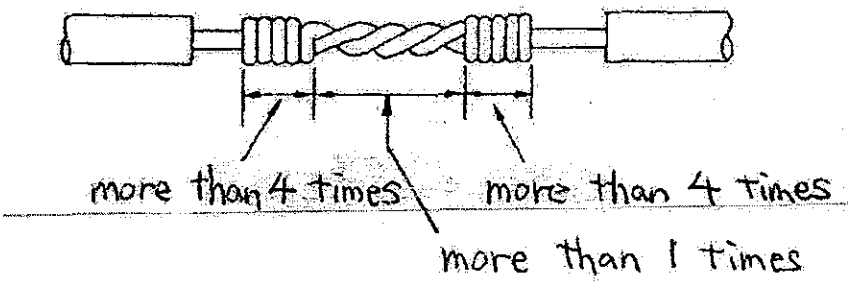
Remarks	Revisions	
	2003/Nov.	Original

Category	Chapter	2	Technical Standards of Electric Power Facilities	Document No. IW33-1
	Paragraph	8	House Wiring	
	Clause			
Title	Connection Methods of Indoor Wiring (1/4)			

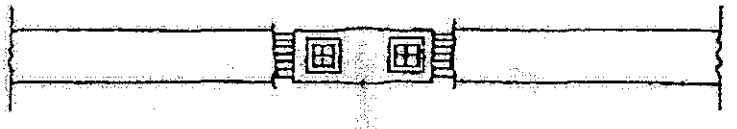
Connection methods of indoor wiring shall be as follows;
However, The number of twist, twist length or pressed points in figure are just reference.

1. Straight joint

(1) Twist joint of thin single wire (no more than 5.3mm^2)
The joint part shall be waxed.



(2) Pressed joint by straight sleeve
This joint measure shall be applied for both single wire and twisted wire.



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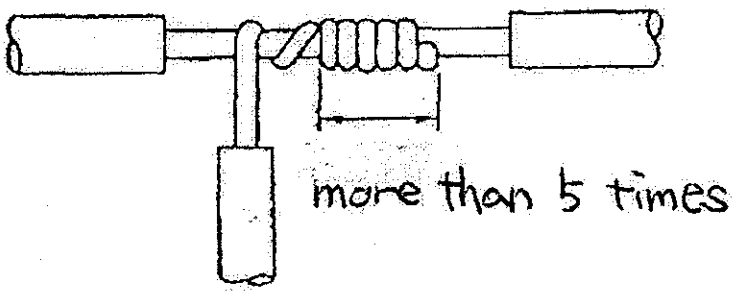
Category				Document No. IW33-2
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	8	House Wiring	
	Clause			
Title	Connection Methods of Indoor Wiring (2/4)			

2. Branch joint

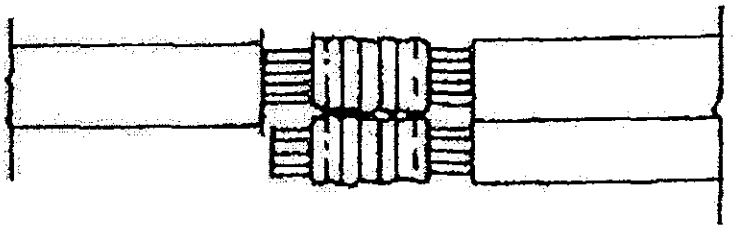
(1) Branch joint of thin single wire (no more than 5.3mm^2)

The joint part shall be waxed.



(2) Branch joint by T type connector

This joint measure shall be applied for both single wire and twisted wire.



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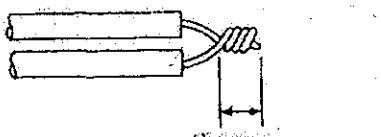
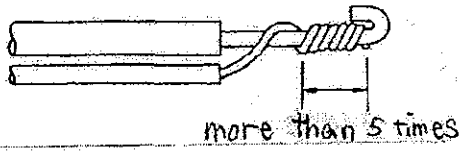
Category	Chapter	2	Technical Standards of Electric Power Facilities	Document No. IW33-3
	Paragraph	8	House Wiring	
	Clause			
Title	Connection Methods of Indoor Wiring (3/4)			

3. Terminal joint

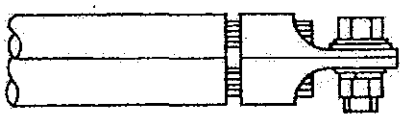
(1) Terminal joint of thin single wire (no more than 3.1mm^2)
The joint part shall be waxed.



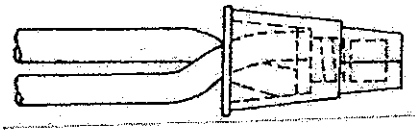
(2) Terminal joint of thin single wire
(No more than 3.1mm^2,in case of different diameter)
The joint part shall be waxed.



(3) Joint by pressed joint terminal



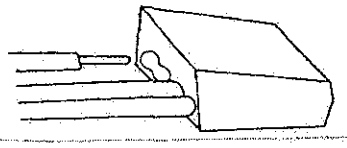
(4) Joint by screw type wire connector



(5) Joint by ring sleeve

(6) Joint by lap sleeve

(7) Joint by insertion type connector



Remarks	Revisions	
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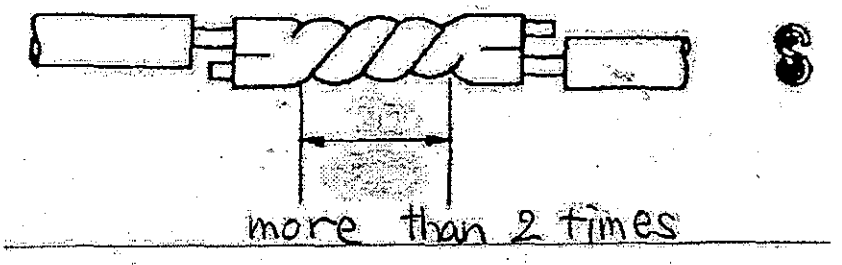
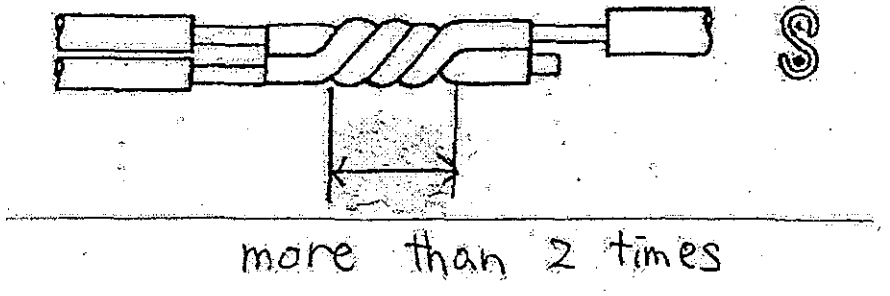
Category				Document No. IW33-4
	Chapter	2	Technical Standards of Electric Power Facilities	
	Paragraph	8	House Wiring	
	Clause			
Title	Connection Methods of Indoor Wiring (4/4)			

4. Sleeve joint

(1) Straight joint by S-type sleeve



(2) Branch joint by S-type sleeve



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	2003/Nov.	Original

Category				Document No. IW34
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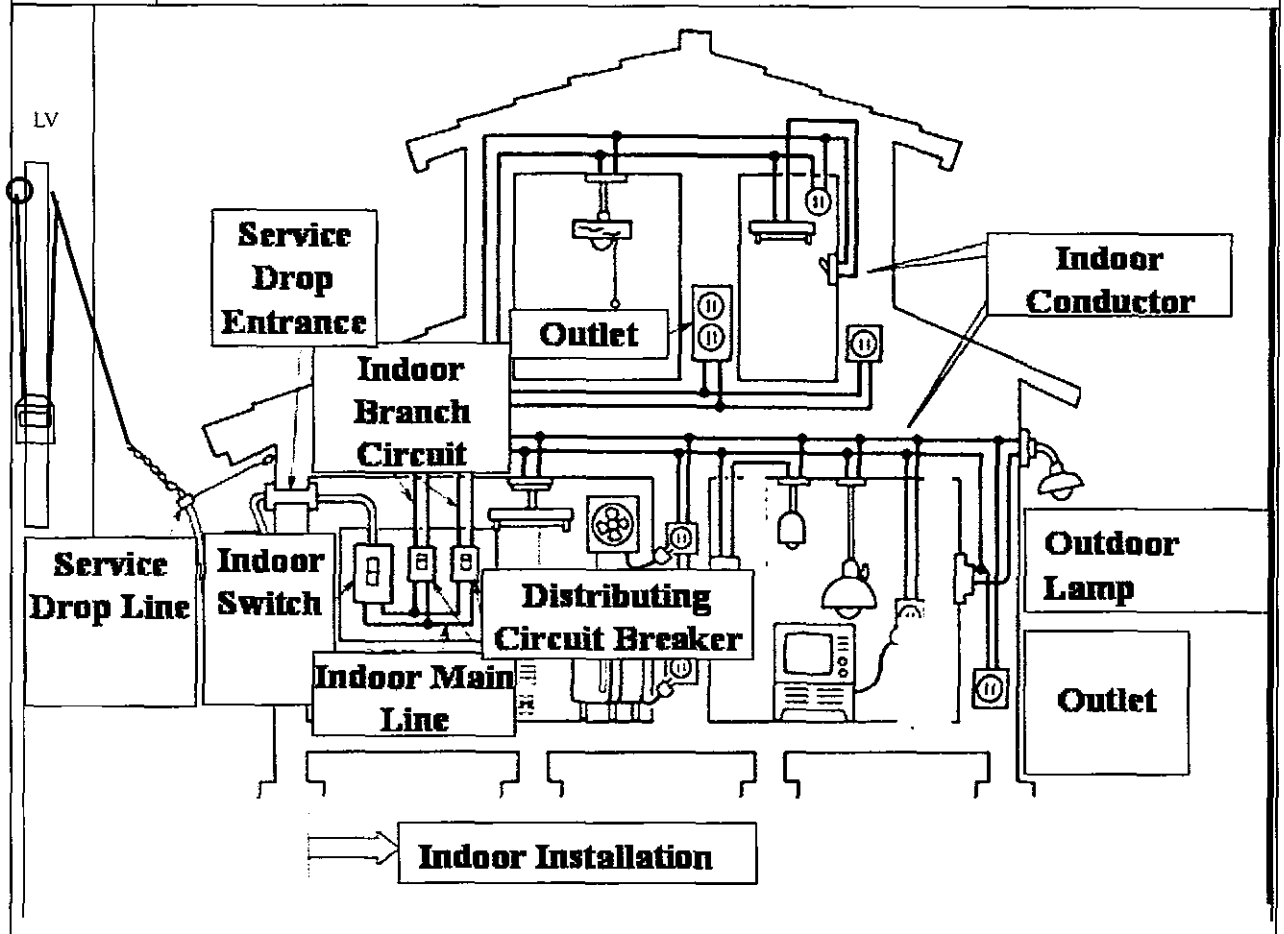
	Clause			
Title	Equipment of Indoor Wiring			



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for
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