

GUIDEBOOK FOR POWER ENGINEERS

MIME (JICA)

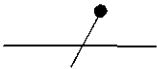
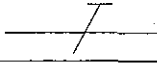
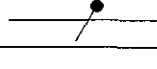
Category	Chapter	2	Technical Standards of Electric Power Facilities	Document No. IW 2-1
	Paragraph	8	House Wiring	
	Clause	58	Grounding	
Title	Grounding System Types (1/3)			
<p>Grounding systems are classified into three types in IEC, TN system, TT system, IT system, and their details are as follows.</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>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.</p>				
Remarks			Revisions	
			2003/Nov.	Original

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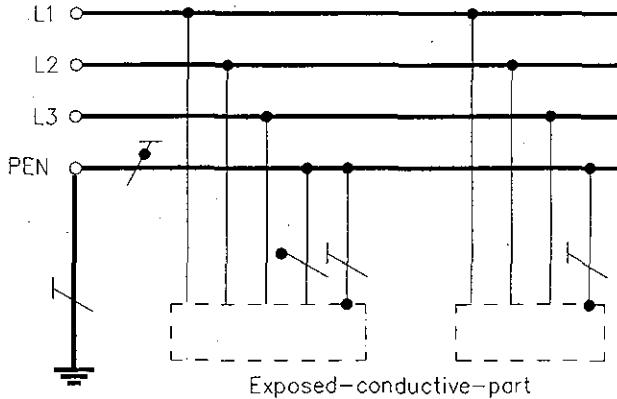
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Category	Chapter	2	Technical Standards of Electric Power Facilities	Document No. IW 2-2
	Paragraph	8	House Wiring	
	Clause	58	Grounding	
Title	Grounding System Types (2/3)			

Symbols according to IEC617-11 (1983)

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

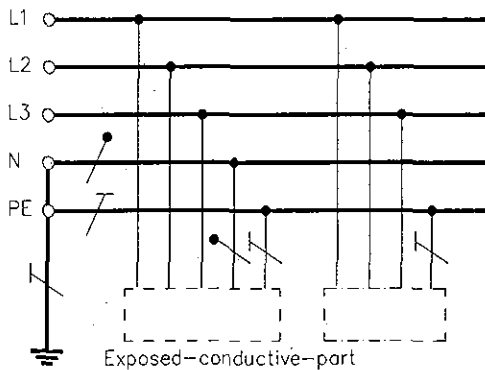
TN-C System



Earthing of system

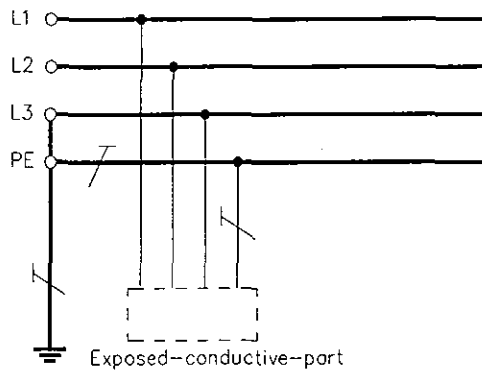
Neutral and protective functions combined in a single conductor throughout the system

TN-S System



Earthing of system

Separate neutral and protective conductors throughout the system



Earthing of system

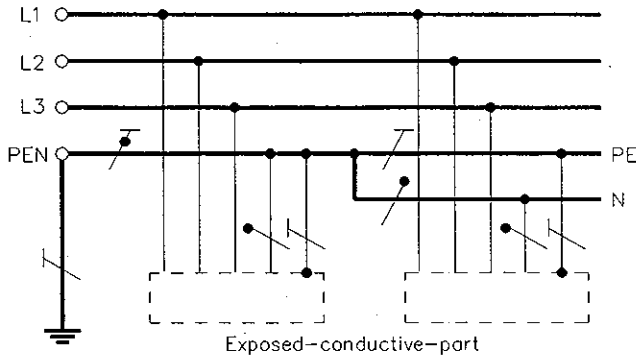
Separate earthed phase conductors and protective conductors throughout the system

Remarks	Revisions	
	2003/Nov.	Original

Category	Chapter	2	Technical Standards of Electric Power Facilities	Document No. IW 2-3
	Paragraph	8	House Wiring	
	Clause	58	Grounding	

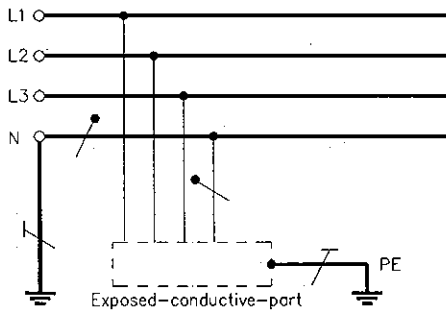
Title	Grounding system types (3/3)
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TN-C-S System

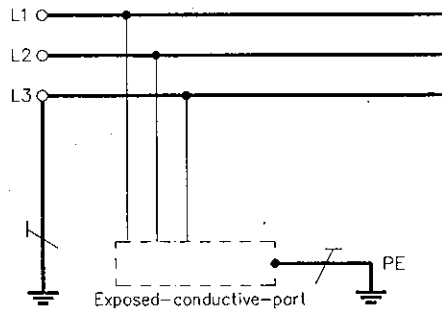


Earthing of system

TT-System

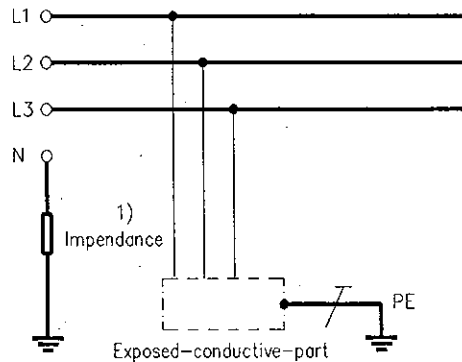


Earthing of system

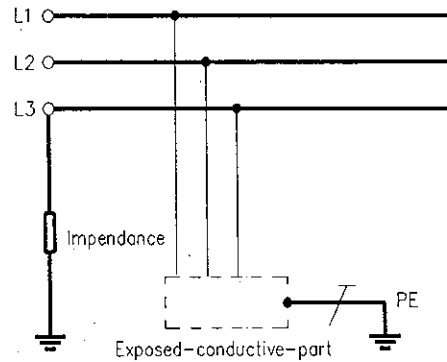


Earthing of system

IT-System



Earthing of system



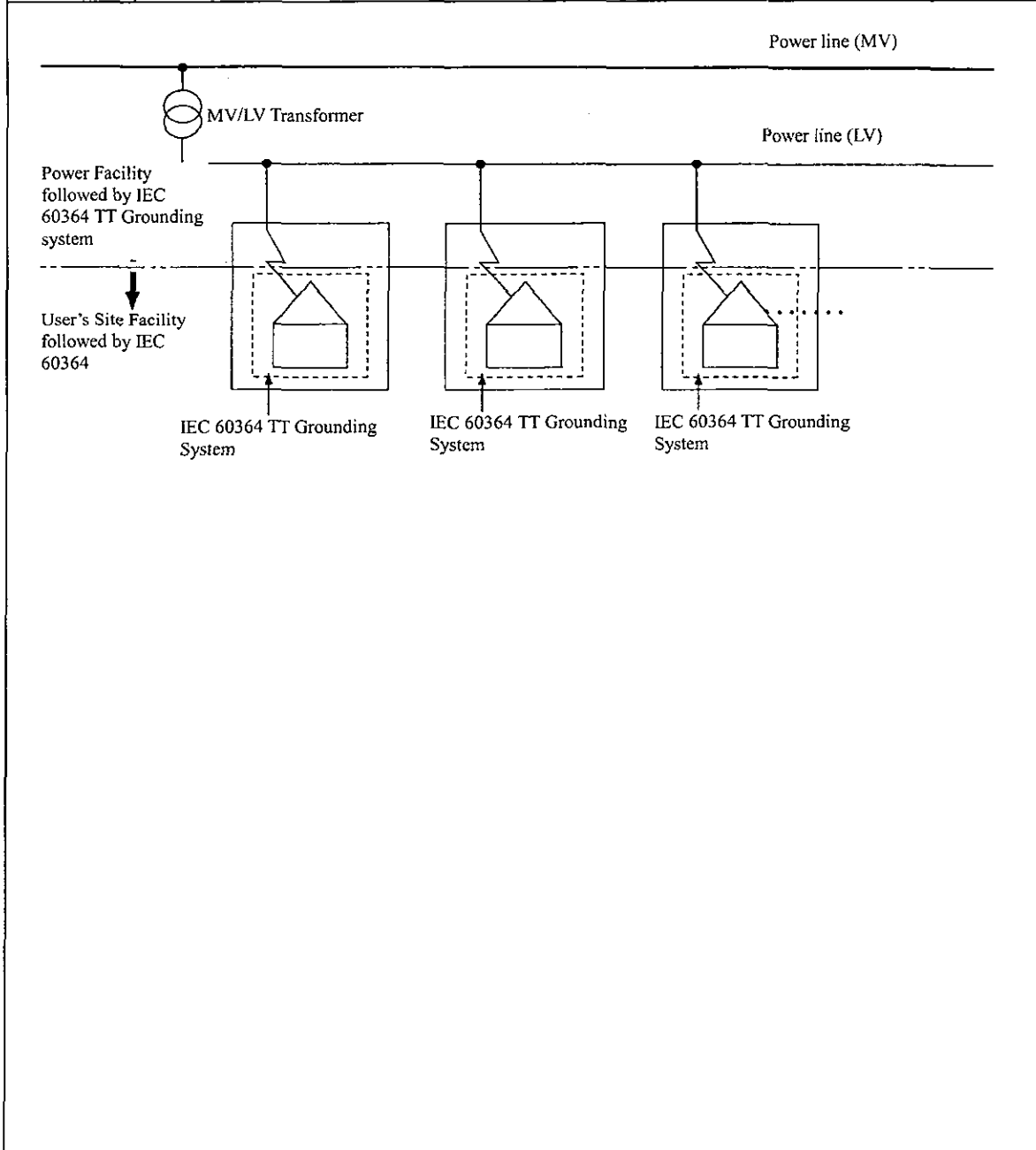
Earthing of system

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

Remarks	Revisions	
	2003/Nov.	Original

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

Title	Prohibition of Using Different Grounding System
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Remarks	Revisions	
	2003/Nov.	Original

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Category	Chapter	2	Technical Standards of Electric Power Facilities	Document No. IW 4								
	Paragraph	8	House Wiring									
	Clause	59	Protection against Overcurrent									
Title	Grounding Arrangements											
<p>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.</p> <p>Minimum sectional areas of protective conductors (Table 54F of IEC 60364-5-54-543.1.2)</p> <table border="1"> <thead> <tr> <th>Sectional area of phase conductor of facility S [mm²]</th> <th>Minimum cross-sectional area of protective conductor Sp [mm²]</th> </tr> </thead> <tbody> <tr> <td>$S \leq 16$</td> <td>S</td> </tr> <tr> <td>$16 < S \leq 35$</td> <td>16</td> </tr> <tr> <td>$S > 35$</td> <td>S/2</td> </tr> </tbody> </table>					Sectional area of phase conductor of facility S [mm ²]	Minimum cross-sectional area of protective conductor Sp [mm ²]	$S \leq 16$	S	$16 < S \leq 35$	16	$S > 35$	S/2
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$S \leq 16$	S											
$16 < S \leq 35$	16											
$S > 35$	S/2											
Remarks			Revisions									
			2003/Nov.	Original								

Category	Chapter	2	Technical Standards of Electric Power Facilities	Document No. IW 5
	Paragraph	8	House Wiring	
	Clause	59	Protection against Overcurrent	

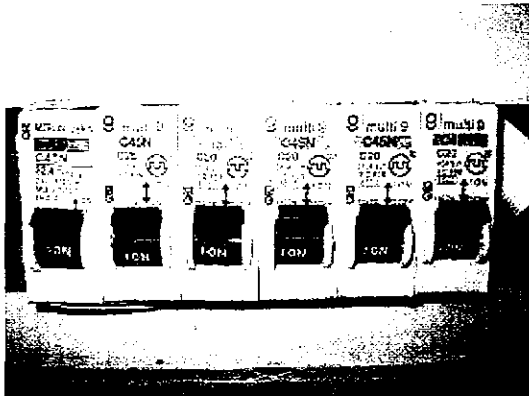
Title Exceptions to Installation of Over Current Protection Devices

It is desirable to install an overcurrent protection devices at necessary places to protect the equipment and devices and electrical conductor.

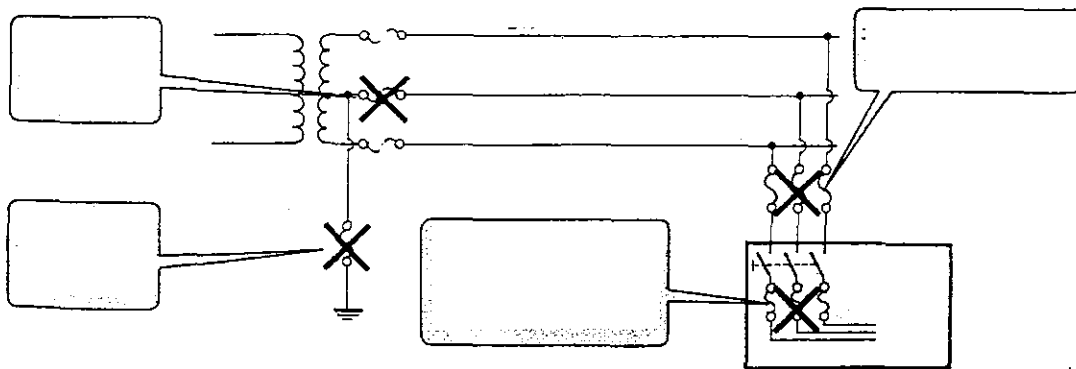
But no overcurrent circuit breaker shall be installed at the following places:

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

Title	Over Current Protection for Electric Motor
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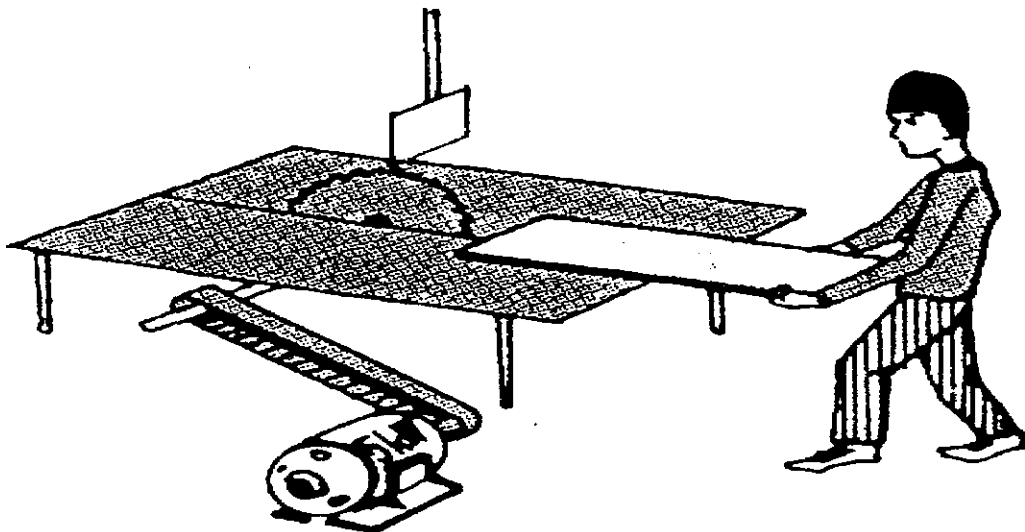
For an electric motor to be installed indoors with a rated output exceeding 0.2 kW, an appropriate device (like Over current breaker, Buzzer etc) shall be installed to automatically block out, or alert the operator of an overcurrent that may burn out the motor.

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	Chapter	2	Technical Standards of Electric Power Facilities	Document No. IW 7
	Paragraph	8	House Wiring	
	Clause	60	Protection against Ground Fault	

Title	Protection Method against Ground Fault Divided by Grounding Work Type
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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.

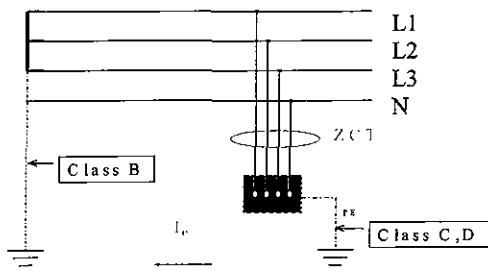
4. TN-C

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



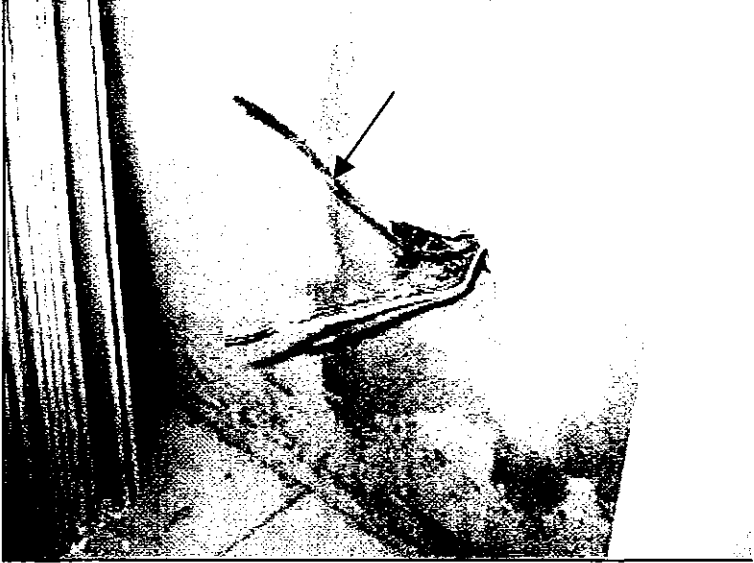
Remarks	Revisions	
	2003/Nov.	Original

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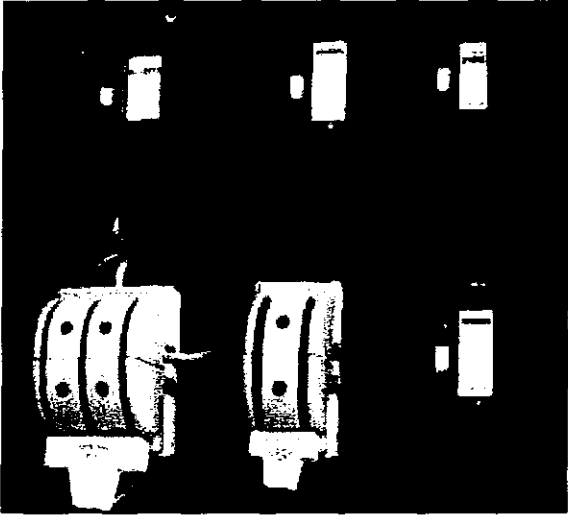
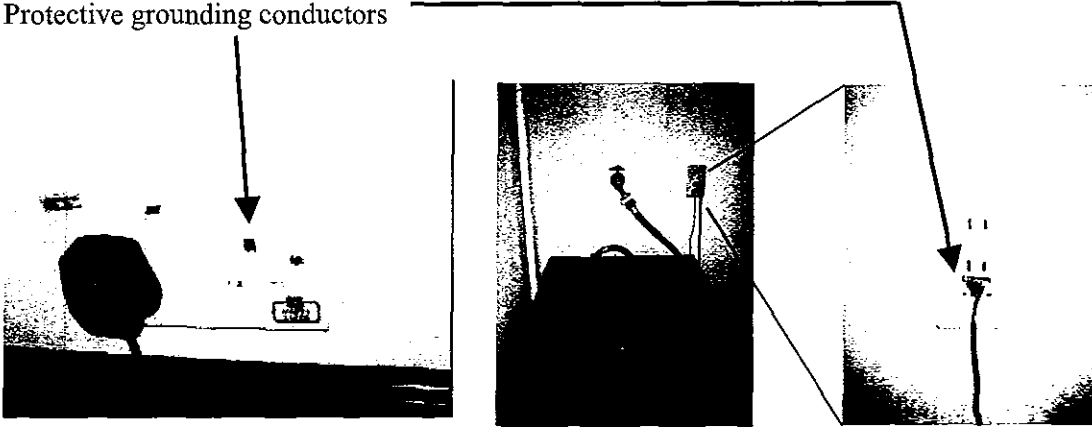
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Category	Chapter	2	Technical Standards of Electric Power Facilities	Document No. IW 8										
	Paragraph	8	House Wiring											
	Clause	60	Protection against Ground Fault											
Title	Recommended Equipment for Installation of Ground Fault Breaker													
<p>It is desirable to install ground fault breaker in electrical circuit in such cases as using following equipment.</p> <p style="text-align: center;">Installed place of leakage circuit breaker</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 30%;">Installed place of equipment and devices</th> <th>Equipment and devices used</th> </tr> </thead> <tbody> <tr> <td>Wet or moist place</td> <td>Washing machine, clothes dryer (in bathroom), hot water boiler, refrigerator-freezer (kitchen), laundry workshop, filling station's car wash, and others</td> </tr> <tr> <td>Under the eaves (exposed to rain)</td> <td>Well pump, air conditioner, washing machine, boiler, outdoor outlet, automatic vending machine, icebox, showcase, and others</td> </tr> <tr> <td>Outdoor</td> <td>Outdoor unit of air conditioner, well pump, illuminating light around a pond, garden light, outlet installed outdoors, automatic vending machine, showcase, icebox, and others</td> </tr> <tr> <td>Used on a 400 V circuit (3-phase,3-wire)</td> <td>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</td> </tr> </tbody> </table>					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
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Remarks			Revisions											
			2003/Nov.	Original										

Category	Chapter	2	Technical Standards of Electric Power Facilities	Document No. IW 9															
	Paragraph	8	House Wiring																
	Clause	60	Protection against Ground Fault																
Title	Leakage Influence on Human Bodies																		
<p>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.</p> <ul style="list-style-type: none"> · sensitive current is less than 30mA · work time is less than 0.1s <p>An estimate of the amount of current flow through the body under different circumstances when contact is made with Wires at a standard distribution voltage.</p> <table border="1"> <thead> <tr> <th>Conditions</th> <th>Body current</th> <th>Effect</th> </tr> </thead> <tbody> <tr> <td>Dry skin</td> <td>3 mA - 10 mA</td> <td>Tingling sensation, slight shock.</td> </tr> <tr> <td>Damp conditions, sweaty skin</td> <td>10 mA - 20 mA</td> <td>Tightening muscles, acute discomfort, and difficulty in separating from electrical contact. Prolonged contact harmful.</td> </tr> <tr> <td>Damp conditions, sweaty skin, electrical contact with water</td> <td>20 mA - 50 mA</td> <td>Harmful, sometimes severely. Acute tightening of muscles, especially in the chest area.</td> </tr> <tr> <td>Damp conditions, sweaty skin, electrical contact with water</td> <td>50 mA and up</td> <td>Usually fatal. Irregular contraction of heart muscles (fibrillation).</td> </tr> </tbody> </table>					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).
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Remarks			Revisions																
			2003/Nov.	Original															

Category	Chapter	2	Technical Standards of Electric Power Facilities	Document No. IW 10
	Paragraph	8	House Wiring	
	Clause	61	Indoor Wiring	
Title	Sign of Indoor Wiring			
<p>1. The color of sign</p> <p>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).</p> <p>The color of sign for phase conductor is not needed. And that color of sign shall be free except for green or white.</p> <p>2. The example measures</p> <p>The example measures for color of sign are as follows:</p> <p>(1) The color of cover of insulated wire</p> <p>(2) Winding of vinyl tape</p> <p>(3) In case of multi core cable, the color of sigh of core wire etc</p>				
				
Remarks			Revisions	
			2003/Nov.	Original

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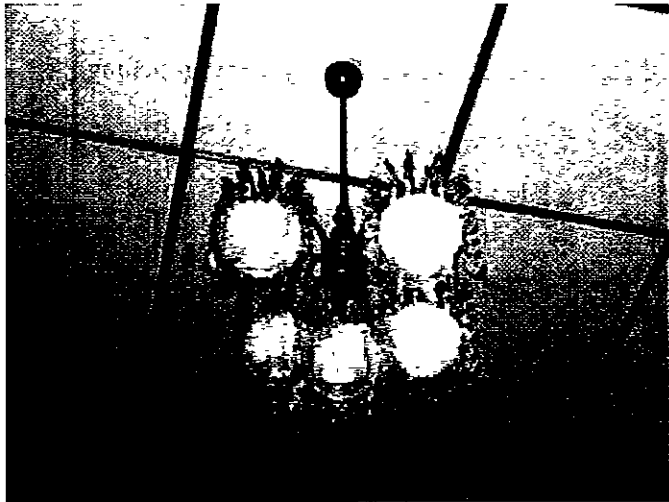
Category	Chapter	2	Technical Standards of Electric Power Facilities	Document No. IW 11
	Paragraph	8	House Wiring	
	Clause	62	Indoor wiring utensils	
Title	Indoor Wiring Utensils			
Types of Indoor wiring utensils Switch, outlets, fuse, circuit breaker, ground fault breaker				
No live parts shall not be exposed and connected fast and electrically safely by screw fastening or the like				
				
<p>Protective grounding conductors</p> 				
Remarks	Revisions			
	2003/Nov.		Original	

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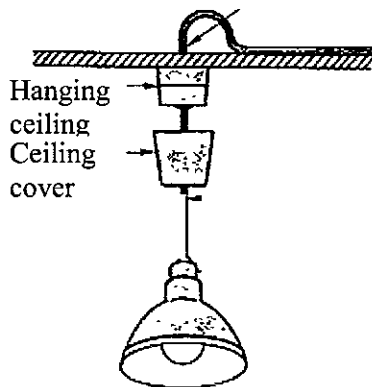
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Category	Chapter	2	Technical Standards of Electric Power Facilities	Document No. IW 12
	Paragraph	8	House Wiring	
	Clause	63	Installation Methods of Indoor Electrical Appliances	
Title	Indoor Electrical Appliances			

No live parts of electrical household appliances shall be exposed



No mechanical tension shall act on the connection point



Remarks

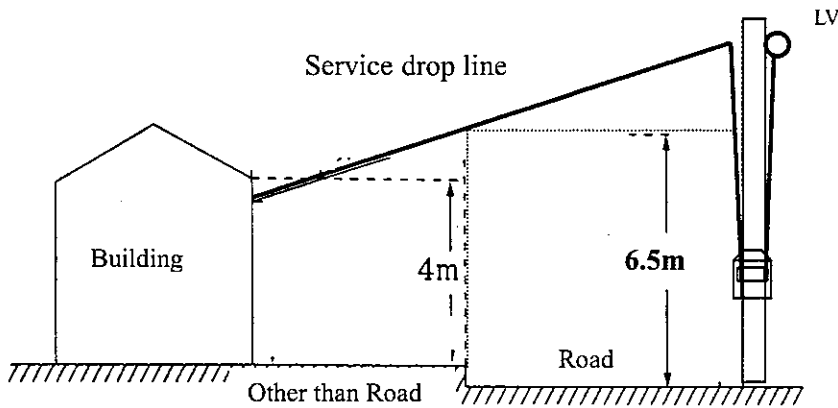
Revisions	
2003/Nov.	Original

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			
<p>Not to contact Telecommunication conductor, Water supply pipe, Gas pipe etc.</p> <div style="text-align: center; margin: 20px 0;"> </div>				
Remarks	Revisions			
	2003/Nov.		Original	

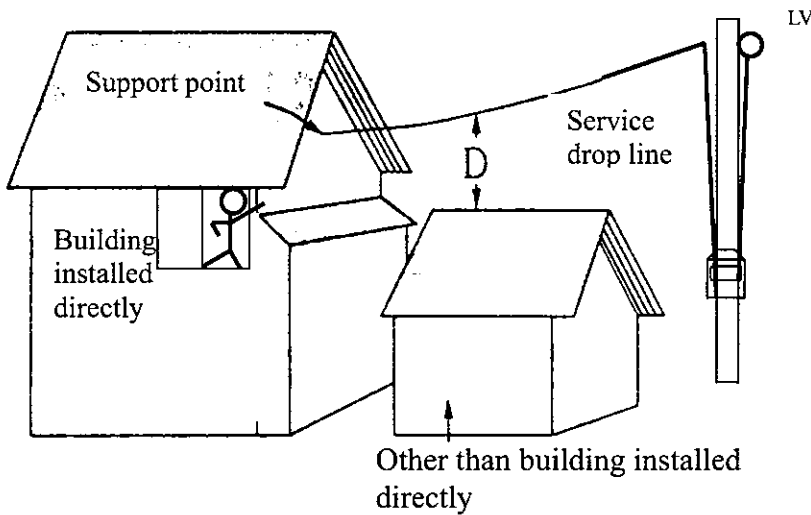
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Category	Chapter	2	Technical Standards of Electric Power Facilities	Document No. IW 14
	Paragraph	8	House Wiring	
	Clause	65	Outdoor Installation at user's site	
Title	Overhead Low-voltage Service Drop Lines			

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

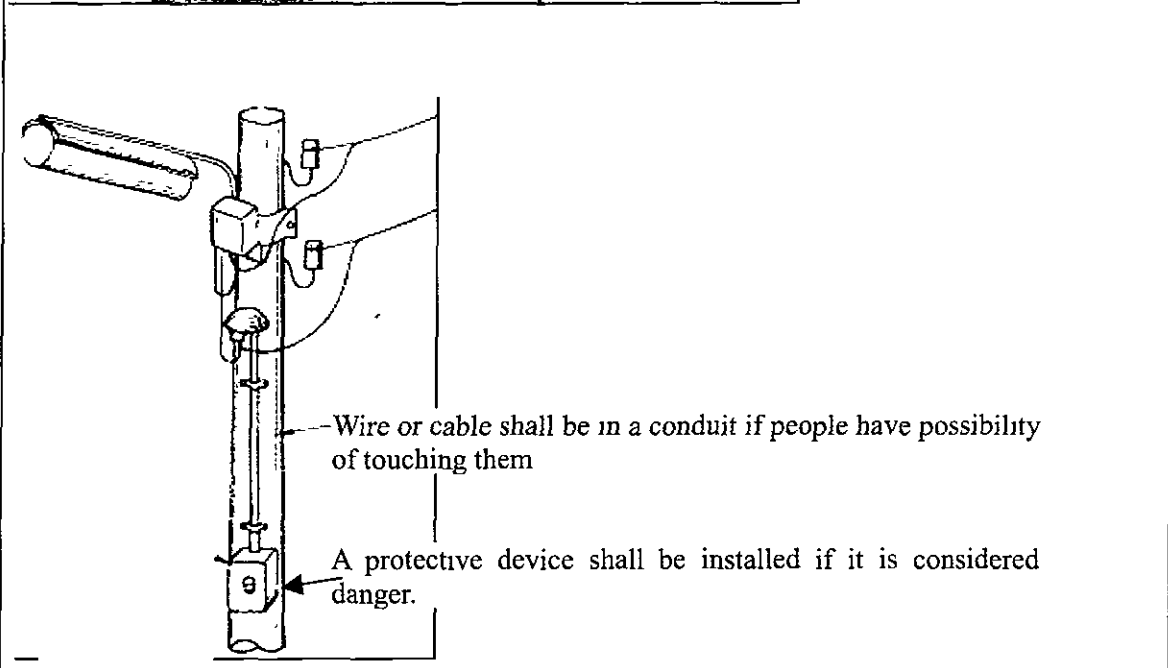
Revisions

2003/Nov.	Original
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Category	Chapter	2	Technical Standards of Electric Power Facilities	Document No. IW 15
	Paragraph	8	House Wiring	
	Clause	65	Outdoor Installation at user's site	

Title	Other Outdoor Installation at User's Site
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Outlets shall be waterproof type if they have possibility of taking rainwater.



Remarks	Revisions	
	2003/Nov.	Original

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Category	Chapter	2	Technical Standards of Electric Power Facilities	Document No. IW16-1
	Paragraph	8	House Wiring	
	Clause			

Title	Allowable Indoor Line Current (1/3)
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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

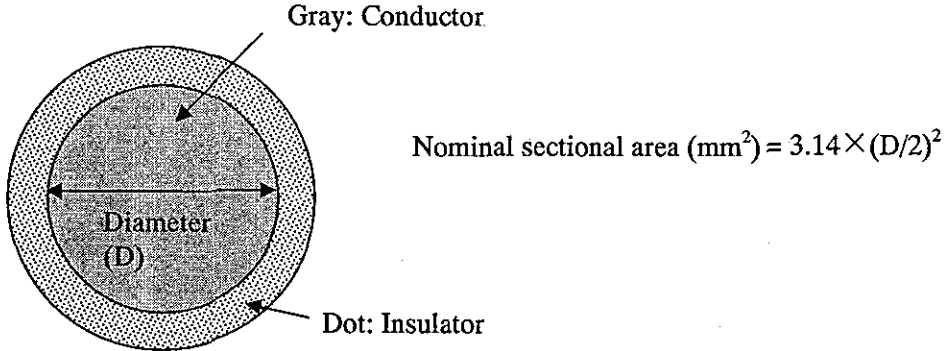
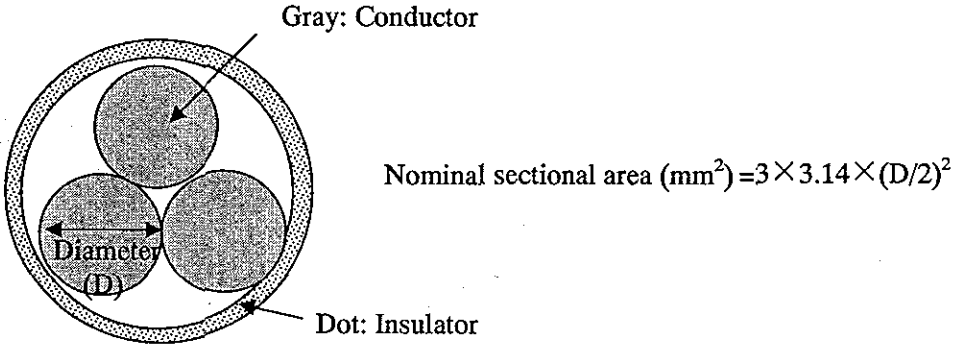
	Conductor		Allowable current (A)		
	Nominal sectional area, mm ²	Diameter, mm	Copper wire	Aluminum wire	Aluminum alloy wire
Single wire	0.8 or more and under 1.1	1.0 or more and under 1.2	16	12	12
	1.1 or more and under 2.0	1.2 or more and under 1.6	19	15	14
	2.0 or more and under 3.1	1.6 or more and 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

GUIDEBOOK FOR POWER ENGINEERS

MIME (JICA)

Category	Chapter	2	Technical Standards of Electric Power Facilities	Document No. IW16-2
	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	$\sqrt{\frac{90-\theta}{30}}$	
<p>2. Allowable current when put in a conduit</p> <p>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.</p>				
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)			
<p>Single wire</p>  <p>Gray: Conductor</p> <p>Nominal sectional area (mm²) = $3.14 \times (D/2)^2$</p> <p>Diameter (D)</p> <p>Dot: Insulator</p>				
<p>Twisted conductor</p>  <p>Gray: Conductor</p> <p>Nominal sectional area (mm²) = $3 \times 3.14 \times (D/2)^2$</p> <p>Diameter (D)</p> <p>Dot: Insulator</p>				
Remarks				Revisions
				2003/Nov. Original

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

Title	Installation of Main Conductors
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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.

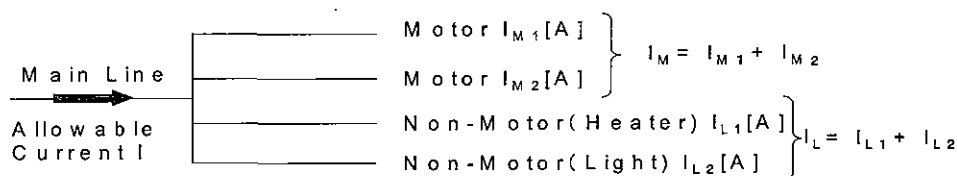
2. If the load on electric motors and the like exceeds 50%:

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]
$I_M \leq I_L$	-	$I \geq I_M + I_L$
$I_M > I_L$	$I_M \leq 50$	$I \geq 1.25 \times I_M + I_L$
	$I_M > 50$	$I \geq 1.1 \times I_M + I_L$

Remarks	Revisions	
	2003/Nov.	Original

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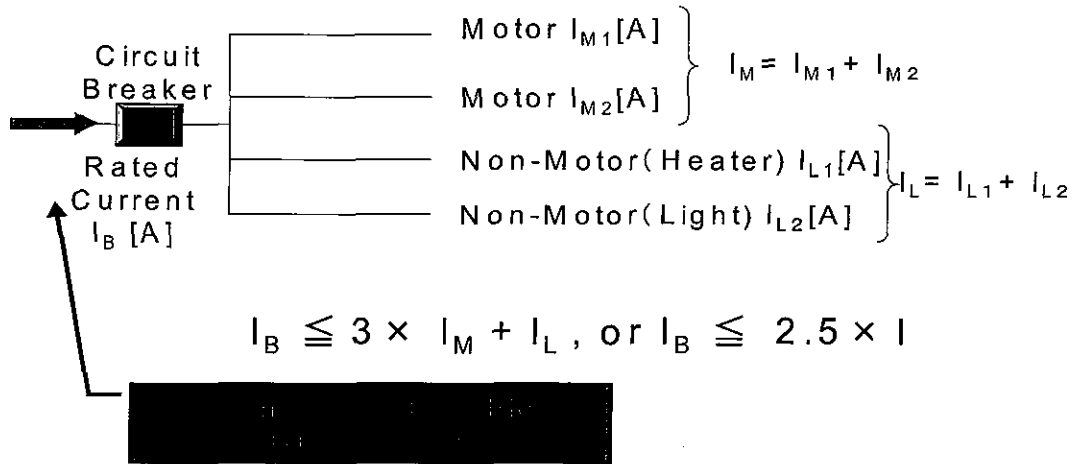
Category	Chapter	2	Technical Standards of Electric Power Facilities	Document No. IW18-1
	Paragraph	8	House Wiring	
	Clause			
Title	Installation of Overcurrent Circuit Breakers for Main Conductor (1/2)			
<p>On the power supply side of the mains, an overcurrent circuit breaker to protect such mains shall be installed on each pole except the neutral wire according to the following items:</p> <ol style="list-style-type: none"> 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: <ol style="list-style-type: none"> 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

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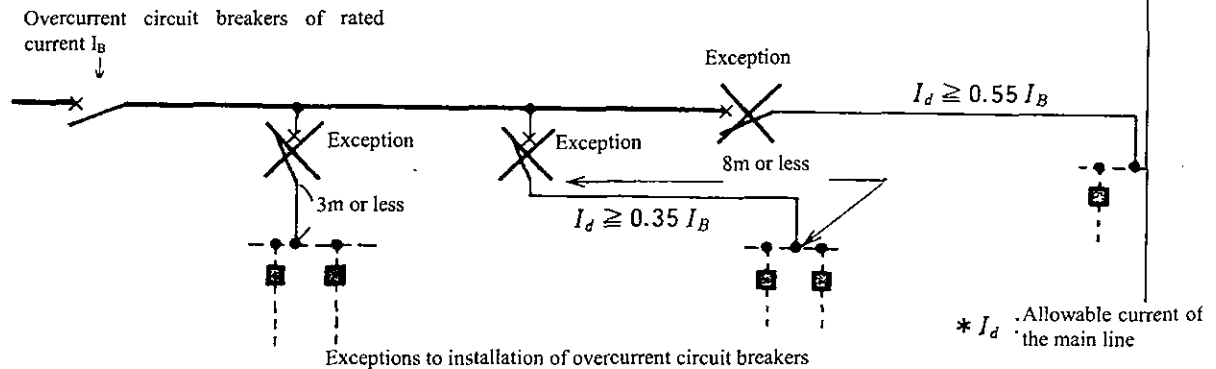
Category	Chapter	2	Technical Standards of Electric Power Facilities	Document No. IW18-2
	Paragraph	8	House Wiring	
	Clause			

Title Installation of Overcurrent Circuit Breakers for Main Conductor (2/2)

Installation of Overcurrent Circuit Breakers



Exceptions to installation of overcurrent circuit breakers



Remarks	Revisions	
	2003/Nov.	Original

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

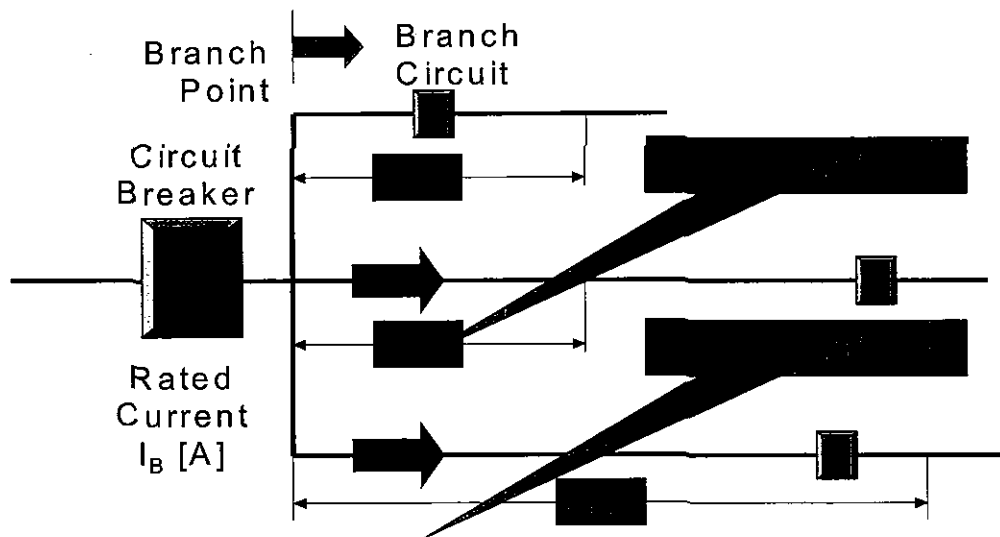
For a branch circuit, a switching device and overcurrent circuit breaker shall be installed on each pole (*1) at a place within 3 m from the branching point on the mains.

*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 Overcurrent Circuit Breakers



Remarks	Revisions	
	2003/Nov.	Original

Category	Chapter	2	Technical Standards of Electric Power Facilities	Document No. IW20
	Paragraph	8	House Wiring	
	Clause			

Title	Indoor Branch Circuit (Household Electric Appliance Exceeding 50 A)
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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:

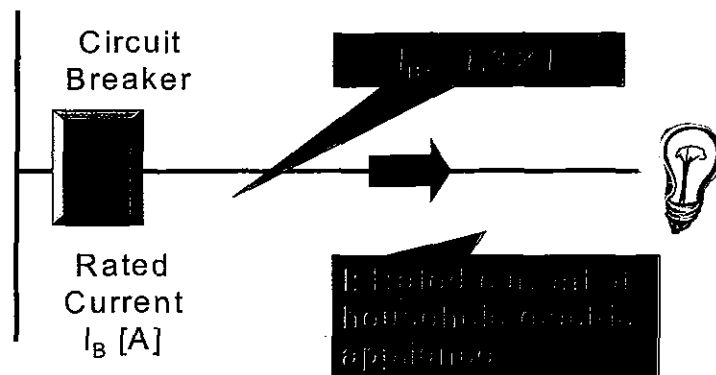
1. No other load than this household electric appliance shall be connected to this branch circuit.
2. The rated current of the overcurrent circuit breaker shall not exceed the value 1.3 times the rated current of that household electric appliance (*1).

(*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

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Category	Chapter	2	Technical Standards of Electric Power Facilities	Document No. IW21
	Paragraph	8	House Wiring	
	Clause			
Title	Indoor Branch Circuit (Electric Motor Alone)			
<p>A branch circuit supplying electricity to an electric motor alone shall be installed as follows:</p> <ol style="list-style-type: none"> 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

GUIDEBOOK FOR POWER ENGINEERS

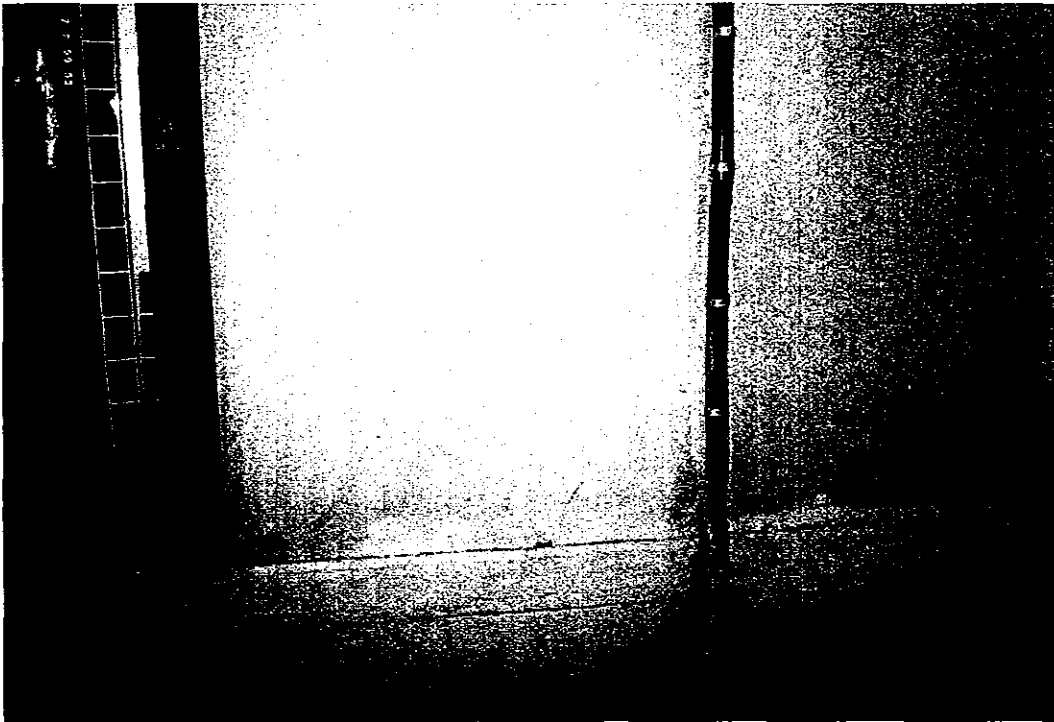
MIME (JICA)

Category	Chapter	2	Technical Standards of Electric Power Facilities	Document No. IW22
	Paragraph	8	House Wiring	
	Clause			
Title	Indoor Branch Circuit (Other Branch Circuits)			
<p>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.</p>				
Remarks			Revisions	
			2003/Nov.	Original

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Category	Chapter	2	Technical Standards of Electric Power Facilities	Document No. IW23						
	Paragraph	8	House Wiring							
	Clause									
Title	Low-voltage Indoor Wiring Work (Cable Work)									
<p>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.</p> <p>2. Installation methods</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 15%;">Electrical conductor</th> <th style="width: 35%;">grounding work</th> <th style="width: 50%;">Installation method</th> </tr> </thead> <tbody> <tr> <td>Cable</td> <td>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.</td> <td> <ul style="list-style-type: none"> • 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. </td> </tr> </tbody> </table>					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.	<ul style="list-style-type: none"> • 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.
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.	<ul style="list-style-type: none"> • 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. 								
<p>Cable Work</p> 										
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)
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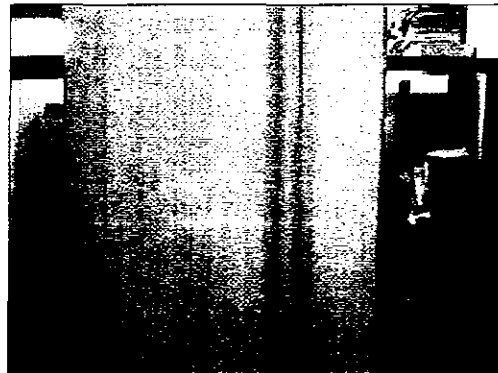
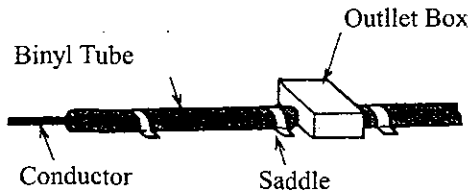
1. Outline

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.

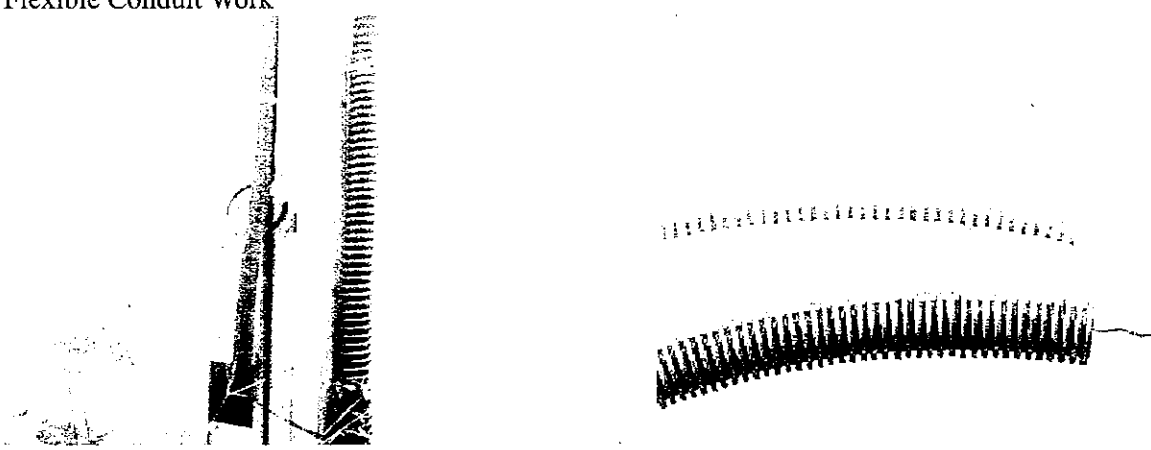
2. Installation methods

Electrical conductor	Grounding work	Installation method
Insulated and stranded wire (excluding the case of 3.2 mm or less)	—	<ul style="list-style-type: none"> • 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

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)									
<p>1. Outline</p> <p>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.</p> <p>2. Installation methods</p> <table border="1"> <thead> <tr> <th>Electrical conductor</th> <th>Grounding work</th> <th>Installation method</th> </tr> </thead> <tbody> <tr> <td>Insulated and stranded wire (excluding the case of 3.2 mm or less)</td> <td>Class D Grounding work shall be applied to tubes for 300 V or less and Class D for more than 300 V (*1)</td> <td> <ul style="list-style-type: none"> • Connection of electrical conductors is not allowed in the tube • Tube and accessories shall be made of metal </td> </tr> </tbody> </table> <p>(*1) Apply class D grounding work if 300 V is exceeded and there is no danger of a person's touching the duct.</p> <p>Flexible Conduit Work</p> 					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)	<ul style="list-style-type: none"> • Connection of electrical conductors is not allowed in the tube • Tube and accessories shall be made of metal
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)	<ul style="list-style-type: none"> • Connection of electrical conductors is not allowed in the tube • Tube and accessories shall be made of metal 								
Remarks			Revisions							
			2003/Nov.	Original						

Category	Chapter	2	Technical Standards of Electric Power Facilities	Document No. IW26
	Paragraph	8	House Wiring	
	Clause			

Title	Low-voltage Indoor Wiring Work (Metallic Tube Work)
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1. Outline

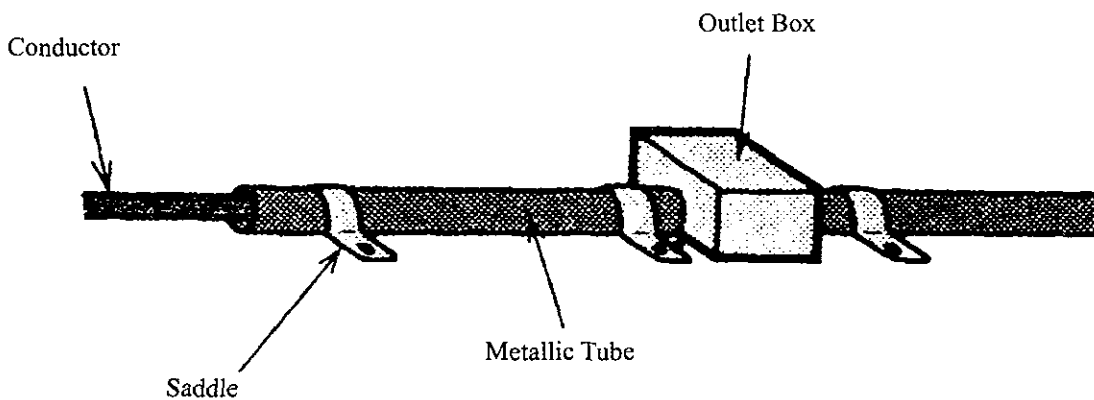
Metallic tube work is executed by drawing the insulated conductor into a steel conduit. This work method is strong against the mechanical impact and, widely used for installation of low-voltage wiring in an office building or factory.

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)	<ul style="list-style-type: none"> • 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.

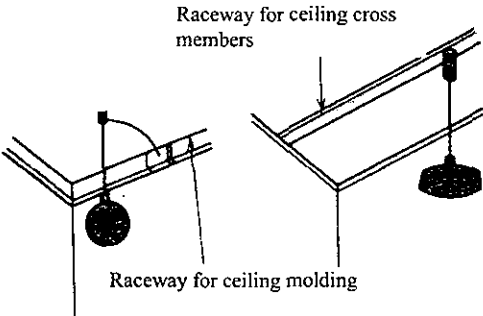
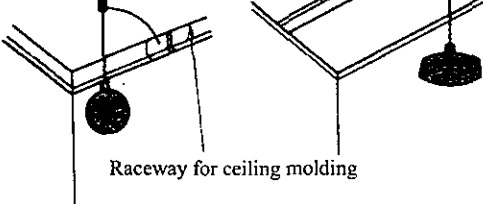


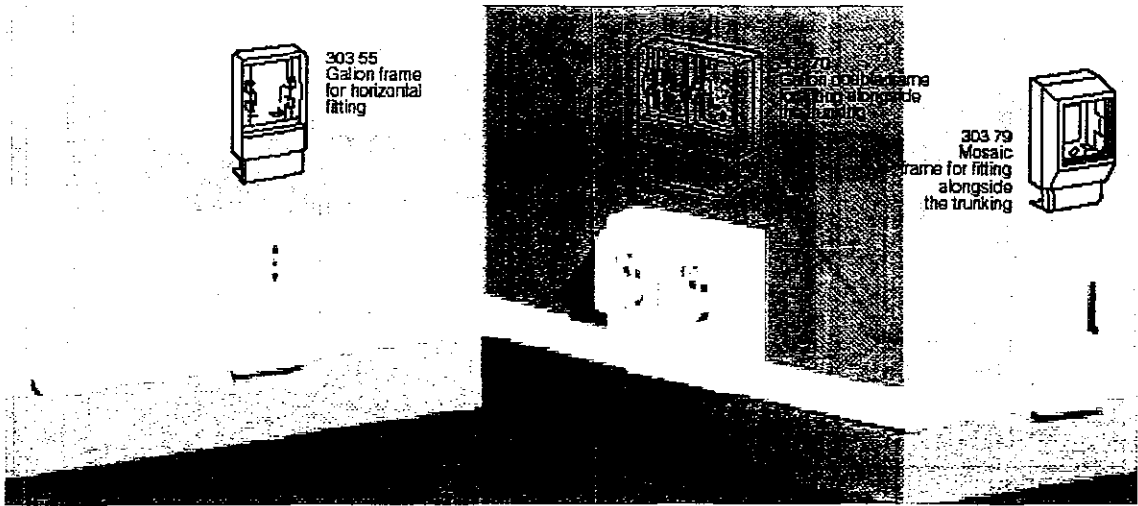
Metallic Tube Work



Remarks	Revisions	
	2003/Nov.	Original

GUIDEBOOK FOR POWER ENGINEERS

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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)									
<p>1. Outline</p> <p>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.</p>										
<p>2. Installation methods</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 33%;">Electrical conductor</th> <th style="width: 33%;">Grounding work</th> <th style="width: 34%;">Installation method</th> </tr> </thead> <tbody> <tr> <td>Insulated conductor (excluding PVC-insulated conductor)</td> <td style="text-align: center;">-</td> <td>Connection of electrical conductors is not allowed in the raceway</td> </tr> </tbody> </table>					Electrical conductor	Grounding work	Installation method	Insulated conductor (excluding PVC-insulated conductor)	-	Connection of electrical conductors is not allowed in the raceway
Electrical conductor	Grounding work	Installation method								
Insulated conductor (excluding PVC-insulated conductor)	-	Connection of electrical conductors is not allowed in the raceway								
<p>Synthetic Resin Raceway Work</p> <div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="text-align: center;">  <p>Raceway for ceiling cross members</p> </div> <div style="text-align: center;">  <p>Raceway for ceiling molding</p> </div> </div> <div style="display: flex; justify-content: space-around; align-items: center; margin-top: 20px;"> <div style="text-align: center;">  <p>303 55 Galon frame for horizontal fitting</p> </div> <div style="text-align: center;">  <p>303 79 Mosaic frame for fitting alongside the trunking</p> </div> </div> 										
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)
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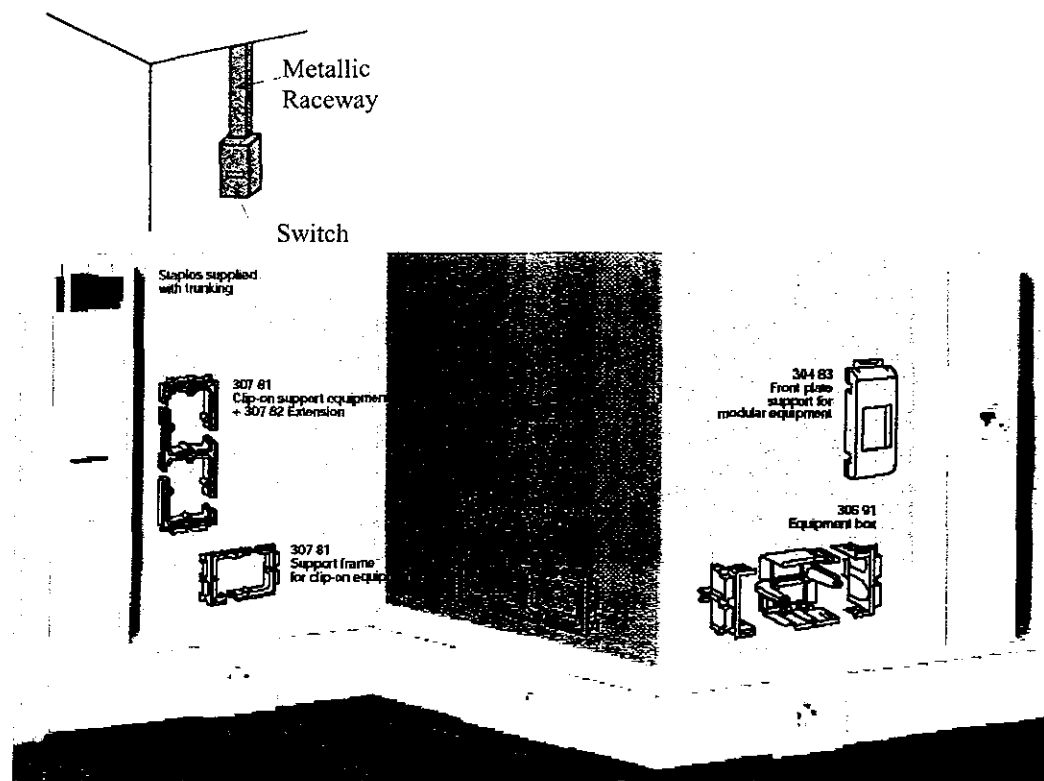
1. Outline

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.	<ul style="list-style-type: none"> Connection of electrical conductors is not allowed in the tube Tube and accessories shall be made of brass or copper

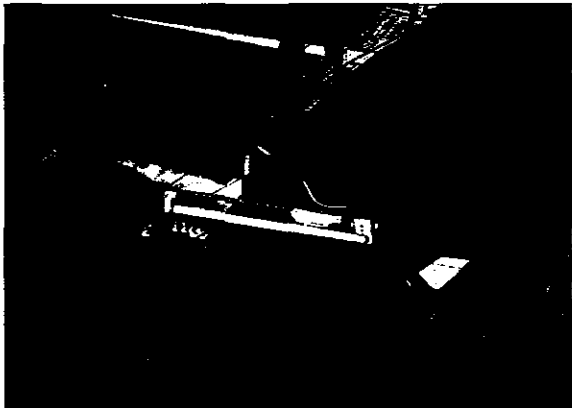
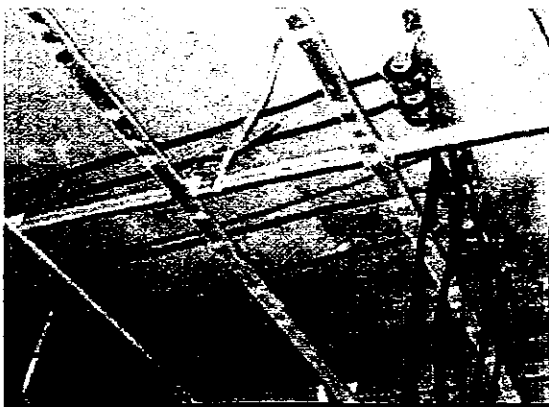
Metallic raceway work



Remarks	Revisions	
	2003/Nov.	Original

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Category	Chapter	2	Technical Standards of Electric Power Facilities	Document No. IW29						
	Paragraph	8	House Wiring							
	Clause									
Title	Low-voltage Indoor Wiring Work (Insulator Work)									
<p>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.</p>										
<p>2. Installation methods</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 25%;">Electrical conductor</th> <th style="width: 25%;">Grounding work</th> <th style="width: 50%;">Installation method</th> </tr> </thead> <tbody> <tr> <td style="vertical-align: top;">Insulated conductor (excluding PVC-insulated conductor) (*1)</td> <td style="text-align: center;">-</td> <td style="vertical-align: top;"> <ul style="list-style-type: none"> 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. </td> </tr> </tbody> </table>					Electrical conductor	Grounding work	Installation method	Insulated conductor (excluding PVC-insulated conductor) (*1)	-	<ul style="list-style-type: none"> 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.
Electrical conductor	Grounding work	Installation method								
Insulated conductor (excluding PVC-insulated conductor) (*1)	-	<ul style="list-style-type: none"> 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. 								
<p>Insulator Work</p> <div style="display: flex; justify-content: space-around;">   </div>										
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)
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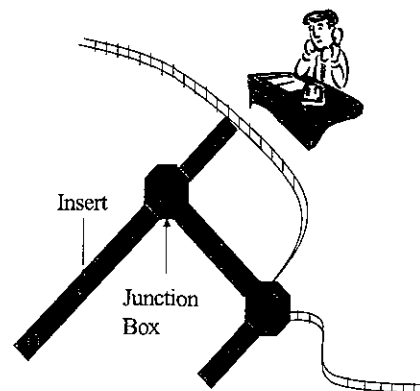
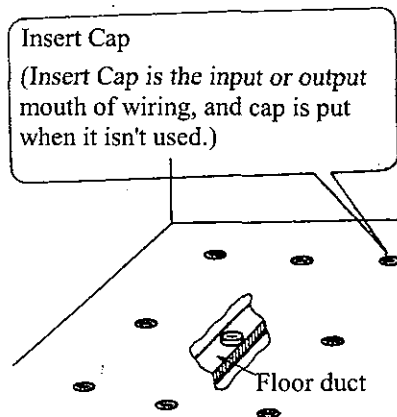
1. Outline

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.	<ul style="list-style-type: none"> • 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	Chapter	2	Technical Standards of Electric Power Facilities	Document No. IW31
	Paragraph	8	House Wiring	
	Clause			

Title	Applications of Work Methods
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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

GUIDEBOOK FOR POWER ENGINEERS

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Category	Chapter	2	Technical Standards of Electric Power Facilities	Document No. IW32
	Paragraph	8	House Wiring	
	Clause			
Title	Allowable Voltage Drop at Indoor Wiring			
<p>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.</p> <p>This service entrance means as follows;</p> <p>Low voltage supply: Attachment place of service drop wire at building</p> <p>Medium or high voltage supply: Transformer at electrical user's site</p>				
Remarks			Revisions	
			2003/Nov.	Original

Category	Chapter	2	Technical Standards of Electric Power Facilities	Document No. IW33-1
	Paragraph	8	House Wiring	
	Clause			

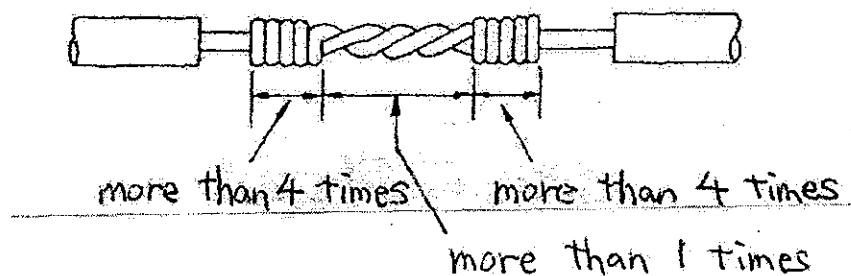
Title	Connection Methods of Indoor Wiring (1/4)
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Connection methods of indoor wiring shall be as follows;
 However, The number of twist, twist length or pressed points in figure are just reference.

1. Straight joint

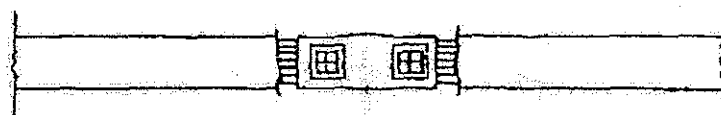
(1) Twist joint of thin single wire (no more than 5.3mm²)

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.



Remarks	Revisions	
	2003/Nov.	Original

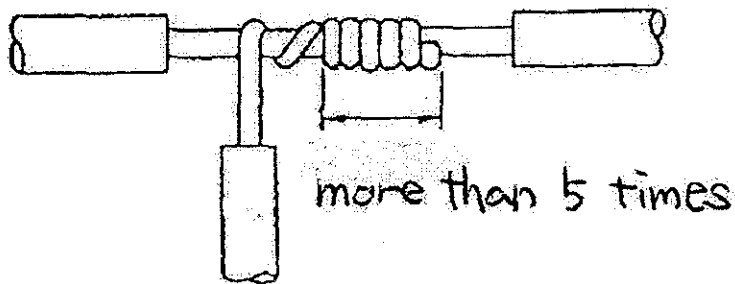
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Category	Chapter	2	Technical Standards of Electric Power Facilities	Document No. IW33-2
	Paragraph	8	House Wiring	
	Clause			

Title	Connection Methods of Indoor Wiring (2/4)
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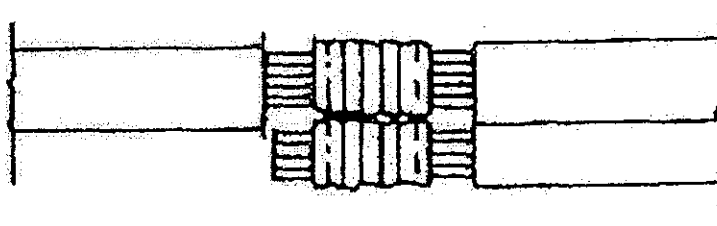
2. Branch joint

- (1) Branch joint of thin single wire (no more than 5.3mm²)
The joint part shall be waxed.

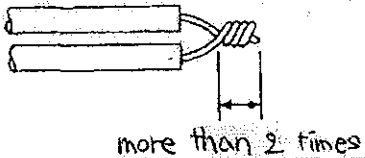
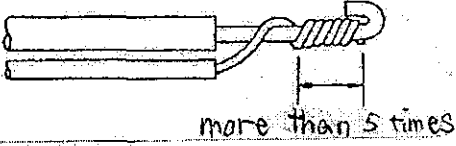
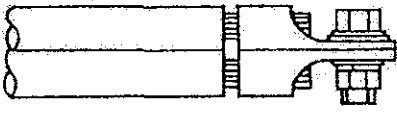


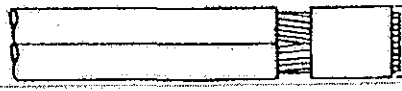
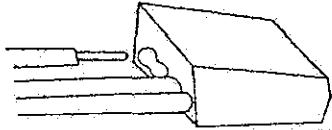


- (2) Branch joint by T type connector

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



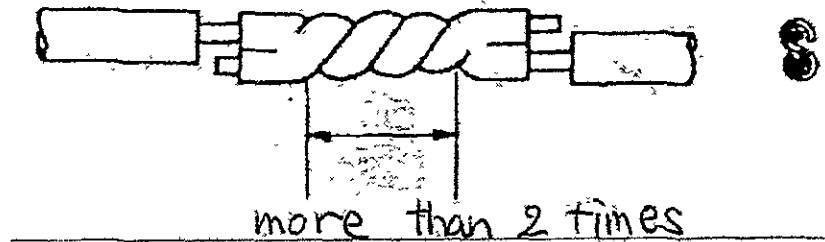
Remarks	Revisions	
	2003/Nov.	Original

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	
			2003/Nov.	Original

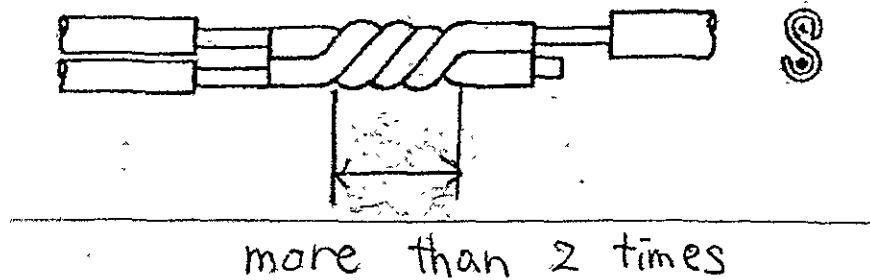
Category	Chapter	2	Technical Standards of Electric Power Facilities	Document No. IW33-4
	Paragraph	8	House Wiring	
	Clause			
Title	Connection Methods of Indoor Wiring (4/4)			

4. Sleeve joint

(1) Straight joint by S-type sleeve



(2) Branch joint by S-type sleeve

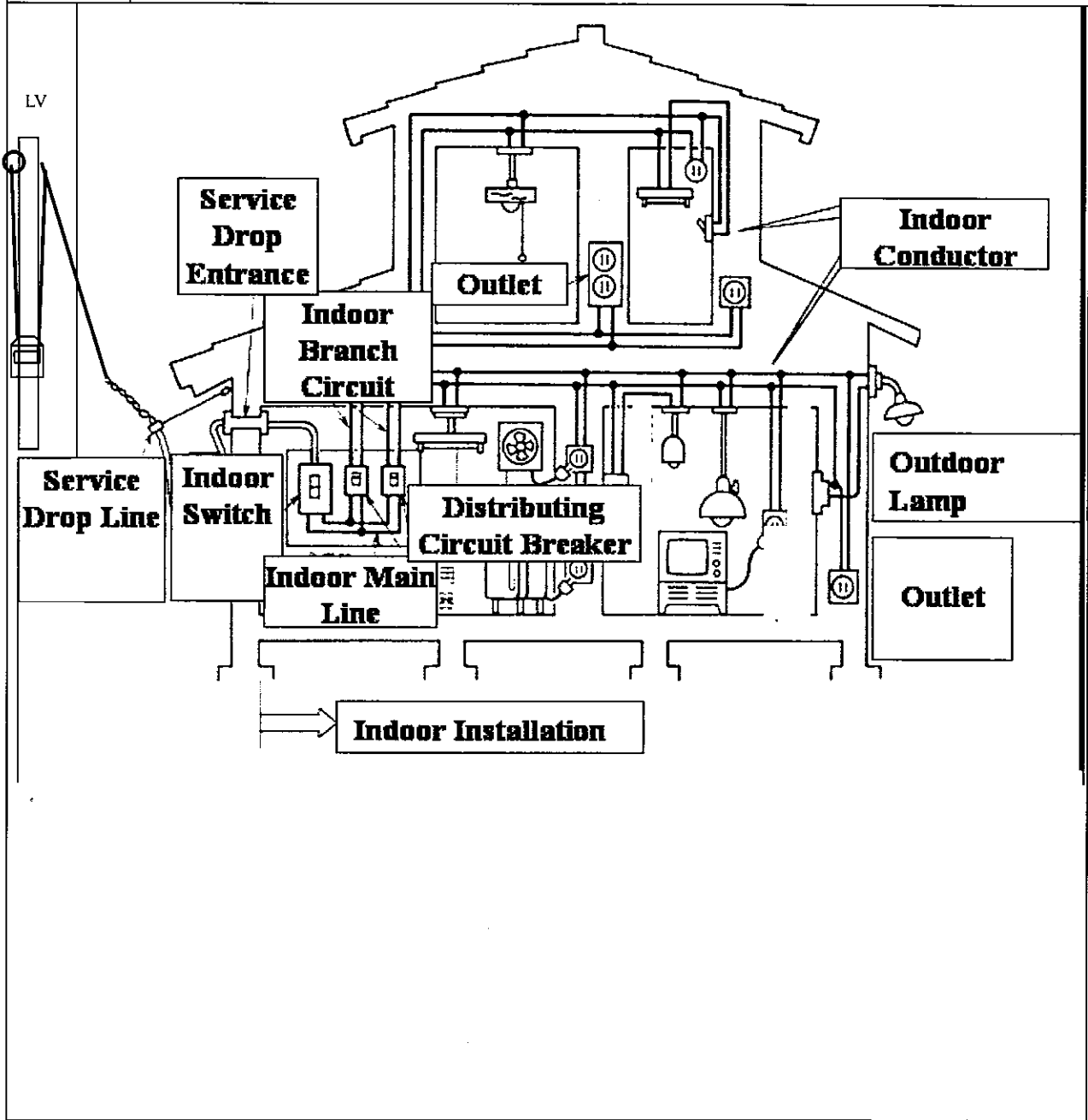


Remarks	Revisions	
	2003/Nov.	Original

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Category	Chapter	2	Technical Standards of Electric Power Facilities	Document No. IW34
	Paragraph	8	House Wiring	
	Clause			
Title	Equipment of Indoor Wiring			



Remarks	Revisions	
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for

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