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3 Installing RF Antenna and Feeder System

The RF antenna and feeder system of BTS consists of antenna, feeder, jumper and feeder grounding clip, etc.

3.1 Installation Flow

According to different installations of the BTS major equipment, the installation of the antenna and feeder system differs. The installation flow of the antenna and feeder system is shown in Figure 3-1.

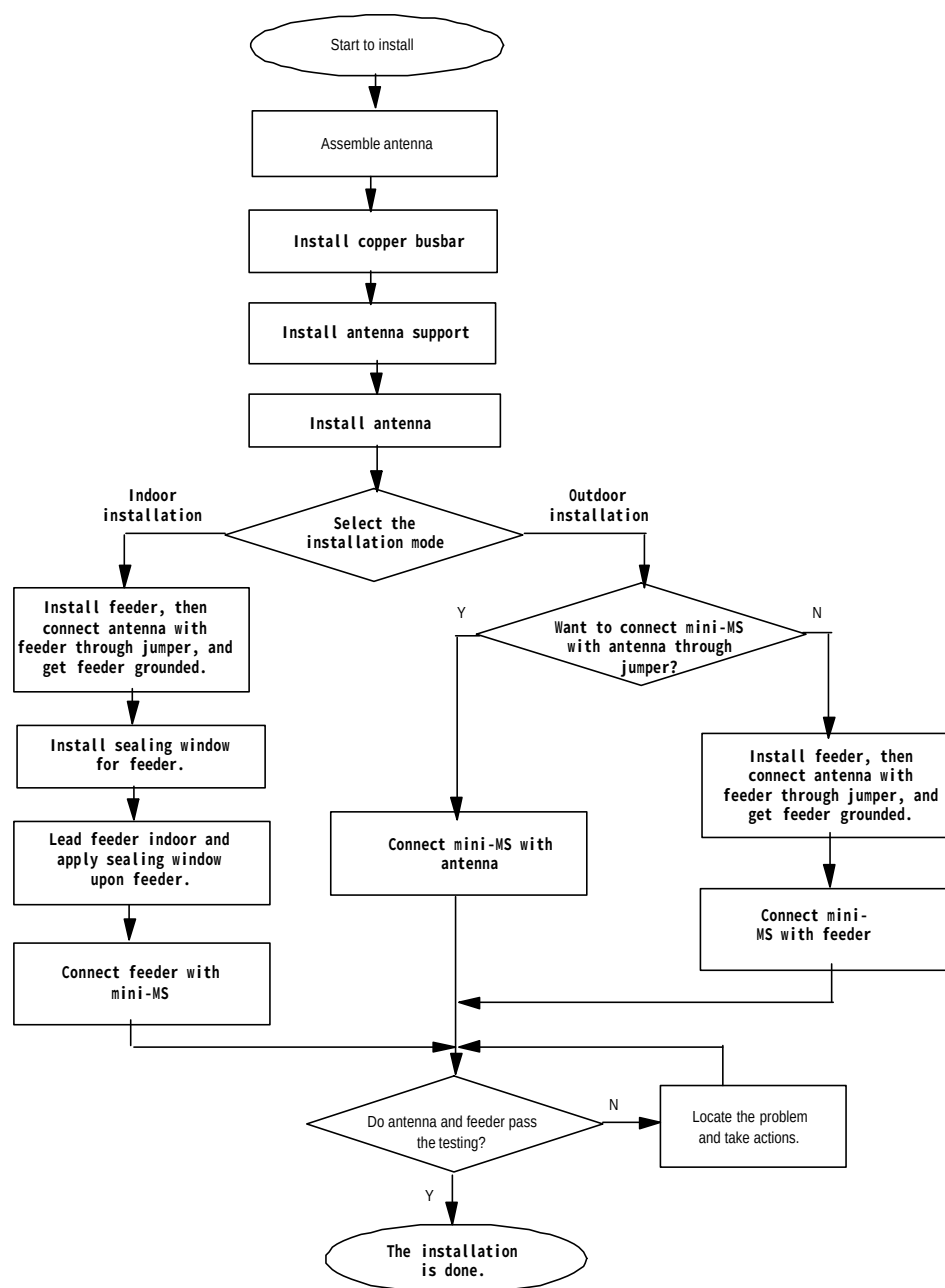


Figure 3-1 Installation flow of antenna and feeder system

Note:

The installation of antenna and feeder system is exemplified by the indoor installation of BTS. For the antenna and feeder installation in case of BTS outdoor installation, please refer to the installation of the antenna and feeder system of BTS indoor installation.

3.2 Installing Antenna Accessories

3.2.1 Installing Omni Antenna Accessories

Accessories used to assemble the omni antenna are antenna fixing clip and jumper. The omni antenna fixing clip is shown in Figure 3-2 and Figure 3-3.

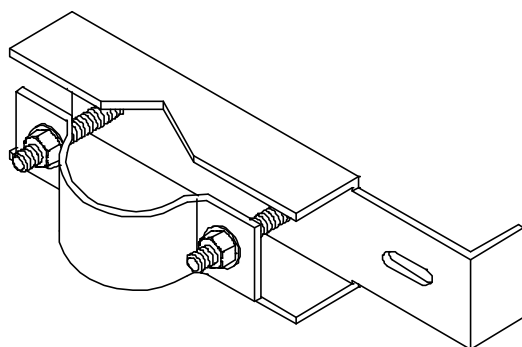
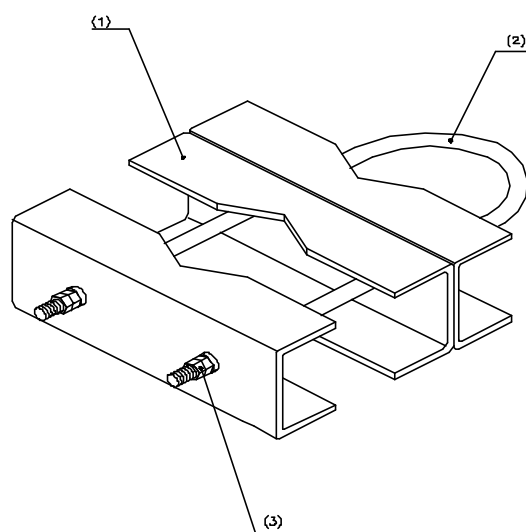


Figure 3-2 Omni antenna fixing clip (1)



(1) Omni antenna joint

(2) M12×580 U-bolts

(3) Nut M12

Figure 3-3 Omni antenna fixing clip (2)

 Note:

There are various types of fixing clips for the omni antenna, including the two shown in Figure 3-2 and Figure 3-3 for reference. In practical installation, the fixing clips should be applied according to the actual situations. The following takes the antenna fixing clip as shown in Figure 3-2 as an example.

The installation procedure of accessories is as follows:

- 1) Assemble the two fixing clips of the omni antenna with the part contacting the antenna fastened so as to reduce the work on the tower or the building-top, as shown in Figure 3-4.



Figure 3-4 Fixing omni antenna

- 2) Connect the jumper connector to the antenna connector and fasten it.
- 3) Perform waterproof and sealing treatment to the joint between the antenna and the jumper. Please refer to Section 2.3.6 for the waterproof treatment.

 Note:

Steps 2) and 3) can be completed on the tower or the building-top.

3.2.2 Installing Directional Antenna Accessories

Accessories used to assemble the directional antenna are antenna fixing clip (as shown in Figure 3-5), tilt angle adjustment device (as shown in Figure 3-6), and jumper.



Figure 3-5 Directional antenna fixing clip



Figure 3-6 Directional antenna tilt angle adjustment device

The installation procedure of accessories is as follows:

- 1) First, determine the two fixed adjusting points on the top and bottom of the antenna according to the label on the back of the antenna. The point on the top of the antenna is for adjusting the pitch angle, and the point on the bottom for fixing the antenna and its support.
- 2) Mount each accessory to its position according to the assembly diagram provided by the vendor. All the accessories must be furnished with spring washers and plain washers.
- 3) Jumper connection: Take off the jacket at the lower part of the antenna. Then connect the jumper connector and the antenna connector and fasten them.
- 4) Perform waterproof treatment to the connector (the same method as that to the connector between omni antenna and jumper).

Figure 3-7 shows the connection between the directional antenna and jumper, and the jumper connector after treatment.

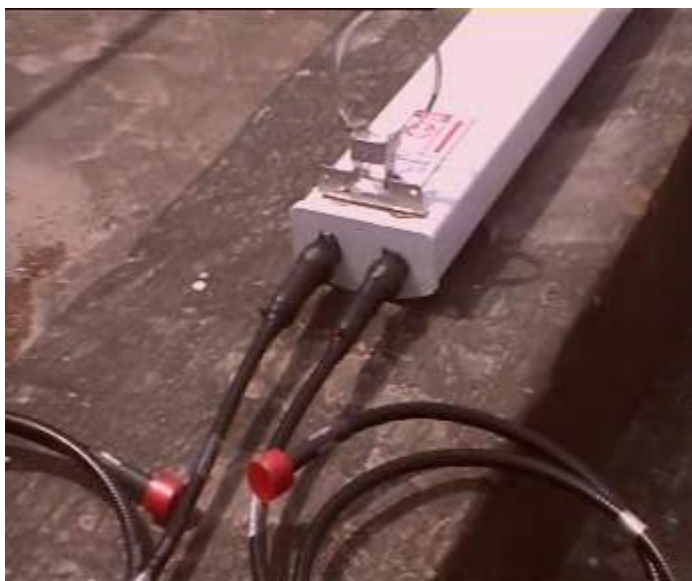


Figure 3-7 Connection between directional antenna and jumper and jumper connector after treatment

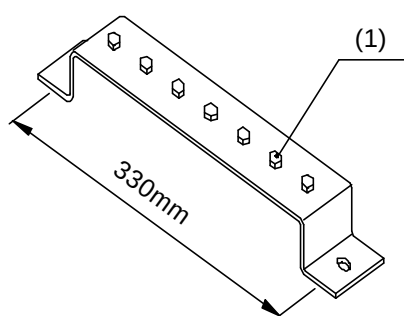


Caution:

Antenna fixing clip and pitch angle adjustment device must be furnished with spring washers and plain washers in correct installation sequence.

3.3 Installing Grounding Bar

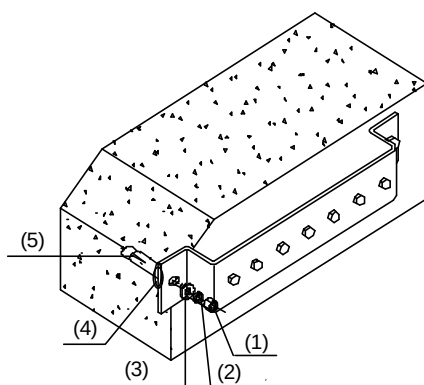
Grounding copper bar is used to connect the PGND and working ground of the cabinet. It should be installed both indoor and outdoor. In indoor installation, it is usually mounted on the wall near the BTS; while in outdoor installation, it is usually mounted near the BTS, yet its specific position is determined according to the actual situation. The structure of grounding copper bar is shown in Figure 3-8.



(1) M8 bolt

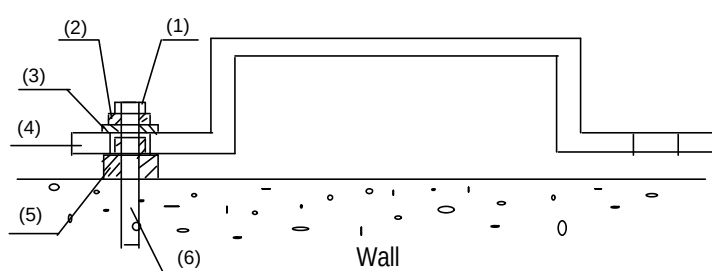
Figure 3-8 Structure of the grounding copper bar

The installation is shown in Figure 3-9 and Figure 3-10.



(1) Nut M12 (2) Spring washer $\phi 12$ (3) Large plain washer
(4) Insulation washer (5) M12 $\times$ 80 exploded expansion bolt

Figure 3-9 Installing the grounding copper bar



(1) Nut M12 (2) Spring washer $\phi 12$ (3) Large plain washer
(4) Indoor grounding copper bar (5) Insulation washer (6) M12 $\times$ 80 exploded expansion bolt

Figure 3-10 Sectional view of grounding copper bar installation

The insulation washer is shown in Figure 3-11.



Figure 3-11 Insulation washer



Caution:

Insulation washer should be furnished when the expansion bolt is installed. So the grounding copper bar is insulated from the wall.

3.4 Installing Antenna Support



Note:

In non-turnkey project, the user should prepare the antenna support when preparing the environment. Huawei is responsible for antenna support installation only in turnkey project.

There are a number of structures and types of antenna support. The following gives two installation methods for antenna support as examples, namely, installing antenna support on tower platform and on building-top.

3.4.1 Installing Support on Tower Platform

I. Antenna support structure

Figure 3-12 shows the antenna support installed on tower.

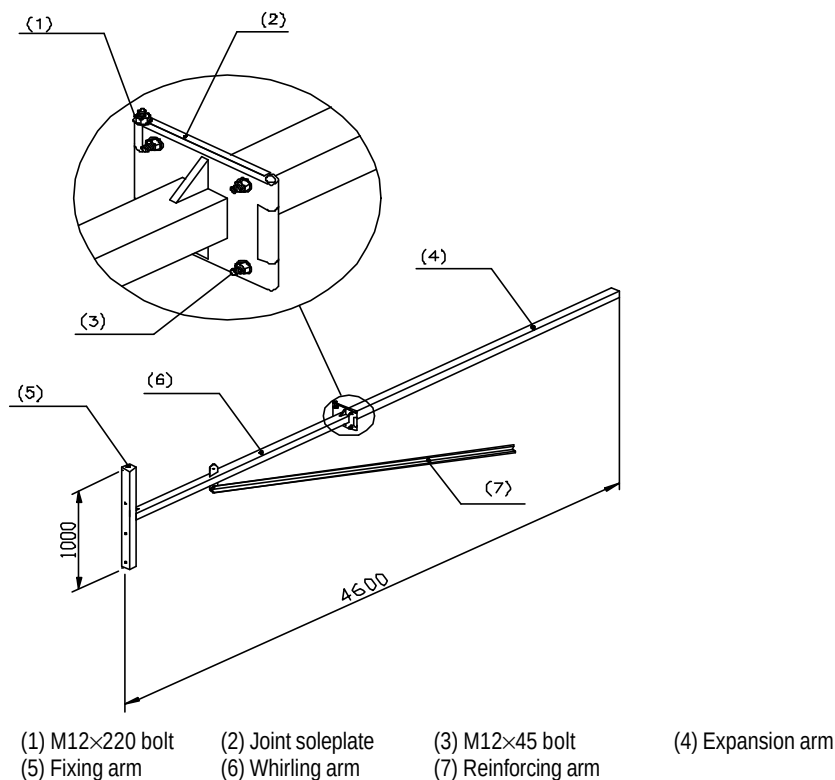


Figure 3-12 Structure of antenna support installed on tower

II. Installation requirements

- 1) Installation plane of the antenna support should be vertical to the horizontal plane.
- 2) Tower lightning arrester mast should be installed separately with the height satisfying lightning protection requirements of all antennae. When the support extends out of the tower platform, it should be ensured that the antenna is within the protection range formed by 30° pitch angle of the lightning arrester apex, as shown in Figure 3-13.

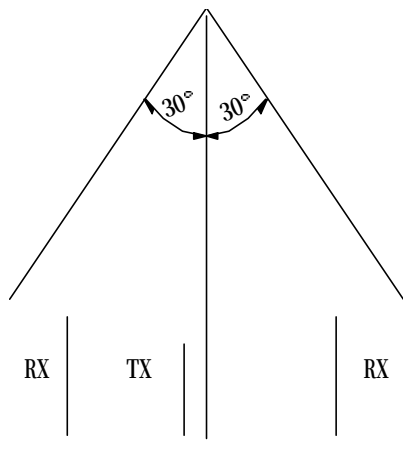


Figure 3-13 Installing the lightning arrester

- 3) Make sure that the installation direction of the antenna support would not influence the receiving (RX)/transmitting (TX) performance and direction adjusting of the antenna.
- 4) If necessary, take suspension measures to avoid distortion of the antenna support as it will be in use for a long time.
- 5) Whirling arm should be reinforced by reinforcing arm. The length of expansion arm and whirling arm may be determined according to the onsite situation. The fracture should be soldered with cover plate to avoid leaking water.
- 6) All the soldered parts should be secure enough without dry joint and open solder point. The surface of the support should be covered by anti-rust silvery paint. Better choose zinc-coated steel for the support.

III. Installation procedure

- 1) Install a fast pulley on the tower top. Use one or two lifting ropes to hoist the support to the tower platform via the fixed pulley. Besides, a rope is needed to control the upward direction of the support;
- 2) Determine the installation position of the antenna support on building-top according to the antenna and feeder installation diagram in the engineering design drawing.
- 3) Fix the support on the tower with a U-shape fixing clip, as shown in Figure 3-14.
- 4) Connect the tower platform guardrail and joint soleplate with M12×45 bolt.

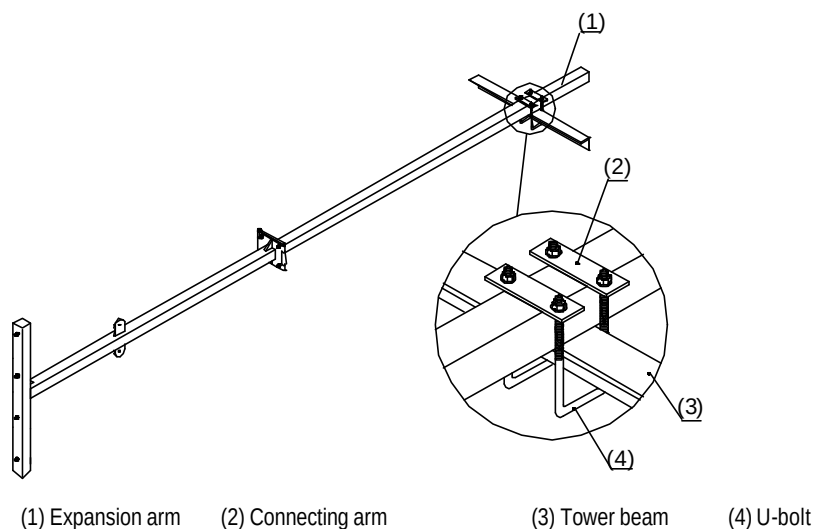


Figure 3-14 Installing the antenna support on tower

3.4.2 Installing Support on Building-top

I. Antenna support structure

Figure 3-15 illustrates the antenna support installed on building-top.

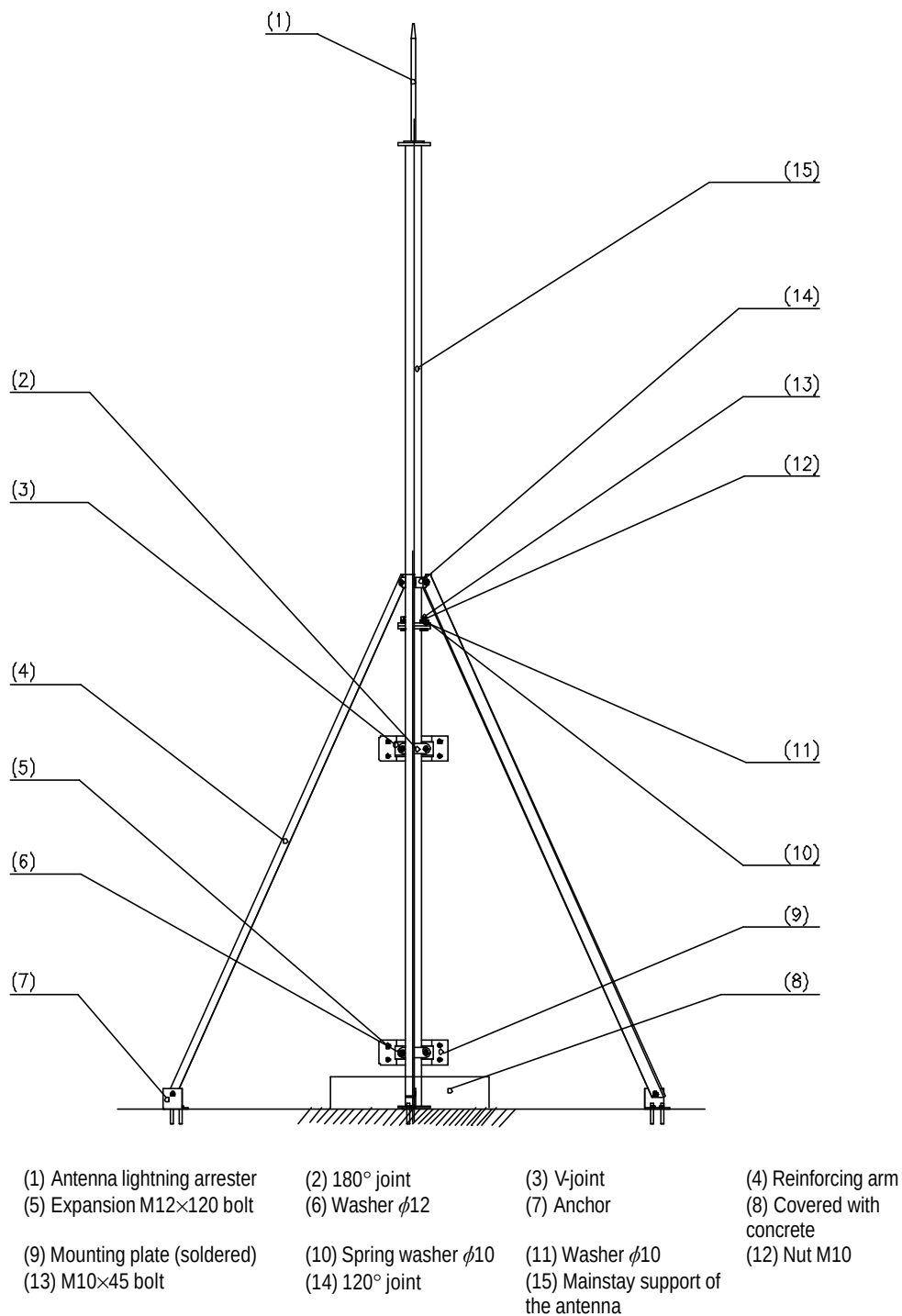


Figure 3-15 Structure of antenna support installed on building-top

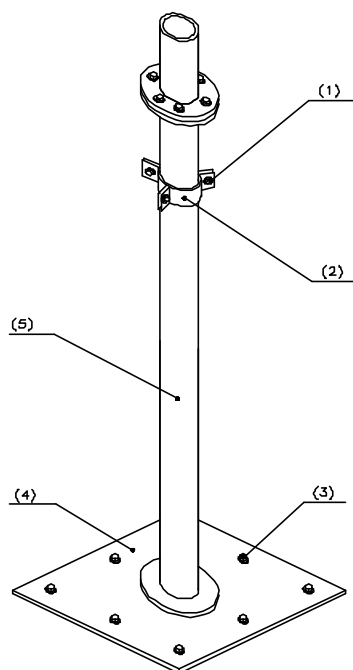
II. Installing requirements

- 1) The installation position of joint for reinforcing arm should not affect the adjustment of antenna direction and pitch angle.
- 2) Antenna support must be vertical to the horizontal plane.

- 3) Antenna support on building-top must be equipped with lightning arrester, and the support should be connected to the building lightning-protection network.
- 4) The surface of the support and all the soldered parts should be covered by anti-rust paint. All the soldered parts should be secure enough without dry joint and open solder point.

III. Installing the support on building-top without parapet

- 1) Hoist the support to the building-top.
- 2) Determine the installation position of the antenna support on building-top according to the antenna and feeder installation diagram in the engineering design drawing.
- 3) Solder the lightning arrester on the mainstay support of the antenna (with the axes aligned).
- 4) As shown in Figure 3-16, fix the base of the antenna on the building-top vertically with eight M10×45 expansion bolts.



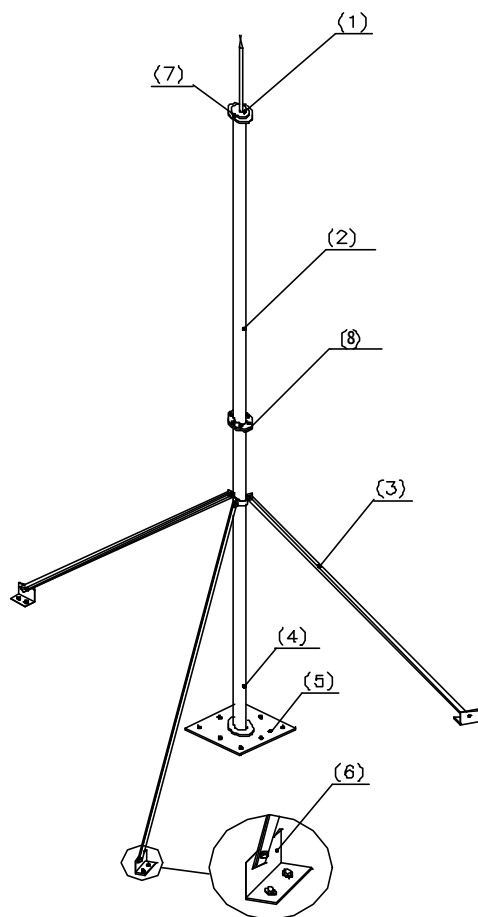
- | | | |
|---|-------------------------------------|------------------------------------|
| (1) Hexagonal M10×50 bolt | (2) Joint for reinforcing arm | (3) M10×50 exploded expansion bolt |
| (4) Plastic foot for antenna mainstay support | (5) Mainstay support of the antenna | |

Figure 3-16 Installing the antenna support base

- 5) Mainstay support needs to be reinforced with reinforcing arm whose length is determined according to that of the mainstay support. As shown in Figure 3-17, the reinforcing arm is connected to the mainstay support through its joint. Connect the anchors to the reinforcing arm and fix the anchors of each reinforcing arm on

the building-top floor with two M10×45 expansion bolts. Make sure the connection of the reinforcing arms will not be twisted.

- 6) As shown in Figure 3-17, connect mainstay support 2 with mainstay support 1 tightly with six M10×80 bolts.



- | | | | |
|--------------------------------|-------------------------------|---------------------|------------------------|
| (1) Antenna lightning arrester | (2) Mainstay support 2 | (3) Reinforcing arm | (4) Mainstay support 1 |
| (5) Plastic root for support | (6) Anchor of reinforcing arm | (7) Soldered parts | (8) M10×80 bolt |

Figure 3-17 Installing the antenna support

- 7) There are such cases that the building-top antenna support is not soldered with outdoor cabling rack; or soldered but the cabling rack is not connected with the lightning-protection network of the building. In this case, connect the base of the antenna support to the lightning-protection network of the building with a lightning-protection connecting bar (the lightning-protection connecting bar is the installation parts for outdoor cabling rack).
- 8) Cover all the soldered parts and the support base with anti-rust paint.
- 9) Base of the building-top antenna support, anchors of the reinforcing arm and the expansion bolts connected with the floor should all be covered with concrete for protection.

IV. Installing the support on building-top with parapet

If there is parapet around the building-top, and it is inconvenient to install the support on the building-top, just mount the support on the parapet. Figure 3-18 illustrates the antenna support fixing clip mounted on the parapet.

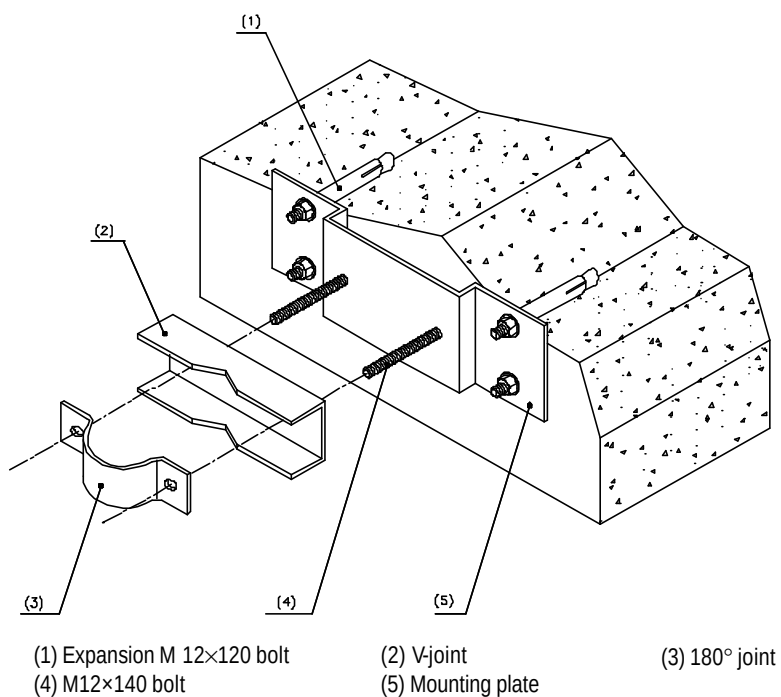


Figure 3-18 Fixing clip of antenna support installed on parapet

In the case the parapet is not shorter than 1200mm, fix the two fixing points of the support on the parapet with expansion bolts, as shown in Figure 3-19.

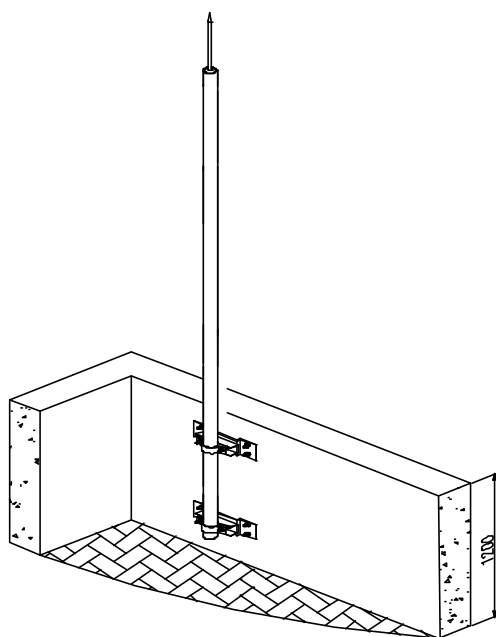


Figure 3-19 Antenna support fixed on parapet (with parapet not shorter than 1200mm)

In the case the parapet is shorter than 1200mm, fix one fixing point of the mainstay support to the parapet with expansion bolt, and the other fixing point to the building, as shown in Figure 3-20.

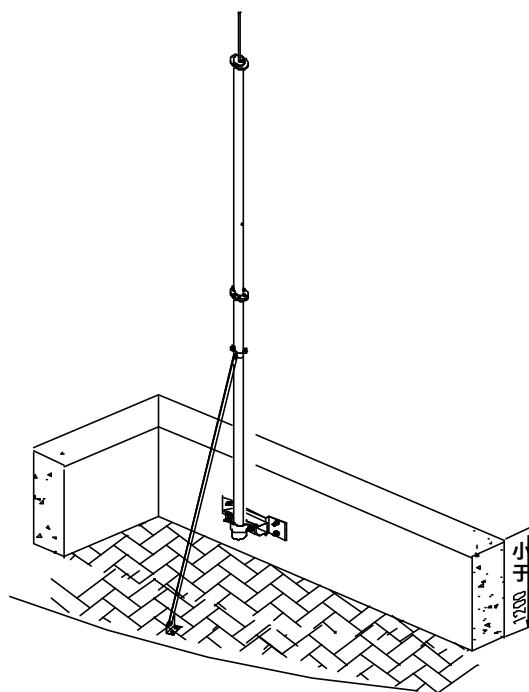


Figure 3-20 Antenna support fixed on parapet (with parapet shorter than 1200mm)

3.5 Installing Antenna

3.5.1 Antenna Facade

The façade of omni antenna and directional antenna is shown in Figure 3-21.

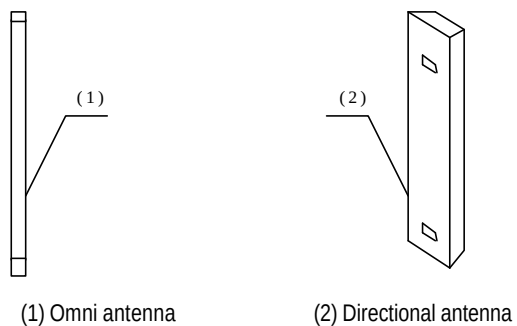


Figure 3-21 Antennae

3.5.2 Hoisting Antenna

Tie a knot at both ends of the antenna with a rope. Persons both on the tower and down the tower cooperate to hoist the antenna to its position. The persons down the tower should strain on the rope so as to avoid damage to the antenna due to clashing between the antenna and the tower body or the building.

3.5.3 Installing Omni Antenna

Installation of the omni antenna on the tower platform is shown in Figure 3-22.

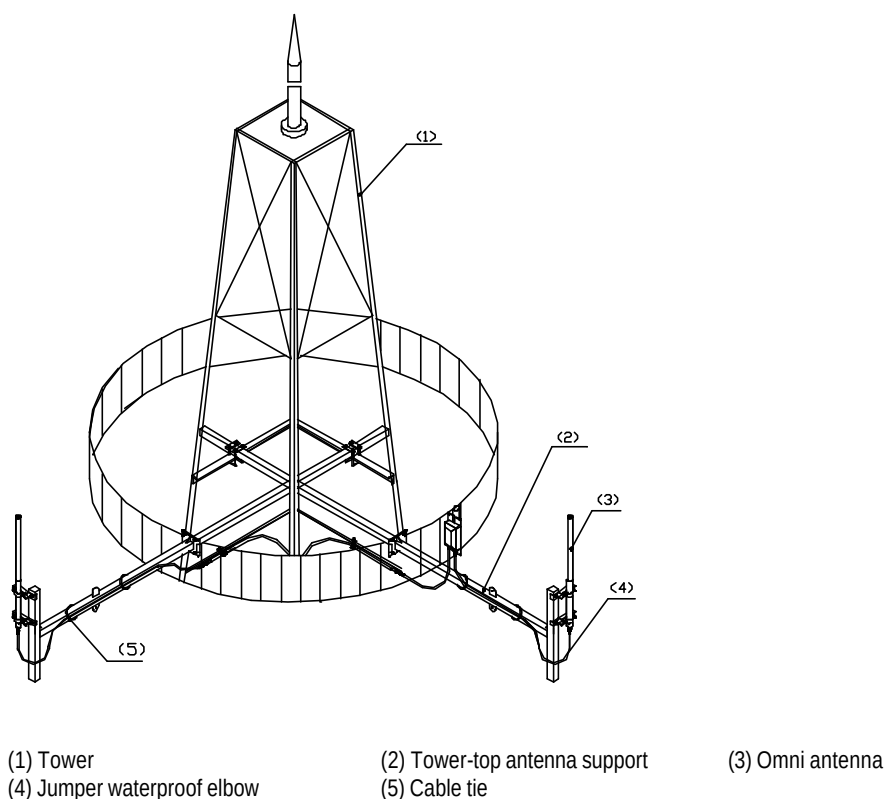


Figure 3-22 Installing the omni antenna on tower platform

I. Installation requirements

- When installing the omni antenna on the tower, make sure the antenna is in the protection range of lightning arrester on the tower. The distance between the omni antenna and the tower body should be left at least 1.5m.
- The antenna axis should be vertical to the horizontal plane with error less than $\pm 1^\circ$.
- The TX and RX antenna of omni antenna can be installed on one antenna support, or be separately installed. The specified installation position should be determined according to the engineering design drawing.

II. Installation procedure

- 1) Make the feeding point of the antenna facing down and the jacket near the mainstay support. The top of the jacket should be on the same level or a little bit higher than the top of the support.
- 2) As shown in Figure 3-23, secure the antenna fixing clip and the mainstay support properly to ensure its load bearing and wind resistibility. It should not be too tight to damage the jacket of the antenna.
- 3) Check whether the antenna axis is vertical to the horizontal plane with angle tester. If the error is equal to or greater than $\pm 1^\circ$, adjust the antenna axis and then fasten it.
- 4) Make waterproof elbow at the antenna connector.

- 5) Route the antenna jumper with natural jumper curves of proper angle. Generally, it is required that the radius of the curves be 20 times larger than the jumper diameter and the jumper be bound to the steel rack of the tower along the support crosspiece with black cable tie.



Caution:

The cable ties should be bound toward the same direction with a margin of 5~10mm to avoid the ties fall off when temperature changes.

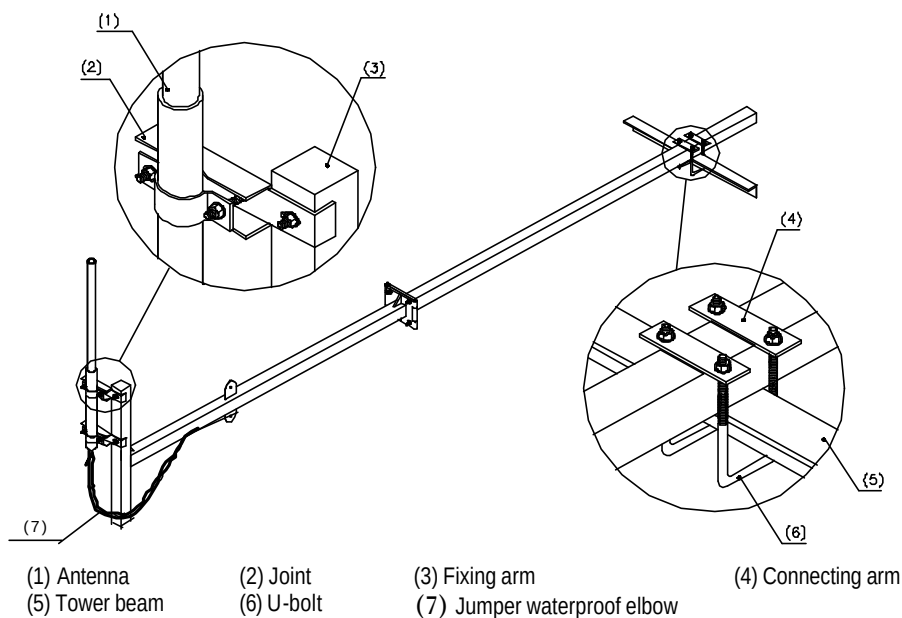
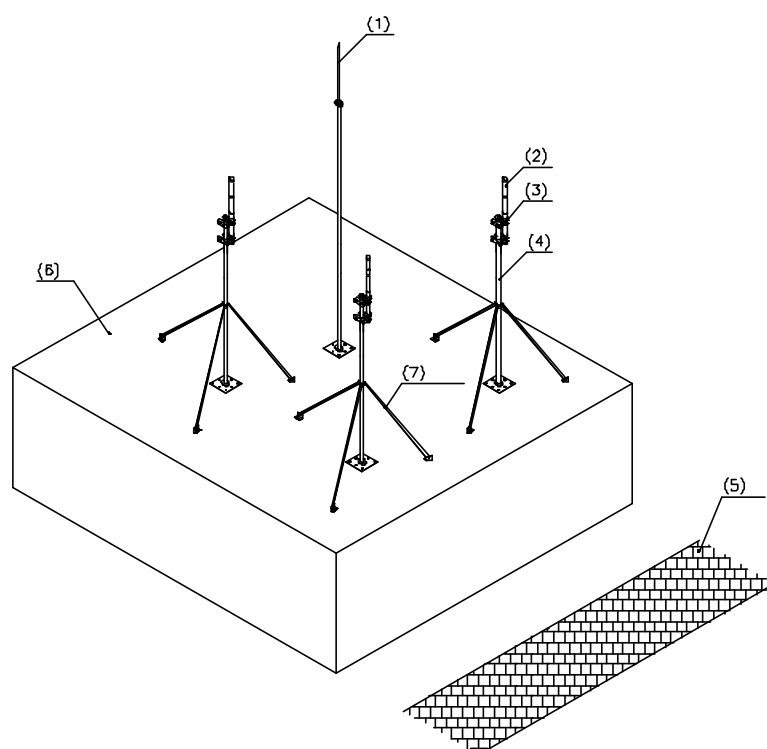


Figure 3-23 Installing the omni antenna

Installation of omni antenna on building-top support is similar to that on tower side. The installation is shown in Figure 3-24.



- | | | | |
|--------------------------------|------------------|------------------------------|---------------------------------|
| (1) Antenna lightning arrester | (2) Antenna | (3) Omni antenna fixing clip | (4) Mainstay support of antenna |
| (5) Road surface | (6) Building-top | (7) Reinforcing arm | |

Figure 3-24 Installing the omni antenna on building-top support

3.5.4 Installing Directional Antenna

The installation of directional antenna on the tower side is shown in Figure 3-25.



Figure 3-25 Installing the directional antenna on the tower side

I. Installation requirements

- When installing the directional antenna on the tower, make sure the antenna is in the protection range of lightning arrester on the tower. The antenna should stretch out of the tower body for at least 1m.
- Waterproof elbow must be made to the antenna jumper.

II. Installation procedure

- 1) Determine the installation direction of the antenna according to the engineering installation drawing.
- 2) Fix the antenna onto the main supporting post. The fixing tightness should be right enough for weight bearing and wind resistance. Looseness may cause loose connection while too much tension may damage the antenna sheathing;
- 3) Adjust the antenna azimuth angle: Determine the antenna azimuth angle with a compass according to the engineering design documents. Normally, Starting from the north clockwise, the area covered by the first antenna is sector 1. Sector 2 lies in the clockwise 120° direction and sector 3 in the next clockwise 120° direction, as shown in Figure 3-26. While adjusting the azimuth, turn the antenna azimuth slightly till it satisfies the design index value with the azimuth error not greater than 5°.

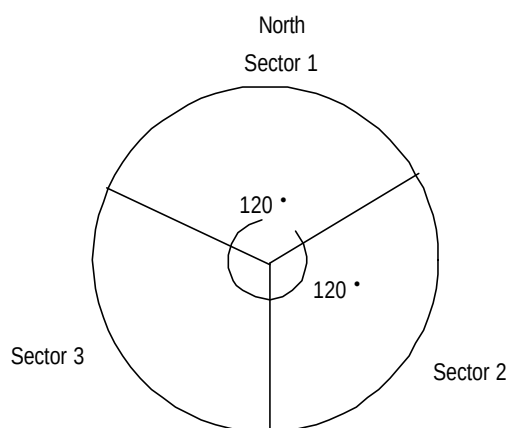


Figure 3-26 Correspondence between directional antenna azimuth and sector

- 4) Tighten up the lower fixing clip of the antenna till it cannot be moved by hand.
- 5) Adjust the antenna pitch angle: For the directional antenna whose mounting hole corresponds to its pitch angle, install it via its mounting hole directly. Make sure the supporting post of its support is kept strictly perpendicular to the ground during the installation. Adjust the pitch angles of other antennae in the following way:
 - Determine the antenna pitch angle using an inclinometer.
 - Turn the antenna slightly and adjust the pitch angle till it satisfies the engineering design index value. Generally the error of the pitch angle should be $\leq 0.5^\circ$.
 - Tighten up the upper fixing clip of the antenna till it cannot be moved by hand;

Use the inclinometer in the way as shown in Figure 3-27 and Figure 3-28.

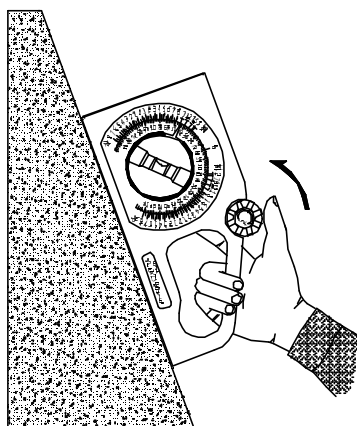


Figure 3-27 Pitch angle of the antenna before being adjusted by the inclinometer

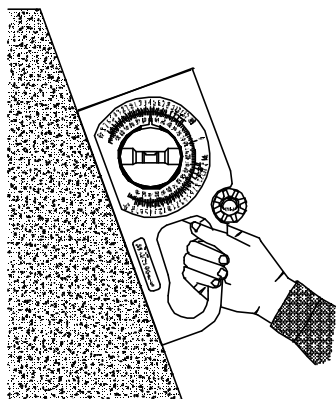


Figure 3-28 Pitch angle of the antenna after being adjusted by the inclinometer

6) Make waterproof elbow for the antenna jumper and route the jumper.

Installation of directional antenna on building-top support is similar to that on tower side. The installation is shown in Figure 3-29 and Figure 3-30.

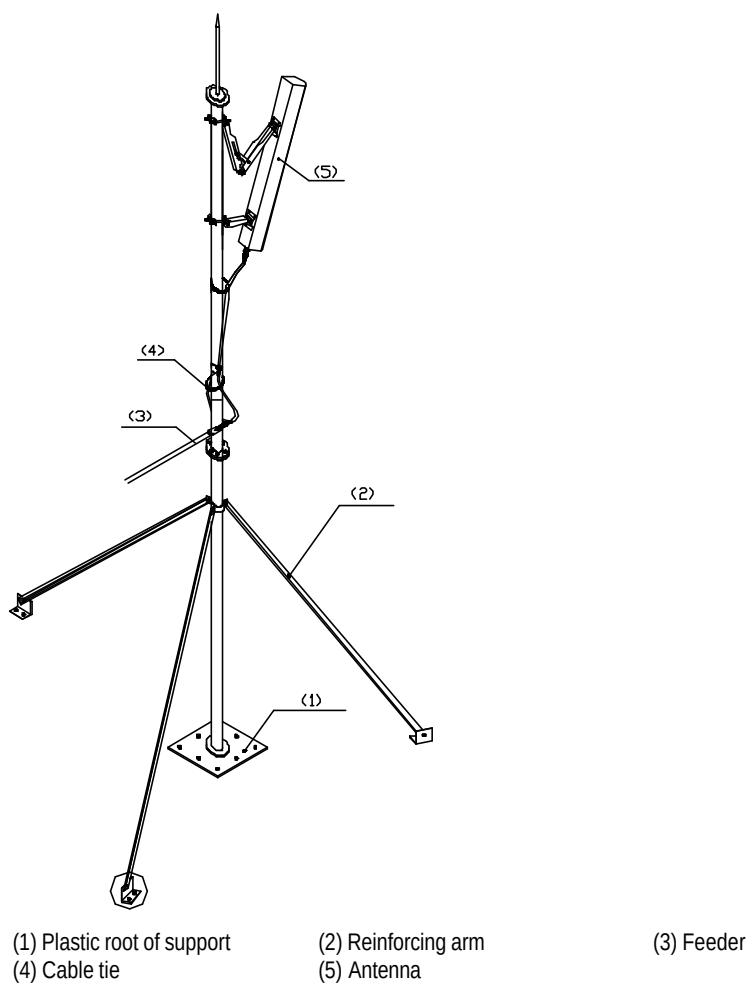


Figure 3-29 Installing the directional antenna on building-top (without parapet)

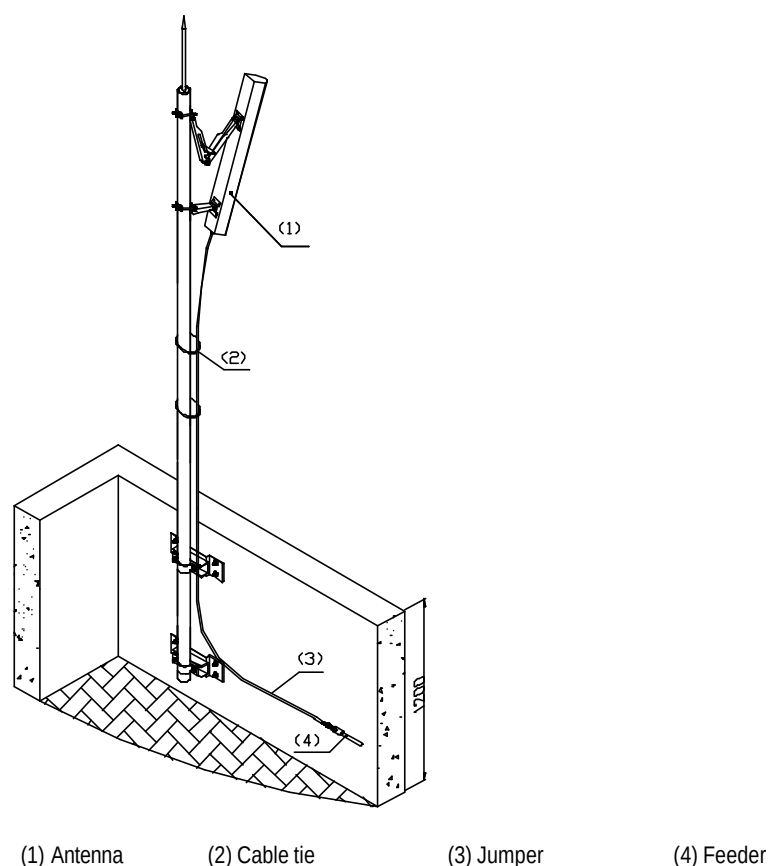
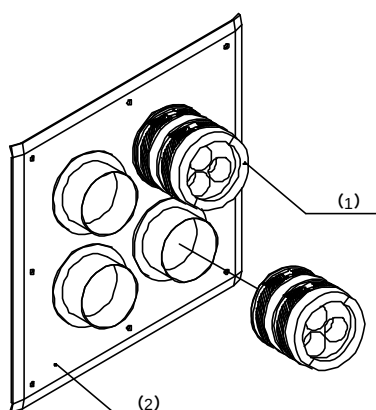
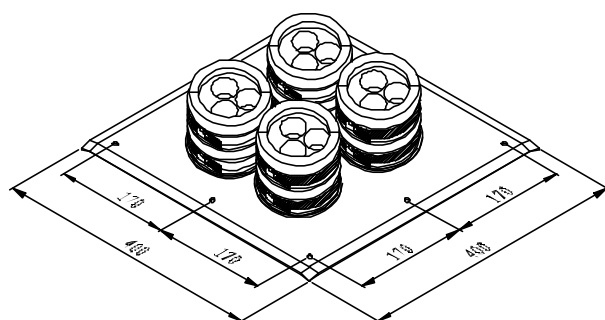


Figure 3-30 Installing the directional antenna on building-top support (with parapet not shorter than 1200mm)

3.6 Installing Feeder Window

3.6.1 About Feeder Window

There are two types of feeder windows: 12-hole feeder window and 27-hole feeder window. The former is used most frequently. Figure 3-31 shows its structure, dimensions and its connection with the sealing gland. The following gives the installation method of 12-hole feeder window only.



(1) Sealing packing ring of feeder window

(2) Feeder window board

Figure 3-31 Structure and dimensions of feeder window

3.6.2 Installing Feeder Window

Feeder window is usually installed outdoors near and above the cabling rack. If feeders enter the equipment room from building-top, the feeder window should be installed on building-top.

Installation procedure is as follows:

- 1) Determine the indoor installation position for the feeder window according to the engineering design drawing and the dimensions of the window. Mark the positions for expansion bolt holes and for feeder window cavity on the wall.
- 2) As shown in Figure 3-32, drill a square cavity of 250mm × 250mm on the wall, then drill 8 holes for expansion bolts using a percussion drill.
- 3) As shown in Figure 3-33, secure the feeder window board with expansion bolts. When mounting the expansion bolts, note the sequence of spring washer and plain washer. The sealing gasket and sealing gland may be mounted when leading the feeder indoor.

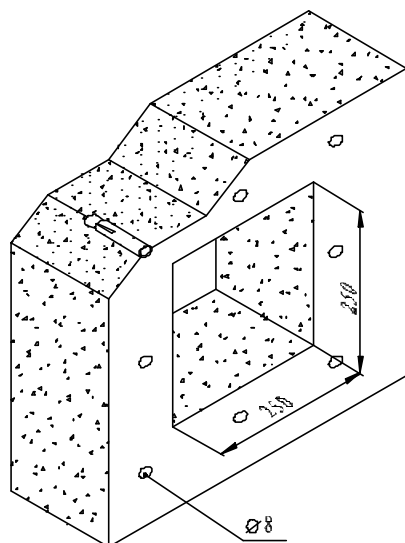
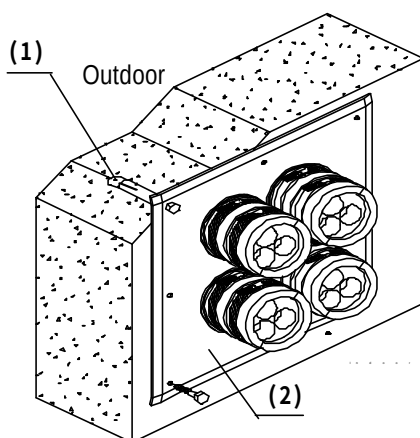


Figure 3-32 Mounting holes for feeder window



(1) M8x80 exploded expansion bolt

(2) Feeder window board

Figure 3-33 Installing feeder window

3.7 Installing Feeders

3.7.1 Cutting Feeder

The feeders can be cut prior to or after feeder hoisting.

- 1) Determine the length of the feeders required in each sector according to the engineering design drawing;
- 2) Cut the feeder by the determined length, leaving a margin of 1m~2m. When cutting the feeder, do not bend it and prevent it from being rolled over or stepped on by vehicles or pedestrians;

- 3) Attach the corresponding labels to both ends of the feeder after cutting a piece.

3.7.2 Hoisting Feeder

- 1) Wrap the feeder end in a piece of gunny cloth (or antistatic bag) after the corresponding connector is completed. Bind the cloth up using a rope or a binding tape;
- 2) Knot the lifting rope at the point about 0.4m away from the feeder end and tie another knot at the point about 4.4m away from the feeder end to prepare for feeder hoisting, as shown in Figure 3-34.

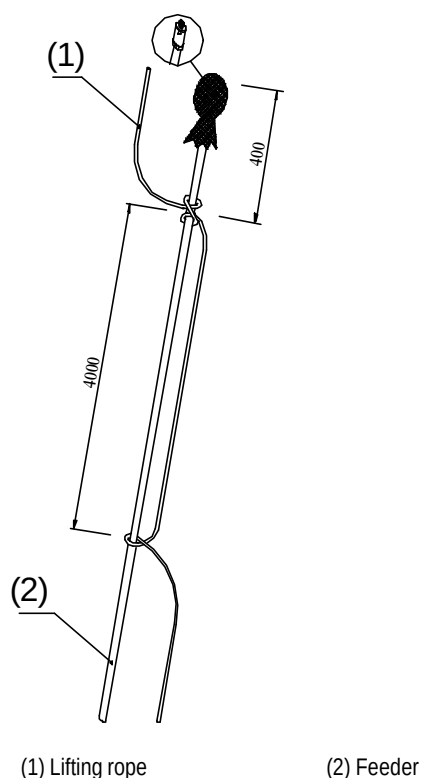


Figure 3-34 Protection of feeder connector

- 3) Hoist the feeder to the tower platform. No violent hoisting is allowed so as to avoid damage to the feeder skin due to possible collision with the building or the tower. In the meantime, take care of your safety.
- 4) Fix the upper end of the feeder in a proper position by multiple-point fastening lest that the feeder fall from the tower. However, it should not be too close to the antenna, as shown in Figure 3-35. Select 1-for-1 fixing clip or 1-for-3 fixing clip as is required, as shown in Figure 3-36.



Figure 3-35 Feeder upper end fixed on tower

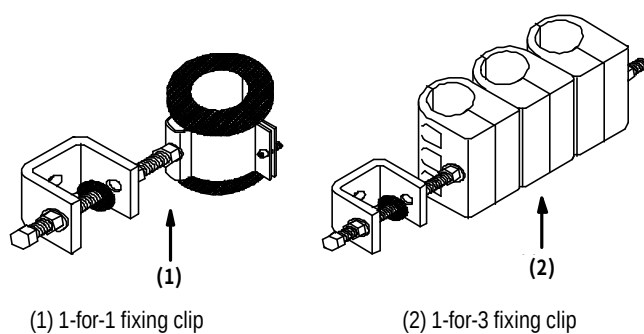


Figure 3-36 Feeder fixing clip

- 5) Connect the jumper between antenna and feeder and perform waterproof and encapsulation treatment to the connectors. Attach a temporary label at the point 10cm away from the jumper end.

3.7.3 Routing Feeder

Routing procedure:

- 1) Design the feeder arrangement according to the sector requirement in the engineering design. Determine the arrangement and lead-in plan. Usually, there is one row or column of feeders in a sector arranged in the same sequence.
- 2) Route the feeders according to the planned sequence.
- 3) Arrange the feeders neatly while fixing them onto the tower or the cabling rack with fixing clips. Meanwhile, mount the feeder grounding clip and attach feeder labels.

3.7.4 Affixing Feeder Labels

I. Label format

Figure 3-37 illustrates the standard nameplate used as both indoor and outdoor labels.

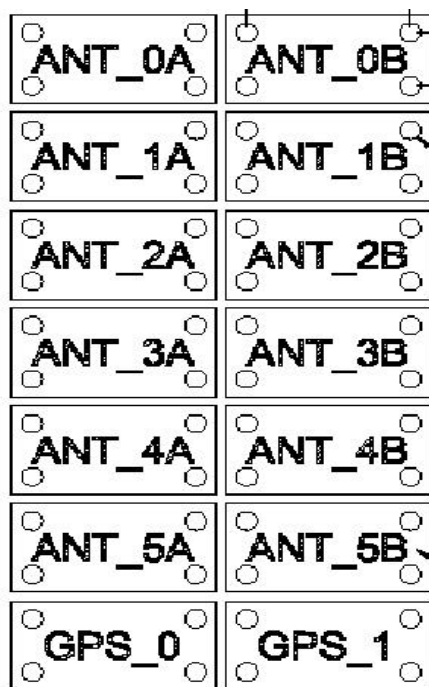


Figure 3-37 RF antenna and feeder label

II. Label position

1) BTS indoor installation mode

Feeder labels can be affixed in three positions, which are (from the top down):

- 0.3m to the outdoor feeder connector;
- Outside the feeder entrance to the feeder window;
- 0.3m to the indoor feeder connector.

2) BTS outdoor installation mode

Feeder labels can be affixed in two positions, which are (from the top down):

- 0.3m to the outdoor feeder connector;
- 0.3m to the front end connecting the BTS.

3.7.5 Grounding Feeders

Installation of feeder grounding clip and routing of feeders are carried out simultaneously. When grounding the feeders, ground the feeder skin with the lightning protection grounding clip. The grounding cable led out should be connected to the

protection grounding bar directly. The following gives description of feeder grounding points in different installation modes.

I. BTS outdoor installation mode

- Within the range of 1m~2m under the antenna;
- The front end connecting the BTS.



Caution:

- 1) When soft jumper is adopted for the feeder and the feeder is not longer than 5m, the shielding covering of the feeder may be grounded at the front end connecting the BTS.
 - 2) If the feeder is longer than 60m, feeder grounding clips should be applied in the middle of the feeder, with the clip spacing of 20m.
-

II. BTS indoor installation with the outdoor feeder longer than 20m

- Within the range of 1m~2m under the antenna;
- Within 1m range of the mast or of where the feeder is led from the tower platform;
- At the outer side of the feeder window where the feeder enters the equipment room (connecting to outdoor PGND bar).
- Close to the indoor protection grounding bar after it enters the equipment room.

Others:

- If the feeder is longer than 60m, feeder grounding clips should be applied in the middle of the feeder, with the clip spacing of 20m.
- If the feeder is led into the room after being routed for a stretch of distance on the building-top, and the distance exceeds 20m, a feeder grounding clip should be applied on building-top.
- For the feeder that enters the room from the building-top along the wall, if a cabling rack is used, the cabling rack should also be grounded.
- Feeder grounding cable should be routed toward the BTS antenna and feeder port along the antenna. The included angle between the feeder grounding cable and the feeder should not be greater than 15°. The feeder grounding clip should be directly secured to the steel board on the nearby tower body.

III. BTS indoor installation with the outdoor feeder shorter than 20m

- Within the range of 1m~2m under the antenna;
- At the outer side of the feeder window where the feeder enters the equipment room (connecting to outdoor PGND bar);
- Close to the indoor PGND bar after it enters the equipment room.



Caution:

- 1) When soft jumper is adopted for the feeder and the feeder is not longer than 10m, the shielding covering of the coaxial soft jumper may be grounded at two points, i.e., below the antenna and indoor.
 - 2) When soft jumper is adopted for the feeder and the feeder is not longer than 5m, the shielding covering of the coaxial soft jumper may be grounded at one point indoor.
-

3.7.6 Leading Feeder into Equipment Room

I. Feeder arrangement principle

- There are 4 big holes in a 12-hole feeder window, and 3 small holes in each big hole. One feeder can run through a small hole.
- The feeders should be arranged in sequence (i.e. clockwise or counter-clockwise) in the three small holes of the same big hole.
- The arrangement of feeders in the feeder window should facilitate system expansion. The original arrangement of feeders should not be changed during system expansion. It is permitted to add feeders to the feeder window and change the jumper connection on the cabinet top only.
- The arrangement of feeders in the feeder window should facilitate the routing of feeders on the cabling rack and the connection of feeders with the cabinet top. The feeders should be parallel to each other without any cross.
- The length of the feeder entering the feeder window should be 30cm~50cm. If there is an indoor cabling rack, the feeder can be fixed with feeder clip. If not, the feeder may be hanged in air.



Caution:

The minimum feeder curving radius should not be less than 20 times of the feeder diameter. There should be no cross of the feeder when it is routed along the cabling rack and tower cabling ladder. And there should be no crossing or overlapping of the feeder entering the equipment room. Therefore, it is required to get an idea of the feeder routing prior to feeder distribution. It is best to draft the actual feeder routing on paper to avoid rework due to feeder crossing.

II. Procedure

- 1) Make waterproof elbow for the feeder at the outer side of the feeder window.

- 2) Direct the feeders into the equipment room via the feeder window. The corresponding personnel inside the equipment room should guide the operation so as to avoid damage to equipment in the room.
- 3) Mount sealing gasket and sealing gland. Place the hole for filling in glue on the sealing gland facing upward when mounting the sealing gland.
- 4) Cut the feeders correctly according to the design requirements.
- 5) Make the indoor feeder connector.
- 6) Encapsulate the feeder window and the unused holes with adhesive tape, plaster and glass cement, as shown in Figure 3-38.



Figure 3-38 Encapsulation treatment of the feeder window after feeder enters the equipment room

 Note:

If the feeder needs to run through the window glass, remove the glass first. Cut a corner of proper size of the glass and then use rubber or adhesive tape to protect the edge, in order to avoid the feeder being cut. Measures should be taken to prevent rain after the feeder runs through the glass, that is, seal the connection between the glass and the feeder with glass cement.

3.7.7 Connecting Feeder and BTS

The feeder and BTS should be connected with 1/2 jumper. Feeder connector at BTS side has already been connected during the installation of major equipment. Just connect the feeder and jumper. In the case of outdoor installation of BTS, 3layer waterproof treatment should be performed in addition.

3.8 System Testing

Use the Site Master to test the antenna and feeder system. Test the standing wave ratio (SWR) of the feeders. The SWR should be smaller than 1.5 in engineering, yet the SWR of the antenna and feeder system newly set up generally should be smaller than 1.3 (the corresponding return loss is 18dB).

For the usage of the Site Master, please refer to relevant operation instructions.

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4 Installing Satellite Synchronization Antenna and Feeder System

This chapter introduces the installation of satellite synchronization antenna and feeder system taking GPS as an example. In practical installation, it can be performed simultaneously with that of RF antenna and feeder system.

This chapter will not cover the same contents with the installation of RF antenna and feeder system. Instead, it focuses on the differences between the installations of the two systems.

4.1 Installing GPS Antenna and Feeder System

The installation of GPS antenna and feeder system is basically the same with that of RF antenna and feeder system. The major differences lie between the GPS antenna and the RF antenna. In addition, GPS antenna and feeder installation includes the installation of antenna-side and equipment-side lightning arresters. The procedure is:

- 1) Check the installation environment of GPS antenna and feeder system.
- 2) Get familiar with the engineering design documents and determine the installation scheme.
- 3) Install antenna support.
- 4) Install antenna.
- 5) Connect outdoor jumpers.
- 6) Install antenna-side lightning arrester.
- 7) Prepare the connectors of feeders, route the outdoor feeders and attach labels on them.
- 8) Mount grounding clips for feeders.
- 9) Install equipment-side lightning arrester;
- 10) Prepare, route and bind indoor jumpers, and attach labels on them.
- 11) Inspect the project installation.

 Note:

The installation of GPS antenna and feeder system can be performed simultaneously with that of RF antenna and feeder system. The specific installation process can be adjusted according to the actual configuration and environment.

4.2 Installing GPS Antenna

4.2.1 Requirements for Installation Position

The installation position of GPS antenna should have a broad vision without high buildings around, and as far as possible from the compact accessory buildings on the building-top. The available area of the plane for installing GPS antenna should be as big as possible. And the antenna should be vertically erected with a visual angle greater than 90° . See Figure 4-1.

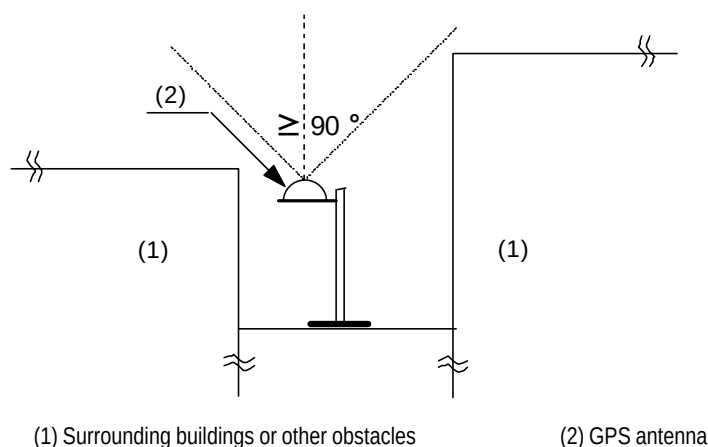


Figure 4-1 Antenna installation position

- Note that the antenna should not be close-range radiated by the front of the main lobe of the mobile communication antenna. In addition, it should not be located at the range of the microwave signal from microwave antenna, not below the high voltage cable, nor under the intense radiation of TV launching tower.
- Considering lightning protection, try the best to install the antenna at the center of the building-top. Do not install it on the stub wall around the building-top. DO not install it at the corner of the building-top as the corner has the greatest possibility of being stricken by lightning.
- The antenna should be installed at the place where there is special lightning arrester or similar facilities such as telecommunication tower around. And the antenna should be located within the valid protection range of the lightning arrester. That is, the included angle between the erect direction and the direction from the antenna RX connector to the lightning arrester or to the tower-top should be less than 30° . If there is no tower or lightning arrester around, the special lightning arrester should be installed to meet the design requirements for lightning protection of the building. The horizontal distance from the lightning arrester to the antenna should be 2m to 3m preferably. And the lightning arrester should be 0.5m higher than that of GPS antenna receive connector.

4.2.2 Installing GPS Antenna Support

In terms of varied installations, there are different supports available.

I. On tower

Figure 4-2 illustrates the support installed on tower.

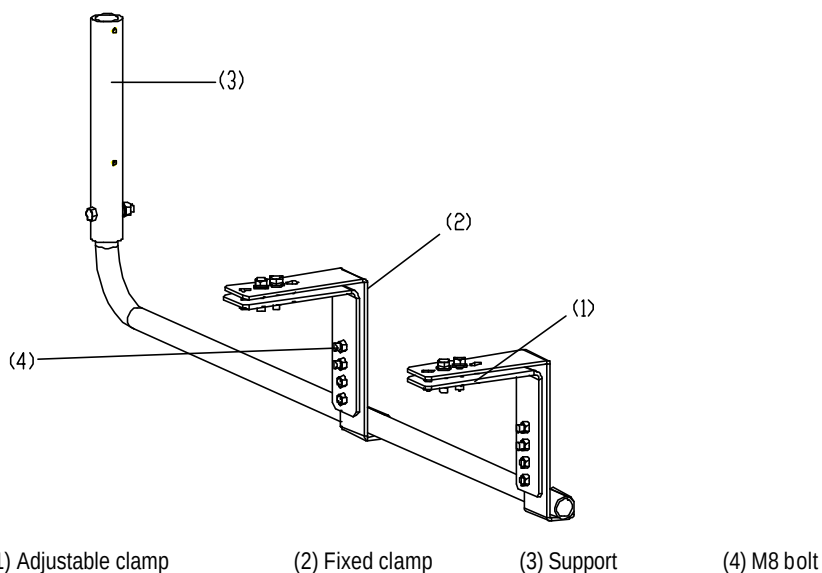


Figure 4-2 Antenna support on tower

Installation procedure is as follows:

- 1) Unscrew the bolts on the fixed clamps and remove the adjustable clamps;
- 2) Place the antenna support in the right position on the tower so that the tower angle steel is between the fixed clamp and the adjustable clamp;
- 3) Fix the support on the tower with fasteners including bolts, plain washers, spring washers and nuts;
- 4) Insert the antenna support lever into the support and put it through the bolt holes. Tighten the bolts to fix the antenna support.

Figure 4-3 illustrates an installed antenna support on tower.

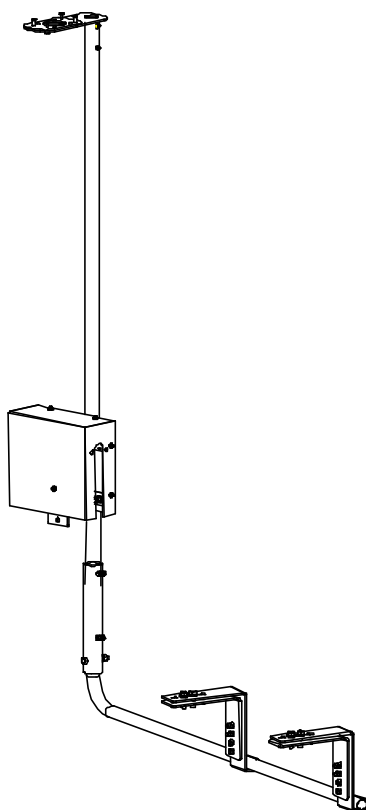


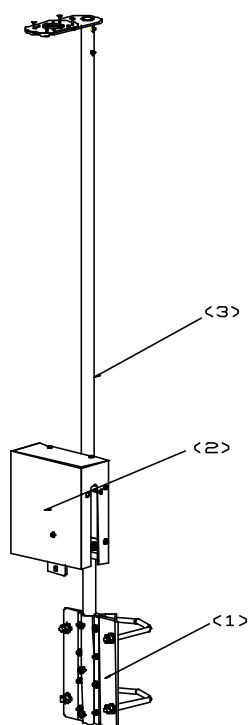
Figure 4-3 Installed antenna support on tower

 Note:

For the tower without angle steel, the above mentioned antenna support cannot be used. Antenna support for metal mast can be adopted. Please refer to the section right below for its installation.

II. On metal mast

The antenna support for installation on metal mast is shown in Figure 4-4.

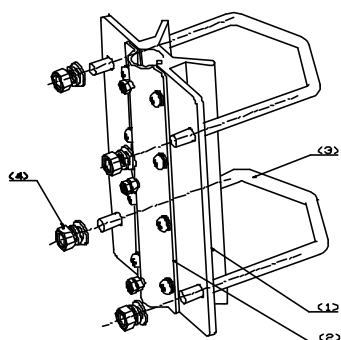


(1) GPS installation anchor ear (2) Lightning arrester enclosure (3) Support

Figure 4-4 Antenna support for installation on metal mast

Installation procedure is as follows:

- 1) Unscrew the fastening bolts on GPS installation anchor ear and remove the anchor ear.
- 2) Round the U-shape clip on the metal mast for GPS antenna. Fasten M10 bolt to fix the GPS installation anchor ear on the metal mast. The structure of GPS installation anchor ear is shown in Figure 4-5.



(1) Front clamp (2) Rear clamp (3) U-shape clip (4) M10 bolt

Figure 4-5 Structure of GPS installation anchor bolt

- 3) Remove the rear clamp on the GPS installation anchor ear. Put the antenna support lever between the front clamp and the rear clamp. Then adjust the direction of the antenna support lever.
- 4) Fasten the rear clamp and the bolts to secure the antenna support lever.

III. On building-top

The GPS antenna support for installation on building-top is shown in Figure 4-6.

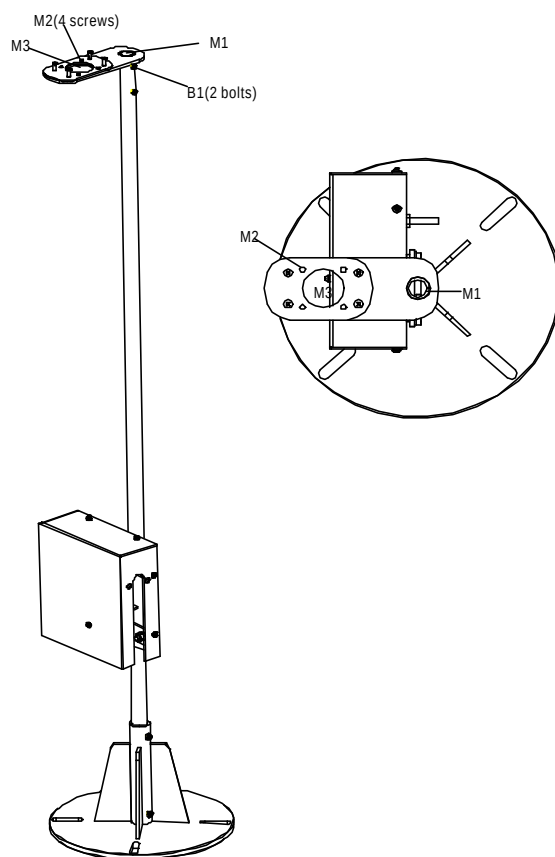


Figure 4-6 Structure of GPS antenna support on building-top

Install procedure is as follows:

- 1) Place the metal base of the antenna support on the concrete base and align the centers. Mark the position of the installation holes with an engineering pen.
- 2) Drill holes at the marks using a drill with the bit of $\phi 12$.
- 3) Install expansion bolts to secure the base. In order to keep the antenna pole erect so as to reach better receiving performance, try to keep the metal base level using washers.
- 4) Insert the support lever into the base to see whether the lever is erect. It is required that the included angle between the support lever and the direction of the plummet be smaller than 5° . If the requirement can not be satisfied, adjust the base.

4.2.3 Installing Antenna

There are various types of antennae. Figure 4-7 and Figure 4-8 show two types of common antennae. The following gives the installation of two types of GPS antennae respectively.



Figure 4-7 GPS antenna of type AT1670-0



Figure 4-8 GPS antenna of type UTONCORE

I. Installing GPS antenna of type AT1670-0

- 1) Insert the jumper connector at the antenna bottom into M3 of the antenna support as shown in Figure 4-6;
- 2) Fasten the four accessory UK-standard bolts at M2;
- 3) Tighten the antenna and the cable connector.

II. Installing GPS antenna of type UTONCORE

- 1) UTONCORE GPS antenna has such auxiliary fixtures as a rubber washer, a metal plain washer and a bolt. During installation, first unfix the bolt at the antenna bottom and install the rubber washer instead. Then insert the antenna into M3 of the antenna support as shown in Figure 4-6;
- 2) Install the metal plain washer on the jumper connector at the bottom of the antenna (with the washer head tightly against the bottom of M3);

- 3) Tighten the antenna connector and the cable socket. Finally reinstall the unfixed bolt. Thus the GPS antenna is fixed on the ellipse holder of the antenna support.



Caution:

- 1) Waterproof treatment should be performed at the antenna connector. Please refer to Section 2.3.6 for waterproof treatment process.
 - 2) Upon completion of installation, cover the antenna support with anti-rust paint, especially the fastening bolts, expansion bolts and the places around the bolt holes.
-

4.3 Installing GPS Feeder

GPS feeder installation includes the installation of jumpers, antenna-side lightning arrester, feeder, equipment-side lightning arrester, etc. The installation and routing of GPS feeder is similar to that of RF feeder. Following gives explanation of points for attention and grounding requirements during the installation.

4.3.1 Routing Feeder

Prior to feeder routing, carefully check the routing environment including the tower and building-top. Determine the routing scheme and sequence as per the engineering drawing.

- In the case of BTS indoor installation, the route leading the feeder from the installation position to the equipment room containing the cabinet and equipment should be clear. It should facilitate fixing the cable properly and meet the routing requirements in the equipment room. In addition, reliable measures should be taken to protect the feeder from rain and corrosion.
- 1.5m jumper should be bound at the outside of the antenna support lever evenly with cable ties. In addition all cable ties should be fastened, with the same spacing of 200mm. The cable tie heads should be toward the same direction, and all the ties should be cut neatly to the end.
- Waterproof elbow should be made at the entrance where the feeder enters the equipment room. The vertical distance from the lowest point of the waterproof elbow to the entrance should not be less than 200mm so as to prevent rain from entering the room.
- In the case of GPS antenna installed on building-top, connectors at both ends of the feeder should be protected with strong materials (such as packing bags for board) to prevent damage to the connectors. The feeder should be fixed with plastic clips attached with steel nails along the root of the parapet on the

building-top. The spacing between plastic clips should be 1m. And the direction of the clip heads should be interlaced regularly. If two feeders are joined, they should be bound together without intersection or curve.

- When routing the feeder, try to expand the feeder roll before routing. Try to avoid bending of it. If it is unavoidable to bend the feeder, the bent radius should not be less than the minimum of the allowed bent radius for the cables so as to avoid damage to the feeder.



Caution:

When the distance from the antenna to the BTS is greater than 100m, 7/8 feeder should be adopted so as to minimize signal loss. If it is unavailable, 1/2 feeder should be adopted, instead.

4.3.2 Installing Lightning Arrester

There are two types of lightning arresters for GPS antenna, i.e. antenna-side lightning arrester and equipment-side lightning arrester. The former is used for lightning protection for active GPS antennae, while the latter for the GPS card. The two arresters are of the same model.

Currently there are two types of lightning arresters. The installation procedure for each type is described in detail as follows:

I. Type iS-MR50LNZ+6 lightning arrester

Figure 4-9 illustrates the appearance of Type iS-MR50LNZ+6 lightning arresters.

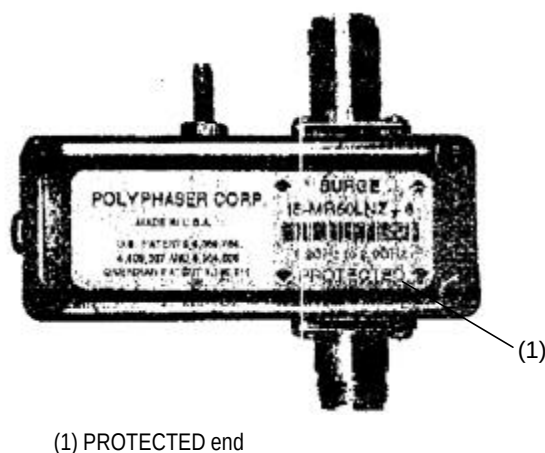


Figure 4-9 Appearance of Type iS-MR50LNZ+6 lightning arrester

Attention:

- 1) GPS antenna-side lightning arrester
 - The "PROTECTED" end of the GPS lightning arrester should face the antenna. That is, the "PROTECTED" end of the arrester is connected with the jumper end.
 - The lightning arrester should not be grounded when it is installed either on the tower or on building-top, but the feeder grounding clip should be as close as possible to the lightning arrester.
 - The lightning arrester is installed inside the lightning arrester box, with its connectors sealed with waterproof adhesive tape and PVC tape in sequence, so as to prevent moisture invasion.
- 2) GPS equipment-side lightning arrester
 - The "PROTECTED" end of GPS lightning arrester should face the BTS. That is, the "PROTECTED" end of the arrester is connected with the GPS port of the BTS.
 - In the case of BTS indoor installation, dual-male conversion connector should be used to connect the lightning arrester directly to the GPS port of MBPM. It is unnecessary to connect the lightning arrester to lightning protection grounding cable.
 - In the case of BTS outdoor installation, dual-male-connector jumper of 0.3m long should be used to connect the lightning arrester to the GPS port of MBPM. The arrester should then be connected to the lightning protection grounding cable that leads to the grounding bar of the BTS. The connector between the arrester and the feeder should be sealed with waterproof adhesive tape and PVC tape in sequence, so as to prevent moisture invasion.

II. Type DGXZ+6NFM-A lightning arrester

Figure 4-10 illustrates the appearance of Type DGXZ+6NFM-A lightning arrester.

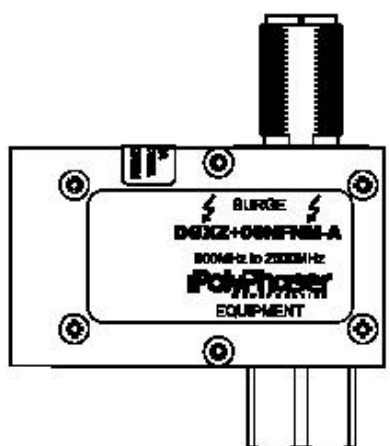


Figure 4-10 Appearance of Type DGXZ+6NFM-A lightning arrester

Attention:

- 1) GPS antenna-side lightning arrester
 - The connectors on both ends of Type DGXZ+6NFM-A lightning arrester are male and female respectively. Therefore, jumpers with male and female connectors should be prepared for the installation of the lightning arrester. The male connector of the jumper is connected with the GPS antenna, while the female connector on the other end is connected with the male connector of the lightning arrester.
 - The lightning arrester should not be grounded when it is installed either on the tower or on building-top, but the feeder grounding clip should be as close as possible to the lightning arrester.
 - The lightning arrester is installed inside the lightning arrester box, with its connectors sealed with waterproof adhesive tape and PVC tape in sequence, so as to prevent moisture invasion.
- 2) GPS equipment-side lightning arrester
 - In the case of BTS indoor installation, the lightning arrester may be directly connected to the GPS port of MBPM. And it is unnecessary to connect the lightning arrester to the lightning protection grounding cable.
 - In the case of BTS outdoor installation, a 0.3m jumper with both male and female connectors should be used. Its male connector is connected to the GPS port of MBPM of the BTS, while its female connector to the male connector of the lightning arrester. The lightning arrester should be connected to the lightning protection grounding cable that leads to the grounding body of the BTS. And the connector between the lightning arrester and the feeder should be sealed with waterproof adhesive tape and PVC tape in sequence, so as to prevent moisture invasion.

4.3.3 Grounding Requirement

GPS feeder grounding and routing are conducted simultaneously. The following gives description of feeder grounding points in different installations.

I. BTS outdoor installation (building-top installation excluded)

- Within the range of 1m~2m under the GPS antenna;
- The front end connecting the BTS.



Caution:

If the GPS feeder is not longer than 5m, its shielding covering may be grounded only at the front end connecting the BTS.

II. BTS outdoor installation on building-top

In this installation mode, GPS feeder shielding covering may be grounded only at the front end connecting the BTS.

III. BTS indoor installation with GPS antenna and BTS antenna installed on the same tower or metal mast

- 1) When the outdoor GPS feeder is longer than 20m:
 - Within the range of 1m~2m under the GPS antenna;
 - Within 1m range of the mast or of where the GPS feeder is led from the tower platform;
 - At the outer side of the feeder window where the GPS feeder enters the equipment room (connecting to outdoor protection grounding bar).
 - Close to the indoor protection grounding bar after it enters the equipment room.
- 2) When the outdoor GPS feeder is not longer than 20m:
 - Within the range of 1m~2m under the GPS antenna;
 - At the outer side of the feeder window where the GPS feeder enters the equipment room (connecting to outdoor protection grounding bar).
 - Close to the indoor protection grounding bar after it enters the equipment room.



Caution:

- 1) If the GPS feeder is longer than 60m, feeder grounding clips should be applied in the middle of the feeder, with the clip spacing of 20m.
 - 2) If the GPS feeder is led into the room after being routed for a stretch of distance on the building-top, and the distance exceeds 20m, a feeder grounding clip is required on the top of the building.
 - 3) For the GPS feeder that enters the room from the building-top along the wall, if a cabling rack is used, the cabling rack should also be grounded.
-

IV. BTS indoor installation with GPS antenna not on the BTS tower but separately placed

- The shielding covering of GPS feeder is grounded at the entrance to the building. The grounding point should be the outdoor grounding bar of the mobile equipment room. The grounding cable should adopt the plastic insulation copper core wire of diameter not less than 6mm². It should be black, or yellow and green.
- If the feeder is longer than 60m, feeder grounding clips should be applied in the middle of the feeder, with the clip spacing of 20m.
- Place the GPS feeder close to the indoor protection grounding bar after it enters the equipment room.



Caution:

When the GPS feeder is not longer than 10m, the shielding covering of the coaxial feeder may be grounded at one point indoor only.

4.3.4 Feeder Label

Figure 4-11 illustrates the standard nameplate used as GPS feeder label.

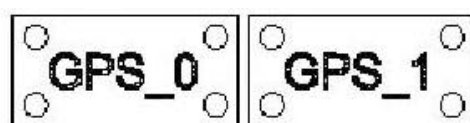


Figure 4-11 GPS feeder label

I. BTS indoor installation

GPS feeder labels can be affixed in three positions:

- 0.3m to the outdoor feeder connector;
- Outside the feeder entrance to the feeder window;
- 0.3m to the indoor feeder connection.

II. BTS outdoor installation

GPS feeder labels can be affixed in two positions:

- 0.3m to the outdoor feeder connector;
- 0.3m to the front end connecting the BTS.

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5 Installation Check

Upon completion of all hardware installation, check the installation including the following aspects: overall check, power-on check, environment condition check and system commissioning.

5.1 Overall Check

5.1.1 Checking Equipment Installation

- All the equipment should be steady and neat in appearance when installed.
- All the bolts and nuts are fastened. And plain washers and spring washers are applied under all the nuts with the plain washer under the spring washer.
- There should be no missing or damaged parts on the equipment, and all the cables should be intact.
- The rack interior should be cleaned. Fingerprints and smudges left during the installation should be cleaned. There should be no dust in the rack.

5.1.2 Checking Cable Connection

- Power cables should be well connected. The connector should not be loose or damaged. And there should be no scratch or fissure on the power cable skin.
- Check whether the contact of the grounding cable is good.
- Check whether the trunk cable connections are secure and correct.
- All the cables should be secure. Do not over-strain the cables running round the corner. Cables and fibers should run in straight and smooth courses without any cross. Cables and fibers in the same direction should be bundled up. The cable layout should be neat and tidy with the same bundling space. Signal cables cannot be bundled with power cables and grounding cables.
- There should be no damage to the skin of all the cables.

5.1.3 Checking Lightning Protection Grounding

I. Checking outdoor grounding

Outdoor grounding check includes the following aspects:

- Outdoor grounding bar should be connected to the counterpoise with grounding bus. DO NOT connect the outdoor grounding bus to the grounding flat steel of the feeder lightning arrester.

- Check whether there is good electrical connection between the UPS shell and the UPS external box via screws. UPS external box should be grounded.
- Check whether the protection grounding cable of AC lightning protection box or IAFB is directly connected to the protection grounding bar. Make sure the grounding cable is shorter than 1m.
- The AC power cable from the exterior to the BTS should be directly connected to the AC lightning protection box (when AC lightning protection box is available) or to the IAFB (when AC lightning protection box is unavailable). It is not allowed to connect the external power cable to the power distribution terminal in the work box first and then to the AC lightning protection box.
- When E1 cable is used for signal transmission of the BTS, if the E1 cable from the exterior to the BTS is coaxial cable with metal shell (provided by the user), its metal shell should be grounded with grounding clip. The grounding cable from the grounding clip should be directly connected to the protection grounding bar instead of to the grounding bar of the IAFB.
- In BTS outdoor tower installation mode, the shielding covering of the BTS coaxial feeder should be grounded at the tower-top and the front end connecting the BTS. The grounding cable should be connected to the tower body nearby. The protection grounding bar should have separate grounding downlead that is not insulated from the tower body.
- When the feeder is not shorter than 60m, the shielding covering of the coaxial feeder should be grounded at the middle of the tower body.

II. Checking indoor grounding

Indoor grounding check includes the following aspects:

- In BTS indoor installation, there should be indoor grounding bar and outdoor grounding bar that should be led into the counterpoise separately instead of being connected in series directly with grounding cables.
- The grounding cable at the point where the feeder enters the feeder window is connected to the outdoor grounding bar in the direction from the antenna to the BTS.
- The AC lightning protection box provides separate grounding cable to connect to the indoor grounding bar. The grounding cable from the AC lightning protection box or from the IAFB to the indoor grounding bar should be shorter than 1m.
- Check whether there is good electrical connection between the UPS shell and the UPS external box via screws. UPS external box should be grounded.
- When E1 cable is used for signal transmission of the BTS, if the E1 cable from the exterior to the BTS is coaxial cable with metal shell (provided by the user), its metal shell should be grounded with grounding clip. The grounding cable from the grounding clip should be directly connected to the indoor grounding bar instead of to the grounding bar of the IAFB.

- The shielding covering of the coaxial feeder should be well grounded at the tower-top, tower-bottom and the outside of the entrance to the equipment room. When the feeder is not shorter than 60m, the shielding covering of the coaxial feeder should be grounded at the middle of the tower body.
- The outdoor grounding bar and indoor protection grounding bar should share the counterpoise of the equipment room. The outdoor grounding bar should not be connected to the tower counterpoise for grounding.
- The feeder skin should be grounded after the feeder enters the equipment room. The grounding cable from the feeder skin should be directly connected to the indoor grounding bar.

5.2 Power-on Check

- 1) Check whether the voltage of the power supply is normal (normal voltage range: 150VAC~300VAC). If it is normal, turn on the power switch of the BTS and check whether the indicators on the power supply module of the BTS are normal. Please refer to User Manual for indicator descriptions.
- 2) Observe the running of boards and modules. Cut off the power supply immediately in case of any exception. Power on all the boards and modules after the fault is removed.

5.3 Checking Environment Condition

- 1) There should be no sundries inside or on top of the sun-shading cover. The cover should be clean without any smudge or fingerprint.
- 2) There should be no redundant tape or cable tie on the cable.
- 3) There should be no tape, cable tie head, waste paper, or packing bag around the BTS.
- 4) All the things around the BTS should be clean and neat in their original appearance.

5.4 System Commissioning

After the BTS is powered on, if the indicators of all the modules are normal, system commissioning should be performed by starting some basic operations and maintenance and function test. The following briefs the items of system commissioning:

- 1) Location update flow
- 2) MO call flow
- 3) MT call flow
- 4) Handover flow
- 5) MO SM flow
- 6) MT SM flow
- 7) MO packet data flow

- 8) MS packet data flow test (downlink traffic rate).

 Note:

System commissioning items can be determined as per the specific situation at the site. The above is the system commissioning item list. For details, please refer to relevant engineering documents.

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A Installing IAFB

There are 3 installation modes for IAFB: Wall installation, metal mast installation ($\phi 60 \sim \phi 114$) and pole installation ($\phi 150 \sim \phi 350$).

A.1 Installation Flow

Figure A-1 is the installation flow of IAFB.

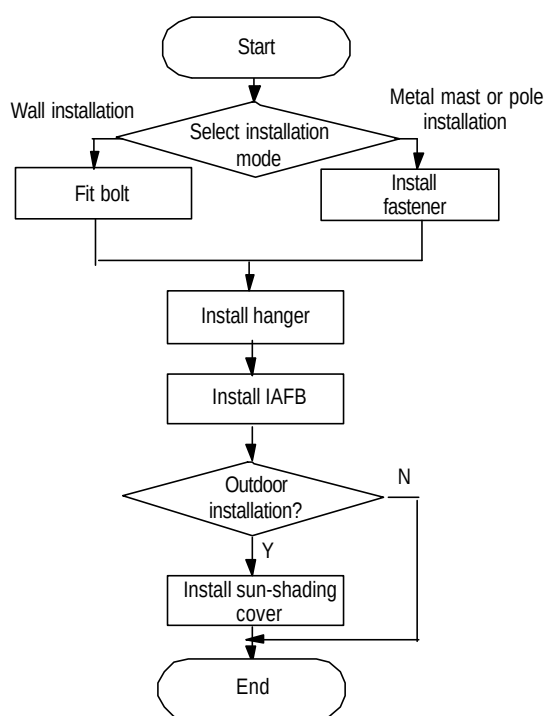
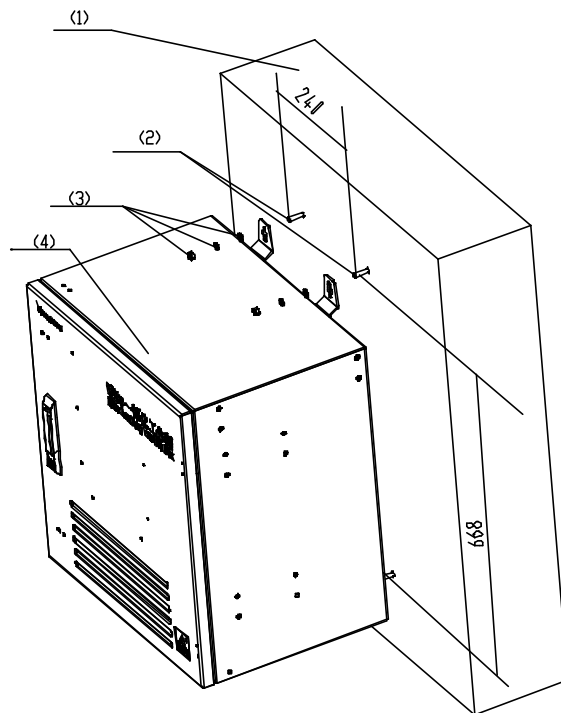


Figure A-1 IAFB installation flow

A.2 Wall Installation

The wall installation procedure of IAFB is as follows:

- 1) Determine a proper installation position on the wall. Mark it with a pencil as the hole for bolt. The hole is the key position for bracket installation, as shown in Figure A-2.



(1) Wall (2) M8×80 exploded expansion bolt (3) Bolt, plain washer, spring washer (4) Box

Figure A-2 Fixing bolts

- 2) Drill a hole with the drill bit of $\phi 10\text{mm}$ at the mark for the bolts, Then mount the exploded expansion M8×80 bolt.



Caution:

The depth of the hole is 50mm~60mm. It cannot be too deep; otherwise, the installation may be affected by the part of the expansion bolt extended outside the wall. Neither can it be too shallow, otherwise it may affect the reliability of the BTS.

- 3) Determine the other three holes with a plumb line and a ruler and mark them with a pencil.
- 4) The procedure to drill holes and install the expansion bolts is similar to that mentioned above.
- 5) Use combination screw M6×12 to mount the 4 hangers on the back of the box, as shown in Figure A-3.

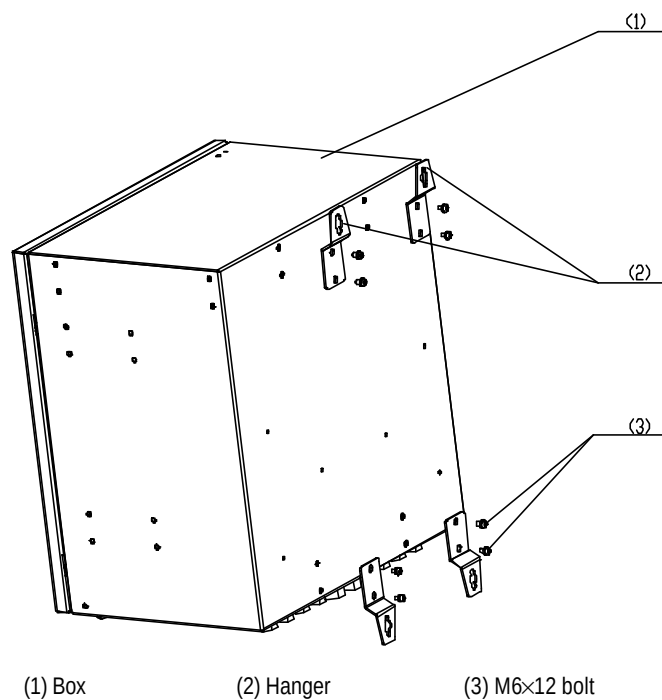


Figure A-3 Installing hanger

- 6) Mount the hangers of IAFB aiming at the four bolts. Mount plain washer, spring washer and nut on the bolt. Then fasten the nut clockwise with an adjustable wrench to fix the bracket on the wall.



Caution:

The length of the bolt outside the wall should be about 20mm. And the washer should be mounted before the nut is fastened.

- 7) The installation of sun-shading cover is shown in Figure A-4. It is fixed with M12x16 bolt.

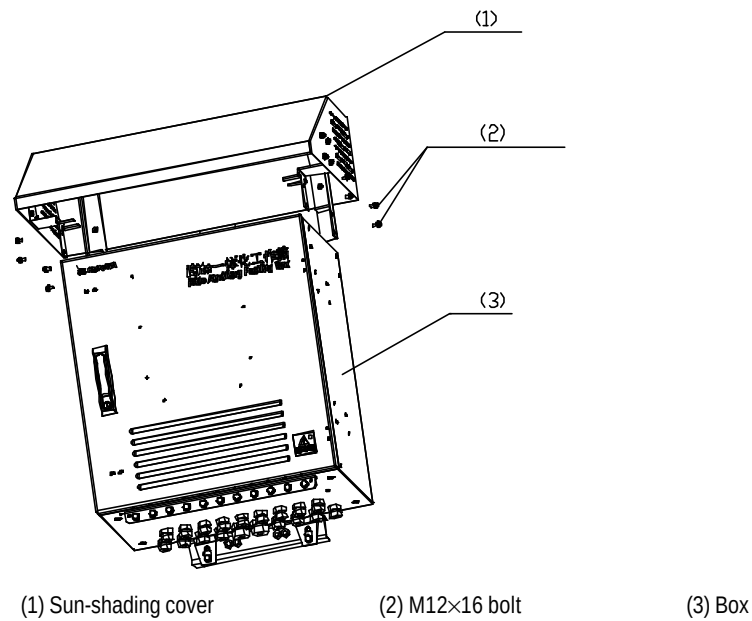


Figure A-4 Installing sun-shading cover

A.3 Metal Mast Installation

The installation procedure of IAFB metal mast is as follows:

- 1) Mount the beam and fastener to the steel pipe with M10 bolt and nut. The pipe is between the beam and the fastener. Then fasten the bolt and nut. See Figure A-5.

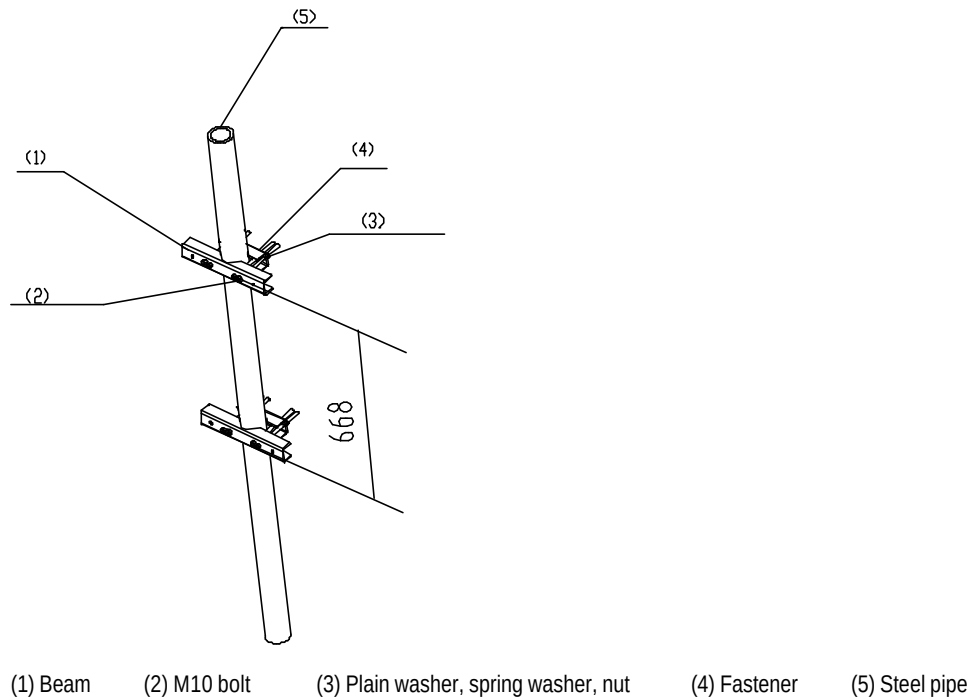


Figure A-5 Installing beam and fastener

- 2) Lean the box of IAFB on the beam and let M8×25 bolt go through the hanger of IAFB. Then fasten the IAFB to the beam. See Figure A-6.

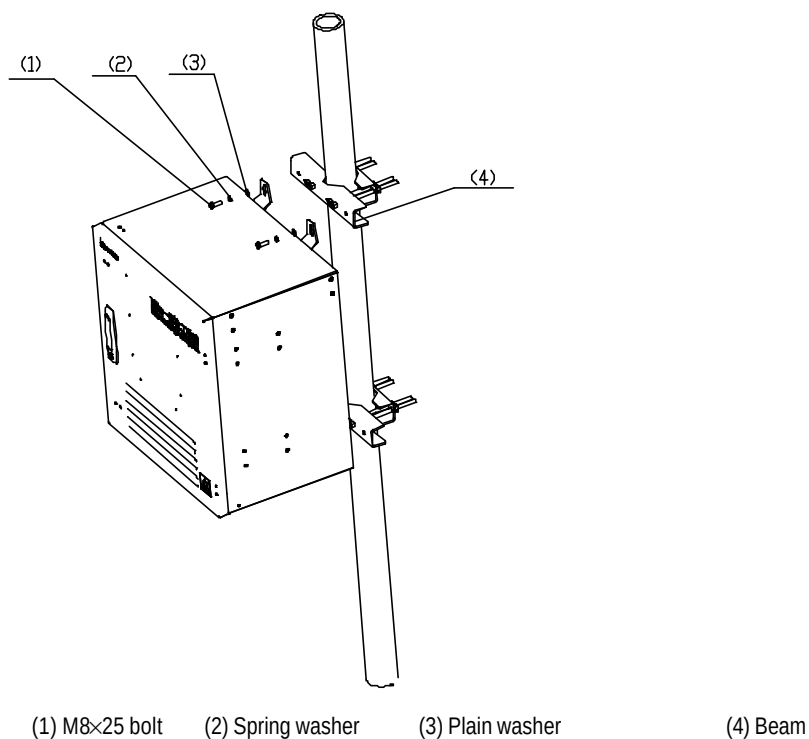
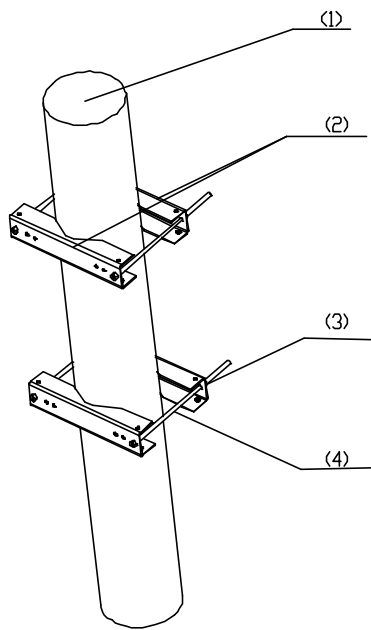


Figure A-6 Fixing IAFB

A.4 Pole Installation

The installation procedure of IAFB pole is as follows:

- 1) Lean the fastener to the pole and fasten the beam to let the pole be in the middle of the pole. Then fasten the beam with bolt and nut. Refer to Figure A-7 below.



(1) Pole (2) Fastener (3) Plain washer, spring washer, nut (4) M12 bolt

Figure A-7 Fixing fastener

- 2) Fix the IAFB to the fastener with M8×25 bolt. Its installation procedure is similar to that on metal mast. See Figure A-6.

A.5 Installation Check

After all the parts are installed, check the installation in the following aspects: parts installation overall check, BTS power-on check and environment check.

I. Overall Check

As a review on the whole foregoing installation process, the overall check includes the following items:

1) Fixation check

The IAFB installed should satisfy the following requirements:

- The IAFB should be secure with neat appearance.
 - All the bolts and nuts are fastened with plain washer and spring washer mounted in correct sequence.
 - There should be no missing or damaged parts, and all the cables should be intact.
 - The IAFB should be clean without any smudge, fingerprint or dust.
- #### 2) Cable connection check
- Power cables should be well connected. The plugs should not be loose or damaged. And there should be no scratch or fissure on the power cable shell.
 - Check whether the contact of the grounding cables is good.

- All the cables should be secure. Do not over-strain the cables running round the corner. Cables and fibers should run in straight and smooth courses without any cross. Cables and fibers in the same direction should be bundled up. The cable layout should be neat and tidy with the same bundling space.
- There should be no damage to the shell of all the cables.

II. Environment condition check

- 1) There should be no sundries inside or on top of the sun-shading cover. The cover should be clean without any smudge or fingerprint.
- 2) There should be no redundant tape or cable tie on the cable.
- 3) There should be no tape, cable tie head, waste paper, or packing bag around the IAFB.
- 4) All the things around the BTS should be clean and neat in their original appearance.

III. Power-on check

Open the door of the IAFB and check whether the voltage of the power supply is normal. If the power switch is turned on normally, test with the multimeter whether the output voltage is normal.

B Requirements for Antenna Isolation

I. Requirements for isolation of omni antenna

Based on the conditions that antenna gain is 10dBi and isolation is 30dB, the spacing between antennae is required as follows:

- When antennae are installed horizontally, the horizontal spacing between transmit (TX) antenna and receive (RX) antenna should not be less than 5.3m.
- When antennae are installed vertically, the vertical spacing between TX antenna and RX antenna should not be less than 0.2m.
- According to the requirements for diversity receiving of omni RX antenna, the horizontal spacing between RX antennae should not be less than 4m.

II. Requirements for isolation of directional antenna

1) Single polarization antenna

Based on the conditions that antenna gain is 15dBi, isolation is 30dB and half-power angle is 65°, the spacing between antennae is required as follows:

- When antennae are installed horizontally, the horizontal spacing between TX antenna and RX antenna in the same sector should not be less than 3m.
- When antennae are installed vertically, the vertical spacing between TX antenna and RX antenna in the same sector should not be less than 0.2m.
- The horizontal spacing between TX antenna and RX antenna in different sectors should not be less than 0.2m.
- According to the requirements for diversity receiving of directional RX antenna, the horizontal spacing between RX antennae should not be less than 4m

2) Dual polarization antenna

For dual polarization antennae, the spacing between the ports of the RX and TX antennae is 30dB. Therefore, the horizontal spacing may not be considered during horizontal installation. But in vertical installation, the vertical spacing between antennae of different sectors should not be less than 0.2m.

Note:

The antenna isolation requirements in this section are subject to typical applications. They are for reference only. During the actual installation, the antenna isolation should be determined by the relevant engineering design documents.

C Making Connectors

C.1 Overview

Preparation of connectors is a very important job during the installation of antenna and feeder system. Normative and correct operation will directly affect the performance of the antenna and feeder system. In this chapter, we respectively introduce the preparation of the DIN connector and N connector of antenna and feeder for the reference of project installation.



Note:

What described in this section is for reference only. The preparation of connectors for antenna and feeder should be follow the auxiliary installation instruction for connectors in the actual installation.

C.2 Making 7/16 DIN Connector and N Connector for Jumper



Caution:

The following takes the preparation of 7/16 DIN connector as an example. N connector is prepared in the same way.

I. Tools required

Spanners (one is 19mm and the other is 22mm), fast cable cutter, fast cable stripper, safety knife, electric blower, diagonal pliers, nipper pliers, pliers, file, brush and ruler are all required.

II. Making connectors

- 1) Get the required tools ready and put them in a convenient place.
- 2) Cut the jumper to be mounted with a connector to the accurate length.

- 3) Cut the skin of the cable at 28 mm away from the connector with the fast cable cutter and the safety knife, as shown in Figure C-1.
- 4) Strip off the outer conductor at 7 mm away from the connector with the fast cable cutter, and keep the cutting surface smooth, as shown in Figure C-2.

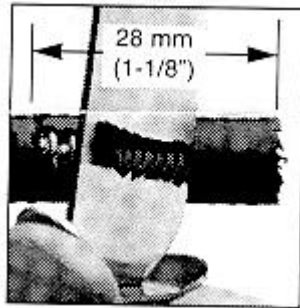


Figure C-1 Cutting cable skin with safety knife

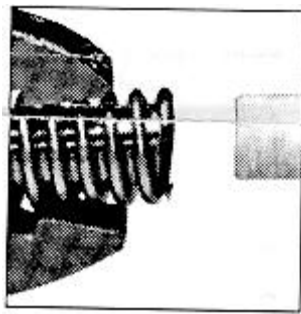


Figure C-2 Stripping off outer conductor

- 5) Remove the foam plastic and the adhesives with the safety knife. Be careful not to damage the inner conductor, as shown in Figure C-3.
- 6) Taper the inner conductor with a file and the nipper pliers, as shown in Figure C-4.

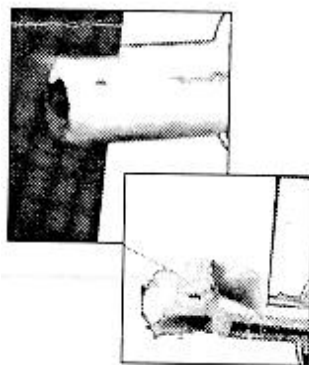


Figure C-3 Removing foam plastic and adhesives

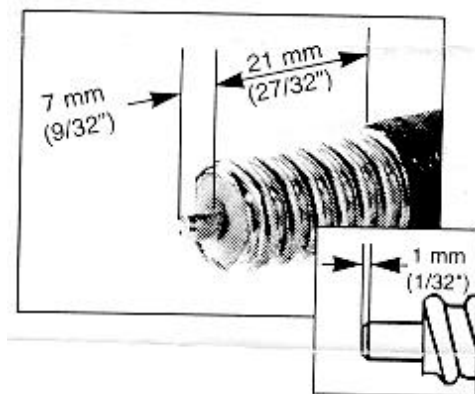


Figure C-4 Tapering inner conductor

- 7) Brush off the residuals, as shown in Figure C-5.

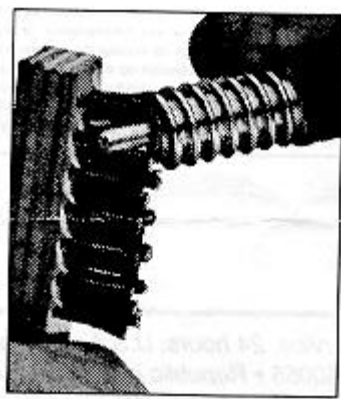


Figure C-5 Brushing off residuals

- 8) Apply grease and mount fixing nut. Place the heat-shrink tube into the cable and then screw the fixing nut to the cable until it is tight, as shown in Figure C-6.

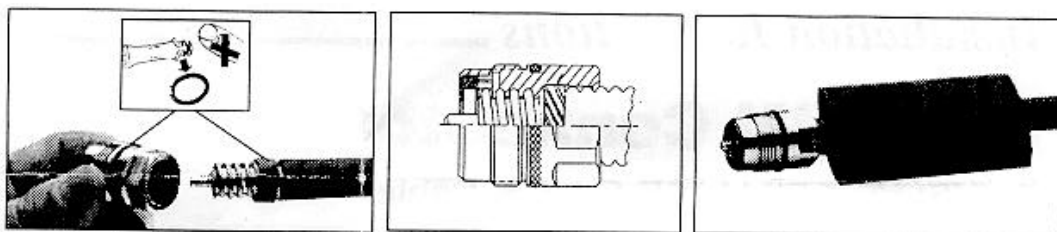


Figure C-6 Screwing fixing nut onto cable

- 9) Mount the connector cap. Screw the connector cap while keeping the fixing nut still, as shown in Figure C-7.

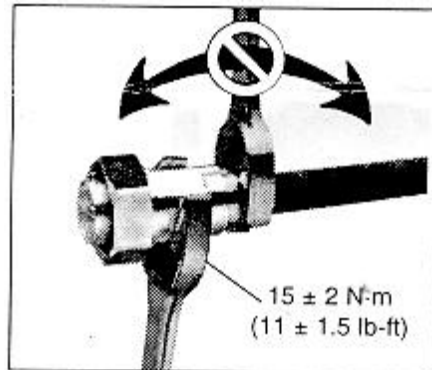


Figure C-7 Mounting connector cap

- 10) Heat up the heat-shrink tube, as shown in Figure C-8.

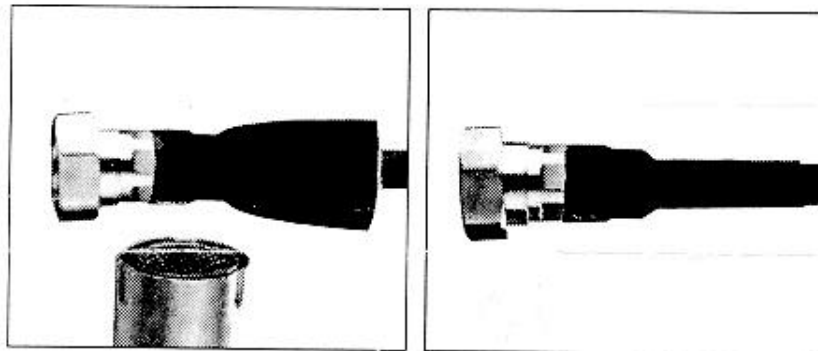


Figure C-8 Heating up heat-shrink tube

- 11) Fit torque, as shown in Figure C-9.

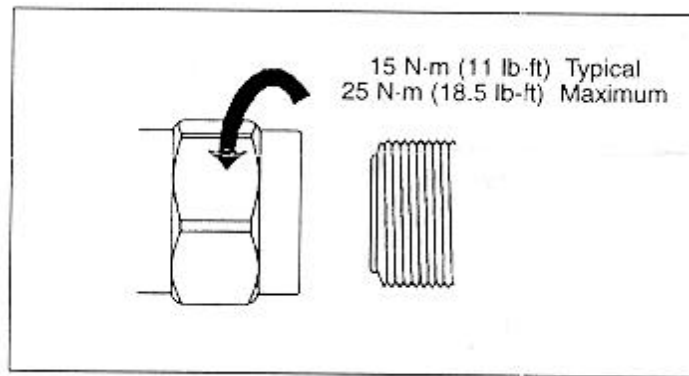


Figure C-9 Fitting torque

- 12) Be sure to test the connector after it is made. It can only be put into use after it passes the test.



Caution:

1. Pay attention to safety during the preparation. Improper operation of sharp-edged tools can cause human injury.
2. Be sure to clean up the feeder remainders to avoid copper scales from mixing up with the connector, which could adversely affect the performance of the antenna and feeder system.

C.3 Making 7/16 DIN Connector and N Connector for 7/8 Feeder



Caution:

The following takes the preparation of N connector as an example. 7/16 DIN connector is prepared in the same way.

I. Tools required

Spanners (one is 19mm and the other is 22mm), fast cable cutter, fast cable stripper, safety knife, electric blower, diagonal pliers, nipper pliers, pliers, file, brush and ruler are all required.

II. Making connectors

- 1) Get the required tools ready and put them in a convenient place.
- 2) Straighten the end of the feeder to be mounted with a connector.
- 3) Cut the feeder with a fast cable cutter. The cutting surface should be smooth.
- 4) Cut the cable skin at 51mm away from the connector with the fast cable cutter and the safety knife, as shown in Figure C-10.
- 5) Add O-ring and apply proper amount of grease on it, as shown in Figure C-11.

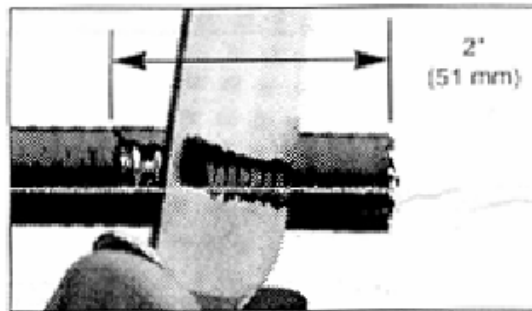


Figure C-10 Cutting cable skin

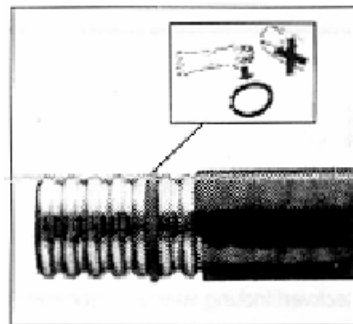


Figure C-11 Adding O-ring and applying grease

- 6) Add fixing nut, as shown in Figure C-12.
- 7) Place spring ring and fix it in the outer conductor trough of the feeder, as shown in Figure C-13.

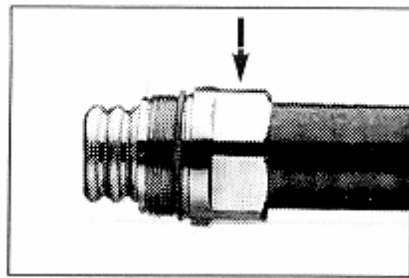


Figure C-12 Adding fixing nut

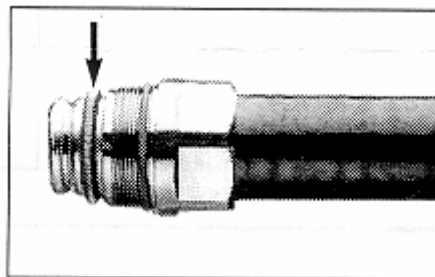


Figure C-13 Adding spring ring

- 8) Adjust the hacksaw and the hacksaw guide (big washer) to cut the cable, as shown in Figure C-14.
- 9) Brush off the burr and residuals, as shown in Figure C-15.

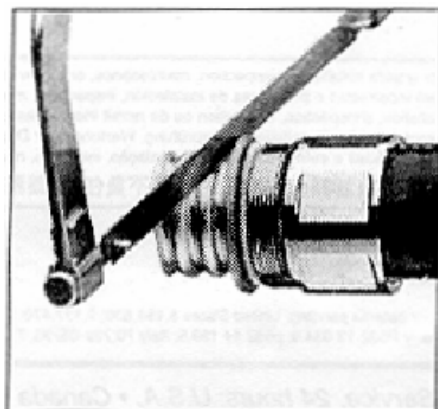


Figure C-14 Cutting cable

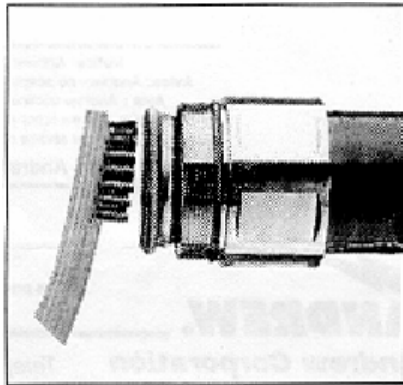


Figure C-15 Brushing off residuals

- 10) Press the foam plastic tightly, as shown in Figure C-16.
- 11) Add O-ring and apply grease to it. Mount the connector body, as shown in Figure C-17.

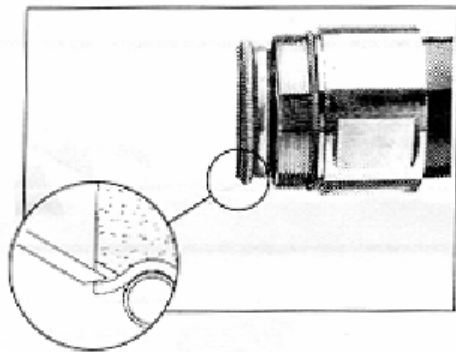


Figure C-16 Pressing foam plastic tightly

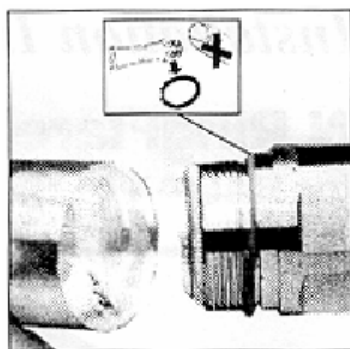


Figure C-17 Mounting connector body

- 12) Expand the outer conductor with a fast cable stripper (fitting the feeder type). Check the stretching surface and clean off the residuals, as shown in Figure C-18.

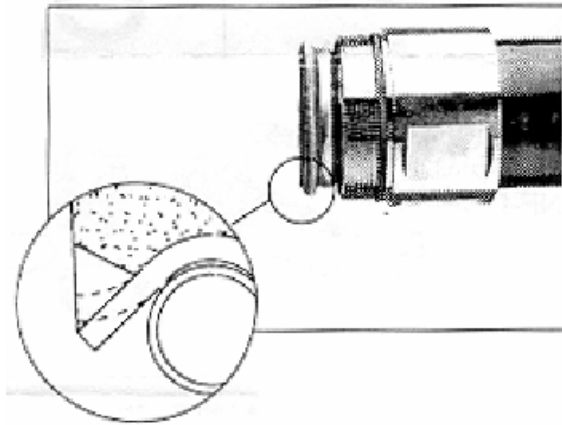


Figure C-18 Stretching outer conductor

- 13) Refit the connector. Never rotate the connector body while installing, as shown in Figure C-19.
- 14) Fit the torque, as shown in Figure C-20.

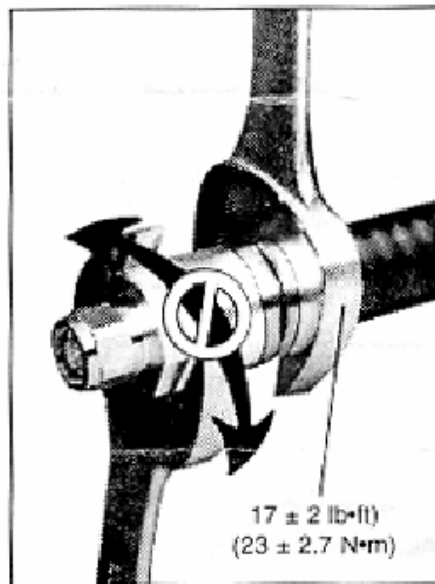


Figure C-19 Fitting connector

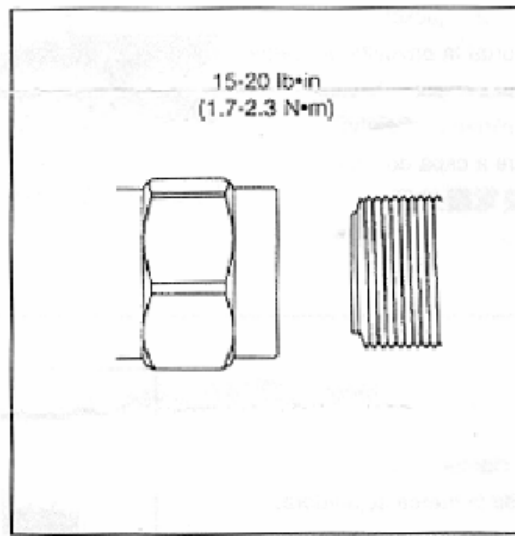


Figure C-20 Fitting torque

D Preparing Grounding Clips

D.1 Overview

During the entire installation, there are many places where grounding clips should be applied. The following is the summary of the places where grounding clips are required.

- 1) Normally, each feeder should be grounded at the following three points at least for lightning-protection:
 - Within 1m's reach behind the place where the feeder is led from the tower platform;
 - Within 1m's reach in front of the place where the feeder is led from the tower body to the outdoor cabling rack;
 - At the outer side of the feeder window before which the feeder is led into (on the spot).

When the length of the feeder along the tower body exceeds 60m, more lightning-protection grounding clips should be added in the middle of the tower body. Typically, one clip is installed for every 20m.

- 2) If the feeder is led into the room after being routed for a stretch of distance on the building-top, and the distance exceeds 20m, a lightning-protection grounding clip is required on the top of the building.
- 3) For the feeder that enters the room from the building-top along the wall, if an outdoor cabling rack is used, the cabling rack should also be grounded.

D.2 Preparation Process

- 1) Prepare the required tools, such as paper cutter, flat screwdriver and nipper pliers, etc.
- 2) Unpack the box and bags containing the lightning-protection grounding clips and put various parts and accessories on clean ground or paper for use, as shown in Figure D-1.



Figure D-1 Installation accessories of lightning-protection grounding clips

- 3) Determine the location for lightning-protection grounding clip installation. Cut the feeder skin according to the clip size to expose the outer conductor, as shown in Figure D-2.



Figure D-2 Striping off feeder skin

- 4) Fix the lightning-protection grounding clip on the feeder. The grounding cable of the clip should be led from the top down with the angle between the feeder and the grounding cable not greater than 15° , as shown in Figure D-3.



Figure D-3 Lightning protection grounding clip fixed on feeder

- 5) Wrap up the lightning protection grounding clip with PVC tape, semi-conductive self-adhesive tape and waterproof tape in turn. When wrapping, do it from the bottom up, then from the top down and finally from the bottom up again. Each turn should be overlapped by the next turn for about one-third of the width as shown in Figure D-4.



Figure D-4 Wrapping lightning protection grounding clip with three layers of tapes

- 6) The sealed lightning protection grounding clip can be connected to the outdoor grounding bar, as shown in Figure D-5, as well as to the well-grounded outdoor cabling rack. The grounding clip in Figure D-4 is connected to the outdoor cabling rack. When the lightning protection grounding clip is connected to the outdoor

cabling rack, the anti-rust paint at the place where the rack is grounded should be removed. When the grounding cables are installed, the place should be covered with anti-rust paint again. Those exposed connector parts should also be painted with anti-rust paint for good grounding, if they are incapable of being wrapped up with insulating tapes.

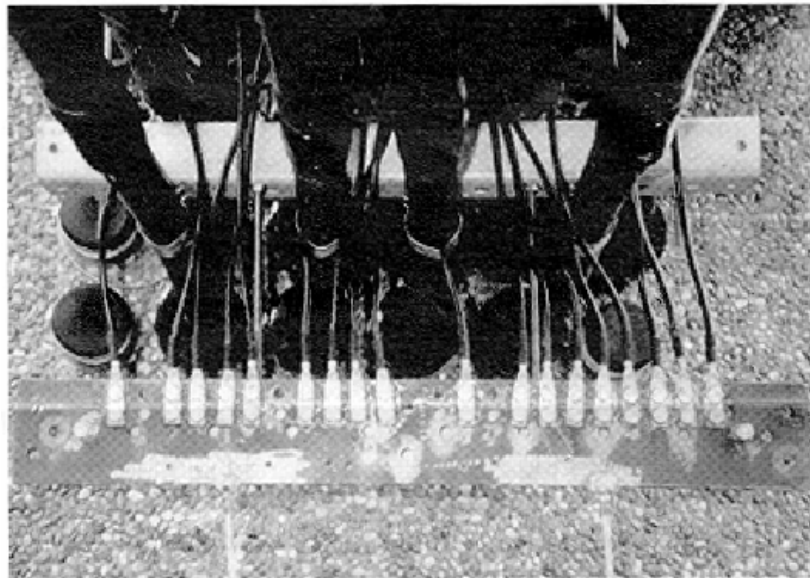


Figure D-5 Lightning protection grounding clip connected to outdoor grounding bar