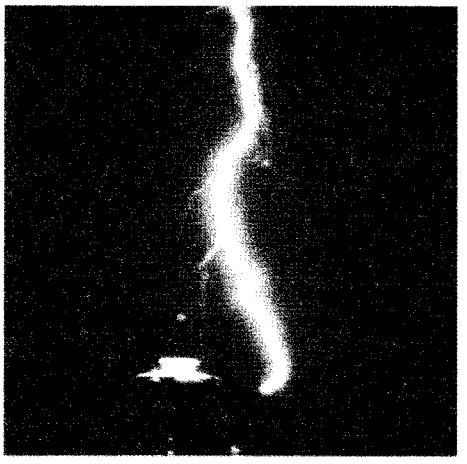


Lightning Protection Equipments

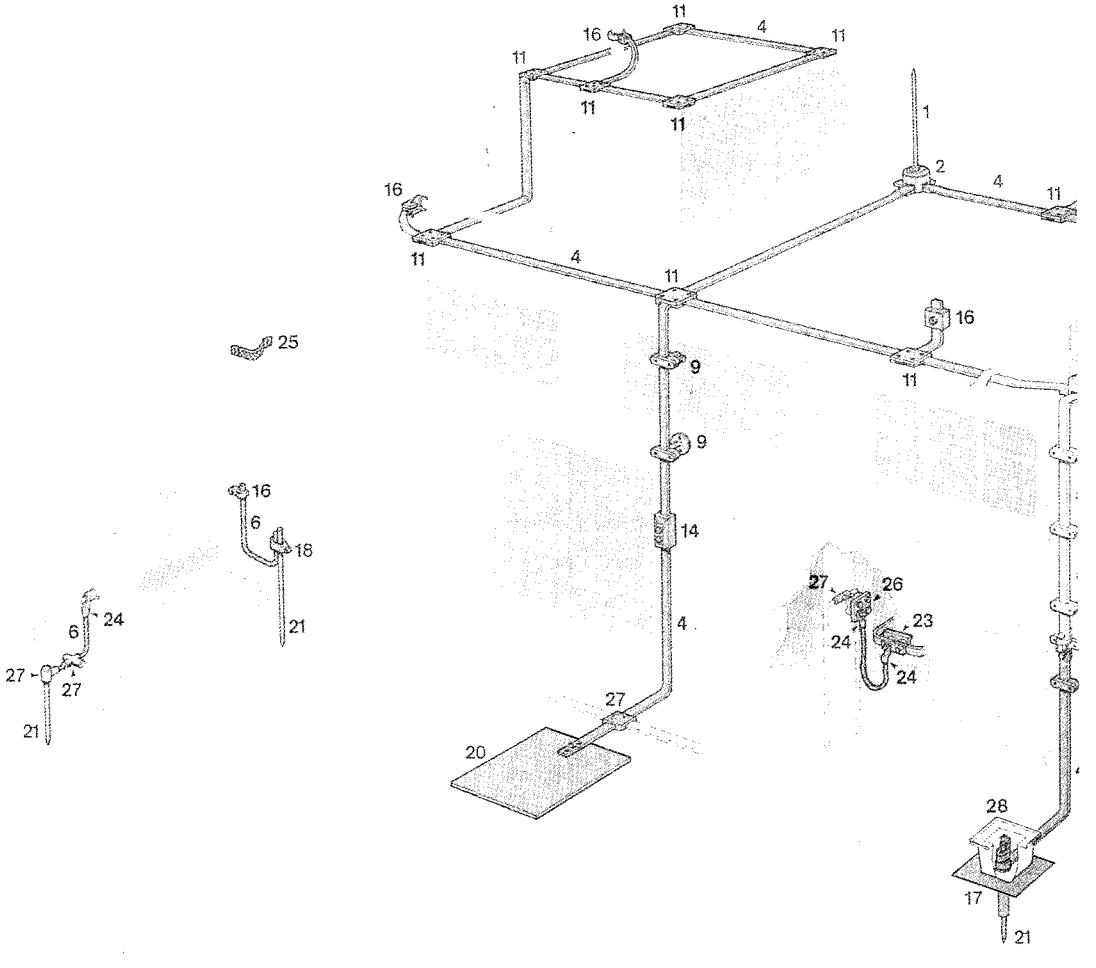
Product Application Guide

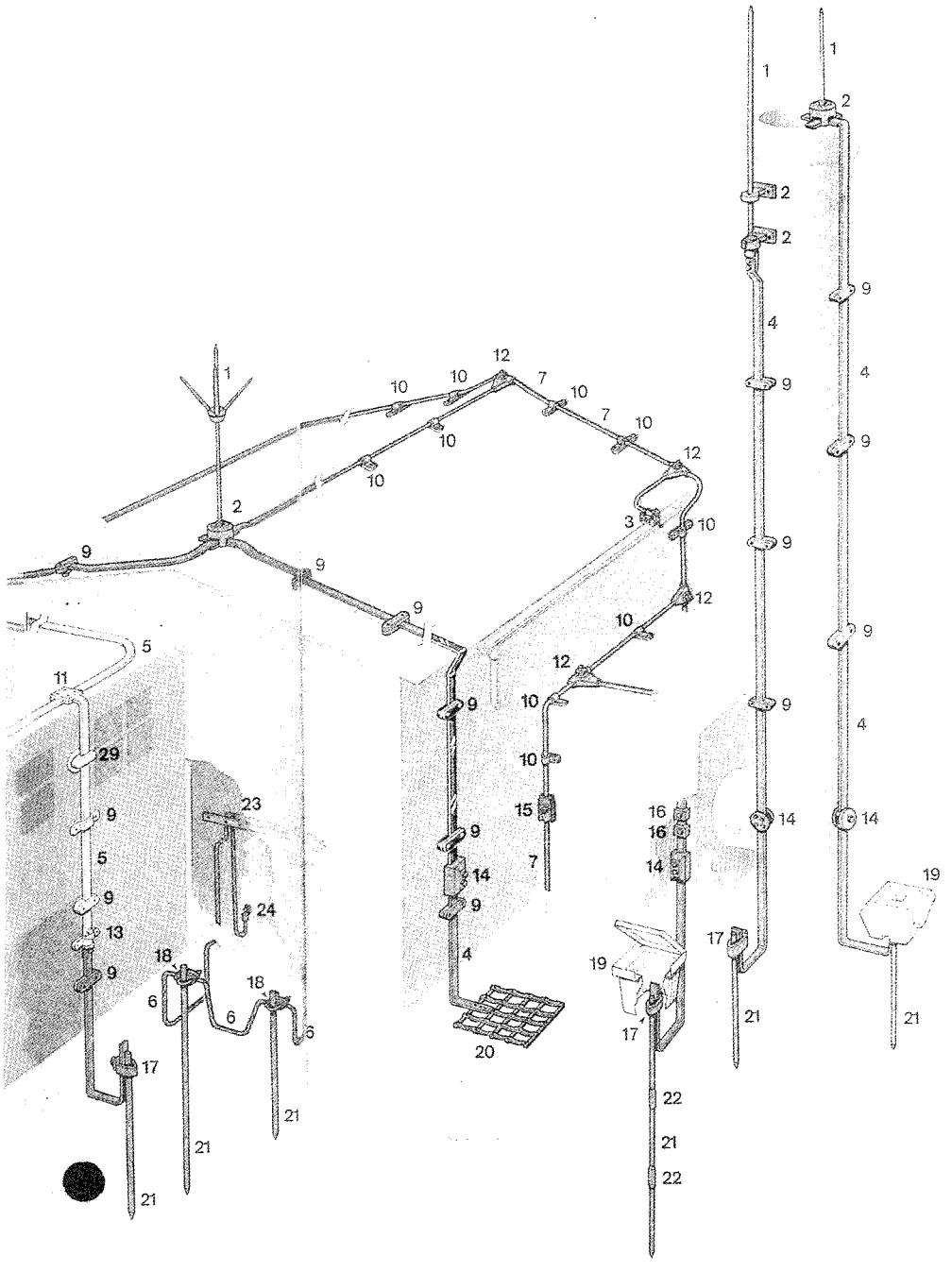
Key

No.	Description
1	Air Terminals
2	Air Terminal Fixings for Tape
3	Holdfast
4	Copper Tape
5	Aluminium Tape
6	Copper Strand
7	Copper Solid Circular Conductor
8	P.V.C. Covered Tape
9	Tape Fixings
10	One Hole Conductor Clip
11	Junction Clamps for Tape
12	Junction Clamp
13	Bi-Metallic Connectors
14	Test Clamps for Tape
15	Test Clamp

Key

No.	Description
16	Bonds
17	Tape – Earth Rod Clamps
18	Cable – Earth Rod Clamps
19	Inspection Pits
20	Earth Plates & Mats
21	Earth Rods
22	Earth Rod Couplings
23	Disconnecting Links/Earth Bars
24	Cable Lugs
25	Flexible Braiding Bonds
26	Earthing Points
27	Exothermic Weld Connections
28	Earth Rod Seal
29	Adhesive D.C. Clip

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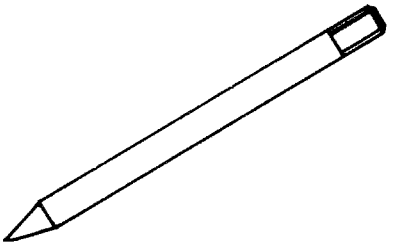
• Lightning Rod *Rod Material : Copper*

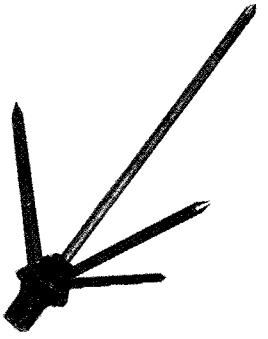
※Other sizes available on request

Type 'JA'



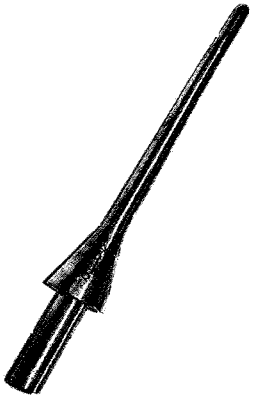
Catalog Number	Size (mm)
JWEL 1001	ø14 X 485
JWEL 1002	ø14 X 600
JWEL 1003	ø14 X 1000
JWEL 1004	ø16 X 485
JWEL 1005	ø16 X 600
JWEL 1006	ø16 X 1000
JWEL 1007	ø20 X 2000

Type 'JB'



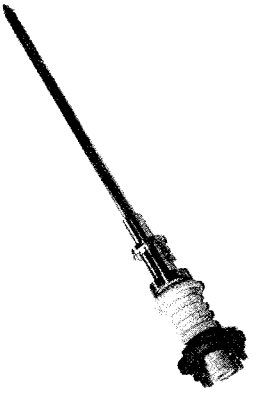
Catalog Number	Size (mm)
JWEL 1011	ø14 X 440
JWEL 1012	ø14 X 495

Type 'JC'



Catalog Number	Size (mm)
JWEL 1021	ø25 X 460

Type 'JD'

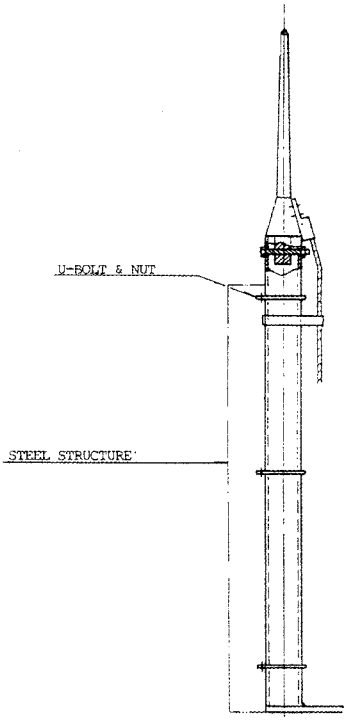


Catalog Number	Size (mm)
JWEL 1031	ø16 X 605
JWEL 1032	ø16 X 705

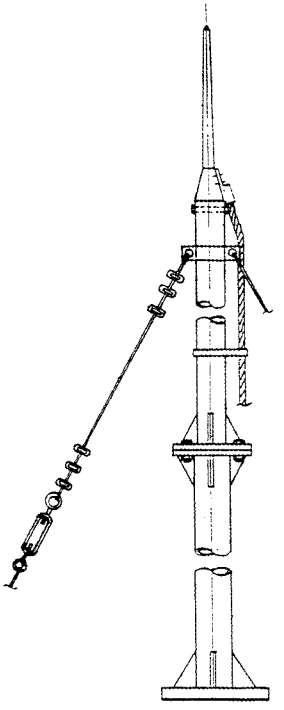
• Lightning Rod with Support

※Other sizes available on request

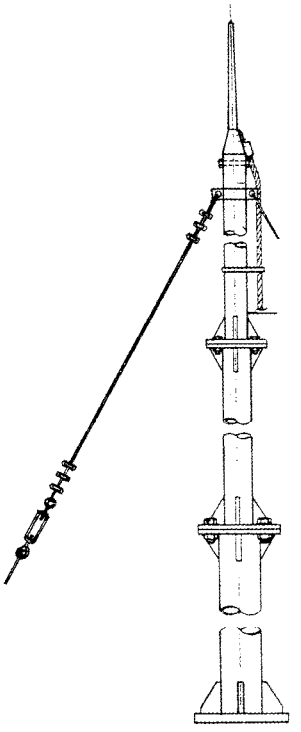
JK-101
(about 4m height)



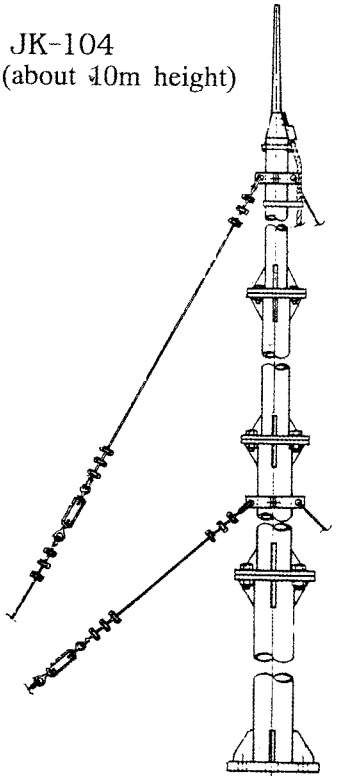
JK-102
(about 6m height)



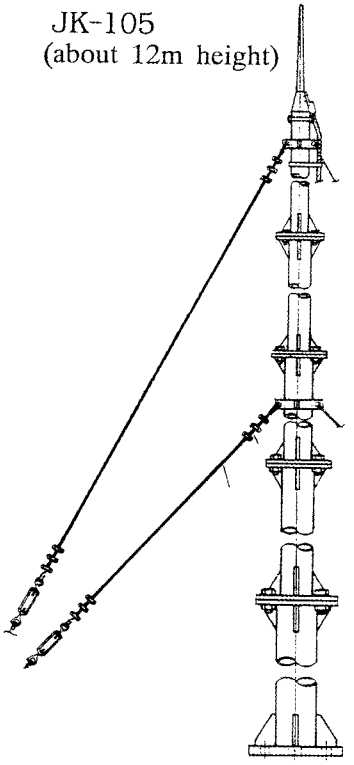
JK-103
(about 8m height)



JK-104
(about 10m height)

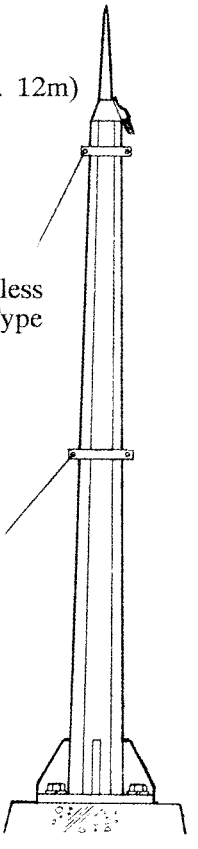


JK-105
(about 12m height)

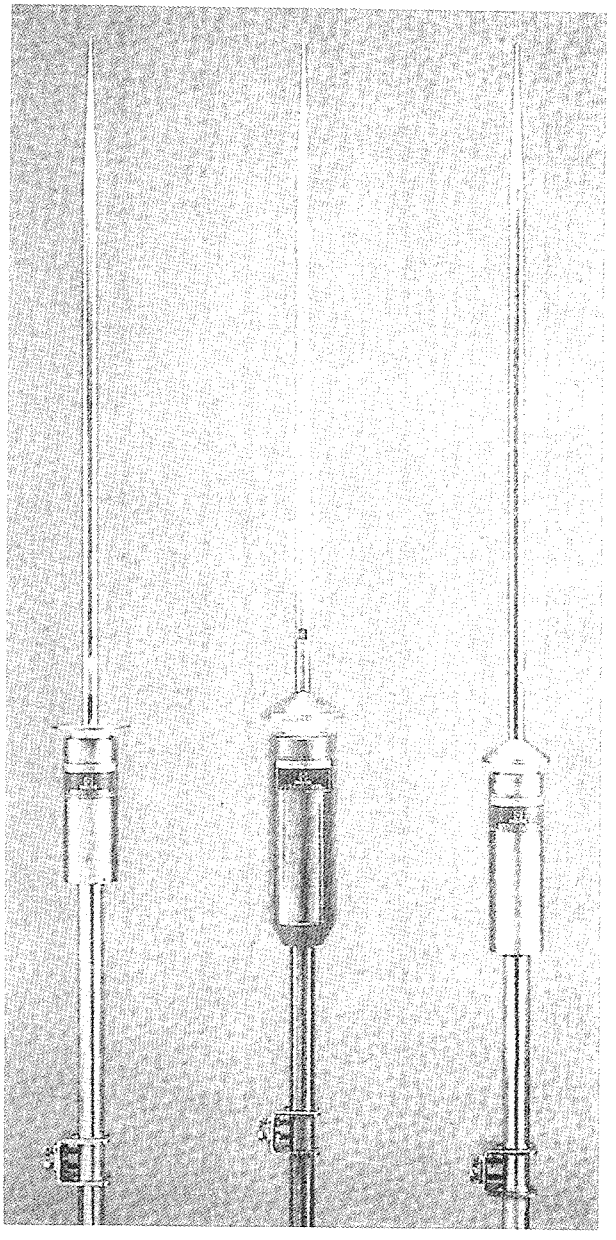


JK-106
(min. 6m/max. 12m)

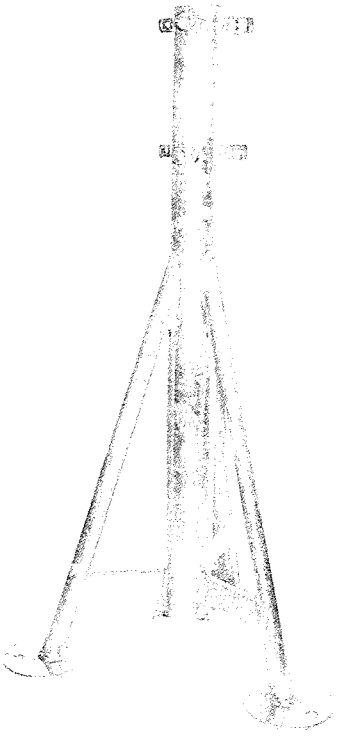
Jointless
Taper-pole Type



• Hight Voltage Pulse Lightning Conductor



P-25 P-40 P-60



Support & Base

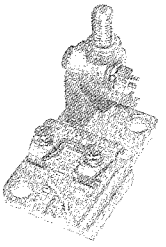
※ If you want, we have pleasure sending you detailed catalog.

• Adjustable Point Base *Material : Bronze or Brass*

Type APBA

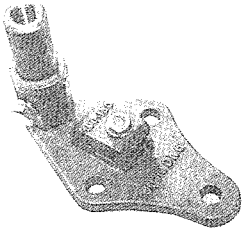
Catalog Number	Conductor Size (mm^2)
JWEL 1041	25~50
JWEL 1042	70~95

Type APBB



Catalog Number	Conductor Size (mm^2)
JWEL 1051	25~50
JWEL 1052	70~95

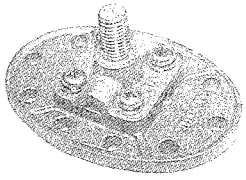
Type APBC



Catalog Number	Conductor Size (mm^2)
JWEL 1061	25~50
JWEL 1062	70~95

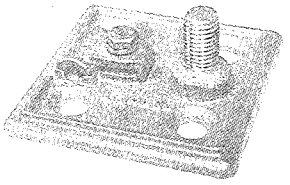
• Point Base *Material : Bronze or Brass*

Type PBA



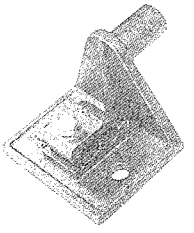
Catalog Number	Conductor Size (mm^2)
JWEL 1071	25~50
JWEL 1072	70~95

Type PBB



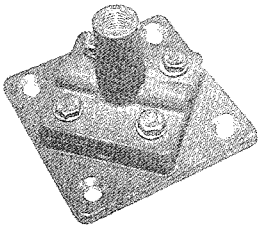
Catalog Number	Conductor Size (mm^2)
JWEL 1081	25~50
JWEL 1082	70~95

Type PBC



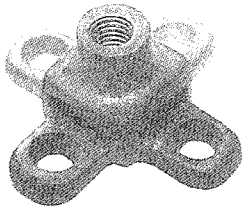
Catalog Number	Conductor Size (mm^2)
JWEL 1091	25~50
JWEL 1092	70~95

Type PBD



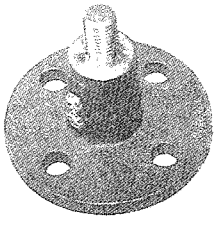
Catalog Number	Conductor Size (mm^2)
JWEL 1101	25~50
JWEL 1102	70~95

Type PBE



Catalog Number	Conductor Size (mm^2)
JWEL 1111	25~50
JWEL 1112	70~95

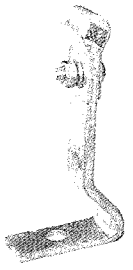
Type PBF



Catalog Number	Conductor Size (mm^2)
JWEL 1121	25~50
JWEL 1122	70~95

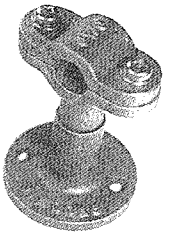
• Conductor Support *Material : Bronze or Brass*

Type COSS



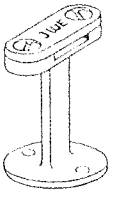
Catalog Number	Cable Size (mm^2)
JWEL 1131	25~50
JWEL 1132	70~95

Type COSB



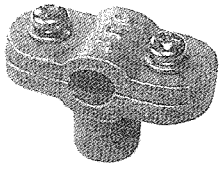
Catalog Number	Cable Size (mm^2)
JWEL 1141	25~50
JWEL 1142	70~95

Type COSC



Catalog Number	Tape Size (mm)
JWEL 1151	20 X 3
JWEL 1152	25 X 3
JWEL 1153	25 X 4
JWEL 1154	30 X 4
JWEL 1155	40 X 5

Type COSD



Catalog Number	Cable Size (mm^2)
JWEL 1161	25~50
JWEL 1162	70~95

Type COSEI

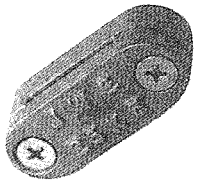
Catalog Number	Cable Size (mm^2)
JWEL 1171	25~50
JWEL 1172	70~95

Type COSPI

Catalog Number	Cable Size (mm^2)
JWEL 1181	25~50
JWEL 1182	70~95

• Tape Clip *Material : Bronze or Brass*

Type TCLA

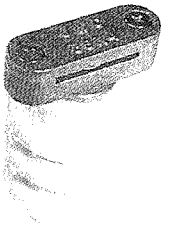


Catalog Number	Tape Size (mm)
JWEL 1191	20 X 3
JWEL 1192	25 X 3
JWEL 1193	25 X 4
JWEL 1194	30 X 4
JWEL 1195	40 X 5
JWEL 1196	50 X 4

Type TCEI

Catalog Number	Tape Size (mm)
JWEL 1201	20 X 3
JWEL 1202	25 X 3
JWEL 1203	25 X 4
JWEL 1204	30 X 4
JWEL 1205	40 X 5
JWEL 1206	50 X 4

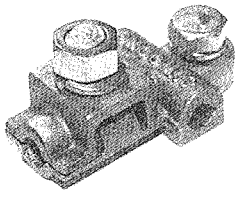
Type TCPI



Catalog Number	Tape Size (mm)
JWEL 1211	20 X 3
JWEL 1212	25 X 3
JWEL 1213	25 X 4
JWEL 1214	30 X 4
JWEL 1215	40 X 5
JWEL 1216	50 X 4

• Cable Splicer *Material : Bronze or Brass*

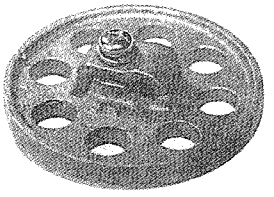
Type CSPA



Catalog Number	Cable Size (mm^2)
JWEL 1221	25~50
JWEL 1222	70~95

• Cable Clip *Material : Bronze or Brass*

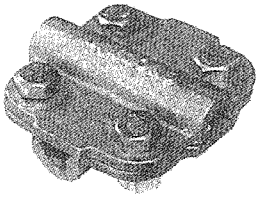
Type CCLA



Catalog Number	Cable Size (mm^2)
JWEL 1231	25~50
JWEL 1232	70~95

• Square Clamp *Material : Bronze or Brass*

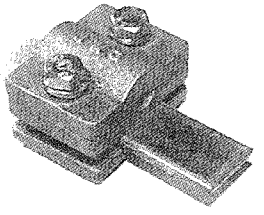
Type SCLA



Catalog Number	Cable Size (mm^2)
JWEL 1241	25~50
JWEL 1242	70~95

• Cable to Tape Clamp *Material : Bronze or Brass*

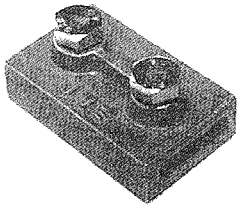
Type CTCA



Catalog Number	Cable Size (mm^2)	Tape Size (mm)
JWEL 1251	50	20 X 3
JWEL 1252	70	25 X 3
JWEL 1253	95	25 X 4
JWEL 1254	120	30 X 4
JWEL 1255	185	40 X 4
JWEL 1256	185	50 X 4

• Junction Connector *Material : Bronze or Brass*

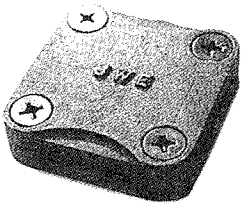
Type JCOA



Catalog Number	Tape Size (mm)
JWEL 1261	20 X 6
JWEL 1262	25 X 6
JWEL 1263	25 X 8
JWEL 1264	30 X 8
JWEL 1265	40 X 10
JWEL 1266	50 X 8

• Tape Clamp *Material : Bronze or Brass*

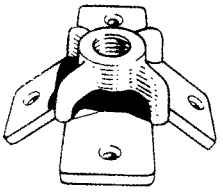
Type TCLA

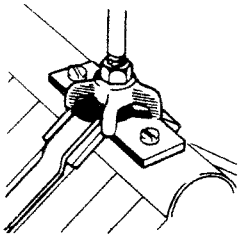


Catalog Number	Tape Size (mm)
JWEL 1271	20 X 3
JWEL 1272	25 X 3
JWEL 1273	25 X 4
JWEL 1274	30 X 4
JWEL 1275	40 X 5
JWEL 1276	50 X 4

• Rigid Saddle

Type RSAR



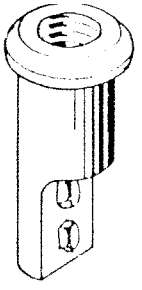


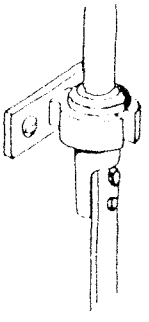
For supporting Lightning Conductor Air Terminals on ridges.

Catalog Number	Cable Size (mm^2)
JWEL 1281	25~50
JWEL 1282	70~95

• Rod to Tape Coupling *Material : Bronze*

Type RTCA

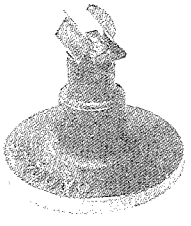




Catalog Number	Air Rod Dia(mm)
JWEL 1291	ø14
JWEL 1292	ø16
JWEL 1293	ø20

• Cable Support *Material : Bronze*

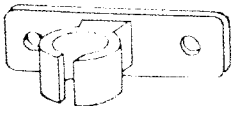
Type CSUA



Catalog Number	Cable Size (mm^2)
JWEL 1301	25~50
JWEL 1302	70~95

• Rod Bracket *Material : Bronze*

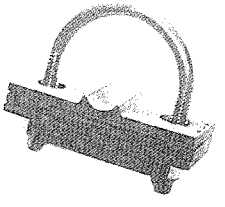
Type RBA



Catalog Number	Air Rod Dia(mm)
JWEL 1311	ø14
JWEL 1312	ø16
JWEL 1313	ø20

• Rod to Tape Clamp *Material : Bronze*

Type RTCU

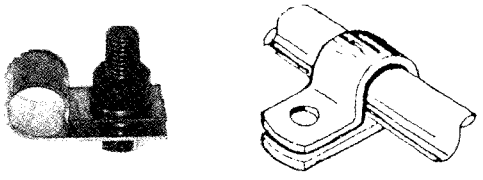


Catalog Number	JWEL 1321

Rod & Tape sizes are user's option

• One Hole Cabble Clip *Material : Tinned Copper*

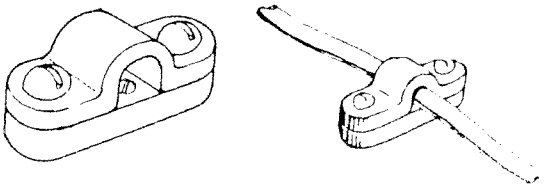
Type OCCA



Catalog Number	Cable Size (mm^2)
JWEL 1331	25~50
JWEL 1332	70~95

• Cable Saddle *Material : Bronze or Brass*

Type CSAA

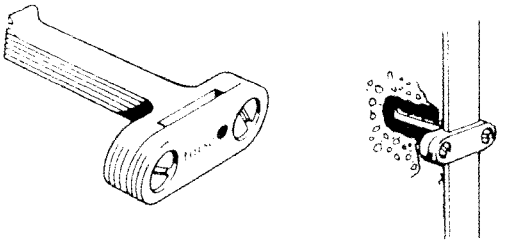


Catalog Number	Cable Size (mm^2)
JWEL 1341	25~50
JWEL 1342	70~95

• Tee Clamp *Material : Bronze or Brass*

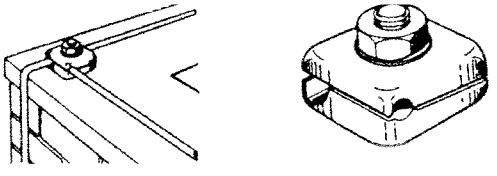
Catalog Number	Cable Size (mm^2)
JWEL 1351	25~50
JWEL 1352	70~95

• Build in Tape Hodlfast *Material : Bronze or Brass*



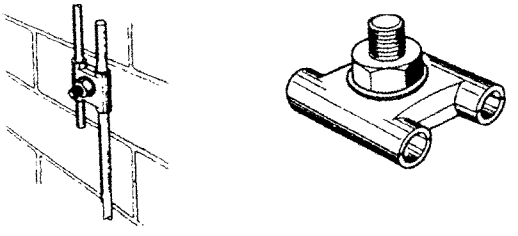
Catalog Number	Tape Size (mm)
JWEL 1361	20 X 2
JWEL 1362	25 X 3
JWEL 1363	25 X 4
JWEL 1364	30 X 4

• Square Clamp *Material : Bronze or Brass*



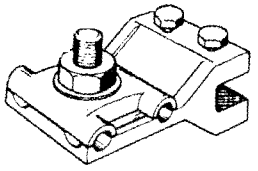
Catalog Number	Cable Size (mm^2)
JWEL 1371	25~50
JWEL 1372	70~95

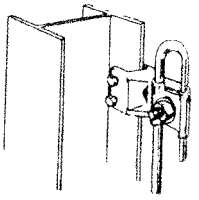
• Jointing Clamp *Material : Bronze or Brass*



Catalog Number	Cable Size (mm^2)
JWEL 1381	25~50
JWEL 1382	70~95

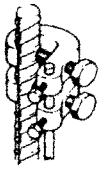
• Metalwork Bond

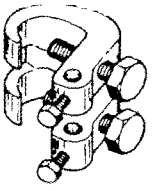




For connecting to all types of metal structures up to 13mm thickness.

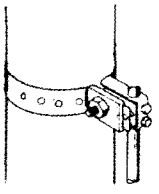
• Rebar Clamp

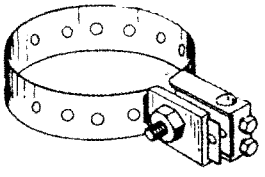




For bonding to re-inforcing bars, steam pipes, handrails, etc.

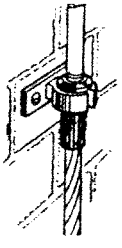
• Pipe Bond

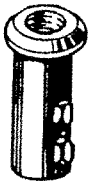




For bonding to ducts and large diameter pipework.

• Rod to Calble Coupling





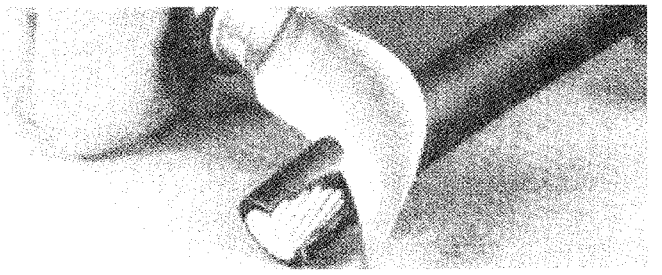
• Oxide-Inhibiting Joint Compounds

PENETROX®

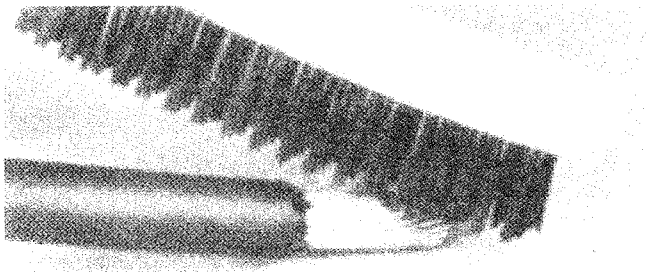
HOW TO INSTALL CONNECTORS:

1. Select the right connector.
Always use an aluminum connector for aluminum or copper conductor. And choose a connector that's marked for the wire size you're using. Never use a copper connector on aluminum conductor.

2. Strip carefully.
Remove the insulation without nicking the wire.

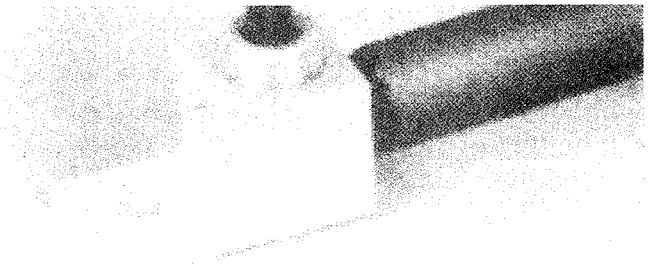


3. Brush thoroughly.
Always wire-brush the stripped portion of the wire. An unplated terminal pad, and the surface to which the terminal will be attached should also be wire-brushed.

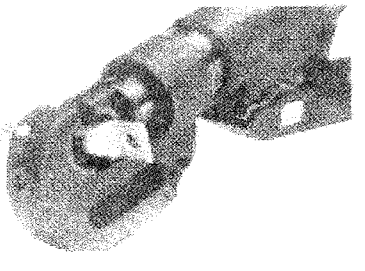


4. Apply PENETROX®
For mechanical connectors, apply PENETROX joint compound liberally to the conductor to prevent the formation of surface oxides once the connection is made. Also apply PENETROX to any terminal pad.

5. Tighten completely.
For mechanical connectors, use wrench or screwdriver to securely tighten the aluminum connectors, as recommended by Burndy.



6. Crimp.
For compression connectors, choose the right die and the right tool. Insert the wire completely and make the recommended number of crimps. Burndy takes the guesswork out of aluminum connections because the connectors and crimp dies are color coded. Crimps can be easily located between marks.



TYPES PENETROX® A, A-13 AND E

OXIDE-INHIBITING JOINT COMPOUNDS

PENETROX® oxide-inhibiting compounds produce low initial contact resistance, seal out air and moisture, prevent oxidation or corrosion, exhibit superior weathering characteristics, are usable over wide temperature ranges, and provide a high conductivity "gas-tight" joint. All PENETROX® compounds contain homogeneously suspended metal particles. The suspended metal particles assist in penetrating thin oxide films, act as electrical "bridges" between conductor strands, aid in gripping the conductor, improve electrical conductivity and enhance the integrity of the connection.

The specially formulated PENETROX compounds are for use with compression and bolted connectors providing an improved service life for both copper and aluminum connections. Additionally, the non-toxic compounds are an excellent lubricant for threaded applications reducing galling and seizing.

PENA-1 LB

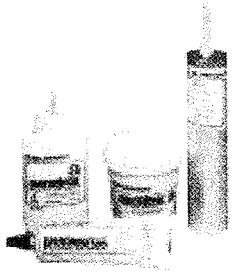
PENA-1 LB is a 1 lb. cartridge filled with PENETROX-A. It's designed to fit standard caulking guns for easy insertion into transmission and distribution connectors. Additionally, this packaging design provides a convenient method for applying PENETROX to many different applications.

PENETROX A-13

PENETROX A-13 is a synthetic base compound with evenly suspended zinc particles. It is recommended for aluminum to aluminum, aluminum to copper connection plus aluminum conduit threads. It is compatible with rubber, polyethylene and other insulating materials. UL listed for all voltages.

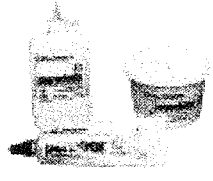
PENETROX A

PENETROX A is a natural (petroleum) base compound with evenly suspended zinc particles. It is recommended for aluminum to aluminum, aluminum to copper connections and aluminum conduit threads. It is not recommended for use with rubber or polyethylene insulated conductors. UL listed to 600V.



PENETROX E

PENETROX E is a synthetic base compound with evenly suspended copper particles. It is recommended for copper to copper, copper threads and all grounding applications. UL listed.



PENETROX A, A-13 AND E

TECHNICAL INFORMATION

PENETROX A

PENETROX A consists of a natural (petroleum) base vehicle in which zinc particles are suspended. For Aluminum to Aluminum, Aluminum to Copper applications and Aluminum conduit threads. It is not recommended for use with rubber or polyethylene insulated conductors. UL listed to 600 volts.

PENETROX A-13

PENETROX A-13 consists of a non-petroleum base vehicle in which zinc particles are suspended. Recommended for Aluminum to Aluminum, Aluminum to Copper applications and Aluminum conduit threads. Compatible with insulating materials such as rubber, or polyethylene. UL listed and recommended for all voltages.

*MSDS sheets available through customer service.

PENETROX E

PENETROX E consists of a non-petroleum base vehicle in which copper granules are suspended. Recommended for Copper to Copper applications, grounding and for use on Copper conduit threads. UL listed.

Easy to apply.

1. Scratch brush the conductor surfaces until bright and clean.
2. Immediately apply PENETROX to the conductive surfaces.
3. For EHV applications, remove all excess PENETROX after installation is complete.

SHELF LIFE

When stored in its original container in cool (under 100°F) dry environment, PENETROX oxide inhibiting compound will remain workable and functional for (5) years from the date marked on the container provided it is mixed per instructions prior to use.

PROPERTIES OF PENETROX®

PROPERTY	DEFINITION	VALUE	
		PENETROX® E & A13	PENETROX® A
PENETRATION (UNWORKED)	The value in accordance to ASTM D217 indicates the consistency of a grease. The higher the number, the softer the grease.	250	230
DROPPING POINT (MIN)	The temperature at which the grease passes from the semi-solid to a liquid state under test conditions.	500°F	230°F
POUR POINT (MAX.)	The lowest temperature at which the compound will flow. Pour point is the lubricant's ability to perform in cold conditions.	-10°F	-15°F

ORDERING INFORMATION

CATALOG NUMBER			CONTAINER TYPE	CONTAINER SIZE
PENETROX® A	PENETROX® A-13	PENETROX® E		
	PEN A13-3	-	TUBE	3 oz.
PEN A-4	PEN A13-4	PEN E-4	SQUEEZE BOTTLE	4 oz.
P8A	PEN A13-8	PEN E-8	SQUEEZE BOTTLE	8 oz.
PEN A-1LB	PENA13-1LB	-	CARTRIDGE	1 lb.*
PEN A-PT	PEN A13-PT	PEN E-PT	PLASTIC TUB	1 PINT
PEN A-QT	PEN A13-QT	PEN E-QT	PLASTIC TUB	1 QUART
PEN A-GAL	PEN A13-GAL	PEN E-GAL	CAN	1 GALLON
PEN A-5GAL	PEN A13-5GAL	PEN E-5GAL	PAIL	5 GALLONS
PEN A-55GAL	PEN A13-55GAL	PEN E-55GAL	DRUM	55 GALLONS

*1 lb. cartridge will fit standard caulking guns.

Lightning Protection System Design

Jiwoong offer a free advisory service including assistance in determining if a structure requires protection or indeed help with any aspect of lightning protection scheme design or equipment specification.

The Need for Protection

Before proceeding to design a detailed lightning protection system, first carefully consider if the structure needs protection.

In many cases, it is obvious that some form of protection is required. High risk structures ie explosives factories, oil refineries, etc, will require the highest possible class of lightning protection to be provided. In many other cases the need for protection is not so evident.

BS6651 provides a simple mathematical overall risk factor analysis for assessing whether a structure needs protection.

It suggests that an acceptable lightning strike risk factor is 10^{-5} per year ie 1 in 100,000 per year. Therefore, having applied the mathematical analysis to a particular set of parameters, the scheme designer will achieve a numerical solution. If the risk factor is less than 10^{-5} (1 in 100,000), for example 10^{-6} (1 in 1,000,000) then in the absence of other over-riding considerations, protection is deemed unnecessary. If however, the risk factor is greater than 10^{-5} (1 in 100,000) for example 10^{-4} (1 in 10,000) then protection would seem necessary.

Major Components

The principle components of a lightning protection system should comprise the following:

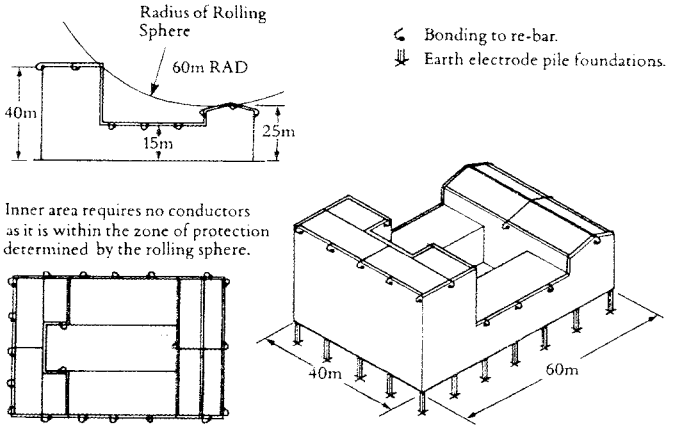
- **Air termination networks**
- **Down conductors**
- **Earth termination networks**
- **Bonding to prevent side flashing**

Air Termination Networks

It is now accepted that lightning can strike the upper part of tall structures. BS6651 now introduces the concept of air termination networks on all sides of tall buildings (ie, vertical air termination networks). No part of the roof within the air termination network should be more than 5m from a conductor. For large flat roofs this will be achieved typically by a network mesh of 10m x 20m. For high risk structures, ie, explosive factories, etc, the air termination mesh is reduced to 5m x 10m.

If a building's metal reinforcing bars are to be used as down conductors, these should be connected to the air termination network in the correct number of positions (see illustration below). Furse can supply purpose designed clamps (see illustration below) for this connection.

Lightning Protection Scheme To BS6651 Using The Re-Inforced Concrete Within The Structure For Down Conductors



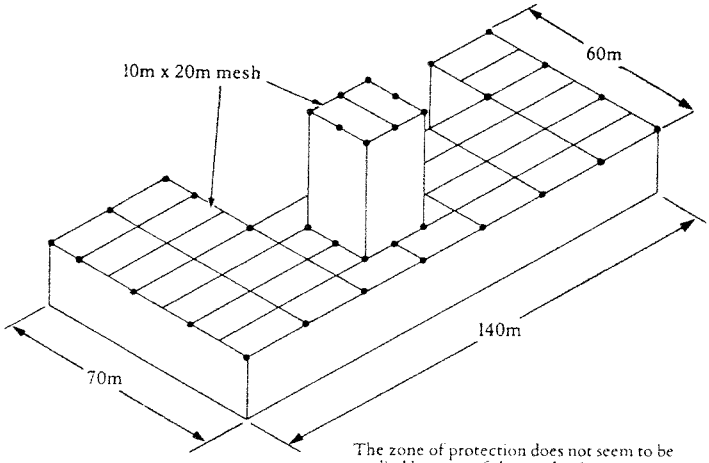
BS6651 advises the use of a rolling sphere to determine zones of protection. To minimise the likelihood of a lightning strike damaging the side of a building, it is suggested that the rolling sphere method be applied to identify those areas where an extension of the air termination network should be considered.
This recommendation could be summarised as follows:-

Where there is a risk that a lightning strike to the sides of a structure may cause masonry to be dislodged, then an extension of the air termination network should be considered.

To ensure complete continuity of the lightning protection system BS6651 recommends that.

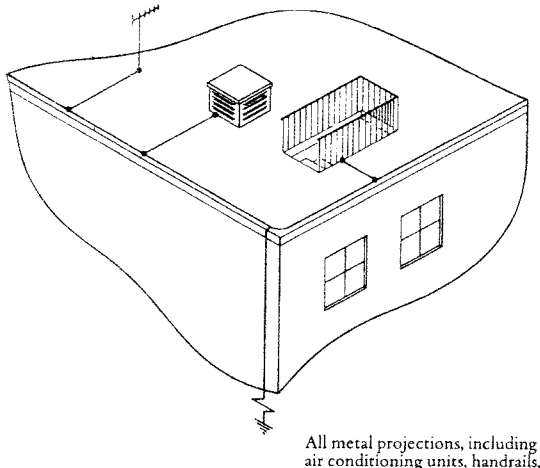
Where structures vary in height and have more than one roof termination network, (see illustration below) the lower roof network should not only be joined to its down conductors, but also joined to the down conductors of the taller portions of the structure. This will ensure that a lightning strike to a lower portion of the structure will not lead to side-flashing to other 'remote' down conductors and will provide a multi down conductor path for the lightning current to disperse.

Air Termination For Tall Conducting Structures



The zone of protection does not seem to be applied because of the need to interconnect the down conductors of the tall block to the air termination of the lower block. In such cases it is necessary to connect the lower air termination up to the lower down conductors to facilitate this inter connection, even though this extension is within the zone of protection of the lower.

Bonding To Air Termination Network



All metal projections, including masts, aerials, air conditioning units, handrails, etc. need to be correctly bonded to the air termination network.

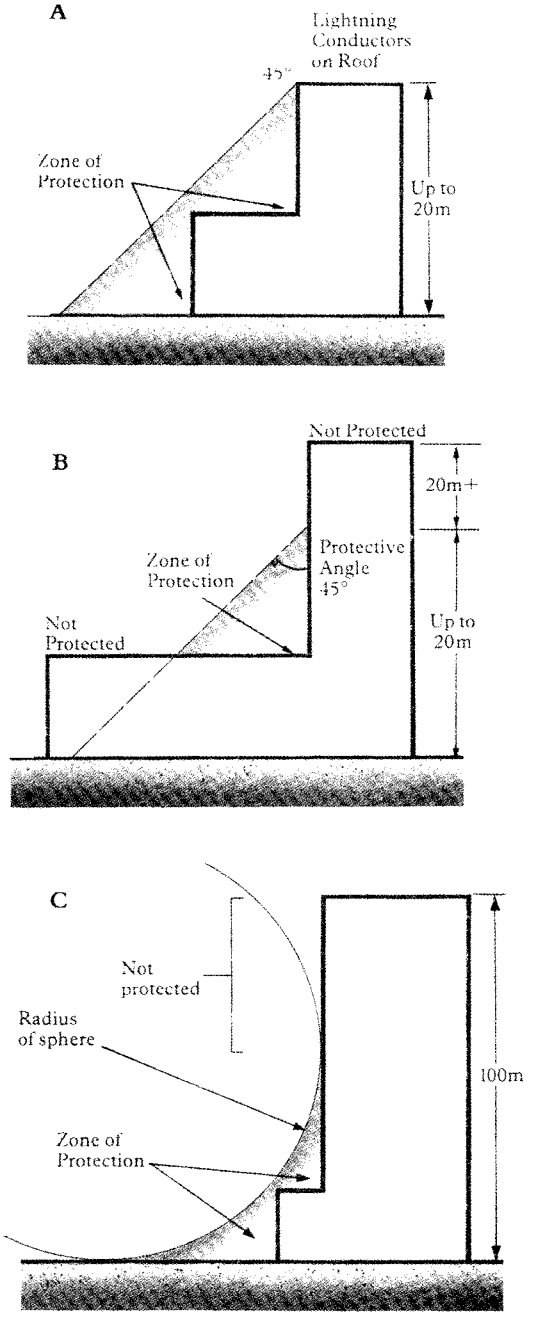
Zones of Protection

BS6651 qualifies, in detail, the meaning of 'Zones of Protection' and the 'Protective Angle.' It is sufficient to say that the 'Zone of Protection' is simply that volume within which a lightning conductor provides protection against a direct lightning strike by attracting the strike itself (see illustration below).

As can be seen in Figure A structures below 20m are regarded as offering a 45° protection angle. For structures greater than 20m in height (Figure B) the protection angle of any installed lightning protection conductors up to the height of 20m would be similar to the structures in Figure A.

For tall structures above 20m in height (Figure C), BS6651 recommends the use of the Rolling Sphere for determining the areas where lightning protection may be advisable.

Zones of Protection



Down Conductors

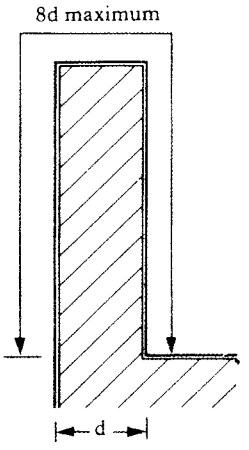
The function of a down conductor is to provide a low impedance path from the air termination network to the earth termination network, to allow the lightning current to be safely conducted to earth.

BS6651 advocates the use of various types of down conductors. A combination of strip and rod conductors, reinforcing bars, structural steel stanchions, etc, can be used as all or part of the down conductor system providing they are appropriately connected to the air and earth termination networks, and are known to offer good electrical conductivity.

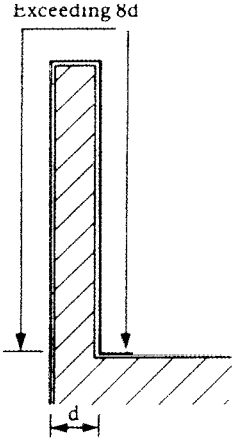
Down conductor systems should, where possible, take the most direct route from the air termination network to the earth termination network. Ideally they should be symmetrically installed around the outside walls of the structure starting from the corners. Routing to avoid side-flashing should always be given particular attention in designing any installation.

Down conductors should be positioned no more than 20m apart around the perimeter at roof or ground level, whichever is the greater. If the structure is over 20m in height, then the spacing is reduced to every 10m or part thereof.

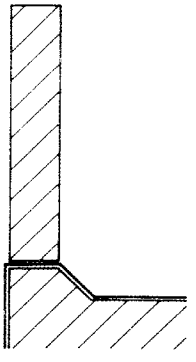
Re-Entrant Loops



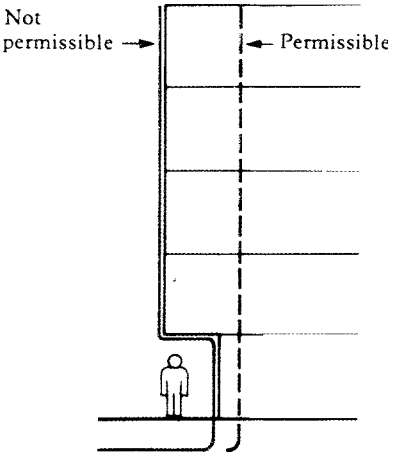
(a) Permissible arrangement



(b) Arrangement that is not permissible



(c) Permissible method of taking conductor through a parapet wall



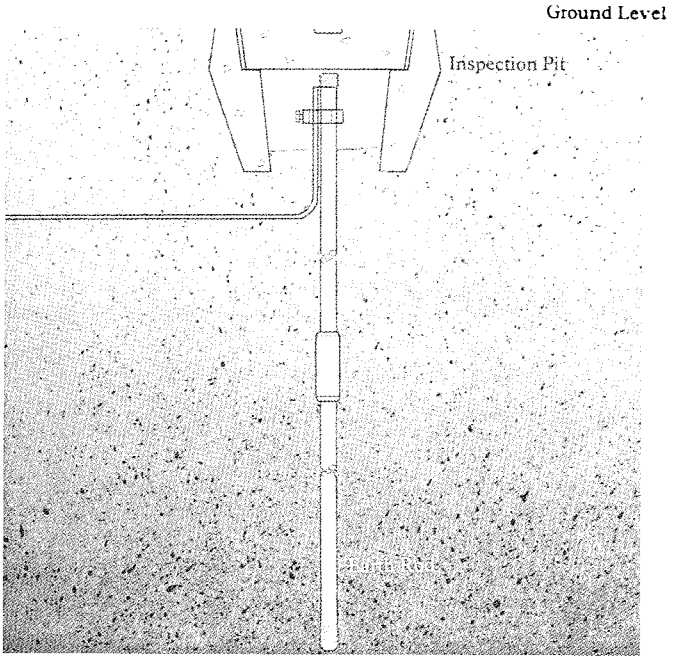
(d) Routes for down conductors in a building with cantilevered upper floors

Types of Earth Termination Networks

Deep Driven Earth Electrodes

A soil resistivity survey indicating lower resistivity at greater depths will make the deep driven earth electrode a logical choice. Deep driven earth electrodes are more likely to reach permanent moisture unaffected by seasonal changes.

Deep Driven Earth Electrode



BS6651 - Materials Specification

The materials specification section of BS6651 is of vital importance to everyone wishing to design and install a reliable lightning protection system.

The correct choice of materials and the installation method adopted should ensure a satisfactory life span of at least 30 years.

To ensure an effective system and a satisfactory long term performance all fittings need to be mechanically robust and provide good corrosion resistance qualities in widely differing environments.

In addition, the system should provide a low electrical resistance path to earth and have the ability to carry high currents repeatedly over the life time of the installation. **It must be remembered that the integrity of a complete system can be jeopardised by even one faulty or inadequate component.**

All Jiwoong Lightning Protection equipment fully complies with BS6651 materials requirements.