Radio Access Network

LTE TDD Outdoor Pico eNB Installation Manual

Describes how to install the Samsung LTE Outdoor Pico eNB including how to connect cables.

Document Version 1.0
August 2014

Document Number: 2600-00GR31GAA

This manual should be read and used as a guideline for properly installing and/or operating the product. Owing to product variations across the range, any illustrations and photographs used in this manual may not be a wholly accurate depiction of the actual products you are using.
This manual may be changed for system improvement, standardization and other technical reasons without prior notice.
Samsung Networks documentation is available at **http://www.samsungdocs.com**

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Preface

This manual describes how to install and connect the cables to 2.5 GHz Outdoor Pico eNB, LTE eNB.

Relevance

This manual applies to the following products/software.

Name	Type
Pico	Hardware

Conventions in This Document

Samsung Networks product documentation uses the following conventions.

Symbols

Symbol	Description
	Indicates a task.
	Indicates a shortcut or an alternative method.
	Provides additional information.
	Provides information or instructions that you should follow to avoid service failure or damage to equipment.
	Provides information or instructions that you should follow to avoid personal injury or fatality.
	Provides antistatic precautions that you should observe.

Menu Commands

menu | command

This indicates that you must select a command on a menu, where **menu** is the name of the menu, and **command** is the name of the command on that menu.

File Names and Paths

These are indicated by a bold typeface. For example:

Copy **filename.ext** into the **/home/folder1/folder2/bin/** folder.

User Input and Console Screen Output Text

Input and output text is presented in the Courier font. For example,

```
context <designated epc-context-name>
```

CLI commands are presented in bold small caps. For example,

Type the **RTRV-NE-STS** command in the input field.

Revision History

The following table lists all versions of this document.

Version	Publication Date
1.0	August 2014

Organization of This Document

Section	Title	Description
Chapter 1	Installation Prerequisites	This chapter introduces the safety rules that must be understood for installing the Outdoor Pico eNB and describes some of the key specifications of the Outdoor Pico eNB.
Chapter 2	System Installation	This chapter describes the procedures to install the Outdoor Pico eNB.
Chapter 3	Connecting Cables	This chapter describes the procedures to connect the cables to the Outdoor Pico eNB.
Chapter 4	Checking Installation Status	This chapter describes the procedures of inspecting installation status after Outdoor Pico eNB installation and cabling is completed.
Appendix A	Acronyms	This appendix describes the acronyms used in this manual.
Appendix B	GPS Antenna Installation	This appendix describes the GPS antenna configurations and its installation requirements.
Appendix C	Sector Antenna Installation	This appendix describes the Sector antenna configurations and its installation requirements
Appendix D	Installing Feeder Cable	This appendix describes cautions and allowed radius of curvature when installing feeder line.
Appendix E	Connector Assembly	This appendix describes the procedure of assembling the connector.
Appendix F	Cleaning Optic Connector	This appendix describes the procedure of Cleaning Optic Connector.
Appendix G	Pressure Terminal Assembly	This appendix describes the procedure of assembling the pressure terminal.
Appendix H	Standard Torque	This appendix describes the standard torque when tightening bolts.

Related Documentation

- LTE TDD Outdoor Pico eNB System Description

Personal and Product Safety

This product safety information includes European directives, which you must follow. If these do not apply in your country, please follow similar directives that do apply in your country.

Electrical

All structural parts are grounded and all input and outputs have built-in isolation from the network. All input and output ports that connect to external power sources are designed to meet relevant national safety requirements.

The product contains hazardous energy levels as defined by UL 60950. Care must be taken when maintaining this equipment as injury to personnel or damage to the equipment could result from mistakes. Maintenance should only be carried out by trained and competent engineers who are familiar with the relevant procedures and instructions.

Lasers

The product is fitted with optic modules rated as Class 1 radiation-emitting devices under IEC 60825-1.

Manual Handling

Care should be taken when handling equipment. Give due consideration to the weight of the equipment, the physical capability of the individual(s) handling the equipment, and movements such as twisting, bending and stooping, which could lead to skeletal and muscular injuries.

Installation

Installation must be carried out by trained and competent engineers only. All relevant safety measures must be taken to ensure equipment is not connected to live power and transmission sources during installation. Equipment must be correctly installed in order to meet the relevant safety standards and approval conditions.

The cable between the power distribution point and the installed equipment must have a cross-sectional area of 1.5 mm^2.

Maintenance

Maintenance must only be carried out by a suitably trained and competent technician. All safety instructions must be carefully observed at all times. Equipment covers should not be removed while live power and transmission is connected unless in a controlled environment by trained technicians.

Environment

The product must be operated in an environment within the specified relative humidity and ambient temperature ranges.

Grounding

To comply with UL 60950, the equipment must be connected to a safety grounding point via a permanent connection. Grounding points are located on the product for this purpose. Always connect the ground cable before fitting other cables. The product must remain grounded continuously unless all connections to the power supply and data network are all removed.

If equipment is grounded through a cabinet or rack, make sure it is done so properly according to the installation instructions.

Chemical Warning

This product contains chemicals known to the State of California to cause cancer and reproductive toxicity.

Double pole /Neutral fusing
Disconnect ac power, before servicing.

Chapter 1 Installation Prerequisites

Unboxing and Transportation

The following instructions will guide you through how to unpack and transport cabinets and other components to the installation location.

Prerequisites Required for Transport

Follow these guidelines when transporting:

- Before moving the system, check the storage site and remove obstacles in advance.
- Carry boards in packing boxes and unpack them when installing or mounting.
- Tighten the system so that it remains secure. Note that the vibration level should be in the range from 1 to 500 Hz.
- Use a lift or cart to prevent accidents. However, if the system is being carried by people then make sure that there are enough people to carry it safely.
- While moving the system, boards and other devices should not be damaged by physical shock, dust, moisture, and static electricity.

OSHA Training

It is important that ALL WORKERS AND LEADS PERFORMING AND SUPERVISING THIS STA installation manual is validated as qualified by their G.C. employers as having sufficient training and adequate proficiency in installing and maintaining MMBS and battery systems, and that they are aware, understand, and abide by all requirements as defined in this manual and the Field Site Audit Review systems checklist.

OSHA stands for the Occupational Safety and Health Administration, an agency of the U.S. Department of Labor

OSHA's responsibility is worker safety and health protection

OSHA website: **http://www.osha.gov**

Unboxing Procedure

Follow these guidelines when unboxing items:

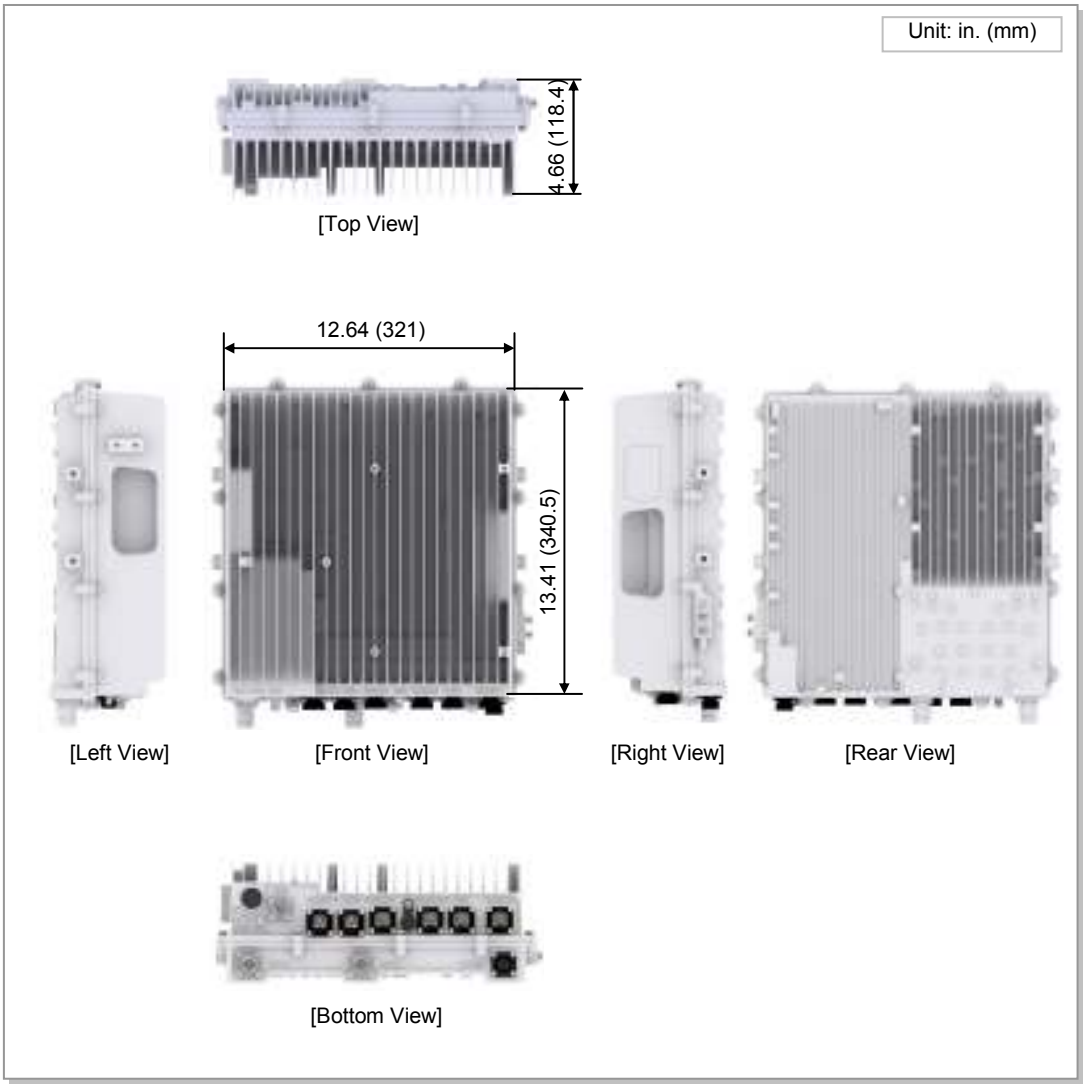
- The items should remain boxed until they reach the installation site.
- The items are classified in accordance with each job specification and stored at a location that does not interfere with the working area.
- Unboxed systems should be installed immediately. If not installed immediately, temporarily store the systems at the installation site.
- Unbox the inner packaging after each system is placed on its installation location.
- Do not recycle packaging waste. Dispose it in accordance with waste management laws.

System Configuration

Outdoor Pico eNB Configuration

Figure 1. Outdoor Pico eNB Configuration shows the configuration of Outdoor Pico eNB.

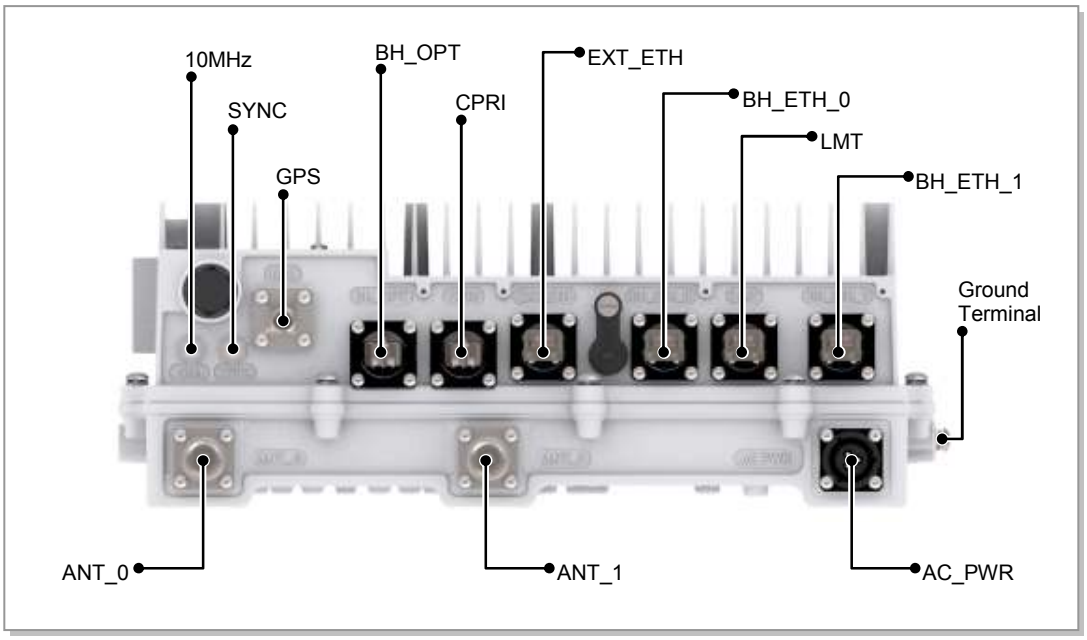
Figure 1. Outdoor Pico eNB Configuration



External Interface of Outdoor Pico eNB

Figure 2. External Interface of Outdoor Pico eNB shows the external interface structure of Outdoor Pico eNB.

Figure 2. External Interface of Outdoor Pico eNB



Specifications

Key Specification

Table 1. Key Specification lists the key specifications of the Outdoor Pico eNB.

Table 1. Key Specification

Category	Specification
Air specification	TDD LTE
Operating Frequency	2496MHz - 2690MHz
Channel Bandwidth	20 MHz
Peak Throughput (with Category 3 UE)	• 20 MHz BW: DL 78.2 Mbps (2x2 MIMO), UL 19.5 Mbps (1x2 SIMO) • Calculation condition: DL/UL PHY error rate 2 %, configuration 1-3
Tx Power /Carrier	• 5 W/Carrier/Path (1 Carrier case) • 3 W/Carrier/Path (2 Carrier case) • 2 W/Carrier/Path (3 Carrier case)
Antenna Configuration	Max. 3Carriers, 2Tx/2Rx
Backhaul	Copper GE 2 port Optic GE 1 port
Daisy chain	Copper FE/GE 1 port
Holdover	8 h

Power Specification

Table 2. Power Specifications lists the power specifications of the Outdoor Pico eNB.

Table 2. Power Specifications

Category	Standard
Rated Voltage	120-240 V AC With tolerance +/- 10%
Rated Current	Rated current 2 A @ 120 V AC

Dimension and Weight

Table 3. Dimension and Weight lists the dimensions and weight of the Outdoor Pico eNB.

Table 3. Dimension and Weight

Item	Specification
Dimension [in. (mm)], W × D × H	12.64 × 4.66 × 13.4 (321 × 118.4 × 340.5)

Weight [lb(kg)]	Less than 26.45 lb (12 kg)

GPSR Specification

Table 4. GPSR Specification lists the specifications of the Outdoor Pico eNB's GPS receiver (GPSR).

Table 4. GPSR Specification

Item	Specification
Received Signal from GPS	GPS L1 Signal
Accuracy/Stability	0.05 ppm
Phase Accuracy	• ±1 us (lock state) • ±8 us (holdover state)

Environmental Condition

Table 5. Ambient Specification lists the environmental conditions and related standards such as operational temperature and humidity.

Table 5. Ambient Specification

Category	Range
Temperature Condition	(-30) to 55°C (without solar load) (-30) to 50°C (with solar load)
Storage Temperature	-40~70°C
Humidity Condition	0~99 % (relative humidity), not to exceed 30g/m^3 absolute humidity
Storage Humidity	5~95 % (relative humidity), not to exceed 30g/m^3 absolute humidity
Altitude	(-60)~1,800 m@50°C
Earthquake	Telcordia GR-63-Core (Zone4)
Sound Pressure Level	N/A
Dust and Waterproof Rating	IEC 60529 IP65
Cooling	Natural Convection Cooling

Cautions for Installation

Observe the following safety instructions while installing the Outdoor Pico eNB.

Before Installing

- Post warning signs in areas where high voltage cables are installed.
- Post 'off limit' signs in areas where accidents are most expected.
- With guardrails or fences, block open areas such as connecting parts, roof, and scaffold.

When you install this equipment in the field, it should be installed in a Restricted Access Location.

While Installing

- The system power must be cut off before installing.
- Be careful that boards mounted on the system and the cables among the boards are not damaged or scratched when the system is transported or installed.

Make sure the power switch of power supply is off when installing the system. Installing the system with power switch on may cause system damage or fatal human injury when cables are not correctly connected.

Wear protection gloves and goggles to prevent damage from debris while drilling holes in a wall or ceiling.

Do not wear accessories such as watches and rings in order to prevent electrical shock.

Cover the unused ports (conduit, cable gland, and so on) with a waterproof cap (sealing cap) to prevent infiltration of foreign material such as dust, moisture, or insects.

Do not use a base station antenna within a distance of 100 cm from people; also do not co-locate nor operate in conjunction with any other antenna or transmitter in order to protect the general public from exposure to radio frequency electromagnetic field.

To prevent foreign substances, outdoor air, and moisture from entering the system input/output port and cable inlet (including cable gland and conduit), finish them as follows:

- Unused Inlet:
Use the hole finishing materials, including waterproof cap and rubber packing.

- Cable-installed Port and Cable Inlet
After installing the cable, block any space in the inlet with tape, compressed sponge, rubber packing, and silicon.

You must not work alone in any key process.

The outdoor fastening materials, such as stud bolts, hex nuts, spring washers, and plain washers, must be made of stainless steel (STS 304). Otherwise, it may cause corrosion and rust to fixing materials.

After Installing

- Cover the cable holes drilled on the floor with a solid cover.
- Remove any debris produced during work and clean up the installation site.

In the system, the laser beam light runs through the optical cable. Handle the optical cables with care as the laser beam can seriously damage your eyes.

Do not damage installed cables while cleaning the system.

While cleaning the power supply device, take caution that the device does not come in contact with foreign objects that may cause power failure.

Installation Tools

The basic tools for installation are listed in Table 6. Basic Installation Tools. Any additional tools required for each site need to be identified and prepared during a site survey before starting installation.

Table 6. Basic Installation Tools

No.	Name	Specification	Remarks
1	Torque Driver Set	No.0~+No.3 (M2.6~M6 '+' Driver) 0.07~4.34 lbf·ft (1.0~60 kgf·cm)	
2	Torque Wrench Set	M6~M12 0.72~2.17 lbf·ft (10~30 kgf·cm), 7.23~36.15 lbf·ft (100~500 kgf·cm), Replaceable head	
3	Drill/Bit Set	0.24~0.67 in. (6~17 mm)	
4	Heating Gun	122~572°F (50~300°C)	
5	Power Extension Cable	98.42 ft. (30 m)	
6	Tape Measure	16.4 ft./164 ft. (5 m/50 m)	
7	Cable Cutter	0.24~1.26 in. (6~32 mm)	
8	Silicon Gun/Silicon	Normal/Grey and Colorless	
9	Hammer Set	Still/Rubber/PVC	
10	Spanner	0.75 in., 0.94 in., 1.42 in. (19 mm, 24 mm, 36 mm)	
11	Wire Stripper	0.24~0.94 in. (6~24 mm)	
12	Level	Normal	

13	Megger	+/- 0.08 %, 40 M Ohms	

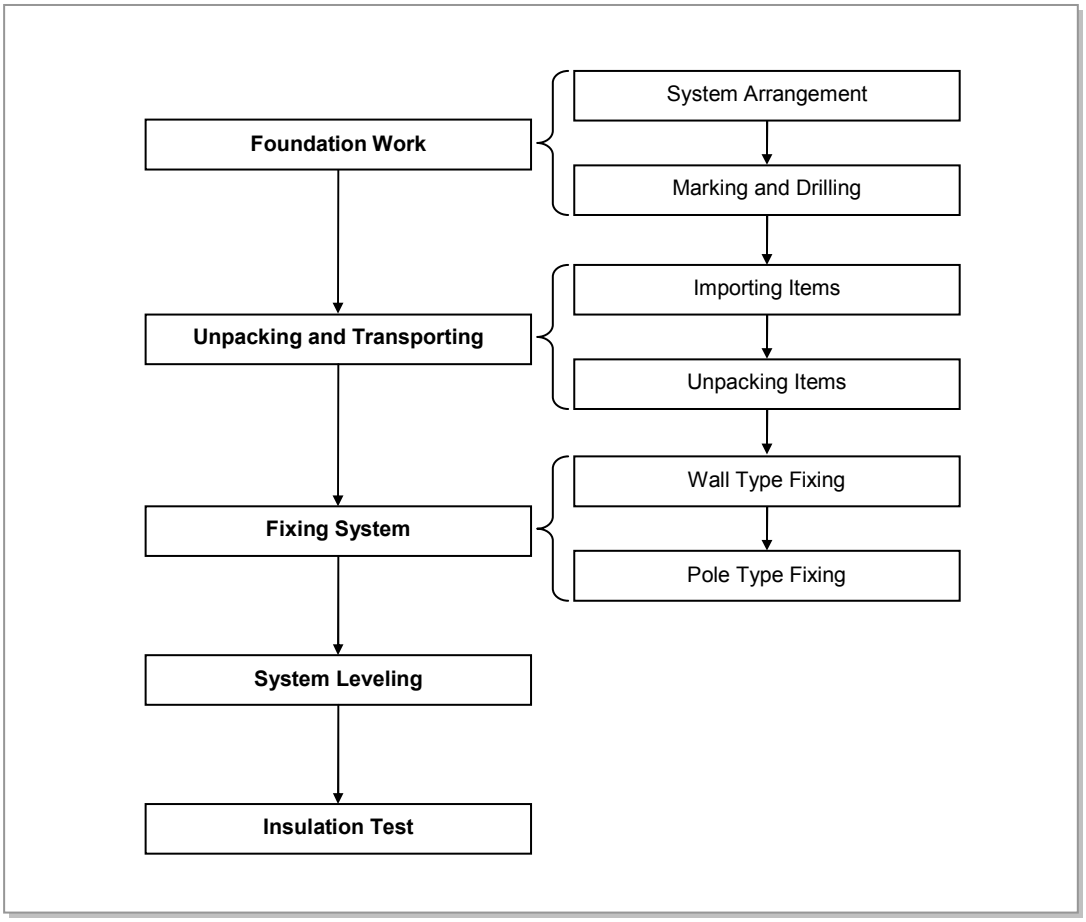
The required installation tools may vary depending on the conditions at the site. In addition to the basic tools, a protractor, compass, GPS receiver, ladder, safety equipment, cleaning tools, and so on should also be prepared in consideration of the site conditions.

Chapter 2 System Installation

Installation of Outdoor Pico eNB

The procedure to install the Outdoor Pico eNB is shown in Figure 3. Procedure to Install the System.

Figure 3. Procedure to Install the System



Foundation Work

System Arrangement

Refer to Table 7. Recommended Distances for System for the minimum distances that must be secured around the Outdoor Pico eNB in each direction for its installation and maintenance.

Table 7. Recommended Distances for System

Category	Recommended Distances
Front/Rear	31.5 in. (800 mm) or more
Side	7.87 in. (200 mm) or more
Top/Bottom	11.8 in. (300 mm) or more

Figure 4. Outdoor Pico eNB Arrangement (Wall Type)

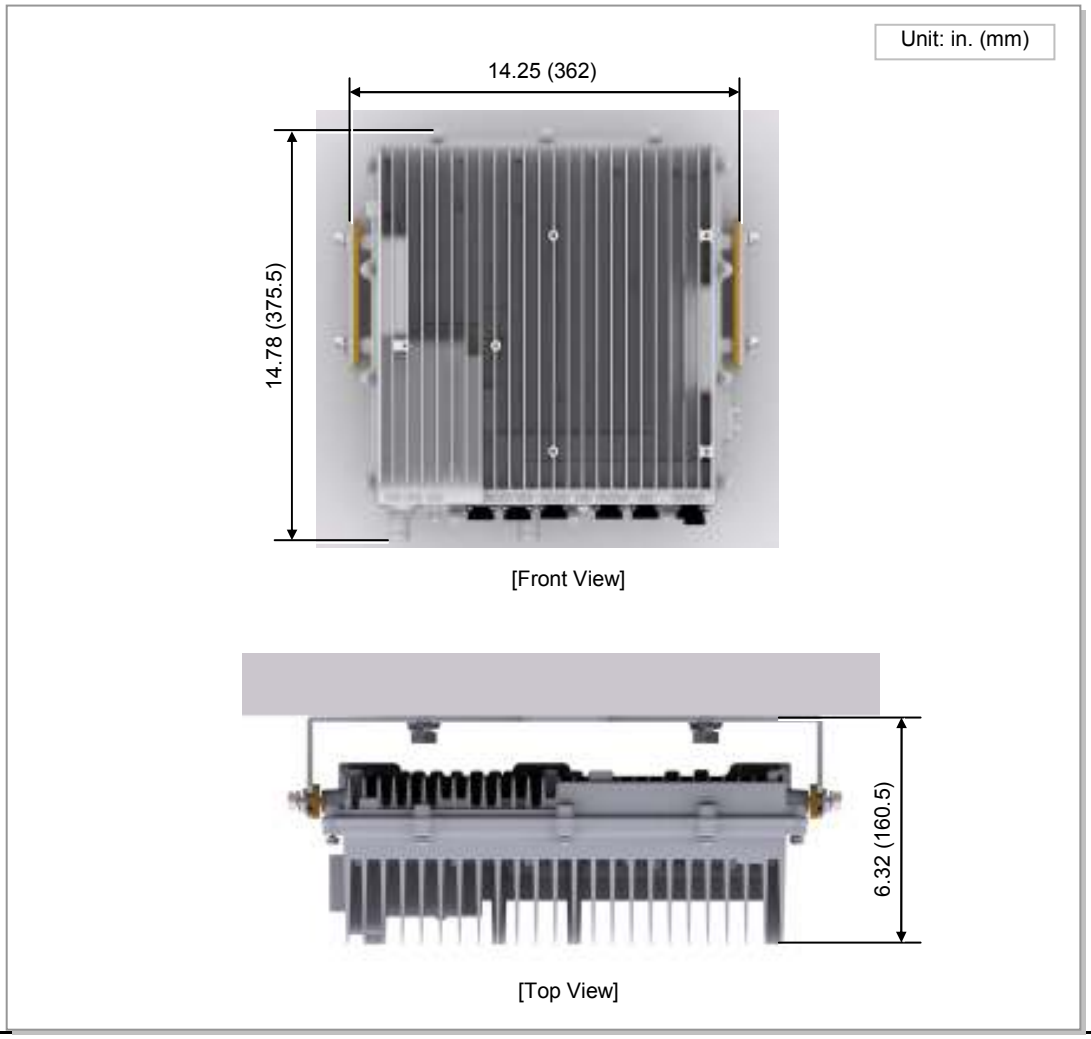
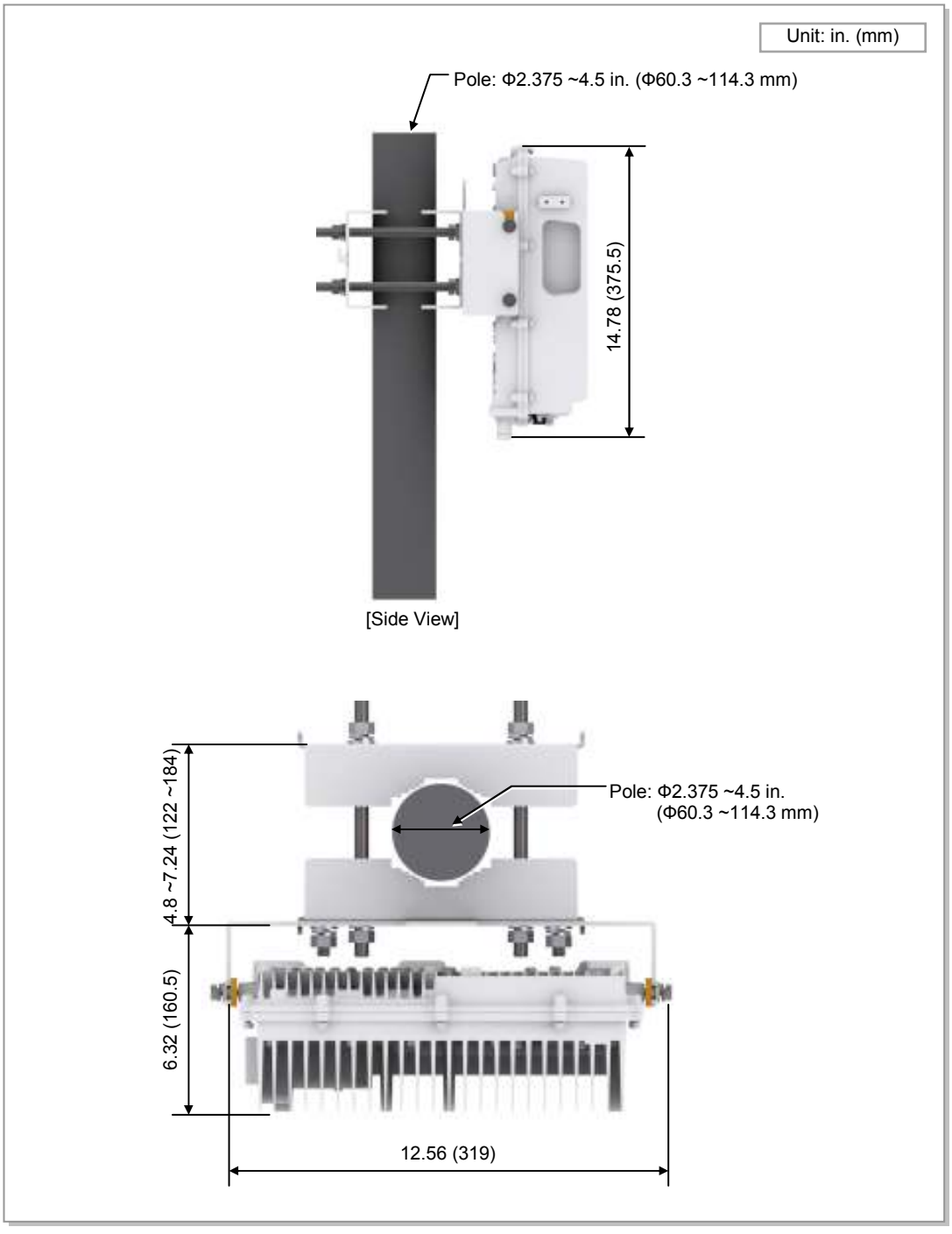


Figure 5. Outdoor Pico eNB Arrangement (Pole Type)



Marking and Drilling

Marking

Before placing the system, mark the position where the system will be installed using an ink line or a pen. Also mark the positions where anchor bolts will be fixed.

As a limited range of tuning is allowed for leveling after the system is mounted on a wall, perform the leveling test (refer to 'System Leveling') to check if positions are marked to be horizontal or vertical before drilling. If the result shows they are not horizontal or vertical, then modify the marking positions.

Before starting work, check the fixing method for the Outdoor Pico eNB because the marking and drilling positions and specifications may differ as per the fixing method.

When position of the system is determined, place the system on the position. Using a pen, mark the positions where anchor bolts will be fixed in order to reduce marking error range.

Figure 6. System Marking-Wall Type (1)

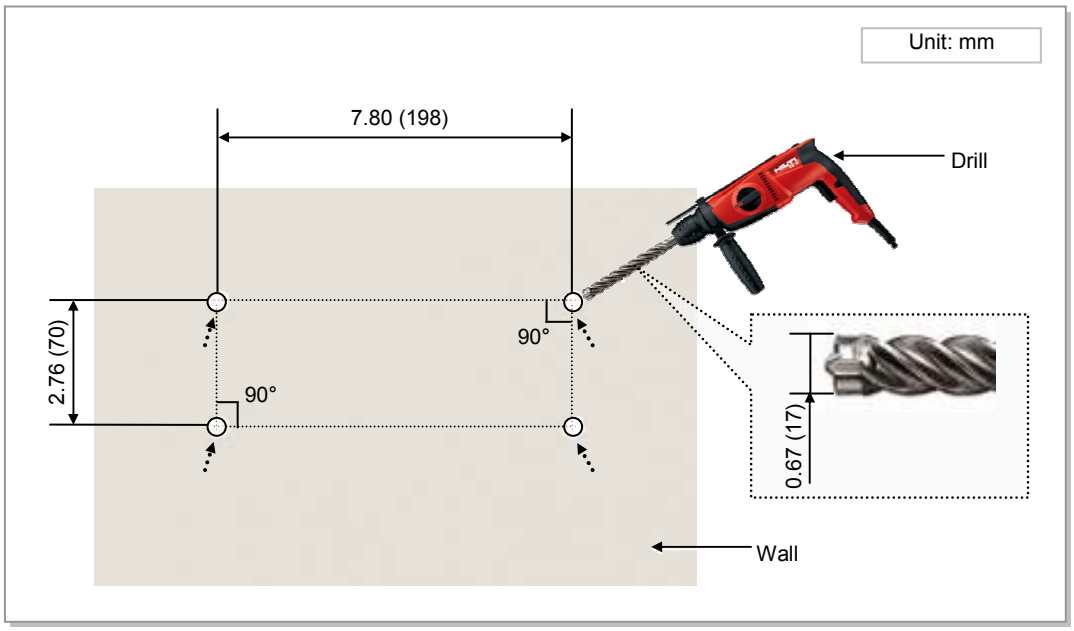
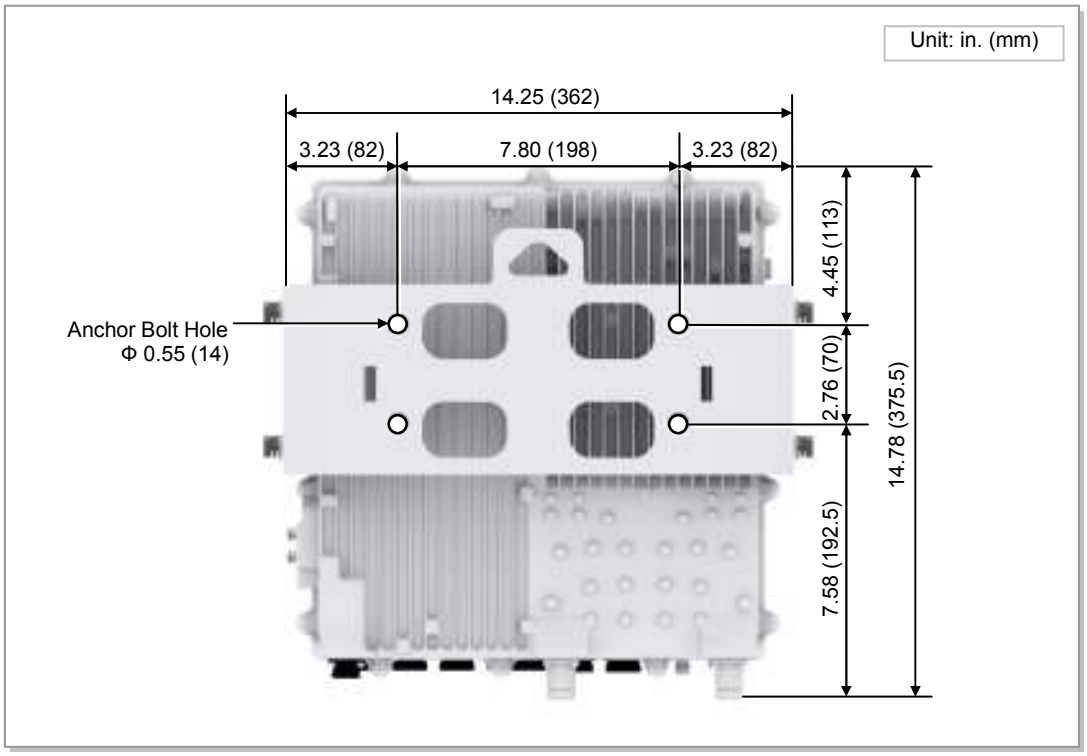


Figure 7. System Marking-Wall Type (2)



Drilling

When marking is completed, drill holes for anchor bolts.

Table 8. Anchor Bolt Drill Bits and Hole Depth

Category	Anchor Bolt	Drill Bits	Hole Depth
Wall Type	M12	0.67 in. (17 mm)	2.17 in. (55 mm)

Fixing System

Table 9. Outdoor Pico eNB Installation Tools and Torque Value and Table 10. Tightening Parts for Outdoor Pico eNB list the installation tools and assembly torque required to install and maintain the Outdoor Pico eNB.

Table 9. Outdoor Pico eNB Installation Tools and Torque Value

Category		Installation Tools	Torque Value
A	M6 SEMS	Driver (+): M6	1.45 lbf·ft (20 kgf·cm)
B	N Type	Hexagon: 19 mm	0.87 lbf·ft (12.0 kgf·cm)
C	Mini DIN Type	Hexagon: 22 mm	8 lbf·ft (110.4 kgf·cm)

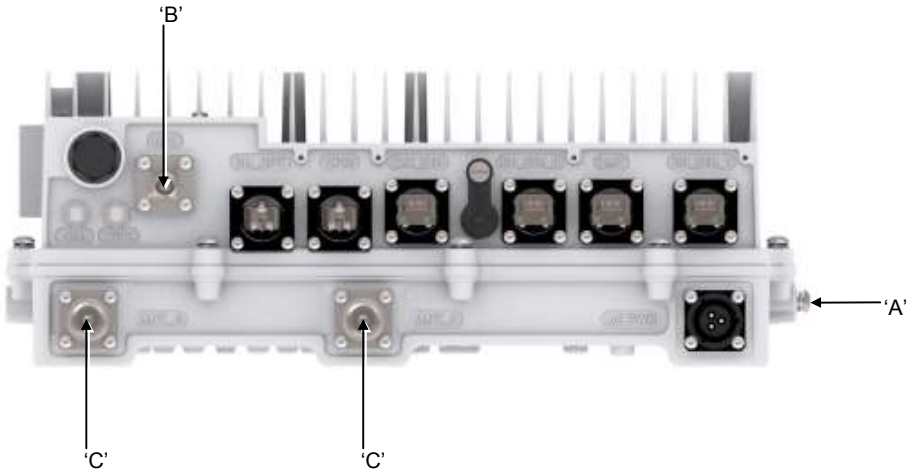


Table 10. Tightening Parts for Outdoor Pico eNB

Category		Installation Tools	Torque Value
M8	Hex Bolt	Hexagon: 13 mm	8.82 lbf·ft (122.0 kgf·cm)
	Hex Nut		

The outdoor fastening materials such as stud bolts, hex nuts, spring washers, and plain washers must be made of stainless steel (STS 304).

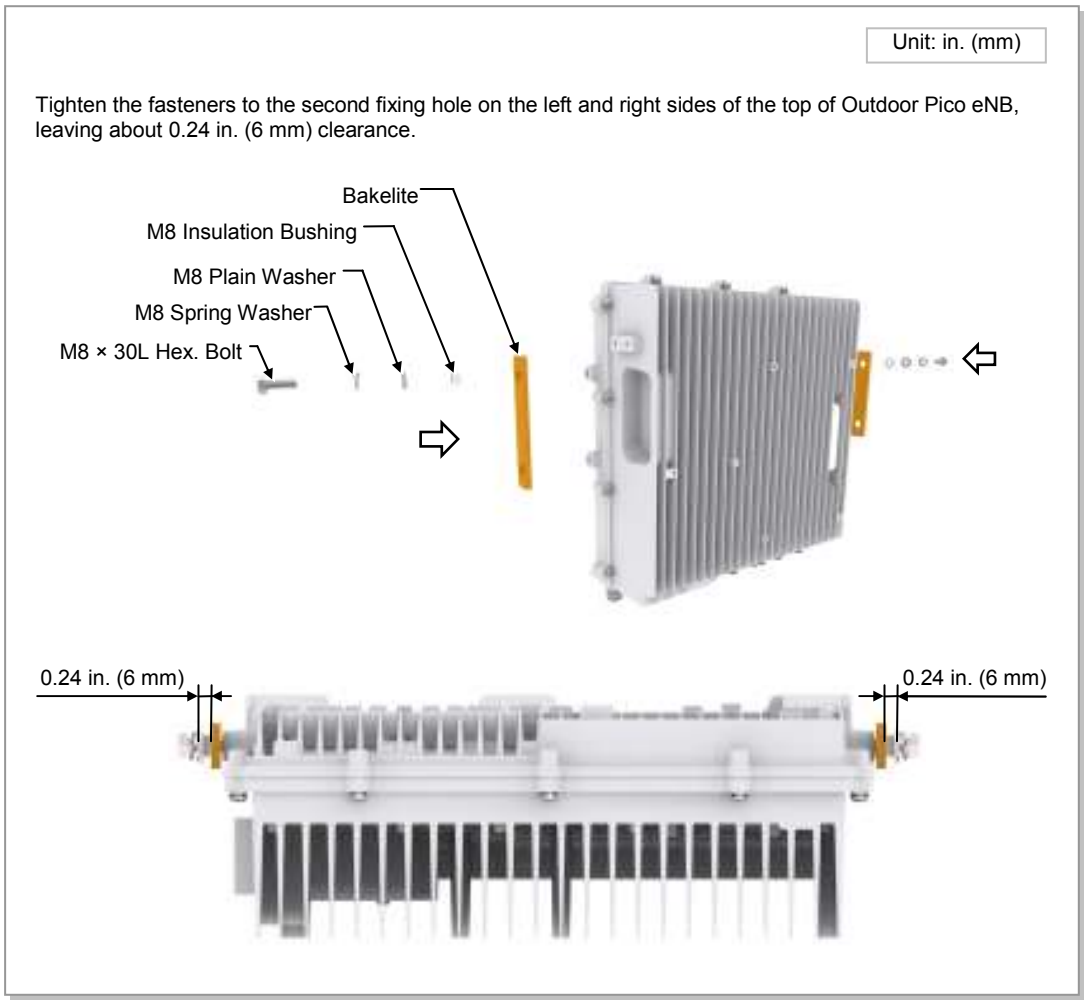
Assemble Tightening Parts for Outdoor Pico eNB

Figure 8. Assemble Tightening Parts for Installing Outdoor Pico eNB illustrates how to assemble the tightening parts to the fixing holes at the top of left/right sides to install the Outdoor Pico eNB to the mounting bracket using the items listed in Table 11. Tightening Parts and Tools for Installing Outdoor Pico eNB.

Table 11. Tightening Parts and Tools for Installing Outdoor Pico eNB

Category	Description	
Fastener	M8 × 30L Hex. Bolt	2 EA
	M8 Spring Washer	2 EA
	M8 Plain Washer	2 EA
	M8 Insulation Bushing	2 EA
	Bakelite (5T)	2 EA
Working Tools	Torque Wrench (Hexagon: 13 mm), Spanner, Steel Ruler	

Figure 8. Assemble Tightening Parts for Installing Outdoor Pico eNB



Fix the Outdoor Pico eNB (Wall Type)

The procedure for fixing the Outdoor Pico eNB on the wall is as follows:

Fix Unit Mounting Bracket

Use Table 12. Unit Mounting Bracket Fixing Parts and Tool (Wall Type) and Figure 9. Fix Unit Mounting Bracket (Wall Type) to fix the unit mounting bracket.
Unit Mounting Bracket Fixing Parts and Tool (Wall Type)

Table 12. Unit Mounting Bracket Fixing Parts and Tool (Wall Type)

Category	Description		
Parts	Unit Mounting Bracket		1 EA
	Fastener	M12 Strong Anchor Assembly • M12 Strong Anchor • M12 Spring Washer • M12 Plain Washer • M12 Hex. Bolt	4 set 1 EA/set 1 EA/set 1 EA/set 1 EA/set
Recommended Torque Value	M12 Hex. Bolt		21.11~31.67 lbf·ft (292.0~438.0 kgf·cm)
Working Tools	Drill, Hammer, Torque Wrench (Hexagon: 19 mm), Level		

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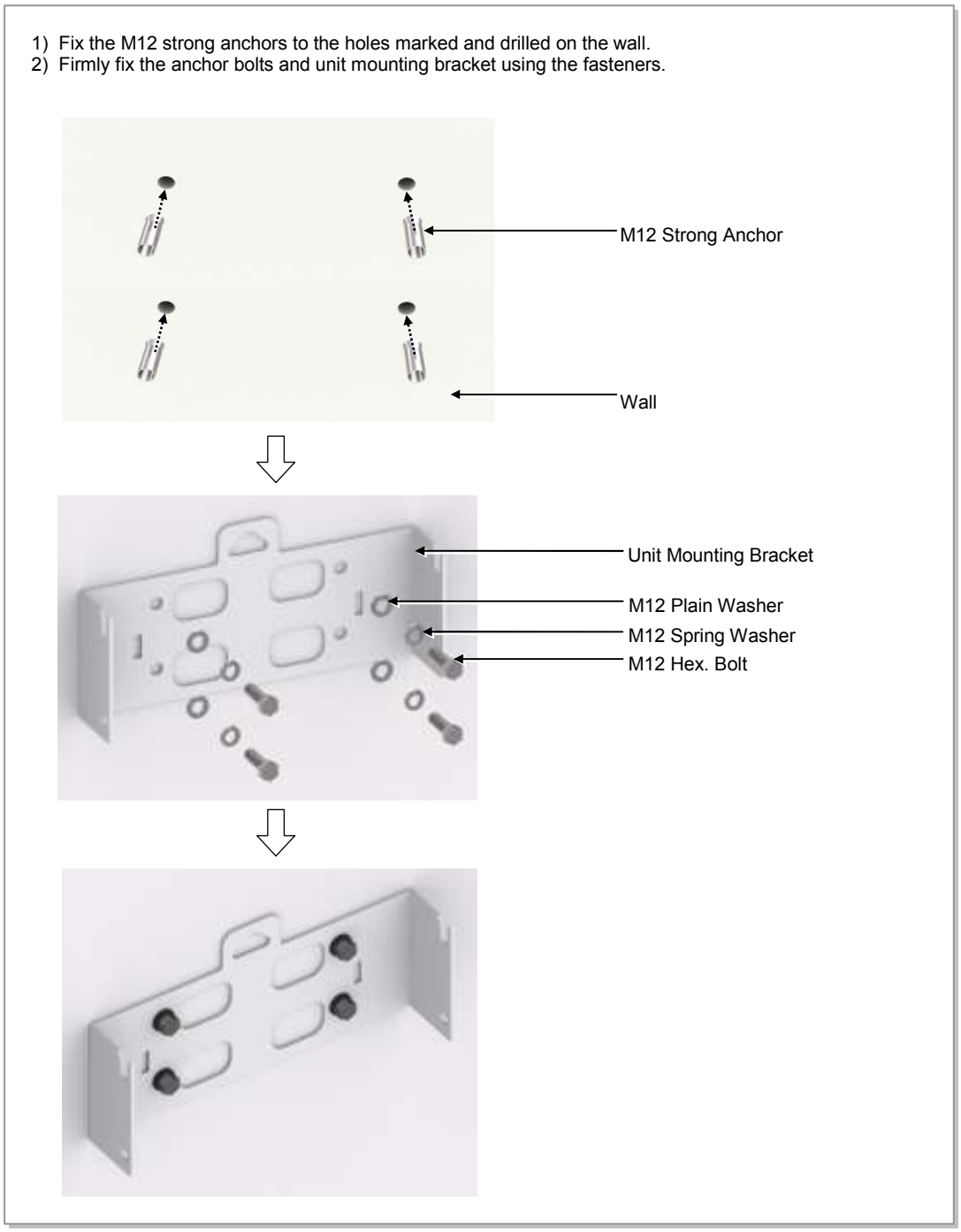
Figure 9. Fix Unit Mounting Bracket (Wall Type)



Fix the Outdoor Pico eNB

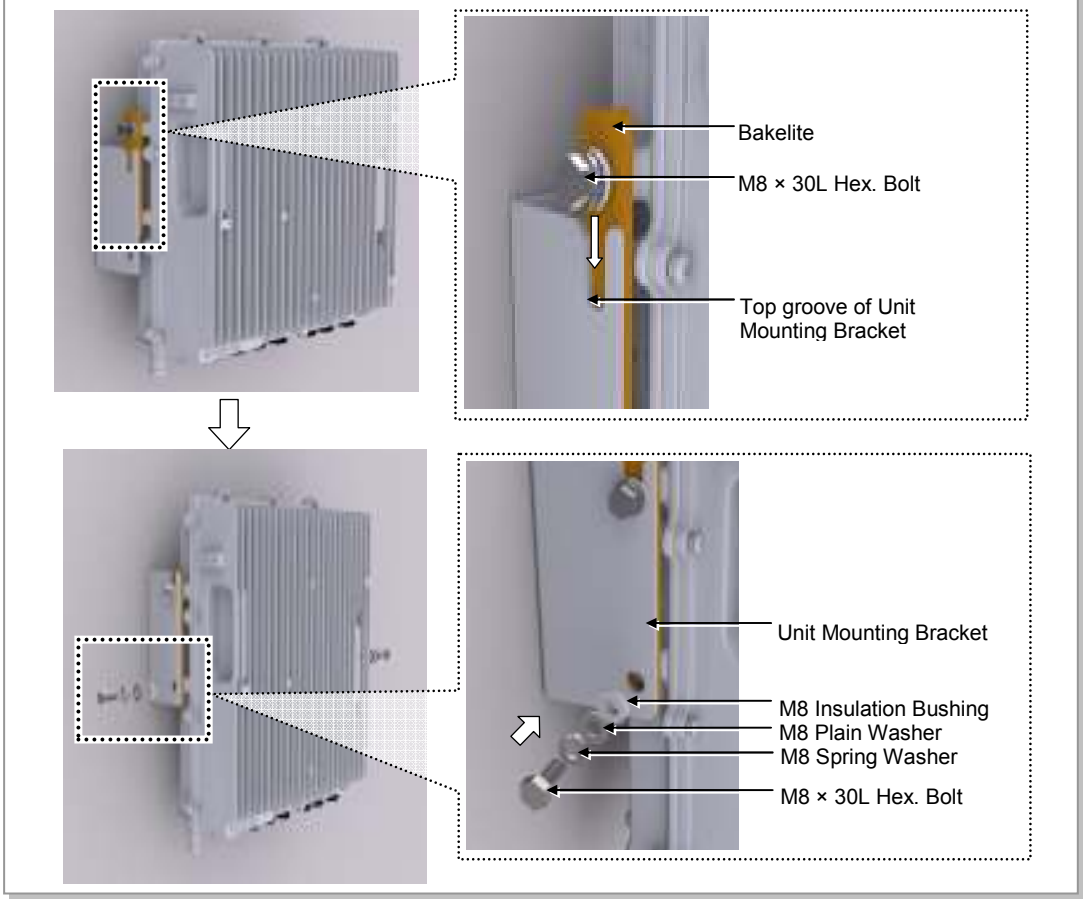
Table 13. Outdoor Pico eNB Fixing Parts and Tools (Wall Type) lists the Outdoor Pico eNB unit mounting bracket parts.

Table 13. Outdoor Pico eNB Fixing Parts and Tools (Wall Type)

Category	Description	
Parts	M8 × 30L Hex Bolt	4 EA
	M8 Spring Washer	4 EA
	M8 Plain Washer	4 EA
	M8 Insulation Bushing	4 EA
Recommended Torque Value	M8 Hex Bolt	8.82 lbf·ft (122 kgf·cm)
Working Tools	Torque Wrench (Hexagon: 13 mm), Spanner	

Figure 10. Fixing the Outdoor Pico eNB (Wall Type) (1)

1) Hang M8 hex. bolts, which are installed in the second fixing holes on left/right sides of Outdoor Pico eNB, can on the groove at the top of the unit mounting bracket. At this point, the plain washer and spring washer should be located outside of the unit mounting bracket.
2) Fix the product securely by tightening fasteners on the remaining holes of the unit mounting bracket.
3) Tighten completely and securely the M8 hex. bolts attached to the second fixing holes on the top of the Outdoor Pico eNB.



Fix the Outdoor Pico eNB (Pole Type)

The procedure for fixing the Outdoor Pico eNB on the 1-sector pole type is as follows:

Fix Unit Mounting Bracket and Pole Mounting Bracket

Use Table 14. Unit/Pole Mounting Bracket Fixing Parts and Tools and Figure 11. To Fix Unit Mounting Bracket and Pole Mounting Bracket to fix the unit mounting bracket and pole mounting bracket.

Table 14. Unit/Pole Mounting Bracket Fixing Parts and Tools

Category	Description		
Parts	Unit Mounting Bracket		1 EA
	Pole Mounting Bracket		2 EA
	Fastener	M12 Stud Bolt M12 Spring Washer M12 Plain Washer M12 Hex Nut	4 EA 8 EA 8 EA 8 EA
Recommended Torque Value	M12 Hex Nut		21.11~31.67 lbf·ft (292.0~438.0 kgf·cm)
Working Tools	Torque Wrench (Hexagon: 19 mm), Spanner		

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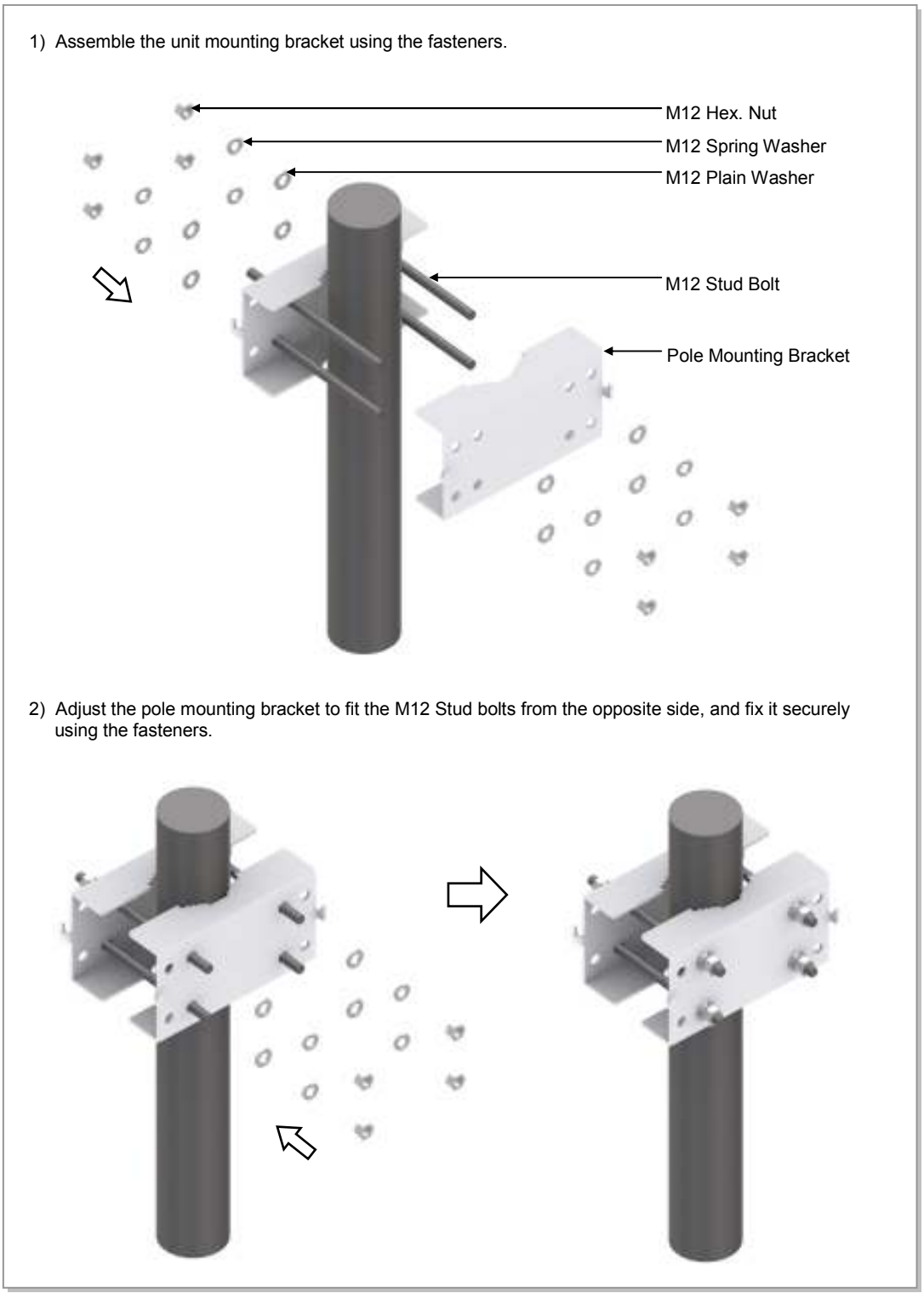
Figure 11. Fix Unit-Mounting Bracket and Pole-Mounting Bracket



Fix the Outdoor Pico eNB

Use Table 15. Outdoor Pico eNB Fixing Parts and Tools (Pole Type) and Figure 12. To Fix the Outdoor Pico eNB–Pole Type (1) and Figure 13. Fixing the Outdoor Pico eNB–Pole Type (2) to mount the Outdoor Pico eNB to the unit-mounting bracket.

Table 15. Outdoor Pico eNB Fixing Parts and Tools (Pole Type)

Category	Description	
Parts	M8 × 30L Hex Bolt	4 EA
	M8 Spring Washer	4 EA
	M8 Plain Washer	4 EA
	M8 Insulation Bushing	4 EA
	Bakelite (5T)	2 EA
	M12 × 40L Hex Bolt	4 EA
	M12 Spring Washer	8 EA
	M12 Plain Washer	8 EA
	M12 Hex. Nut	4 EA
Recommended Torque Value	M8 Hex Bolt	8.82 lbf·ft (122 kgf·cm)
	M12 Hex Nut	21.11~31.67 lbf·ft (292.0~438.0 kgf·cm)
Working Tools	Torque Wrench (Hexagon: 13 mm, 19 mm), Spanner	

Figure 12. Fix the Outdoor Pico eNB–Pole Type (1)

1) Hang M8 hex bolts, which are installed in the second fixing holes on the left/right sides of Outdoor Pico eNB on the top groove of the unit-mounting bracket. Note that the plain washer and spring washer should be located outside of the unit mounting bracket.

2) Assemble the unit mounting bracket and Outdoor Pico eNB using the fasteners.

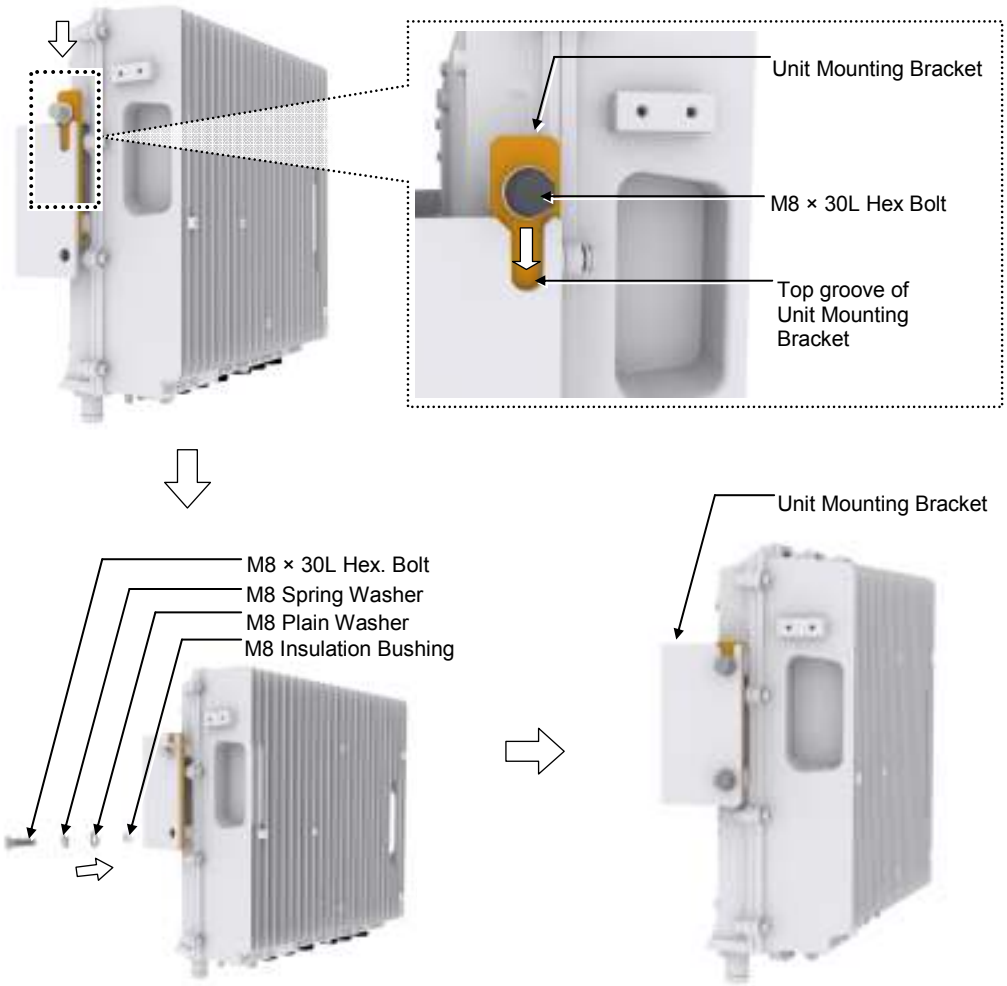
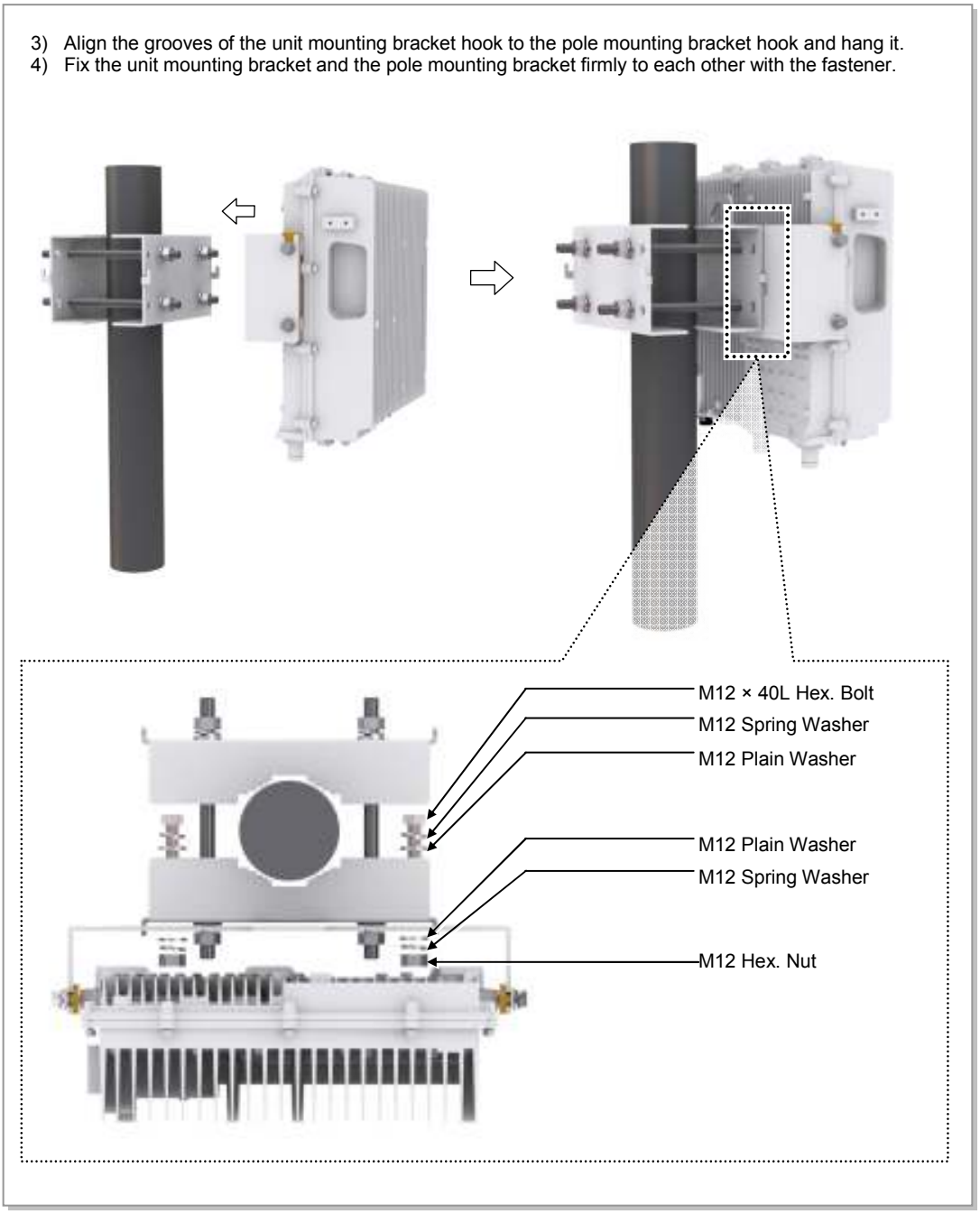


Figure 13. Fixing the Outdoor Pico eNB–Pole Type (2)

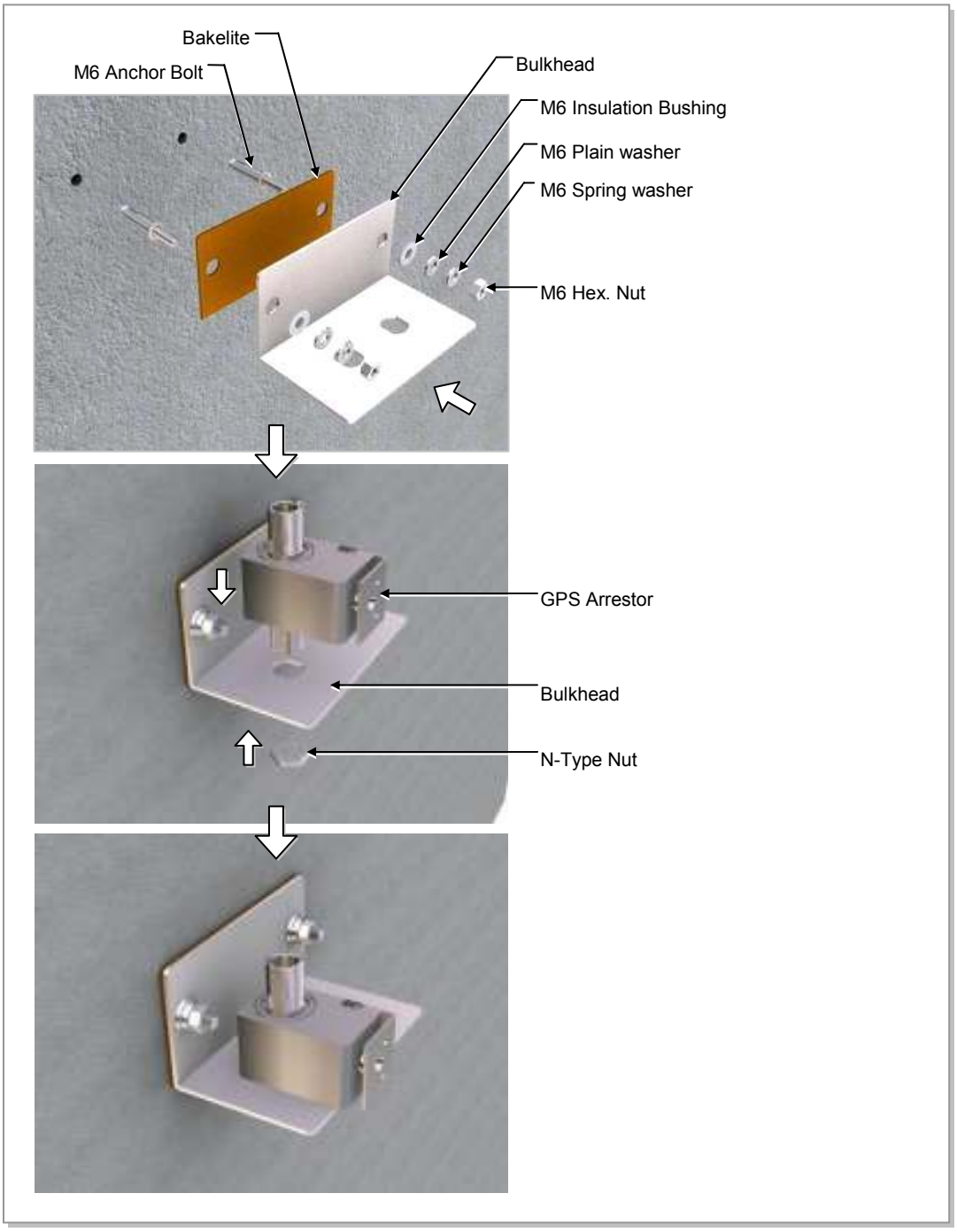


Installing GPS arrestor

Follow the steps below to install GPS arrestor to wall.

* Depending on site condition, install method of GPS arrestor may be vary.

***Figure 14.** Installing GPS arrestor (Wall)*



System Leveling

Leveling refers to compensating for the level difference on the floor when installing devices horizontally or vertically. Leveling can be carried out using a vinyl hose, a balance weight, or a level.

This section describes using a spirit level, a commonly used method.

Refer to Table 16. Leveling Using a Level and Figure 15. Leveling Using a Level (Wall Type) and Figure 16. Leveling Using a Level (Pole Type) to use a spirit level.

Table 16. Leveling Using a Level

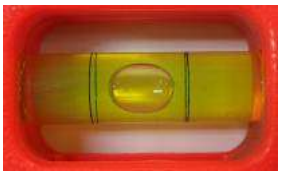
Classification	Description	
Test Method	The level is measured based on the position of a bubble after attaching the spirit level to the top and side of the system.	
Evaluation Criteria	**Good**	**Poor**
		
	If it is level, the bubble of the spirit level is positioned at the center of both lines.	
Corrective Measures for Poor Leveling	Use an aid such as Bakelite or an auxiliary fixture on the backside of the system to adjust the height. Adjust the position of fasteners used to fix the system or its leveling status.	

Figure 15. Leveling Using a Level (Wall Type)

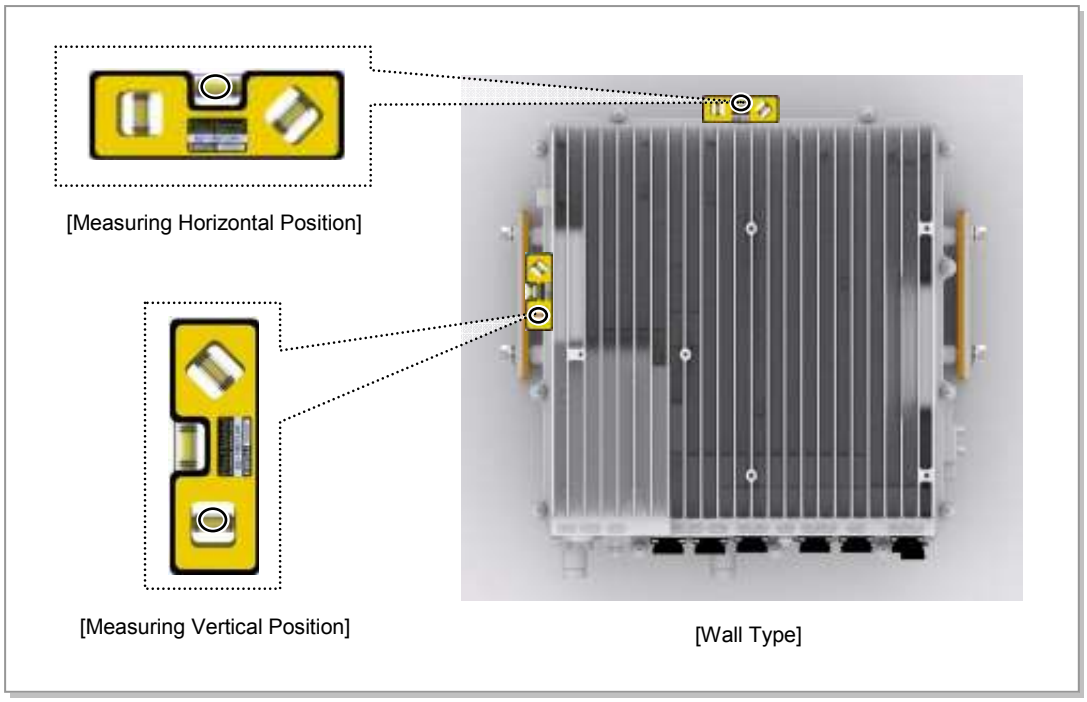
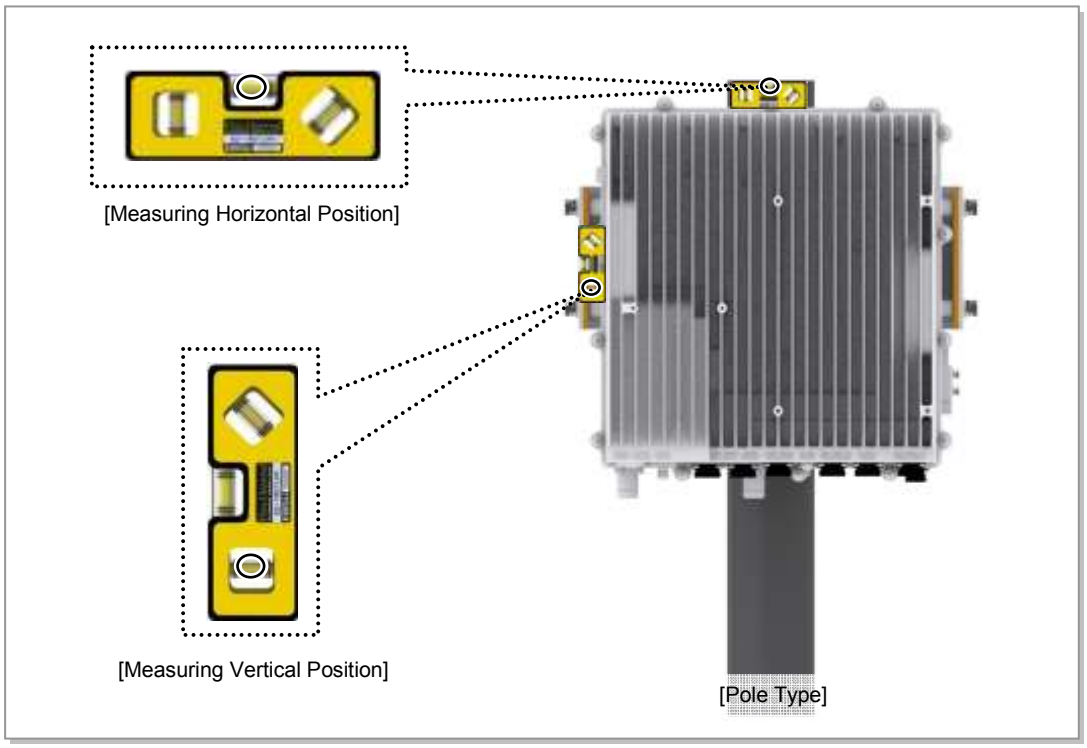


Figure 16. Leveling Using a Level (Pole Type)



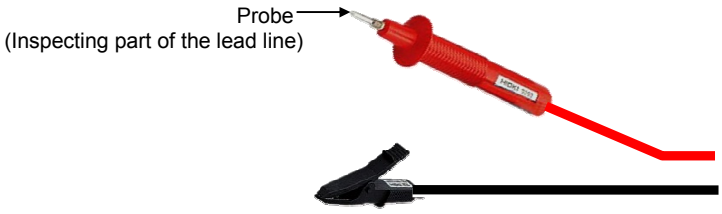
Insulation Test

The insulation test information is show in Table 17. Insulation Test.

Table 17. Insulation Test

Classification	Description			
Test Method	The insulation tester (Megger) is used for measurement.			
	Position of lead line of insulation tester	Wall Type	Lead line_A	Unit Mounting Bracket Fixing Hex. Bolt
			Lead line_B	Outdoor Pico eNB Fixing Hex Bolt
		Pole Type	Lead line_A	M12 Stud Bolt
			Lead line_B	Outdoor Pico eNB Fixing Hex Bolt
Evaluation Criteria	• Good: 500 V/100 MΩ or more • Poor: Less than 500 V/100 MΩ			
Corrective Measures for Poor Leveling	• Check contact between the system and anchor bolt and re-assemble it. (Note: The anchor bolt must be shielded using an insulator such as an insulation bushing.) • Check the damage of an insulator such as an insulation bushing or Bakelite, and replace it accordingly.			

To prevent personal injury caused by an electric shock when using an insulation tester, make sure the polarity is correct when connecting the Earth/Ground COM (black) and AC.V (red) lead lines. Do not touch the connected probe inspecting part of the lead line with your hands and avoid body contact.



Because there is very high voltage, observe the following to prevent any system damage when measuring insulation resistance
- Before measuring insulation resistance, disconnect all cables connected to the system.
- Do not measure insulation resistance when power is on.
- Do not measure insulation resistance at any position other than the target insulation resistance measuring points.

Figure 17. Schematic Diagram for Insulation Test (Wall Type)

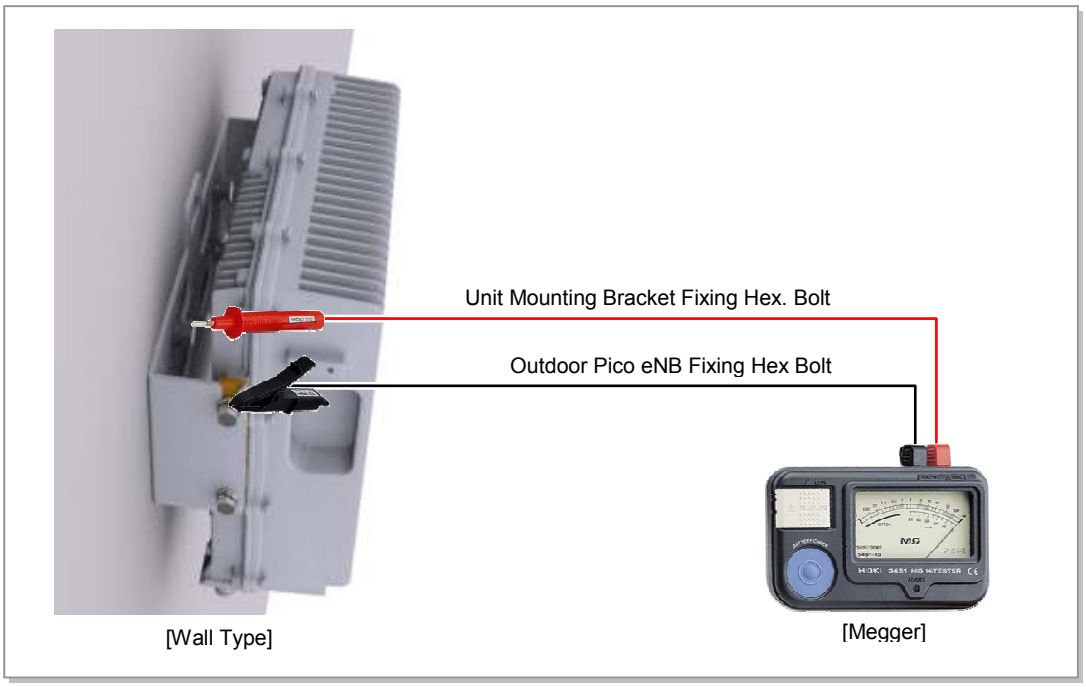
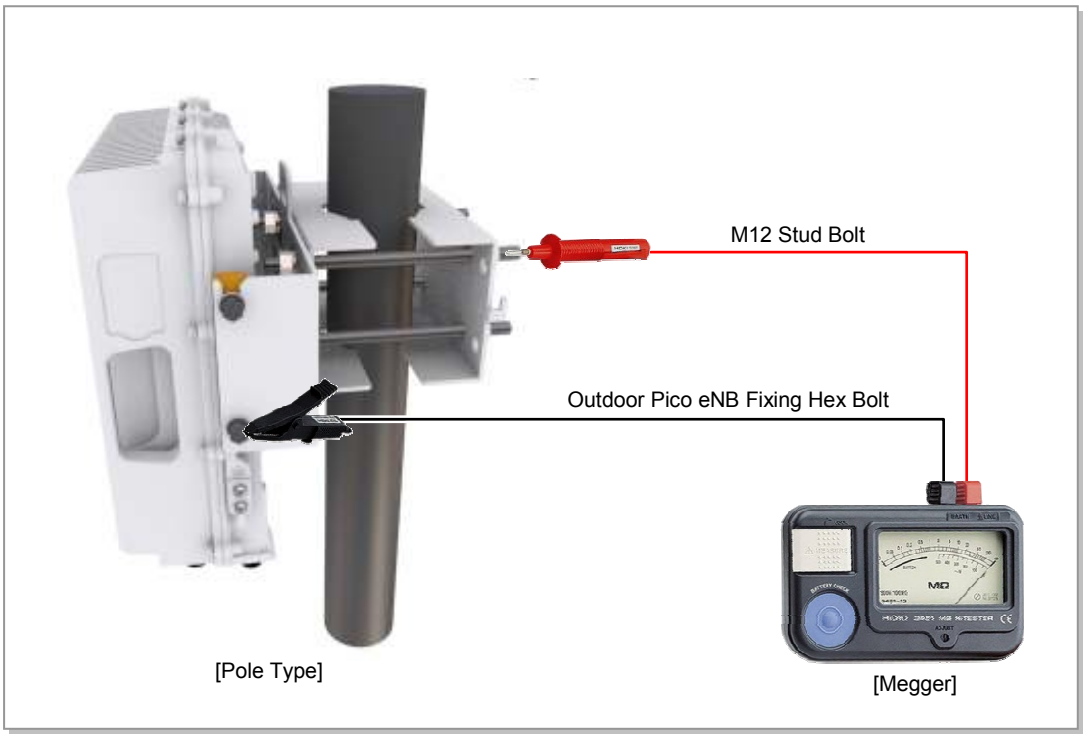


Figure 18. Schematic Diagram for Insulation Test (Pole Type)



Chapter 3 Connecting Cables

Work Flow for Cabling

Figure 19. Work Flow for System Cabling shows the system cable.

Figure 19. Work Flow for System Cabling

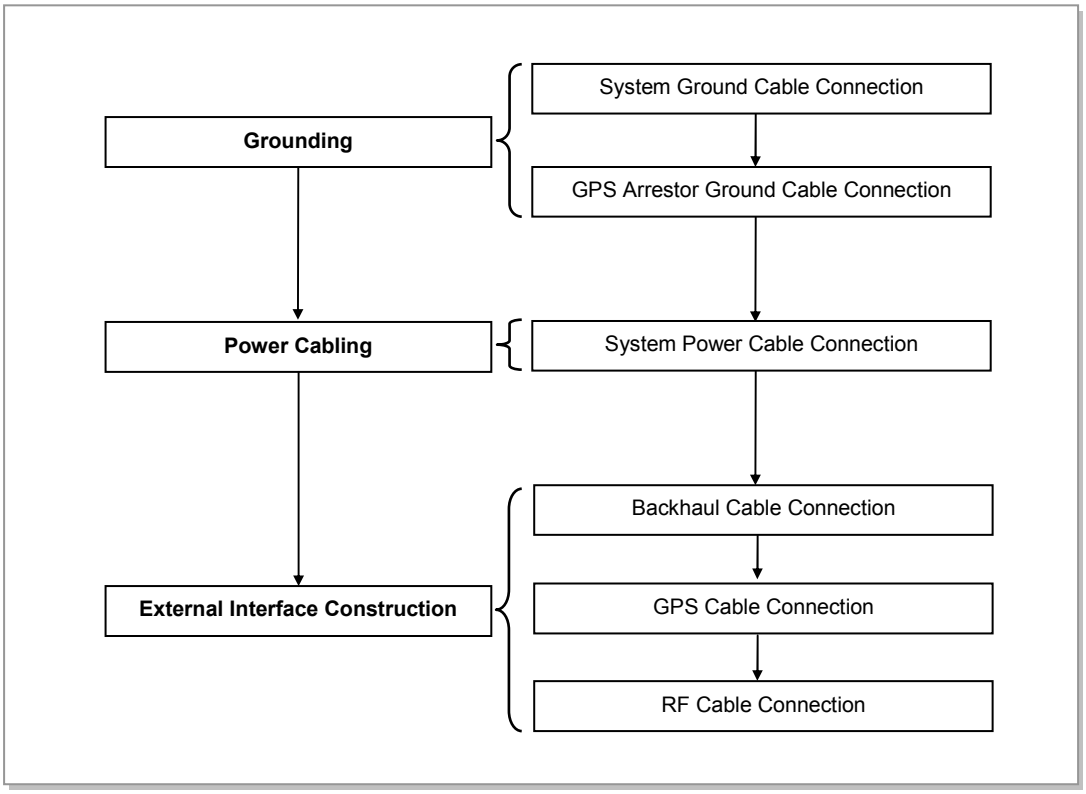
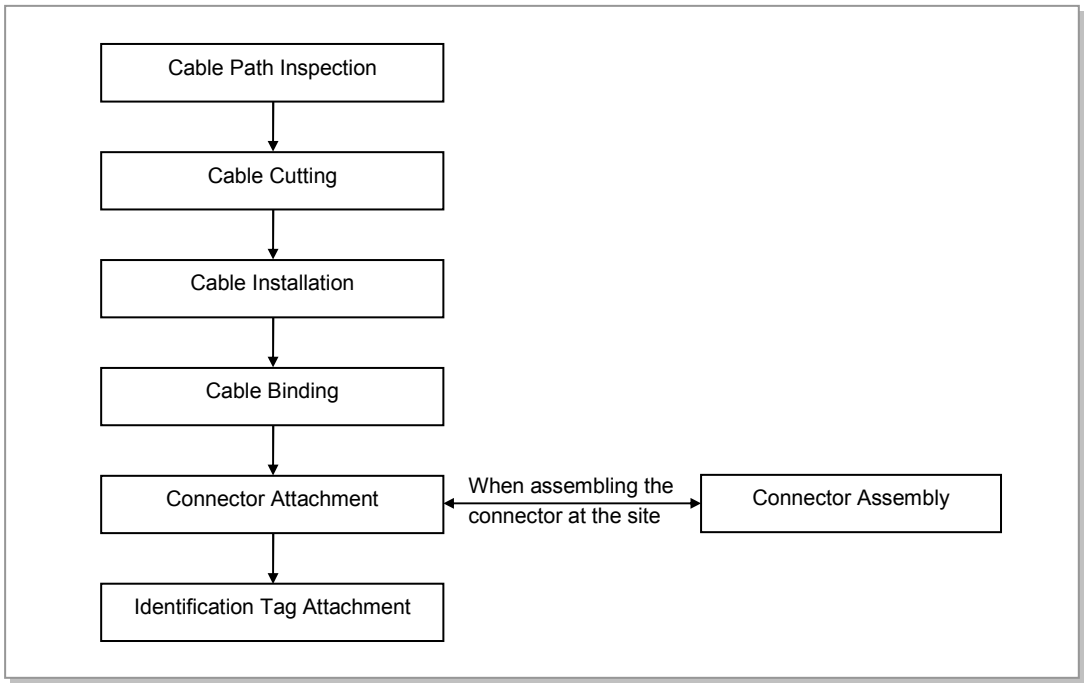


Figure 20. Detailed Cabling Procedure shows the detailed procedure of cabling.

Figure 20. Detailed Cabling Procedure



Before cutting the cable after installation, make sure that the connector is disconnected from the equipment. Installation of the cable with the connector connected to the system may cause failure or damage to the connector assembled to the system and the cable.

The sequence of cable cutting and installation of the cable workflow can be changed depending on the field situation, such as ‘cutting after installing’ or ‘installing after cutting’.

Cable Path Inspection

When installing a cable that connects between the AC distributor, Ground Bar, and backhaul device within the system, inspect the cable path, length, and installation method.

Follow these guidelines while inspecting the cabling path:

- Select a minimum cable length provided it does not affect the cable installation and maintenance.
- Place the cable in a location where it will not be damaged by external factors (power line, flooding, footpaths, and so on).
- In areas where the cable may be damaged by external factors, ensure that measures are taken to prevent damage to the cable (cable tray, ducts, and flexible pipe).

Cable Cutting

Measure the exact distance and carefully check the route. Cut the cable using a cutting tool.

Follow these guidelines while cutting the cable:

- Cut the cable to the length determined in the ‘Cable Path Inspection’ step.
- Use a cable-cutting tool specific to the cable.
- Cut the cable at right angles.
- Be careful to keep the cable away from any moisture, iron, lead, dust, or other foreign material while cutting.
- Remove any foreign material attached to the cable using solvent and a brush.

Cable Installation

Cable installation involves running the cable along a path to the system target connector or to an auxiliary device after path inspection and cable cutting completion.

Follow these guidelines while installing a cable:

- Do not damage the cable.
- If the cable is damaged, cut the damaged section before installation or replace the cable.
- Run the cable to avoid any knots. While installing the cable from a horizontal section to a vertical section, exercise extra care so that the upper and lower lines of the cable are not reversed.

- Always use the maximum possible curvature radius, and make sure that it is in compliance with the minimum curvature radius specification.
- To protect the cable, use a PVC channel, spiral sleeve, flexible pipe, and cable tray.

Table 18. Minimum Recommended Cable Bend Radius

No	Type	Allowed Cable Bend Radius	Remark
1	F-GV/F-CV/FR-8	8 times of the cable external diameter	0.6/1 KV Cable
2	Optic Cable	20 times of the cable external diameter	-
3	UTP/FTP/S-FTP Cable	4 times of the cable external diameter	PVC/LSZH, 4 Pair
4	1/2 in. Feeder Line (Indoor)	1.26 in. (32 mm)	RFS, LS
5	1/2 in. Feeder Line (Outdoor)	4.92 in. (125 mm)	RFS, LS
6	7/8 in. Feeder Line (Outdoor)	9.84 in. (250 mm)	RFS, LS
7	1-1/4 in. Feeder Line (Outdoor)	14.96 in. (380 mm)	RFS, LS
8	1-5/8 in. Feeder Line (Outdoor)	19.69 in. (500 mm)	RFS, LS
9	RG-316D	0.59 in. (15 mm)	-
It should be in compliance with it the allowed cable bend radius as specified by the manufacturer.			

Cable Binding

Cable binding involves fixing and arranging an installed cable using binding thread, cable ties, binding wire, and ram clamps.

Follow these guidelines while binding a cable:

- Do not damage the cable during binding.
- Use appropriate cable binding tools according to the target location (indoor or outdoor) with accordance to the use of the cable (for example, power supply cable, optical cable, or feeder line).
- Do not let the cutting section of a cable tie and binding line be exposed to the outside. This may cause damage to cables or personal injury.
- Cut off the remainder of the cable binding thread by leaving about 1.97 in.(50 mm) of extra length and put it through the knot so that it stays secured.
- Install the cable as short as possible to limit the danger of contact failure in a connector connection due to tension.

Connector Attachment

Connector attachment involves the assembling of a connector to an installed cable or to a device on the site.

Follow these guidelines while attaching a connector.

- Make sure that you are fully aware of the connector assembly method before assembling a connector. Assemble the connector in accordance with its pin map.
- Each connector has a latch to prevent its core positions from being changed.
- Check for a corresponding grooves before connecting one connector to another connector.
- Use a customer approved weatherproof method at all the connectors for cables that are installed outdoors, such as feeder lines, to prevent water leakage and corrosion from occurring at the connection.
- Connect each cable of the connector assembly in a straight line.
- Make sure that there is no cable strain by using extra cable length or cable ties.

Identification Tag Attachment

Identification tag attachment involves attaching a marker cable tie, nameplate, and label to both ends of the cable (connections to a connector) to identify its use and cabling path.

A label can be attached on the marker cable tie.
The appearance and specification may differ depending on the type and manufacturer.

Follow these guidelines when attaching an identification tag.

- When installing a cable outdoors, use relief engraving and coated labels to prevent the markings from being erased.
- Since the form and attachment method for identification tags are different for each provider, consult with the provider before attaching them.

Always connect the ground cable first to prevent system damage or worker injury due to static electricity and short circuit.

Cover the unused ports with a waterproof cap (sealing cap) to prevent infiltration of foreign material such as dust, moisture, or insects.

Make sure the work is done by personnel properly trained for the job.

Cabling

Figure 21. Cabling Diagram shows the cabling of the Outdoor Pico eNB.

Figure 21. Cabling Diagram

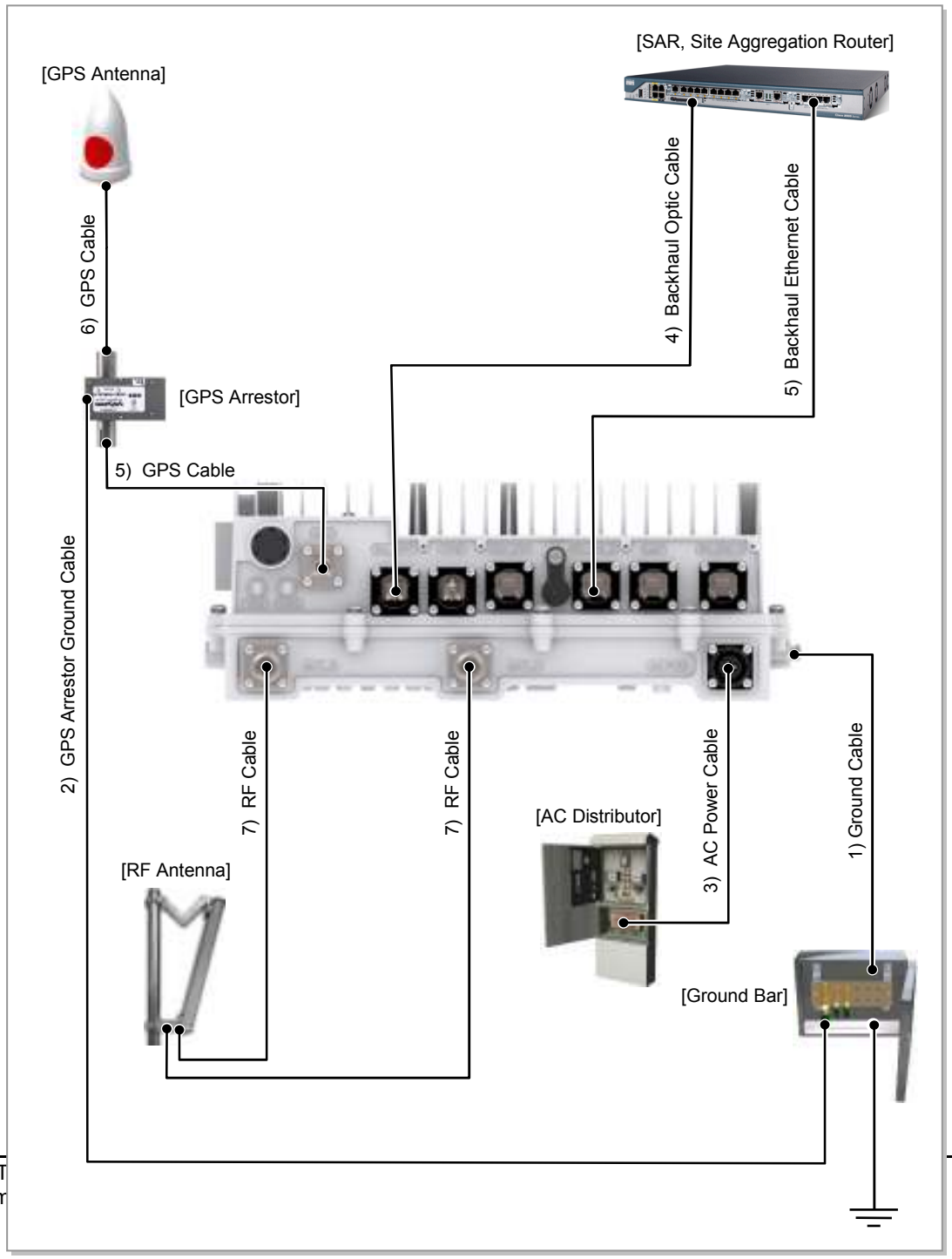


Table 19. Outdoor Pico eNB Connection Cable

From	To	Cable
Ground Bar	Outdoor Pico eNB	**1** Ground Cable : AWG 8, F-GV 6 mm^2 × 1C 2 hole lug : Ex) Manufacturer: Panduit, LCD8-14AF-L or equivalent
	GPS Arrestor	**2** GPS Arrestor Ground Cable : AWG 10, F-GV 4 mm^2 × 1C
AC Distributor	Outdoor Pico eNB	**3** AC Power Cable : AWG 16 × 3C
Outdoor Pico eNB	Site Aggregation Router	**4** Backhaul Cable (Optic) : Single Mode Outdoor, 2LC/UPC
		5 Backhaul Cable (Copper) : S-FTP, Cat.5e or Cat.6, 4 Pair
	GPS Antenna	**6** GPS Cable : 1/2 in. Coaxial Cable Connector: N Type-Male
	RF Antenna	**7** RF Cable : 1/2 in. Feeder Line Connector: Mini DIN Type-Male

Grounding

Grounding is required for protecting the electric systems such as power system, communication system, and control system, from lightning, excessive-current, high-voltage, and electric noise. Grounding will substantially reduce the possibility of accidents, especially when used in combination with other safety measures.

The purpose of grounding is as follows:

- To prevent human life and the system from excessive current, high-voltage, and lightning
- To provide a discharge path for surge voltage generated by lightning and power switch
- To protect the system from static electricity
- To eliminate or minimize the high-frequency potential in system housing
- To stabilize the potential of the circuit against the ground

Connecting cables without the ground cable may cause damage to the equipment or physical injury to the worker. Always connect the ground cable.

Ground bar for lightning protector/power/communication must be isolated from each other. These three ground bars can be grounded using the isolation grounding method, or branched from ground mesh buried in the ground using the common grounding method.

Grounding the Outdoor Pico eNB

Table 20. Grounding the Outdoor Pico eNB and Figure 22. Connection of the Outdoor Pico eNB Ground Cable show the procedure to connect the ground cable of the Outdoor Pico eNB.

Table 20. Grounding the Outdoor Pico eNB

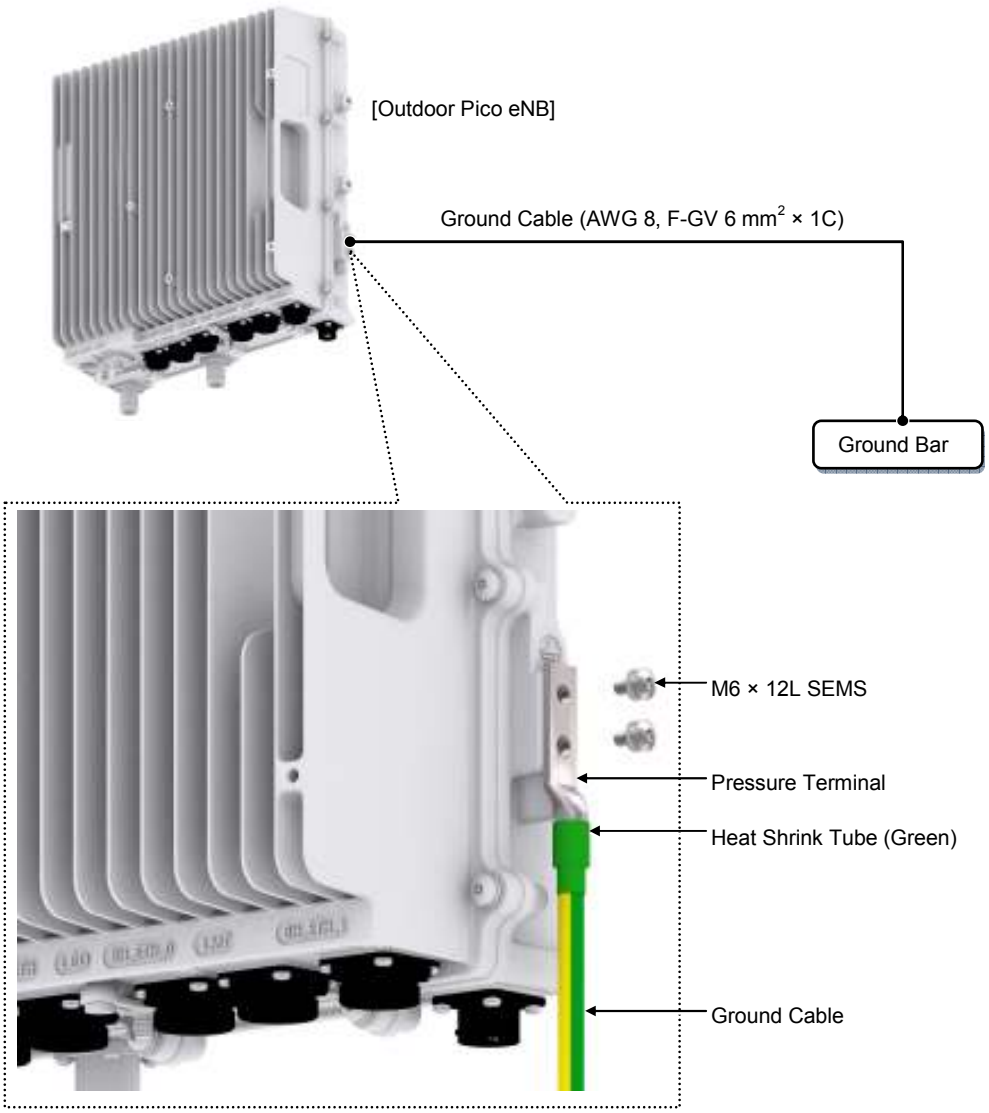
Category	Description	
Installation Section	Ground Bar - Outdoor Pico eNB Ground Terminal	
Cable	AWG 8, F-GV 6 mm^2 × 1C, Yellow/Green	
Heat Shrink Tube (Spec/Color/Length)	Φ 12 mm/Green/50 mm	
Pressure Terminal	Ground Bar	Check Ground Bar specifications per site and preparing connecting parts
	Outdoor Pico eNB	6 mm^2, 2 Hole, 90°, Hole Dia.: 6.3 mm, Hole Dist.: 16 mm
Fastener	Ground Bar	Check Ground Bar specifications per site and preparing connecting parts
	Outdoor Pico eNB	M6 × 12L SEMS/ 2 EA
Recommended Torque Value	M6 SEMS	2.41~3.61 lbf.ft (33.28~49.92 kgf·cm)
Working Tools	Cable Cutter, Wire Stripper, Compressor, Heating Gun, Torque Driver(+), Torque Wrench, Nipper	

Use UL certified products or equivalent for the pressure terminal and cables.
Example: Manufacturer - Panduit
Outdoor Pico eNB: 6 mm^2 Pressure Terminal (LCD8-14AF-L)

Refer to ‘Appendix F Pressure Terminal Assembly’ to see how to assemble a pressure terminal and a heat shrink tube to a cable.

Figure 22. Connection of the Outdoor Pico eNB Ground Cable

1) Install the ground cable from the Ground Bar to the Outdoor Pico eNB ground terminal.
2) Assemble a pressure terminal and a heat shrink tube at the end of the Outdoor Pico eNB ground cable.
3) Align the pressure terminal to the mounting hole of the Outdoor Pico eNB ground terminal.
4) Firmly fix the pressure terminal onto the Outdoor Pico eNB ground terminal using fasteners.



Grounding GPS Arrestor

Follow the steps below to connect the ground cable to the UADU.

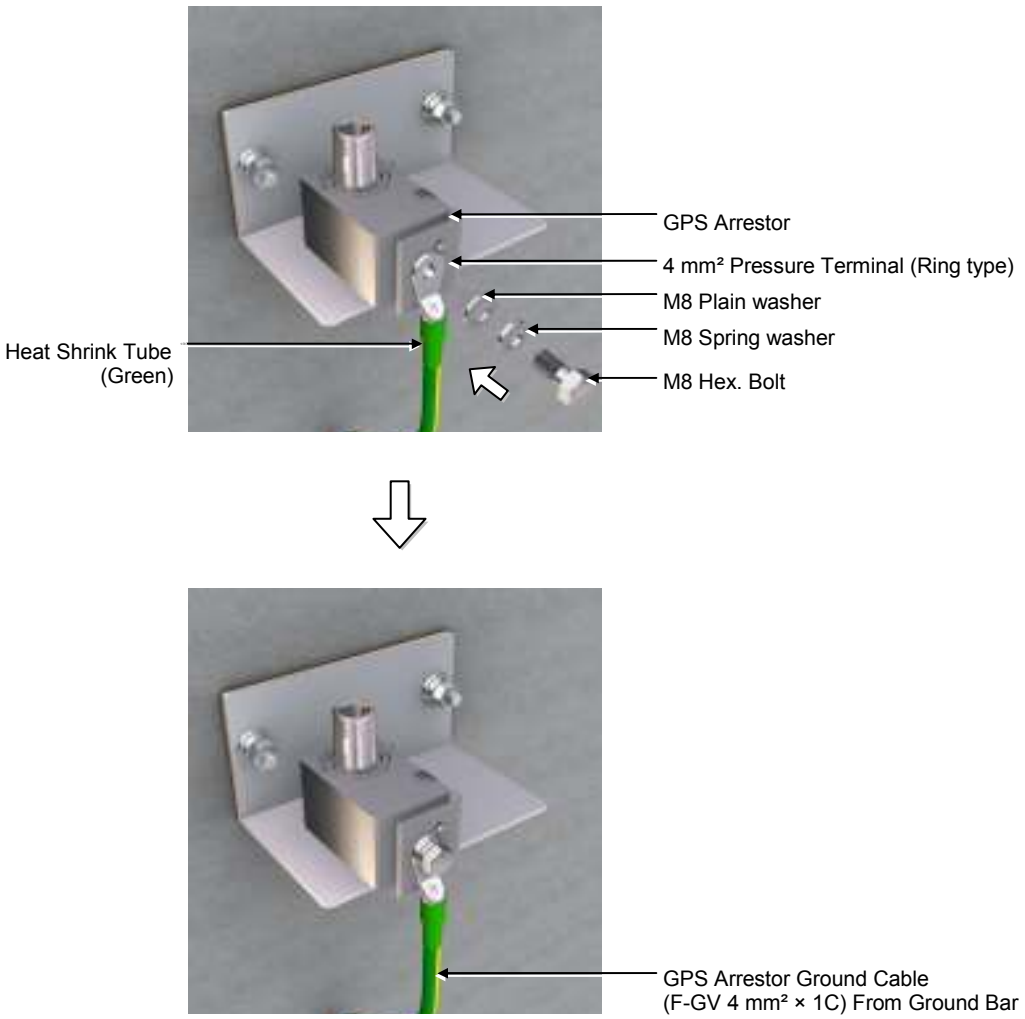
* Depending on site condition, install method of GPS arrestor may be vary.

Table 21. Grounding GPS Arrestor

Category	Description	
Installation Section	Ground Bar - GPS Arrestor Grounding Terminal	
Cable	AWG 10, F-GV 4 mm^2 × 1C, Yellow/Green	
Heat Shrink Tube (Spec/Color/Length)	Φ 12 mm/Green/50 mm	
Pressure Terminal	Ground Bar	Check Ground Bar specifications per site and preparing connecting parts
	GPS Arrestor	4 mm^2, Ring Type, Hole Dia.: 8.3 mm
Fastener	Ground Bar	Check Ground Bar specifications per site and preparing connecting parts
	GPS Arrestor	M8 Hex. Bolt/ 1EA M8 Spring Washer/ 1EA M8 Plain Washer/ 1EA
Recommended Torque Value	M8 Hex. Bolt	5.96~8.94 lbf.ft (82.4~123.6 kgf·cm)
Working Tools	Cable Cutter, Wire Stripper, Compressor, Heating Gun, Torque Driver(+), Torque Wrench, Nipper	

Figure 23. Connecting GPS Arrestor ground cable

1) Install the ground cable from the ground bar to the ground connector of the GPS arrestor.
2) Install the 4 mm² pressure terminal and the heat shrink tube at the end of the cable.
   Pressure terminal: 4 mm², ring type, hole diameter: 8.3 mm
3) Align the assembled pressure terminal to the GPS arrestor fixing holes at the ground cable on the GPS arrestor, and then fix it with the M8 plain washer, spring washer, Hex. bolt.



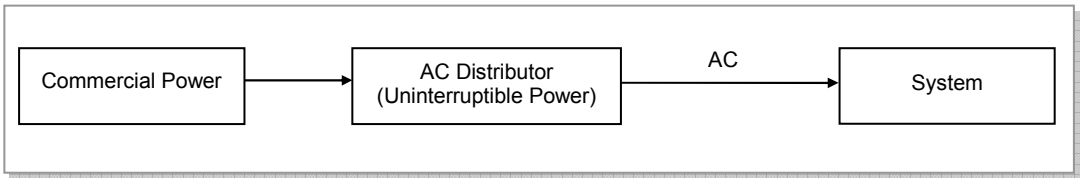
Pressure terminal

As for the pressure terminal or the cable, the UL Listed or equivalent should be used.
Example: Manufacturer-JEONO Electric
- GPS Arrestor: 4 mm² Type Name(JOR 4-8)

Power Cabling

Figure 24. Power Equipment Diagram shows how the power supply is configured.

Figure 24. Power Equipment Diagram



Be sure to check the AC distributor circuit breaker is turned off before connecting the power cable to power connector. If the system is installed while the circuit breaker is on, the worker may be critically injured if the cable is connected incorrectly.

When Using Power Cables
- Ensure the AC distributor power switch or that of the system is turned off to prevent short-circuiting of related cables.
- Because a power accident may occur due to loose parts, make sure that fasteners are firmly fixed.
- For supply connections, use wires suitable for at least 90°C.

SPD
- AC SPD Type 2 or Type 1 with 2500Vmax limit must be installed externally
ex) Raycap Part Number :AC1060-02W-NA

Connecting the AC Power Cable

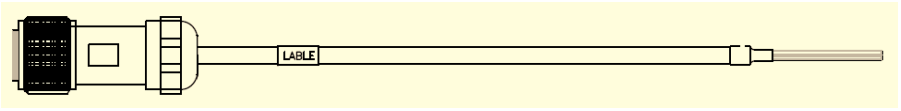
Use the following tables and figures to connect the AC power cable to the Outdoor Pico eNB.

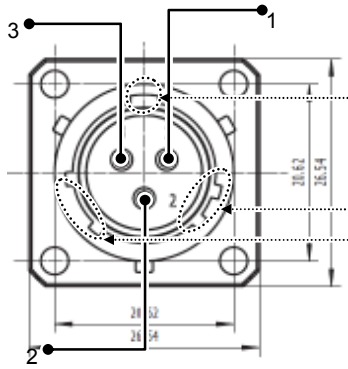
Table 22. Connecting the AC Power Cable

Category	Description	
Installation Section	AC Distributor - Outdoor Pico eNB Power Input Terminal	
Cable	AWG16 × 3C	
Connector	AC Distributor	Check the specification of AC distributor output terminal and prepare fasteners.
	Outdoor Pico eNB	JONHON, DY5T1203SNF, Straight Plug
Working Tools	Cable Cutter, Wire Stripper, Compressor, Heating Gun, Torque Driver(+), Torque Wrench, Nipper, Soldering Iron, and Lead	

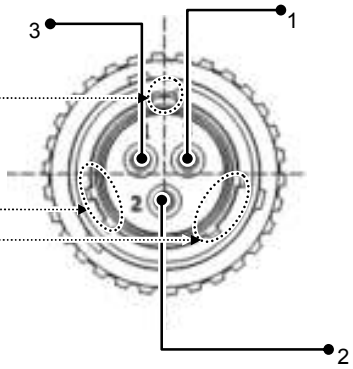
Table 23. Power Connector Pin Map

No.	Color
1 (L)	Black
2 (PE)	Yellow/green
3 (N)	White





[System-side Connector: DY5F1203PNF]



[Cable-side Connector: DY5T1203SNF]

Do not rapidly turn the system ON/OFF (within one second): The Outdoor Pico eNB could be damaged by the counter electromotive force caused by the cable inductance.
- Do not use the power cables linked or power loss will increase.
- For the length of the AC power cable, follow the safety regulation of the installation site.

To prevent foreign substances, outdoor air, and moisture from entering the system input/output port and cable inlet (including cable gland and conduit), finish it as follows:

- Unused inlet
Use the hole finishing materials including waterproof cap and rubber packing.
- Cable-installed port and cable inlet

- After cable installation, block any space in the inlet with tape, compressed sponge, rubber packing, and silicon.

The pin map provided by this manual is based on the connectors on the system side, so it is necessary to check the pin connection positions when connecting to the cable side.

When laying the power cable through the input/output port (conduit) at the bottom of the AC distributor, a sealing material should be used to prevent foreign substances from coming

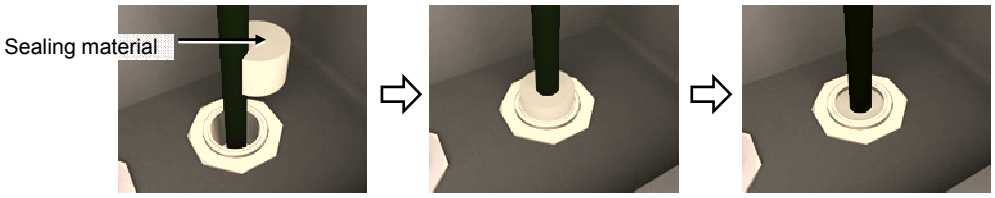


Figure 25. Connecting the Outdoor Pico eNB Power Cable (1)

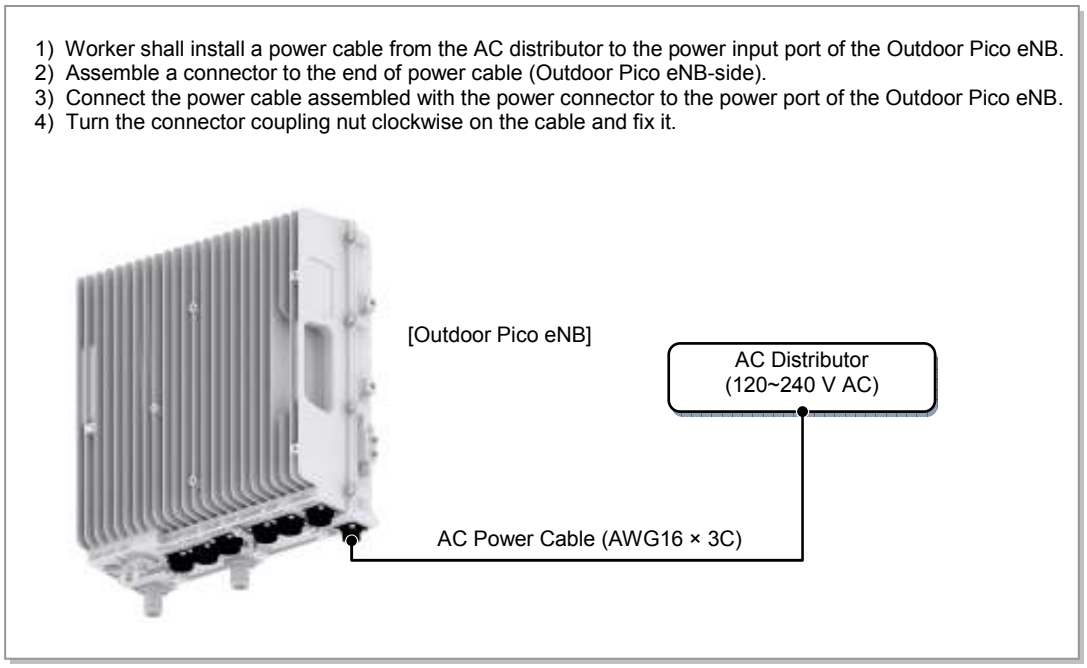
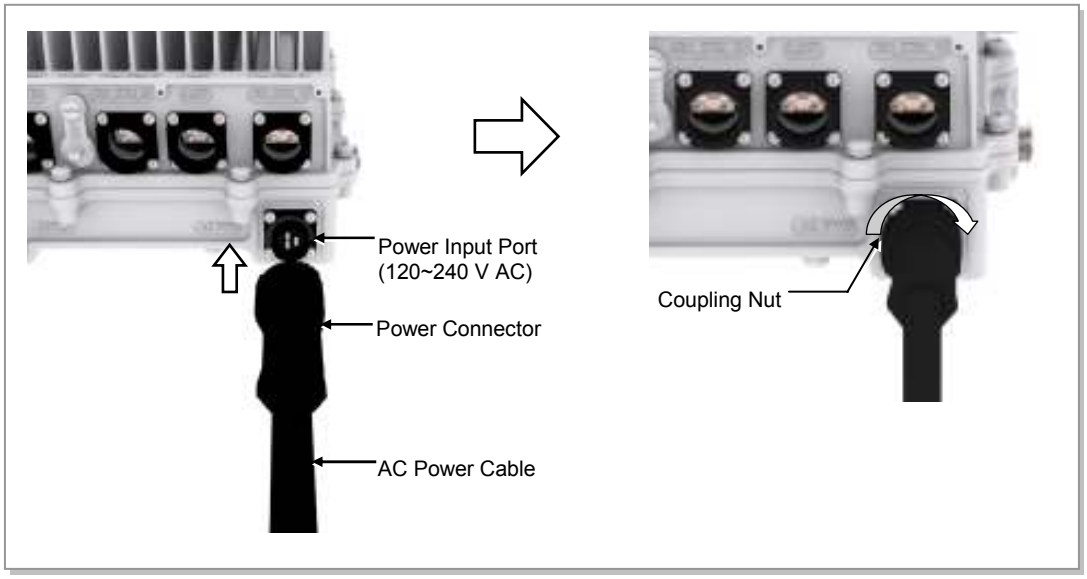


Figure 26. Connecting the Outdoor Pico eNB Power Cable (2)

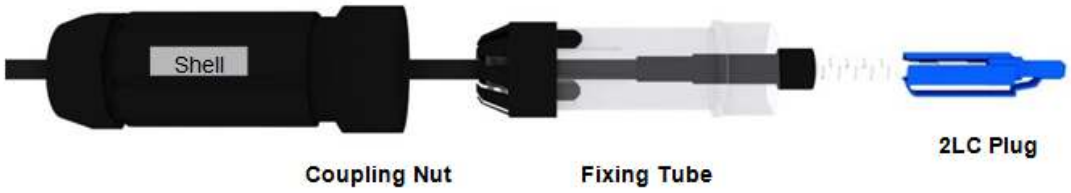


Backhaul Cable Connection (Optic Type)

Follow the steps below to connect the backhaul cable (Optic type) to the Outdoor Pico eNB.

Table 24. Backhaul Cable Connection (Optic Type)

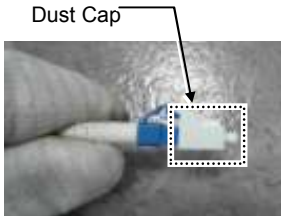
Category	Description	
Installation Section	Site Aggregation Router ~ Outdoor Pico eNB_Backhaul (BH_OPT) Port	
Cable	Optic Cable(Single Mode, Outdoor)	
Connector	Site Aggregation Router	Checking Site Aggregation Router side connector specifications and preparing connecting parts.
	Outdoor Pico eNB	PDLC, 2LC/UPC[JONHON]
Working Tools	Optic Cleaner	



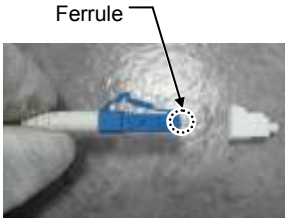
To prevent foreign substances, outdoor air and moisture from entering the system input/output port and cable inlet (including cable gland and conduit), finish it as follows:
- Unused inlet
Use the hole finishing materials including waterproof cap and rubber packing.
- Cable-installed Port and Cable Inlet
After cable installation, block any space in the inlet with tape, compressed sponge, rubber packing, and silicon.

Caution for Laser Beam of Optical Module and Cable
The optical module and cable used in the system emit bright laser beams. Always handle them with care as there is risk of serious injury if the eyes are exposed to the laser beam of the optical cable.

Caution for Optic Cable Connection
1) After removing dust cap of optic cables, use optic cables.
2) Before connecting the optic connector, make sure that the connector is cleaned. If there is any dust or foreign substance when cleaning the connector, do not remove it by blowing with your mouth. Remove the dust or foreign substance by referring to the cleaning instructions in ANNEX E.
3) Don't touch ferrule of optic cables because it is weak.



[Before removing Dust Cap]



[After removing Dust Cap]

Precautions for connecting the optical cable connector are as follows:
- Do not assemble the optical cable while pushing it toward the system.
- After putting the cable in a straight line, pull the cable toward the arrow direction slightly with one hand and fix the coupling nut with the other hand.

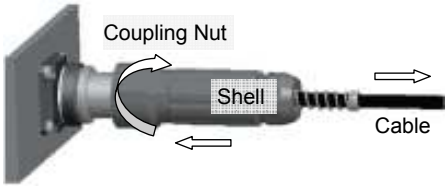
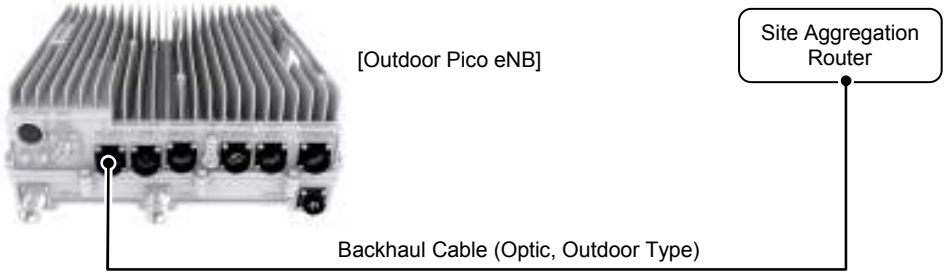
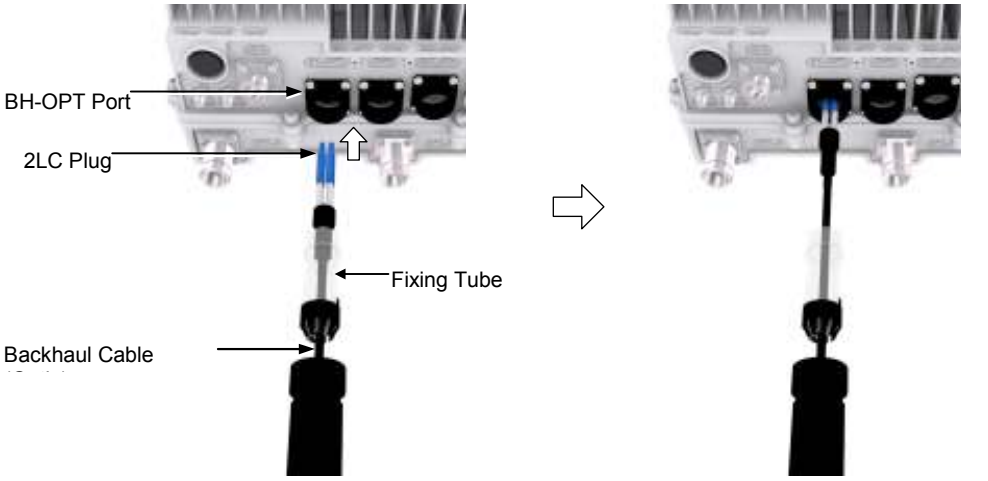


Figure 27. Backhaul Cable Connection–Optic Type(1)

1) Install a backhaul cable from the Site Aggregation Router to the backhaul port (BH_OPT) of the Outdoor Pico eNB.
2) Remove the dust cap in the 2LC plug of the backhaul cable.



3) Connect the 2LC plug on the side of the backhaul cable to the SFP module of the BH-OPT port on the side of the Outdoor Pico eNB.
At the time, after inserting the 2LC plug latch upturned, check the 'click' sound.



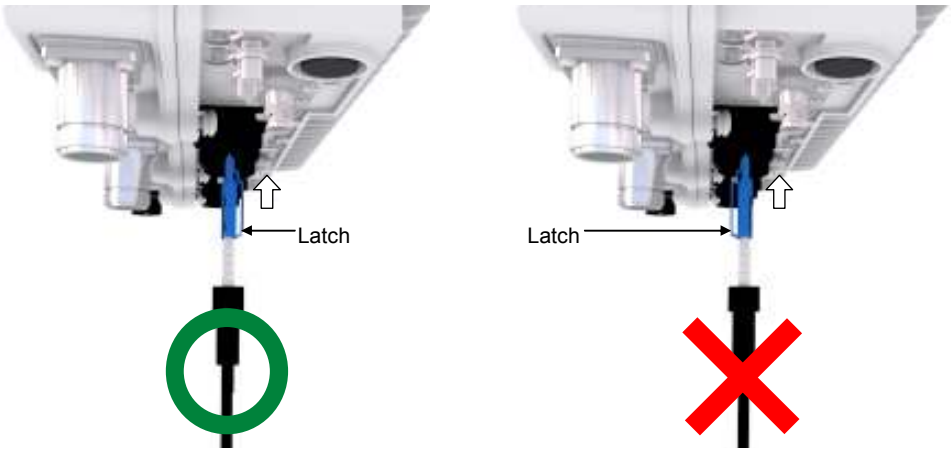
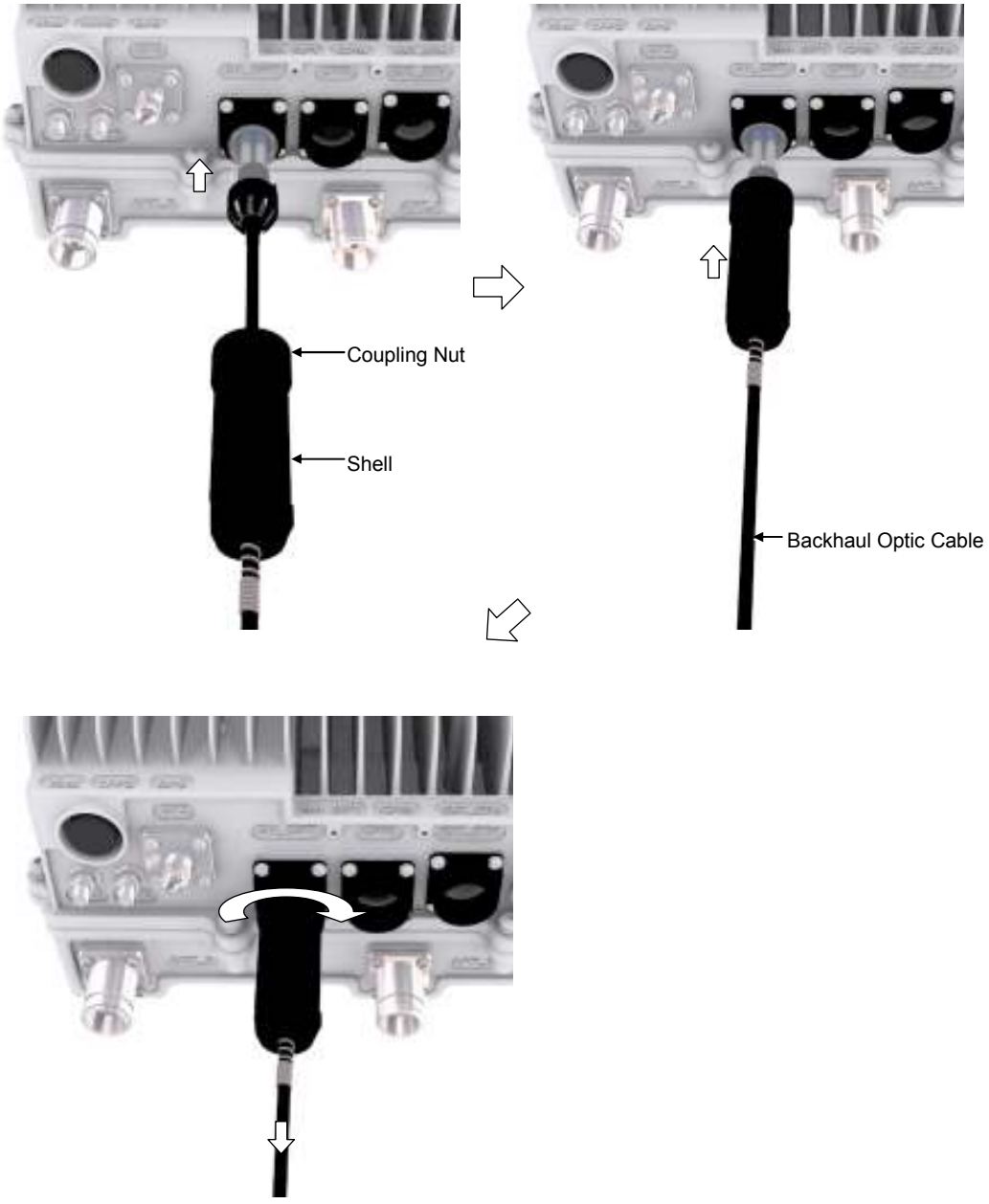


Figure 28. Backhaul Cable Connection–Optic Type(2)

4) Align the fixing tube to the grooves of the BH-OPT connector on the Outdoor Pico eNB and insert it.
5) Push up the shell to the BH-OPT connector on the side of the Outdoor Pico eNB.
6) After putting the cable in a straight line, pull the cable toward the arrow direction slightly with one hand and fix the coupling nut on the top of the shell with the other hand.



External Interface Construction

Backhaul Cable Connection (Copper Type)

Use the following tables and figures to connect the backhaul cable (copper type) to the Outdoor Pico eNB.

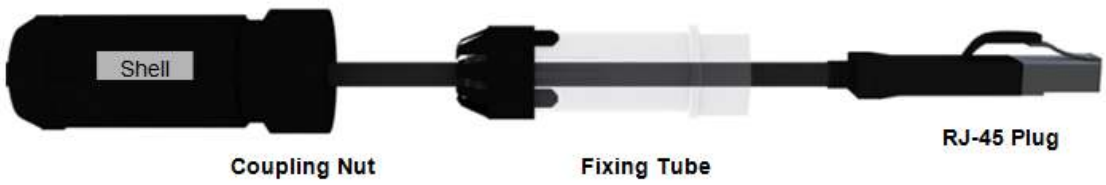
The optic type and copper type have different parts and installation methods. Prepare installation after checking the type with the service provider.

Table 25. Backhaul Cable Connection (Copper Type)

Category	Description	
Installation Section	Outdoor Pico eNB BH-ETH0 Port ~ Site Aggregation Router	
Cable	S-FTP, Cat5e or Cat.6, 4 Pair	
Connector	Site Aggregation Router	Checking Site Aggregation Router side connector specifications and preparing connecting parts
	Outdoor Pico eNB	RJ-45(Shield Type)
Working Tools	LAN Tool, LAN Cable Tester, Nipper, Wire Stripper, Cable Cutter	

Table 26. Backhaul Cable (Copper Type)/Connector Pin Map

Pin No.	Description	Color
1	Gigabit Ethernet Tx/Rx0+	White/Orange
2	Gigabit Ethernet Tx/Rx0-	Orange
3	Gigabit Ethernet Tx/Rx1+	White/Green
4	Gigabit Ethernet Tx/Rx2+	Blue
5	Gigabit Ethernet Tx/Rx2-	White/Blue
6	Gigabit Ethernet Tx/Rx1-	Green
7	Gigabit Ethernet Tx/Rx3+	White/Brown
8	Gigabit Ethernet Tx/Rx3-	Brown
Shell	Shield	Shield



The pin map provided by this manual is based on the connectors on the system side. Check the pin connection positions when connecting to the cable side.

To prevent foreign substances, outdoor air, and moisture from entering the system input/output port and cable inlet (including cable gland and conduit), finish it as follows:

- Unused inlet
Use the hole finishing materials including waterproof cap and rubber packing.

- Cable-installed port and cable inlet

After cable installation, block any space in the inlet with tape, compressed sponge, rubber packing, and silicon.

To connect an RJ-45 connector to a cable, refer to ‘Appendix D Connector Assembly.

Figure 29. Backhaul Cable Connection–Copper Type(1)

1) Install a backhaul cable from the Site Aggregation Router to the backhaul port (BH_ETH) of the Outdoor Pico eNB.
2) Connect the connector of a backhaul cable to the backhaul port (BH_ETH) of the Outdoor Pico eNB. At the time, after inserting the RJ-45 plug latch downturned, check the 'click' sound.

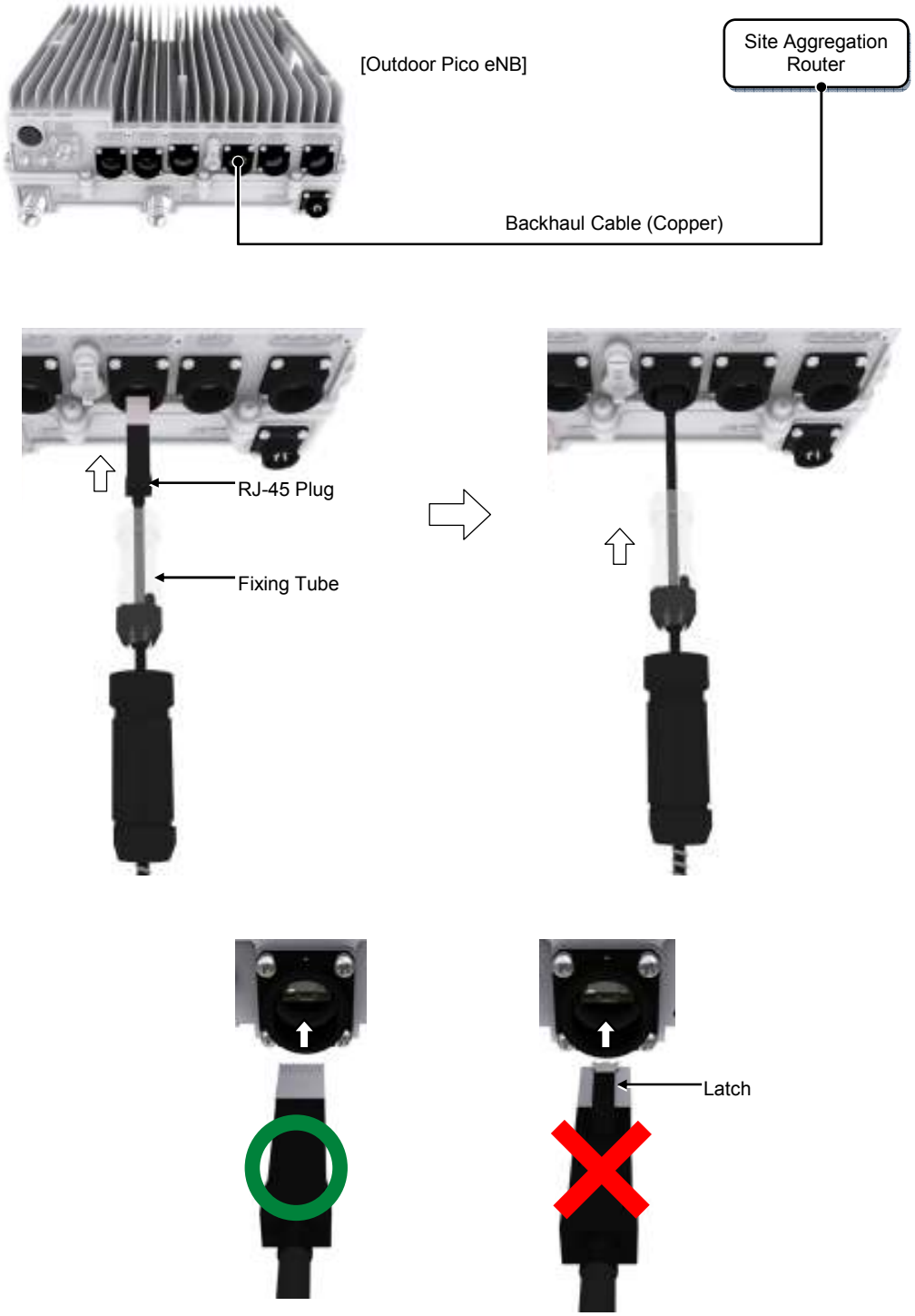
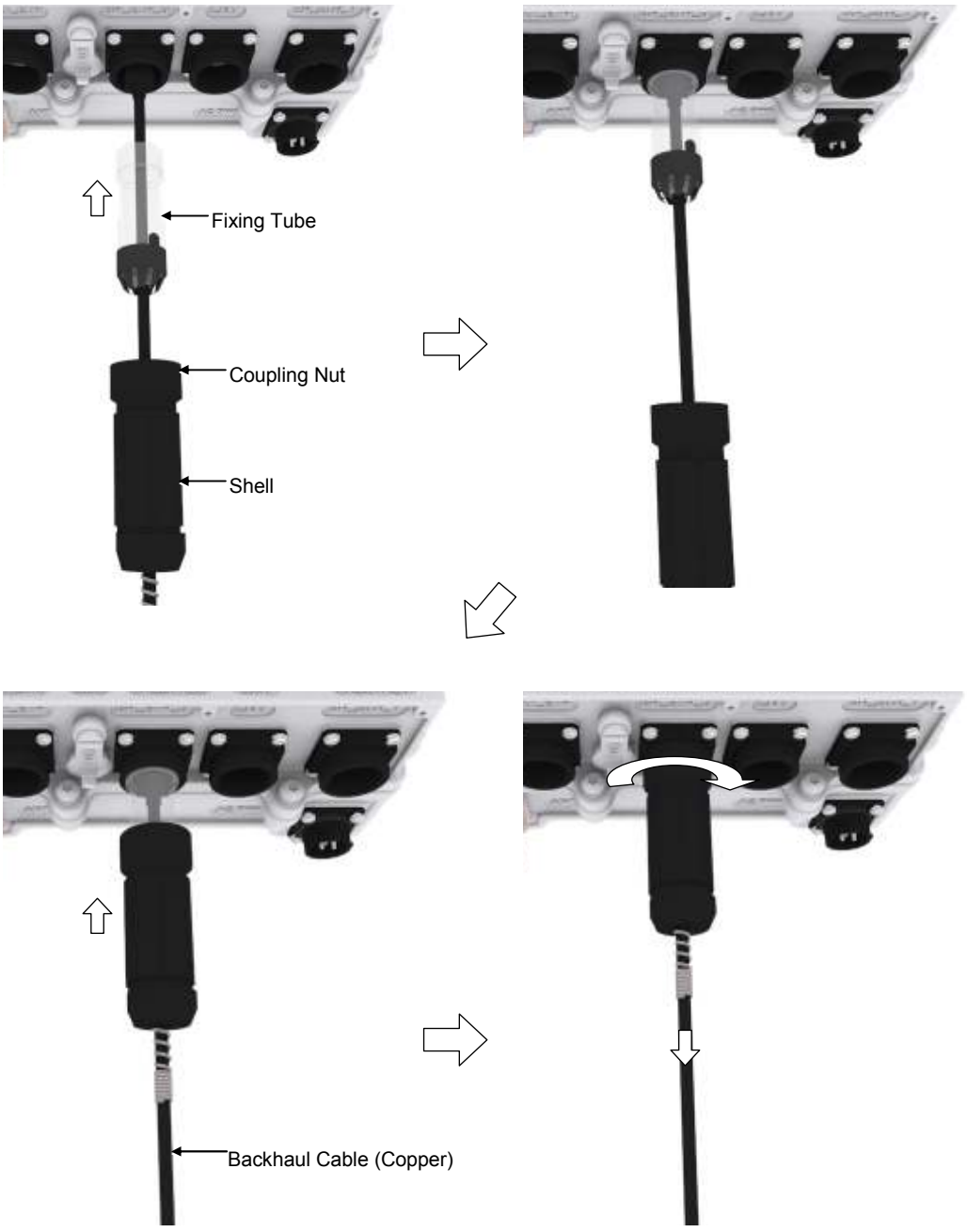


Figure 30. Backhaul Cable Connection–Copper Type(2)

3) Align the fixing tube to the grooves of the BH-ETH connector on the Outdoor Pico eNB and insert it.
4) Push up the shell to the BH-ETH connector on the side of the Outdoor Pico eNB.
5) After putting the cable in a straight line, pull the cable toward the arrow direction slightly with one hand and fix the coupling nut on the top of the shell with the other hand.



GPS Cable Connection

Use the following tables and figures to connect the GPS cable.

Table 27. GPS Cable Connection

Category	Description	
Installation Section	Outdoor Pico eNB - GPS Antenna	
Cable	1/2 in. Coaxial Cable	
Connector	Outdoor Pico eNB	N Type-Male
	GPS arrestor	N Type-Male
	GPS Antenna	N Type-Male
Recommended Torque Value	N Type-Male	1.45 lbf·ft (20 kgf·cm)
Working Tools	Cable Cutter, Wire Stripper, Nipper, Torque Wrench, Spanner, Knife, Soldering Iron, Lead	

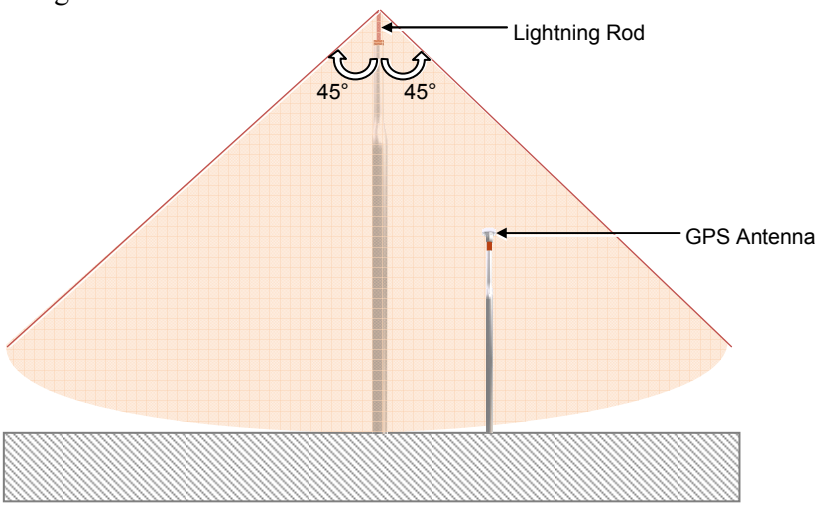
Table 28. GPS Cable Min. Radius of Curvature and Length Limitation

Category	Description		
GPS cable min. radius of curvature	1/2 in. Coaxial Cable	Installation	2 in. (50.8mm)
		Repeated	5 in. (127 mm)
Length limitation of GPS cable	Total length	1/2in. Coaxial Cable	32.8ft(10m or less)

When using GPS arrestor (Polyphaser, Part no.: DGXZ+06NFNF-A) and GPS antenna (PCTEL, GPS-TMG-HR-26N').

If the GPS cable minimum radius of curvature or its length limitation is violated, a GPS signal may not be received seamlessly and it may cause abnormal system operation. Therefore, the minimum radius of curvature and length limitation of a GPS cable specified in Table 28. GPS Cable Min. Radius of Curvature and Length Limitation must be observed.

When you install the antenna, the antenna must be within the protective angle (left/right side 45° each from the central axis) to protect the antenna from lightning damage.



When installing the GPS antenna, you must check the antenna installation location, restrictions, and installing method in ‘Appendix A GPS Antenna Installation’.

Depending on the supplier or manufacturer of the antenna/line amplifier the connector type may be different. Also, the detail specifications of a connector may be different depending on cable type even for the same connector type.
Therefore, check the detail specifications of a connector before preparing parts.
For example, N Type-Male: for 1/2 in. Coaxial Cable, for RG-316D

For GPS antenna, 'PCTEL, GPS-TMG-HR-26N' or equivalent must be used.

Parameters	Specifications
Frequency Band	1575.42 ± 1.2 MHz
Amplifier Gain	26.5 ± 3 dB
Output VSWR	≤ 2.0:1
Noise Figure (including pre-selector)	≤ 4.0 dB @ +25°C (typ.) ≤ 4.5 dB @ +25°C (max.)
Operating DC Voltage	3.3~12.0 V (regulated)
Survival DC Voltage	24 V
DC Current	≤ 40 mA @ 5 V
Filtering	4-stage filtering including pre-selector
Out of Band Rejection	≥ 65 dB @ 1559 MHz ≥ 65 dB @ 1625 MHz

GPS Cable Identification Tag Installation

Attach the identification tape specified in Table 29. Identification Tag of GPS Cable to the GPS cable.

Table 29. Identification Tag of GPS Cable

Classification	Description
Installation position	Attach the identification tag to the ends of the GPS antenna and arrestor.
Materials	Use aluminum coated by vinyl for the identification tag.
Fixing method	Fix the GPS cable to the 2 holes on the identification tag with the black cable tie.
Identification method	Prevent the markings from being erased by using relief engraving or coated labels.

GPS Cable Configuration

The configuration of GPS cable is shown in Figure 31. GPS Cable Configuration.

Figure 31. GPS Cable Configuration

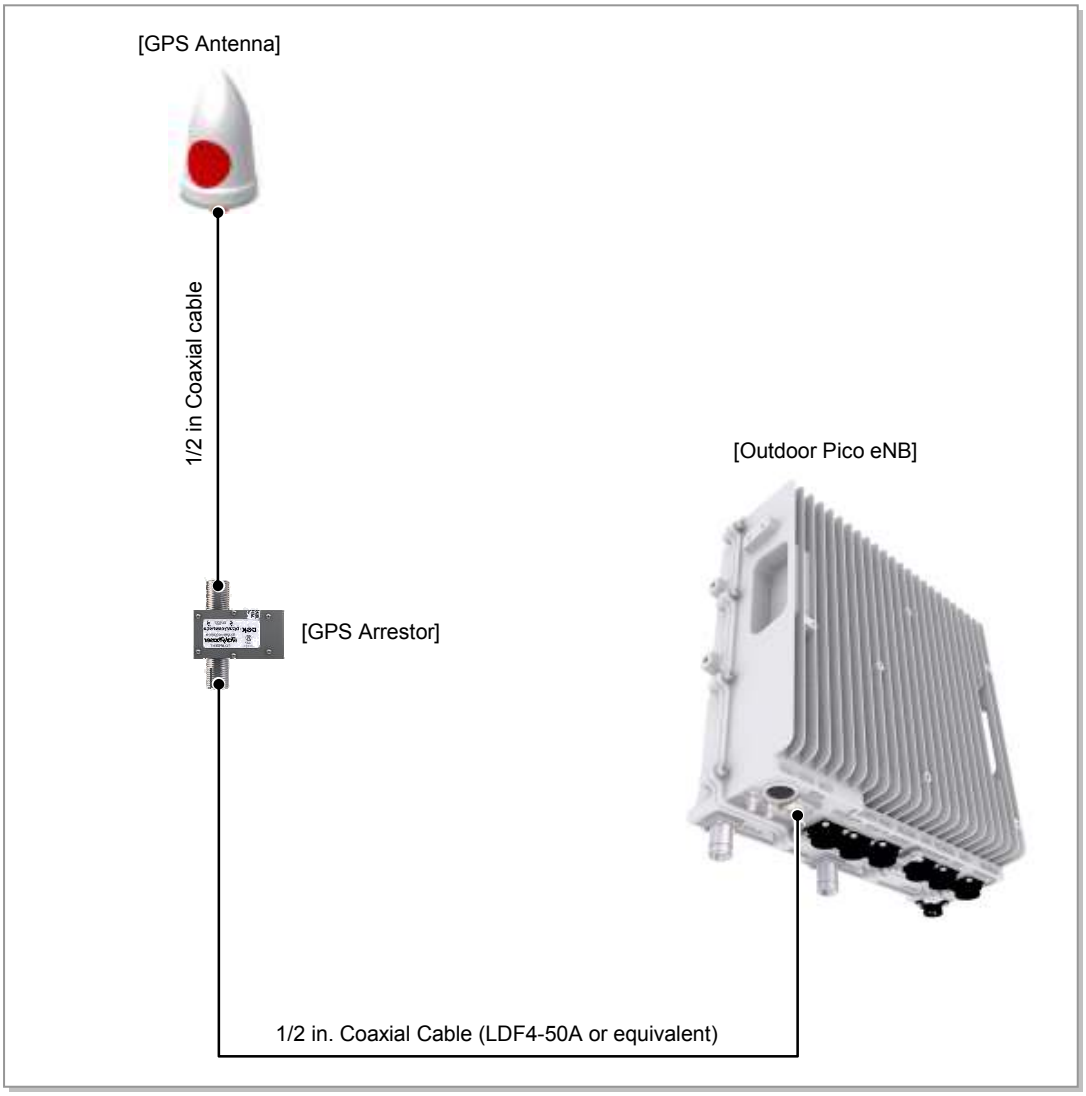


Figure 32. GPS Cable Connection (1)

1) Worker shall install a GPS cable (LDF4-50A) from the GPS port of the Outdoor Pico eNB to the GPS antenna.
2) Worker shall assemble the connector to the GPS cable.
- Outdoor Pico eNB-side Connector: N Type-Male
- GPS Antenna-side Connector: N Type-Male
3) Worker shall connect the N Type-Male connector assembled to the end of the GPS cable to the GPS port of the Outdoor Pico eNB.

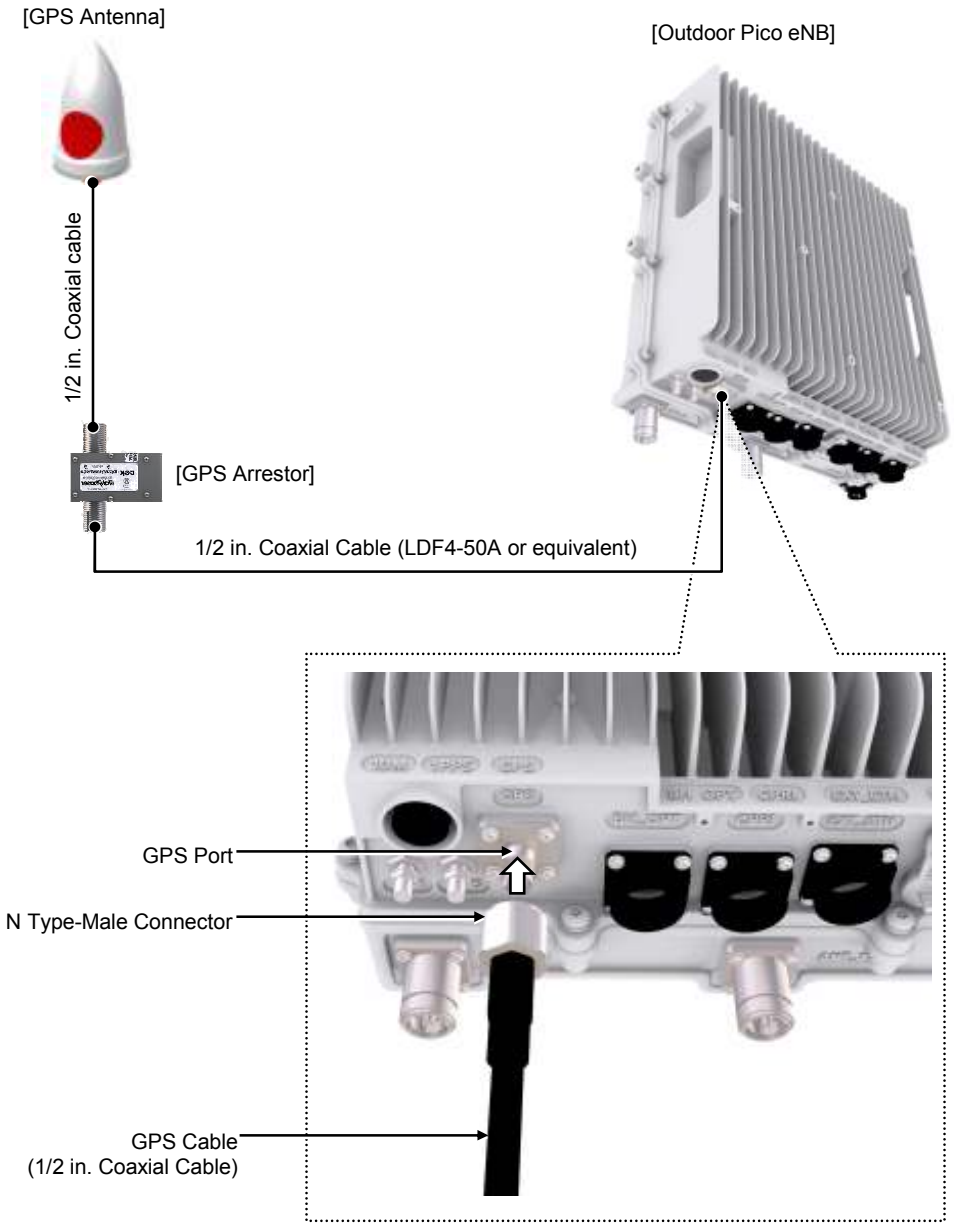


Figure 33. GPS Cable Connection (2)

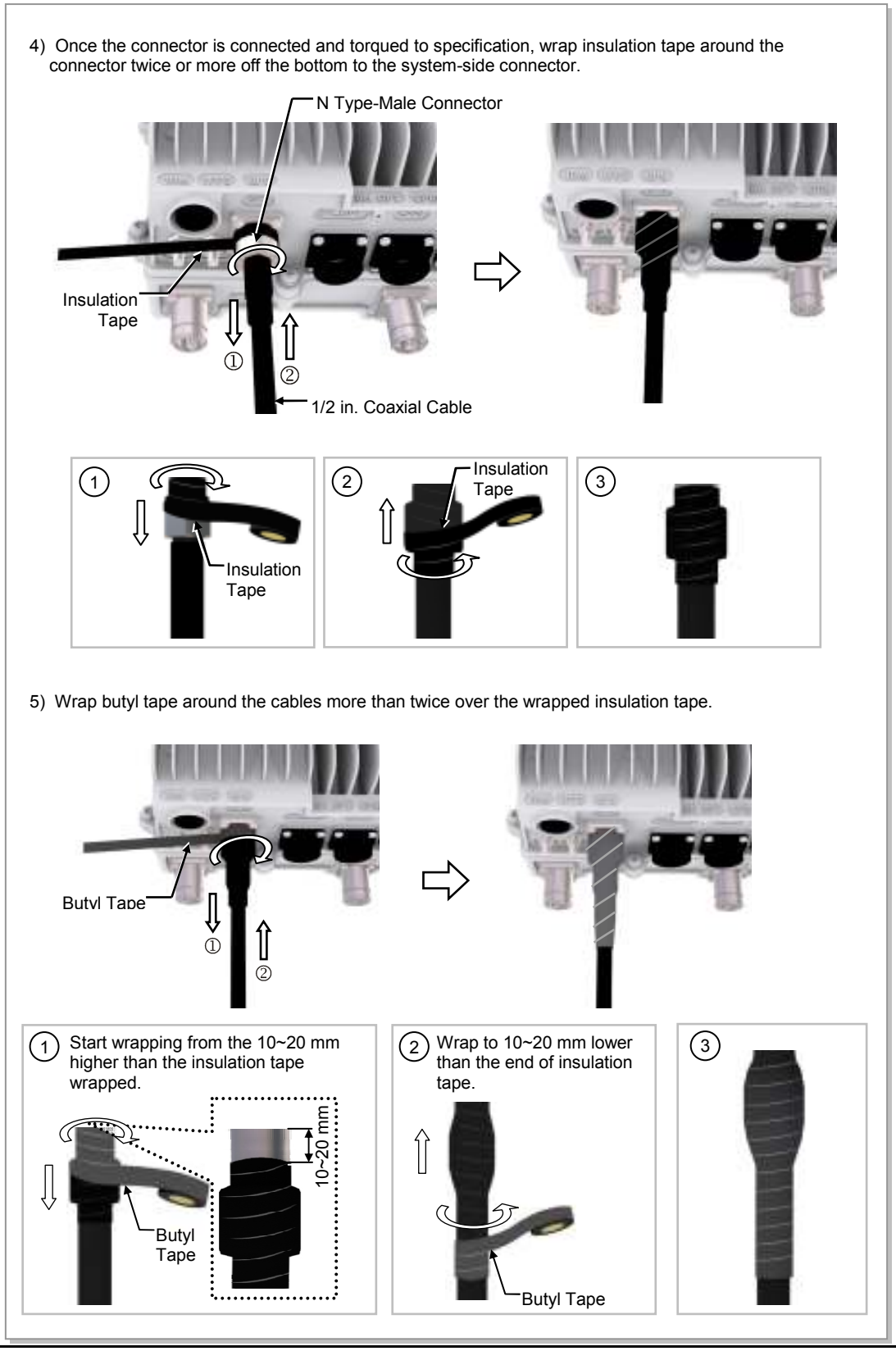
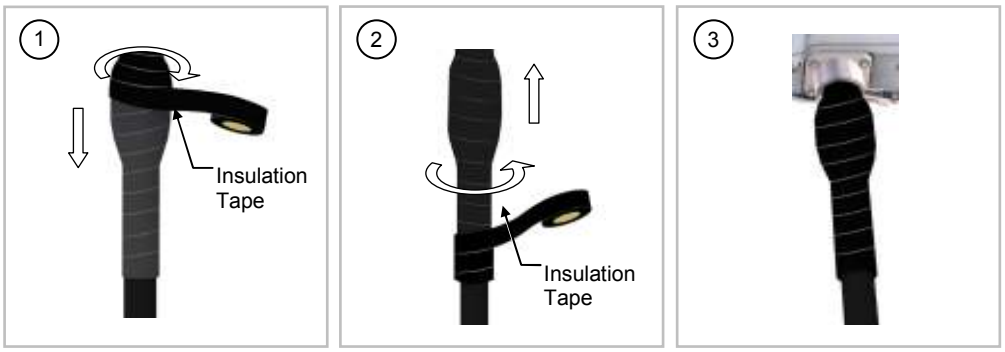


Figure 34. GPS Cable Connection (3)

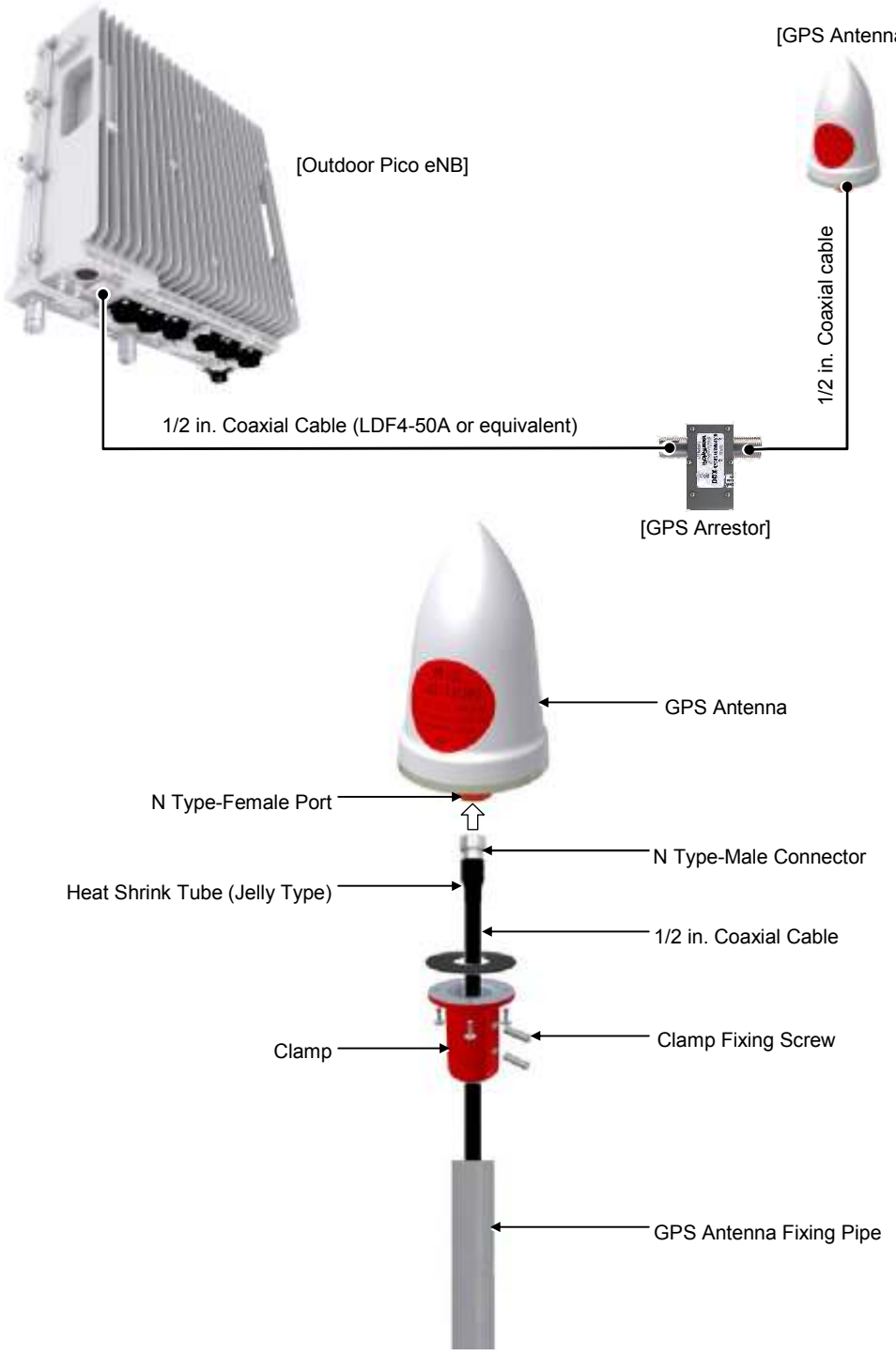
6) Wrap the butyl taping section with insulation tape twice or more in the same way as for the butyl tape.



7) Bind the end of the insulation tape with a cable tie or apply bond or silicone to prevent it from loosening.

Figure 35. GPS Cable Connection (4)

8) Connect the 1/2 in. Coaxial Cable assembled with the N Type-Male connector to the GPS Arrestor port.
9) Connect the N Type-Male connector (assembled to the end of GPS cable) to the GPS antenna port.



RF Cable Connection

Use the following tables and figures to connect the RF cable.

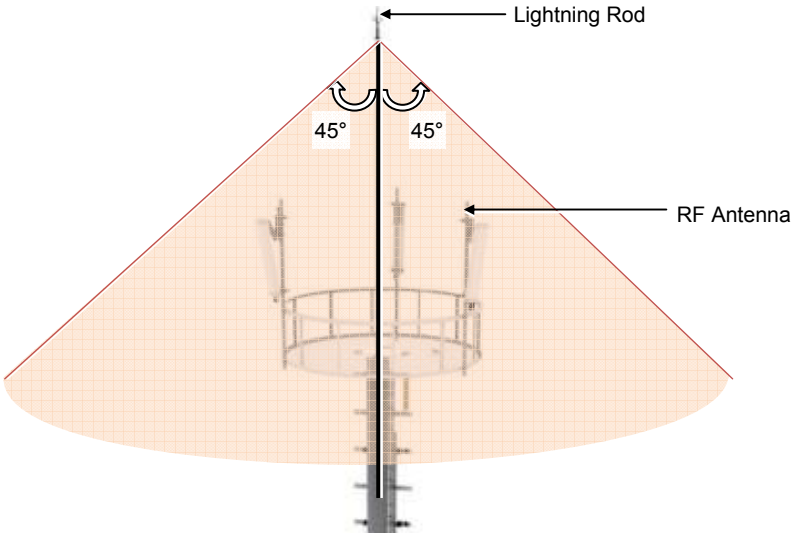
Table 30. RF Cable Connection

Category	Description	
Installation Section	Outdoor Pico eNB RF Antenna Port (ANT) ~ RF Antenna	
Cable	1/2 in. Feeder Line	
Connector	Outdoor Pico eNB	Mini DIN Type-Male
	RF Antenna	Mini DIN Type-Male (Check RF antenna specifications and prepare connector)
Recommended Torque Value	Mini DIN Type-Male	8 lbf·ft (110.4 kgf·cm)
Working Tools	Cable Cutter, Wire Stripper, Nipper, Torque Wrench, Spanner, Knife, Soldering Iron, Lead	

Table 31. RF Cable Radius of Curvature (Min.)

Category	Description		
RF cable radius of curvature (Min.)	1/2 in. Feeder Line (for Indoor)	LS/HFSC-12D	32 mm
		RFS/SCF-12-50	32 mm
	1/2 in. Feeder Line (for Outdoor)	LS/HFC-12D	125 mm
		RFS/LCF12-50	125 mm
	7/8 in. Feeder Line	LS/HFC-22D	250 mm
		RFS/LCF78-50	250 mm

When you install the antenna, it should be within the protective angle (left/right side 45° each from the central axis) to protect it from lightning damage.



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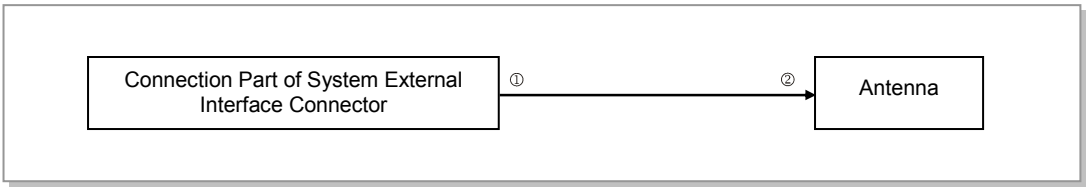
Checking RF Cable Connection

After connecting the RF cables, perform the continuity test and feeder cable return loss to check if it is changed. (Follow latest TS-200 Antenna Transmission Line Acceptance Standards.)

Measure VSWR of antenna and RF cable.



Measure all the section of the cable ①~②. The measured VSWR should be the specification value or less. If the VSWR exceeds the specification value, disassemble the connector and measure each section separately.

If the VSWR value for the minimum cable bend radius and length of RF cable is not applied, the system may not work properly because the RF signals cannot transmit or receive smoothly. Check and apply the VSWR value for minimum cable bend radius and length of RF cable.

When measuring VSWR, if you open the antenna port when the transmission output is not completely off, a spike signal may flow into the reception path. This may cause damage to LNA. Make sure the transmission output is completely off when measuring VSWR.

If you install the feeder line which is connected to the system, it may damage the system and the cable connection. Therefore, install the feeder line to the system's input port before connecting it to the system.

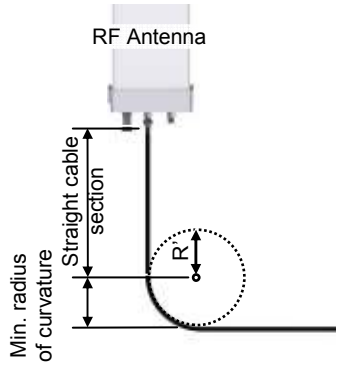
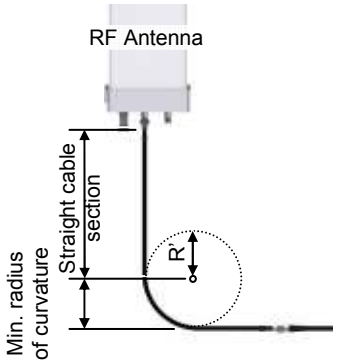
Depending on the supplier or manufacturer of the antenna, the connector type may be different. Also, the detail specifications of a connector may be different depending on cable type even for the same connector type.
Check the detail specifications of a connector before preparing parts.
For example, Mini Din Type-Male: for 1/2 in. Feeder line, for 7/8 in. Feeder Line

As different connector types may be used depending on the RF antenna type, check the antenna connector before connecting the cable.

RF Cable Configuration

The RF cable is connected by the following methods shown in Table 32. RF Cable Connection at Antenna Connection Area. Prepare and install parts based on the method agreed by the service provider based on the site conditions.

Table 32. RF Cable Connection at Antenna Connection Area

Case	Description	
Case #1		Connect a 7/8 in. or longer feeder line directly to the RF antenna. • Space for minimum radius of curvature can be secured when a 7/8 in. or larger feeder line is used. • No excessive force is applied to the connector assembled to the antenna port or cable because the straight cable section is long enough.
Case #2		Connect a 1/2 in. feeder line (jumper cable) to the RF antenna. • Space for minimum radius of curvature cannot be secured when a 1/2 in. feeder line is used. • Excessive force is applied to the connector assembled to the antenna port or cable and it may cause poor contact or damage because the straight cable section is not long enough.

7/8 in. or longer feeder line: 7/8 in., 1 1/4 in., 1 5/8 in. feeder line, and so on.

The RF cable should be connected based on the method agreed by the provider or the site conditions.

The RF cable minimum radius of curvature must be observed.

RF Cable Identification Tag Installation

Refer to Table 33. RF Cable Identification Tag for information on the cable identification tag installation. (Refer to TS-200 Antenna Transmission Line Acceptance Standards for Sprint cable marking requirements.)

Table 33. RF Cable Identification Tag

Category	Description
Installation Position	Attach the identification tag to both ends of the antenna.
Materials	Use aluminum coated by vinyl for the identification tag.
Fixing Method	• Antenna side: Attach the tag to the feeder line using binding strings through the two holes on the tag. • Equipment side: Cover the feeder line with the tag and fix it using binding strings through the two holes on the tag.
Identification Method	Use relief engraving or coated labels to prevent the markings from being erased.

RF Cable Connection

Use the following figures to connect the cable between the Outdoor Pico eNB and the RF antenna.

Figure 36. RF Cable Connection (1)

1) Worker shall connect the connectors to the RF ports (Mini DIN Type-Female) at the bottom of the Outdoor Pico eNB.
2) Worker shall assemble the connector at the end of the RF cable. (The specifications of the antenna, supplier-specific connector, and the tightening method are subject to change.)
   - Outdoor Pico eNB Side Connector: Mini DIN Type-Male
   - RF Antenna Side Connector: Mini DIN Type-Male
3) Connect the connector which is assembled at the end of the RF cable (Outdoor Pico eNB-side) to the RF antenna port of the Outdoor Pico eNB.

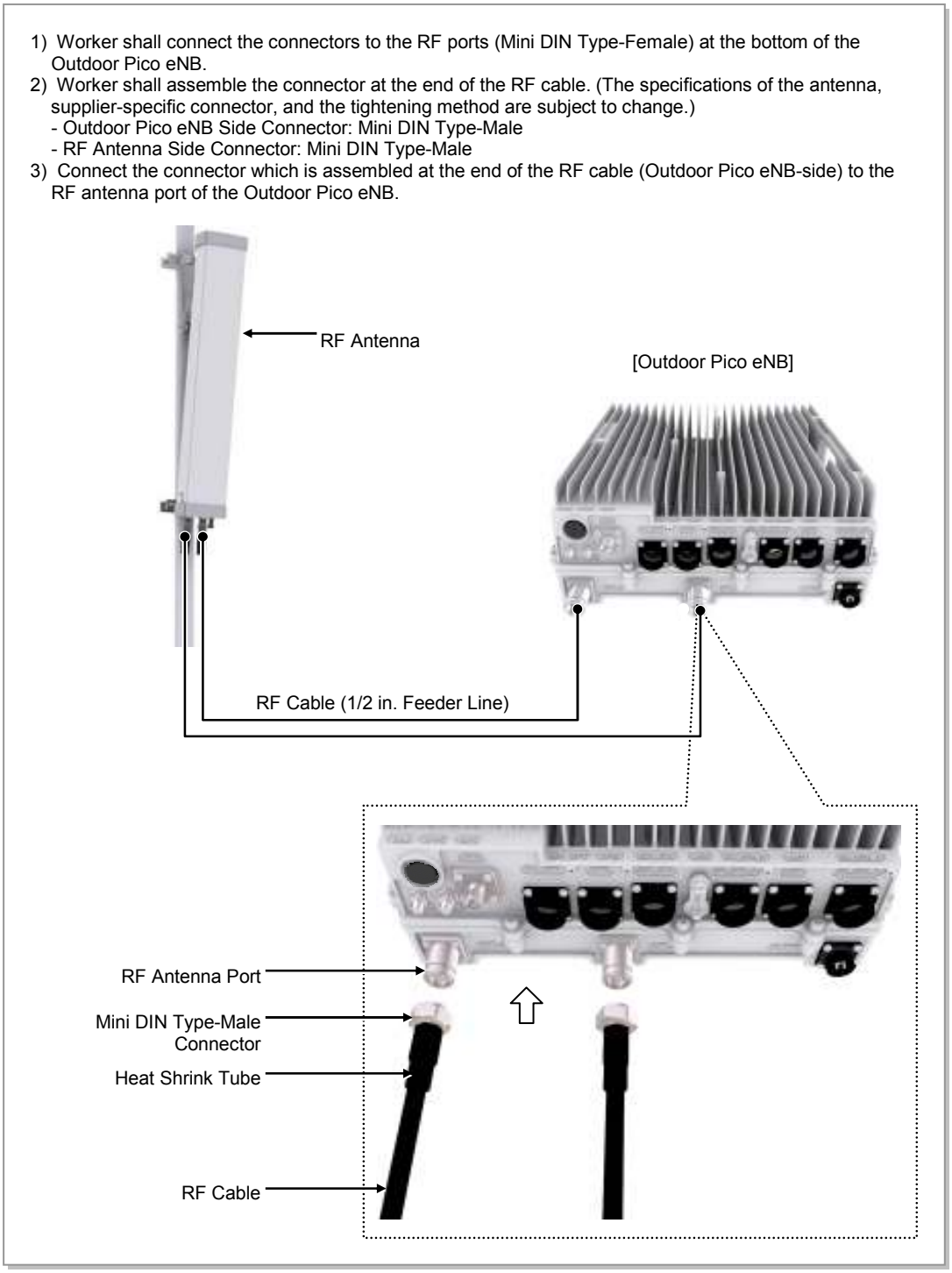


Figure 37. RF Cable Connection (2)

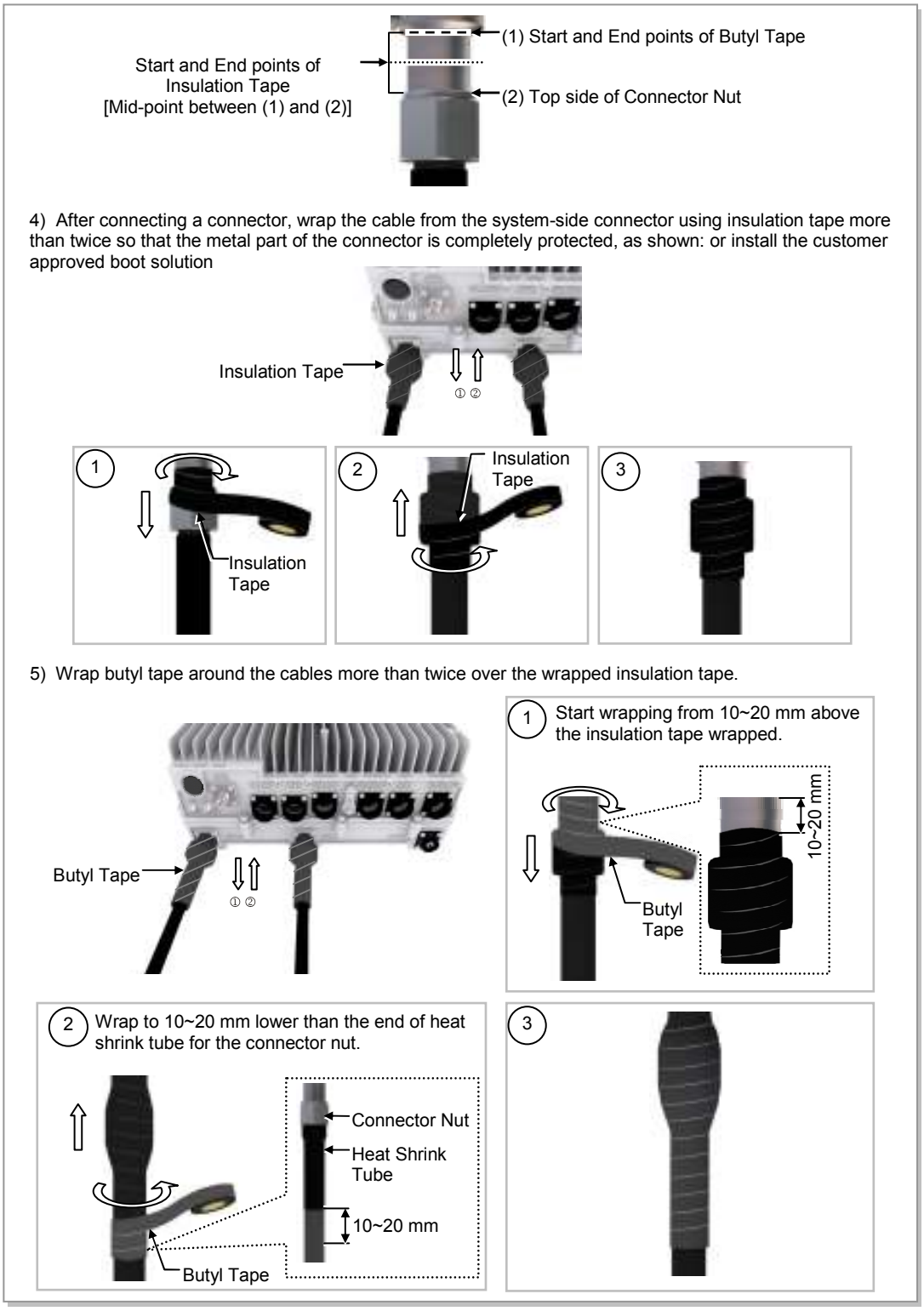


Figure 38. RF Cable Connection (3)

6) Wrap insulation tape around the cable more than twice over the wrapped butyl tape.

7) Bind cable ties at the both ends of the insulation tape to prevent it from loosening.

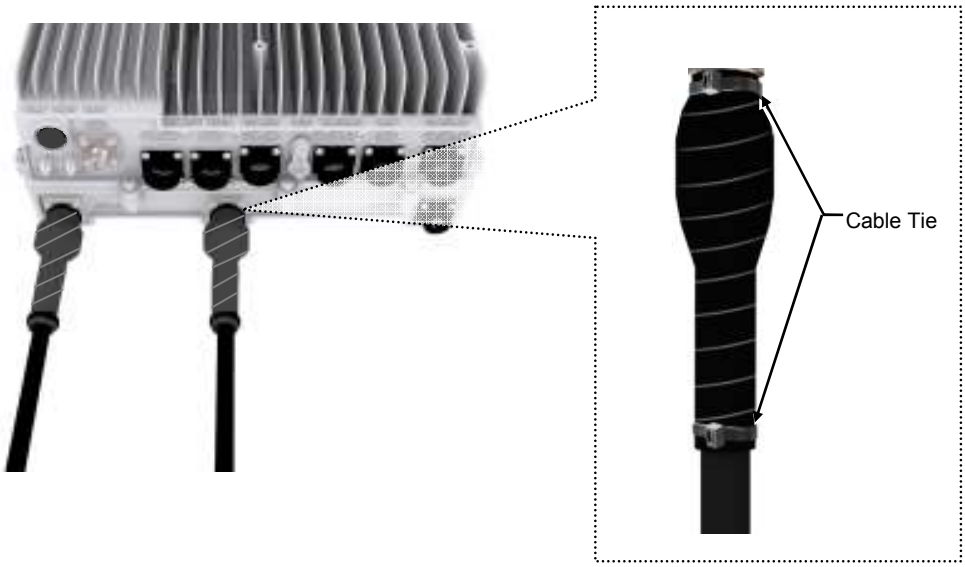
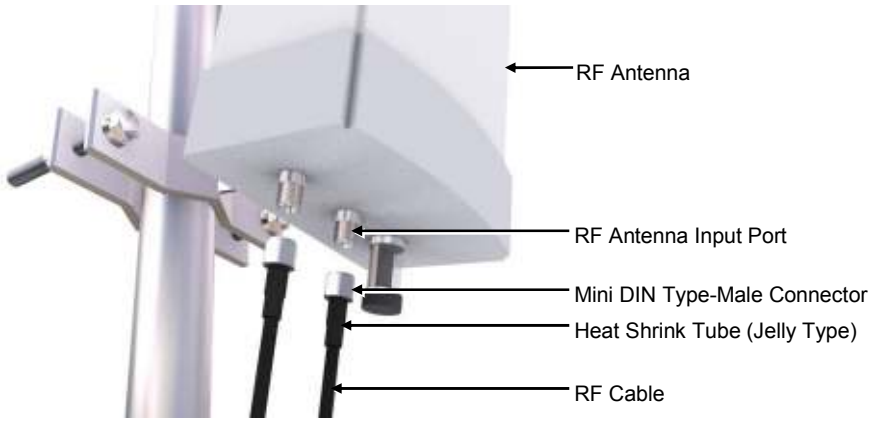
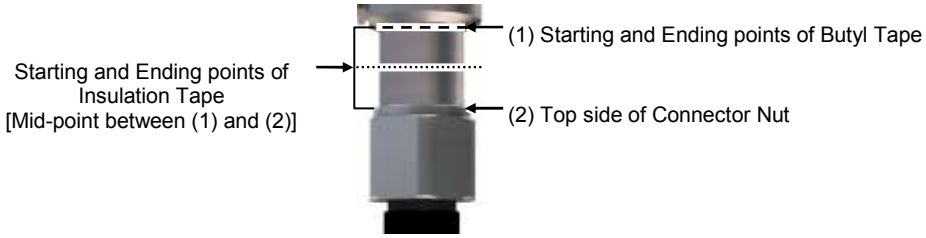


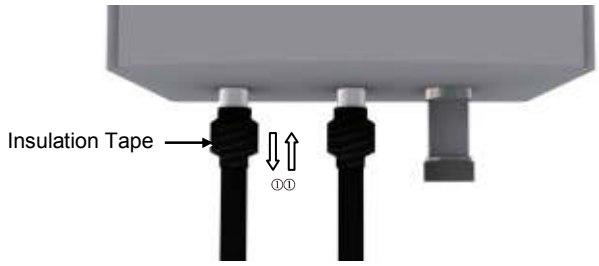
Figure 39. RF Cable Connection (4)

8) Connect the connector (assembled to the end of the cable on the RF antenna side) to the RF antenna port.



9) After connecting a connector, wrap the cable from the system-side connector using insulation tape more than twice so that the metal part of the connection does not show or install a customer approved weather boot solution.





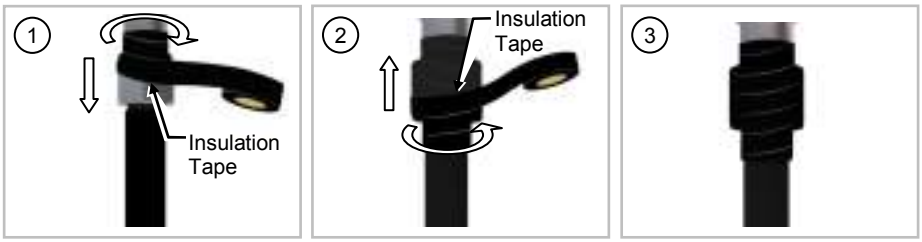


Figure 40. RF Cable Connection (5)

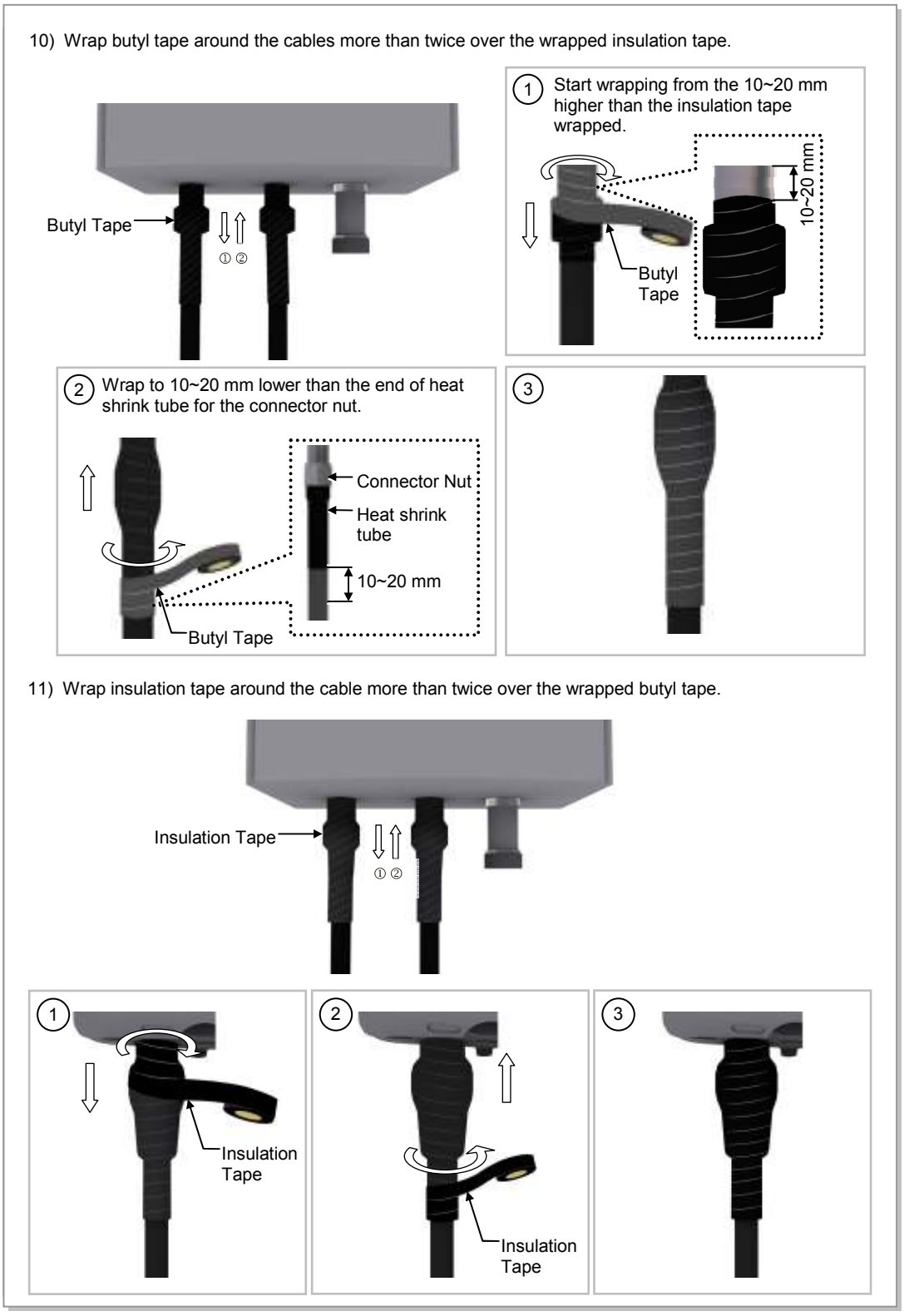
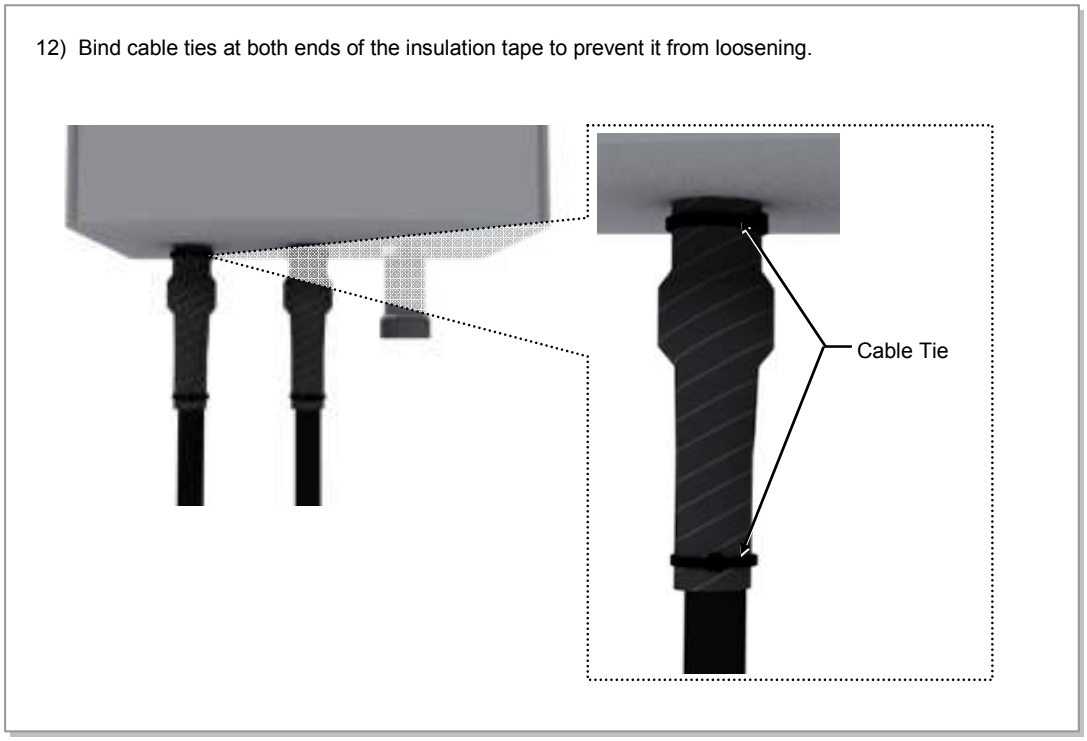


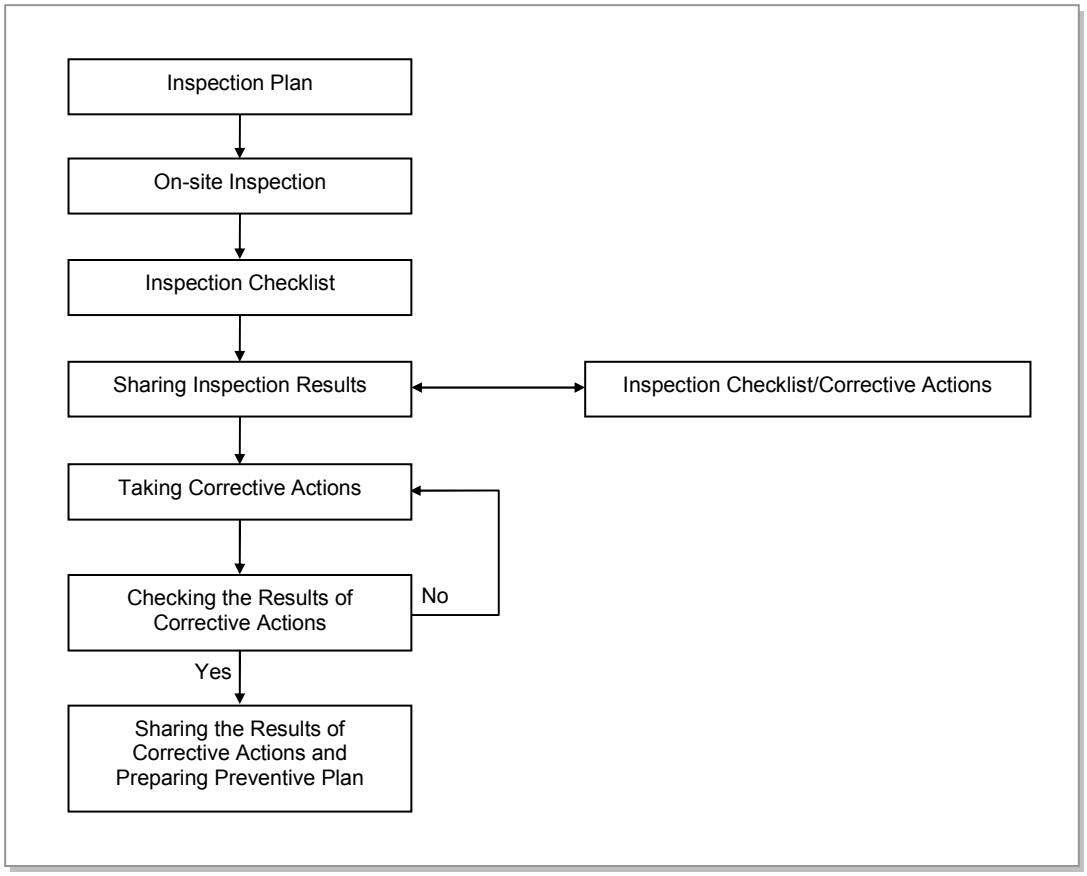
Figure 41. RF Cable Connection (6)



Chapter 4 Checking Installation Status

Figure 42. Installation Checking Procedure shows the procedure to check installation status.

Figure 42. Installation Checking Procedure



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Inspection Plan

Create an inspection sheet as per the system and select an inspector to set an inspection schedule as per site.

On-site Inspection and Inspection Checklist

The on-site inspection is to perform a visual inspection or inspect the site using instruments for each specification, standard, and installation status based on the checklist of the installation location.

The inspector must record the results into the inspection checklist during or after completing filed inspection.

Share Inspection Result and Take Corrective Measures

The inspector must share the inspection result (inspection checklist/corrective action) and the installation operator must take corrective actions if necessary after reviewing all requirements.

Check the Result of Corrective Action

The inspector must verify if the corrective actions are properly taken. If they are not sufficient, the inspector should ask the operator to take the proper actions.

Share Corrective Measure Result and Prepare Preventive Plan

After the corrective actions are completed, the inspector should share the results with the operator and relevant departments. The inspector should also prepare a preventive plan to avoid any re-occurrence of such problems.

Table 34. Construction Situation Checklist

Category	Check Items	Criteria	Result	
			Pass	Fail
Installing Equipment	Appearance of equipment and mechanical parts	Checking for equipment damage such as dents, scratches, and cracks.		
	Placement of equipment and mechanical parts	Checking the maintenance and horizontal/vertical placement		
	Leveling condition of equipment and mechanical parts	Checking horizontal/vertical fixing (level, weight, rubber hose, and so on)		
	Validity of status and specifications of tightening bolt/nut/washer, and so on.	Visually inspecting and magnet checking Checking compliance with tightening torque value		
	Other works (cable duct installation status, and so on)	Checking position and installation status		

Category	Check Items	Criteria	Result	
			Pass	Fail
Grounding	Status of ground bar installation per usage	Checking the separation of communication/power/lightning grounding		
	Cable size	Checking specifications such as thickness, and so on.		
	Cabling and binding status	Checking for cable damage/proper installation route, binding interval, and the condition of used materials		
	Cable connection	Checking the assembly and tightening condition of a pressure terminal Checking compliance with tightening torque value		
	Installation status of cable tag	Checking position, marking, and tag installation type		
Power	Installation status of power supply and circuit breaker	Checking power supply capacity/input voltage (tester) Checking circuit breaker type and capacity		
	Cable size	Checking thickness and length limitation		
	Cabling and binding status	Checking for cable damage/proper installation route, binding interval, and the condition of used materials		
	Cable connection	Checking for cable damage/proper installation route, binding interval, and the condition of used materials		
	Installation status of cable tag	Checking position, marking, and tag installation type		
Other data cables	Cable size	Checking cable specifications per usage		
	Cabling and binding status	Checking for cable damage/proper installation route, binding distance, and the condition of used materials		
	Cable connection	Checking cable connection (pin map), assembly and tightening status of a connector, and compliance with tightening torque value		
	Installation status of cable tag	Checking position, marking, and tag installation type		
RF/GPS	GPS signal reception status (number of GPS reception satellites)	Checking more than 6 reception satellites (C/N 40 or higher) Checking in-band or out-band jamming		
	Antenna installation status	Checking specifications, installation position, fixing status, and gap between antennas		
	Installation status of arrestor/ line amplifier/ splitter, and so on	Checking specifications, installation position, and fixing status		
	Cabling and binding status	Checking for cable damage/proper installation route, binding distance, and		

Category	Check Items	Criteria	Result	
			Pass	Fail
		the condition of used materials		
	Cable connection	Checking cable connection status, connector assembly and tightening status, compliance with tightening torque value, and finishing		
	Installation of cable tag	Checking position, marking, and tag installation type		
Others	Reserved ports and cable inlet status	Finishing (waterproof cap, and so on)		
	Connection of equipment I/O port (conduit/cable gland)	Checking tightening status		
	Installation of cable installation route	Checking installation of cable tray and duct.		
	Status of inside/outside of the equipment and system surrounding area	Checking the stocking condition of waste parts, waste materials, packing materials, and so on.		
Opinion				

Appendix A Acronyms

BPF	Band Pass Filter
DL	Downlink
EMC	Electromagnetic Compatibility
FDD	Frequency Division Duplex
FE	Fast Ethernet
GE	Gigabit Ethernet
GPS	Global Positioning System
GPSR	Global Positioning System Receiver
LNA	LOW Noise Amplifier
LTE	Long Term Evolution
MIMO	Multiple Input Multiple Output
RF	Radio Frequency
SIMO	Single Input Multiple Output
UL	Uplink
VSWR	Voltage Standing Wave Ratio

Appendix B GPS Antenna Installation

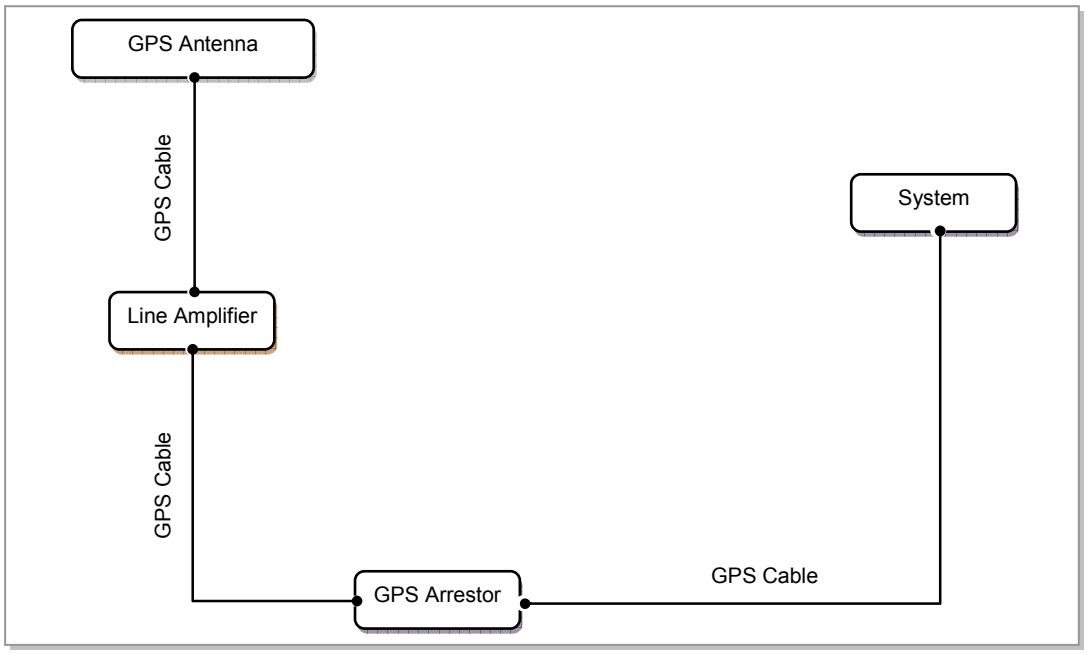
GPS Antenna System Configuration

The GPS antenna system is commonly configured as shown in Table 35. GPS Antenna System Configuration and Figure 43. Example of a Common GPS Antenna System Configuration.

Table 35. GPS Antenna System Configuration

Category	Description
GPS Antenna	Device receiving a signal from a GPS satellite
GPS Line amplifier (Option)	Device amplifying the GPS signal received from the GPS antenna (used to compensate the GPS signal loss caused by GPS antenna, GPS arrestor, cable, and connector)
GPS (Lightning) Arrestor	Device protecting people or system from lightning

Figure 43. Example of a Common GPS Antenna System Configuration



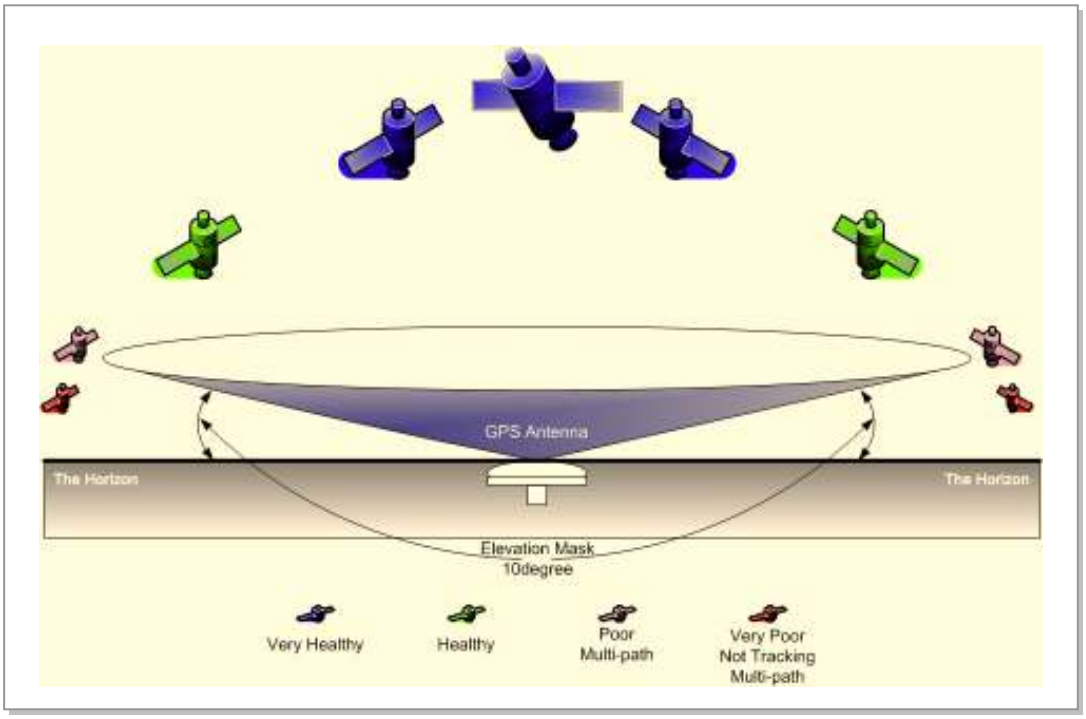
To satisfy the GPS specifications and operate the GPS antenna in a stable manner, the following GPS antenna configuration and installation requirements must be met.

GPS Antenna

Installation Requirements for the GPS Antenna

The GPS antenna must be installed in a location where it has the maximum amount of open sky. The ideal position is one where there are no obstacles that interfere with the antenna within 10 degrees or more of the horizon (the Elevation Angle). This allows the GPS receiver to select the best combination or distribution of GPS satellites which gives optimal performance. Refer to Figure 44. Elevation Mask and Satellites.

Figure 44. Elevation Mask and Satellites



For good signal strength, it is not necessary to place the GPS antenna on a high pole or building, which is often required for RFs and microwaves. It may be installed any place where there are no obstacles blocking the GPS antenna from the sky and where it is protected from the elements such as outside interference is suitable. In this case, it can even be installed on the ground.

However, the GPS antenna may be preventedfrom malfunctioning by installing it in a place where it does not receive reflected satellite signals. As multi-path interference greatly affects the accuracy of the GPS receiver, it is better to minimize reflected satellite signals entering through the top of the GPS antenna.

Therefore, the GPS antenna installation location must meet the following conditions.

- In a location that can avoid an obstacle/building that interferes with reception of the GPS signal or causes multi-path
- In a location that can avoid interference of RF signal that is transmitted/received at another RF antenna (including steel-framed structure for RF antenna) or microwave signal
- In as low as possible location that avoids damage from lightning within coverage area of a lightning rod

Considering the elevation mask, make the GPS antenna take the signals received at a valid elevation angle only.

If a GPS antenna is influenced by external interference signals or multi-paths at a certain place, it is best to install the antenna at another location. An anti-jamming GPS antenna is recommended, if it is not possible to change the location of the antenna.

GPS Antenna Sharing

A recommendation to ensure the GPS receiver works properly is to install one GPS antenna per GPS receiver, and use a GPS-specific splitter only if necessary.

Installing the GPS Antenna

The signals from a GPS satellite have a very low level (-130 dBm). As a result, for the GPS antenna to receive signals, its installation should be in a place where it can receive them as direct as possible from as many satellites as possible.

Therefore, it is important to ensure that there is maximum open sky (the visual field angle must be 360 degrees, and there must be 160 degrees or more above the horizon). Any obstacle within those angles decreases the performance and functionality of the GPS receiver.

The GPS satellites are distributed so that eight of them can always be tracked from any one place around the world, as long as there is no obstacle to them in that particular place.

For the GPS receiver to operate at its best there must be six GPS satellites always with a healthy status (that is, there is no obstacle directly between it and the GPS antenna).

If the position hold operation has been completed, the GPS receiver can only perform its operations stably if at least one satellite can be tracked continually.

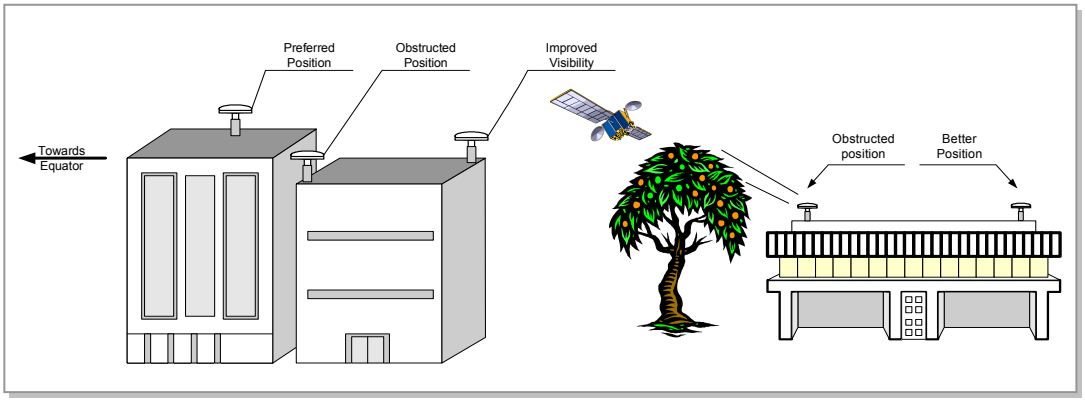
The survey of an object's position using GPS satellites is based on triangulation. Three satellites are enough to survey the position of an object by triangulation. However, to calculate the correct time deviation, a total of four satellites are required.

Usually, the GPS antenna is installed in a high place, such as on a roof. It must be installed away from protruding objects, such as trees or buildings. In addition, it must be positioned away from any obstacle which covers part of the sky around the horizon of the building where it is installed.

If it is impossible to ensure a completely open sky, install the GPS antenna facing the equator providing a maximum view of the Southern sky in the Northern hemisphere (or the Northern sky in the Southern hemisphere). Refer to Figure 45. GPS Antenna Installation.

Furthermore, when installing the GPS antenna using a steel cylinder structure shared by other RF antennas, the antenna must be separated by more than 1 m from that steel structure.

Figure 45. GPS Antenna Installation



Lightening Arrestor

A lightning arrestor is required when there is a danger of lightning striking a cable or related part. The lightning arrestor must be installed in a place where the antenna cable or set of combined cables enters a building or station, or a place inside the building or station in order to protect the people and equipment inside the building or station.

If struck directly by lightning, the lightning arrestor, antenna, or cable must be replaced. Furthermore, inspect the lightening arrestor periodically and replace the antenna and cable periodically if lightning strikes occur frequently at the site.

The lightning arrestor must be well grounded so that it can transmit a large current quickly.

Interference Signal

The GPS system is designed so that it has a strong immunity to noise and can endure interference.

The Samsung GPS receiver provides a quality timing clock in most installations.

However, to ensure that the GPS receiver performs locking successfully and guarantees uninterrupted timing performance, an interference-free environment is required for frequencies near the GPS L1 frequency (1575.42 ± 1 MHz).

Interference Types

There are two types of interference which affect the GPS L1 frequency.

- Narrow band (inband) interference: When a frequency deviation (3.5 kHz), such as an FM wave, inflows around the GPS L1 frequency (1575.42 MHz).

  Narrow band interference is monitored by the spectrum analyzer. But because it has a time lag, a locking failure or a different type of alarm can occur.

- Wideband interference: When frequency deviation is more than 7 kHz around the GPS L1 frequency (1575.42 MHz).

  Wideband interference includes the interference induced by the harmonics from a communication service with a different frequency bandwidth, increased thermal noise from communication services around the L1 band, inflow of interference due to unauthorized communication, saturation due to oscillation of an accessory device, and so on.

  You cannot monitor these kinds of interference with a device such as a spectrum analyzer. If the system has a wideband interference problem, you should consult an expert in this area.

For bandwidths other than the GPS L1 frequency (1575.42 ± 1 MHz), a GPS Band Pass Filter (BPF) must be included within the GPS antenna to remove the interference from the GPS bandwidth. No outband interference must affect the GPS signals.

Avoiding Interference

If more than one antenna for other communications is installed in the surrounding area, such as an antenna for a base station or satellite communication, the GPS antenna must be installed in a location where no interference signals flow.

If interference exists within the GPS L1 frequency bandwidths (1575.42 ± 1 MHz), use a band pass filter (BPF) to prevent interference from affecting the GPS bandwidth.

Furthermore, if the GPS antenna is installed by a transmitter which operates with a bandwidth similar to the GPS L1 frequency, the possibility of interference increases (in this case, interference is caused by harmonics). If the GPS antenna has a problem due to interference, move it to a different location where interference signals can be avoided or minimized.

Inband noise includes narrow band noise and wide band noise that occur in an inband width. (L1, 1575.42 ± 1 MHz)

- Narrow band noise in an inband width: If it is higher than 108 dBm, it can affect the operation of the GPS receiver.
- Wideband noise in an inband width: It may not be detected by a measuring instrument and may impair the sensitivity of the GPS receiver, and thus affect its operation.

If there is an outband interference problem, reduce the effects of interference on the GPS receiver by applying one or more L1 GPS BPFs.

The filter should be installed at the following locations:

- The input connector of the Samsung GPS receiver
- Behind the antenna or the front end of a line amplifier

These filters are used to reject jamming tones for outband signals. If interferences occur in the inband signals, they will result in serious consequences.

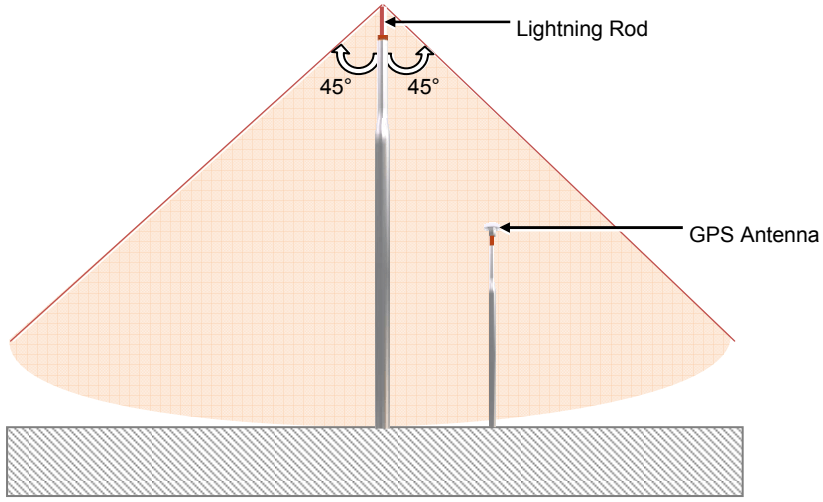
GPS Antenna Installation

The GPS antenna can be fixed to a wall, floor, tower, or pole.

Ensure personal safety when fixing an anchor bolt to a wall and treat the anchor bolt fixing area with a silicon or waterproof finishing material.

Install a concrete block that satisfies the specification regarding size and strength. When installing the concrete block, and before forming the concrete, arrange steel reinforcement bars in a mesh layout at 3.93 in. (100 mm) intervals. (Use either an anchor bolt assembly or a concrete anchor.)

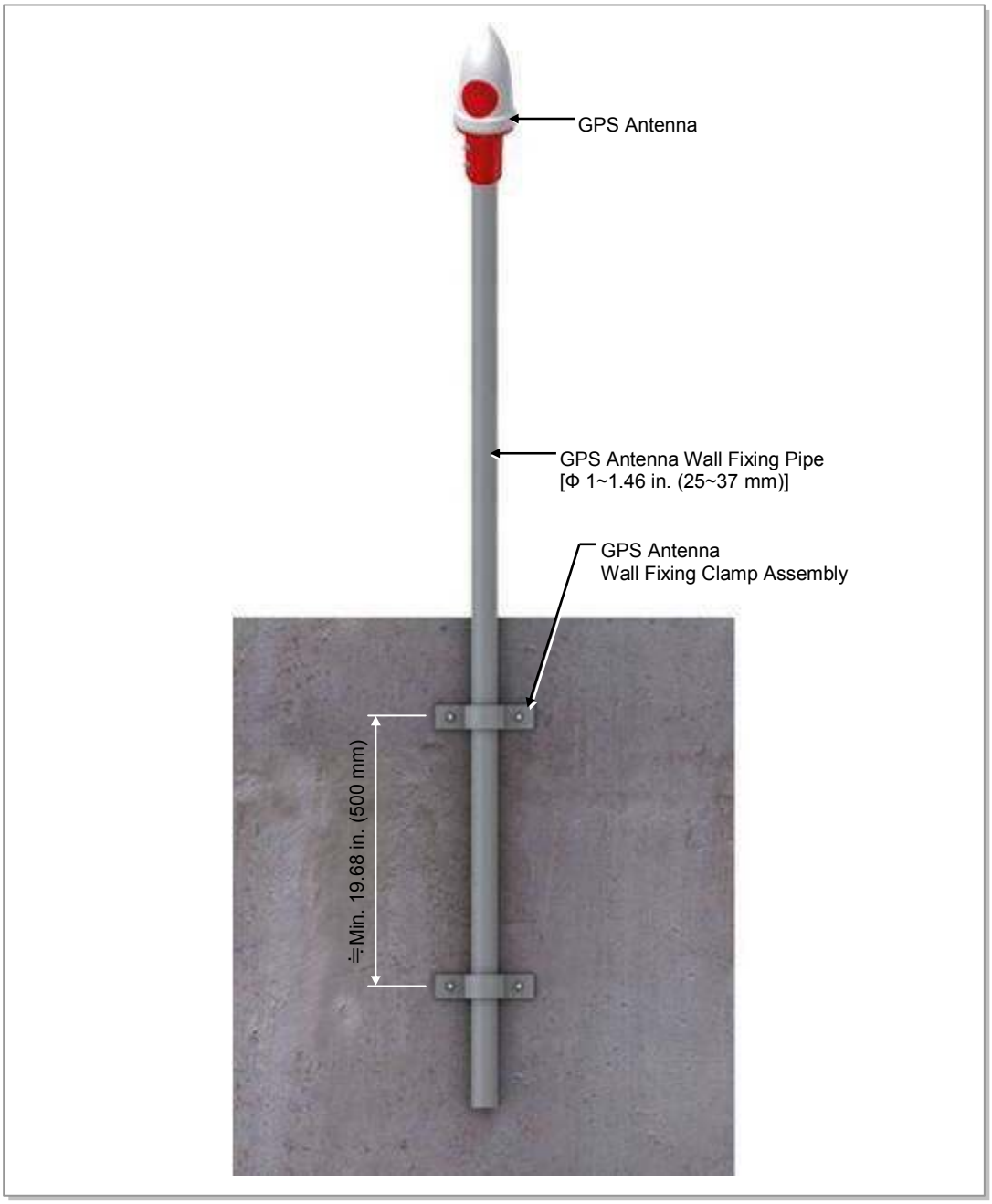
Install the antenna within the protective angle (left/right side 45° each from the central axis) to protect the antenna from lightning damage.



Secure a distance of 3.28~4.92 ft (1~1.5 m) between the antennas to prevent interference.

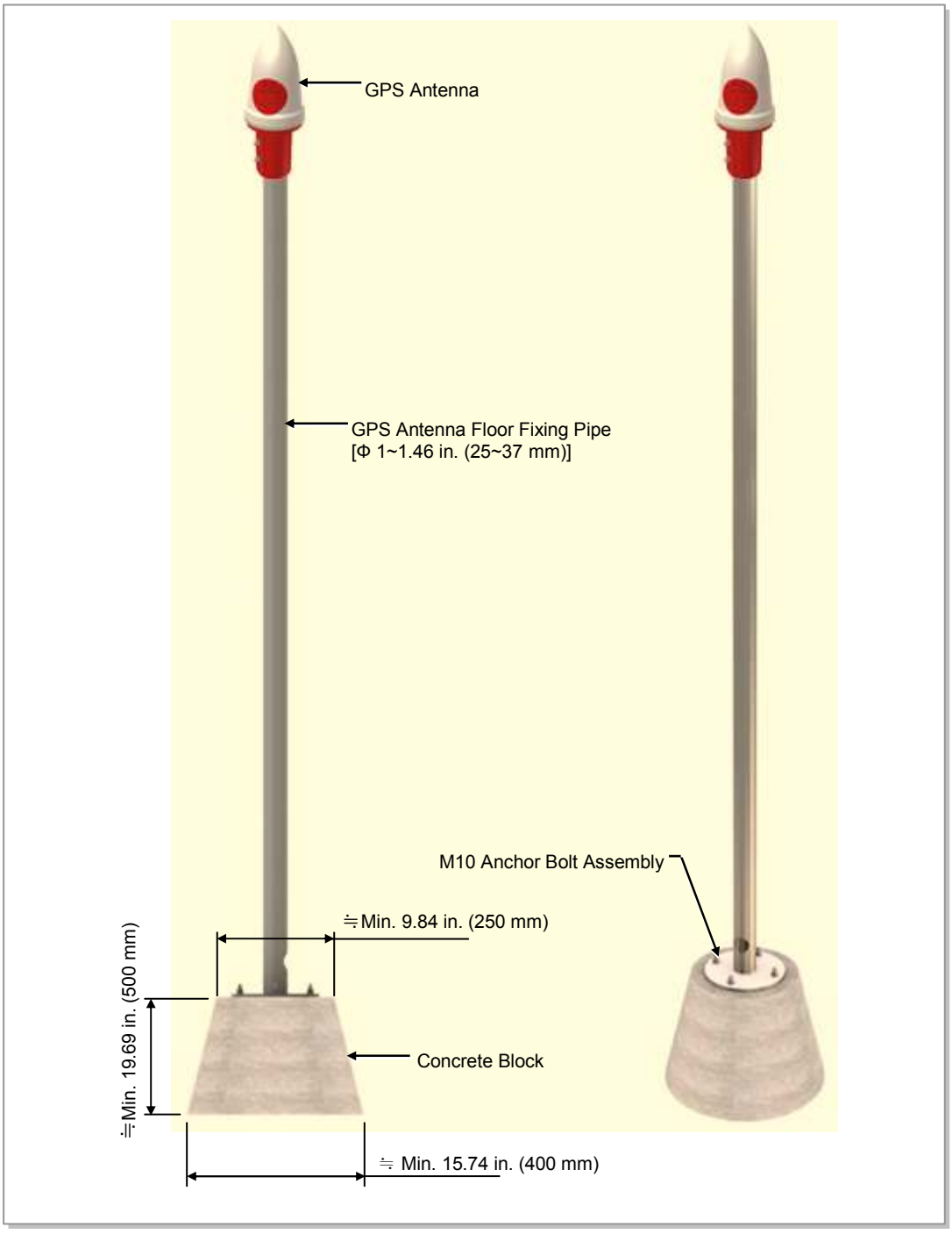
Wall

Figure 46. GPS Antennal Installation (Wall)



Floor

Figure 47. GPS Antennal Installation (Floor)



Appendix C Sector Antenna Installation

Cautions when Installing a Sector Antenna

Precautions of antenna installation are as follows.

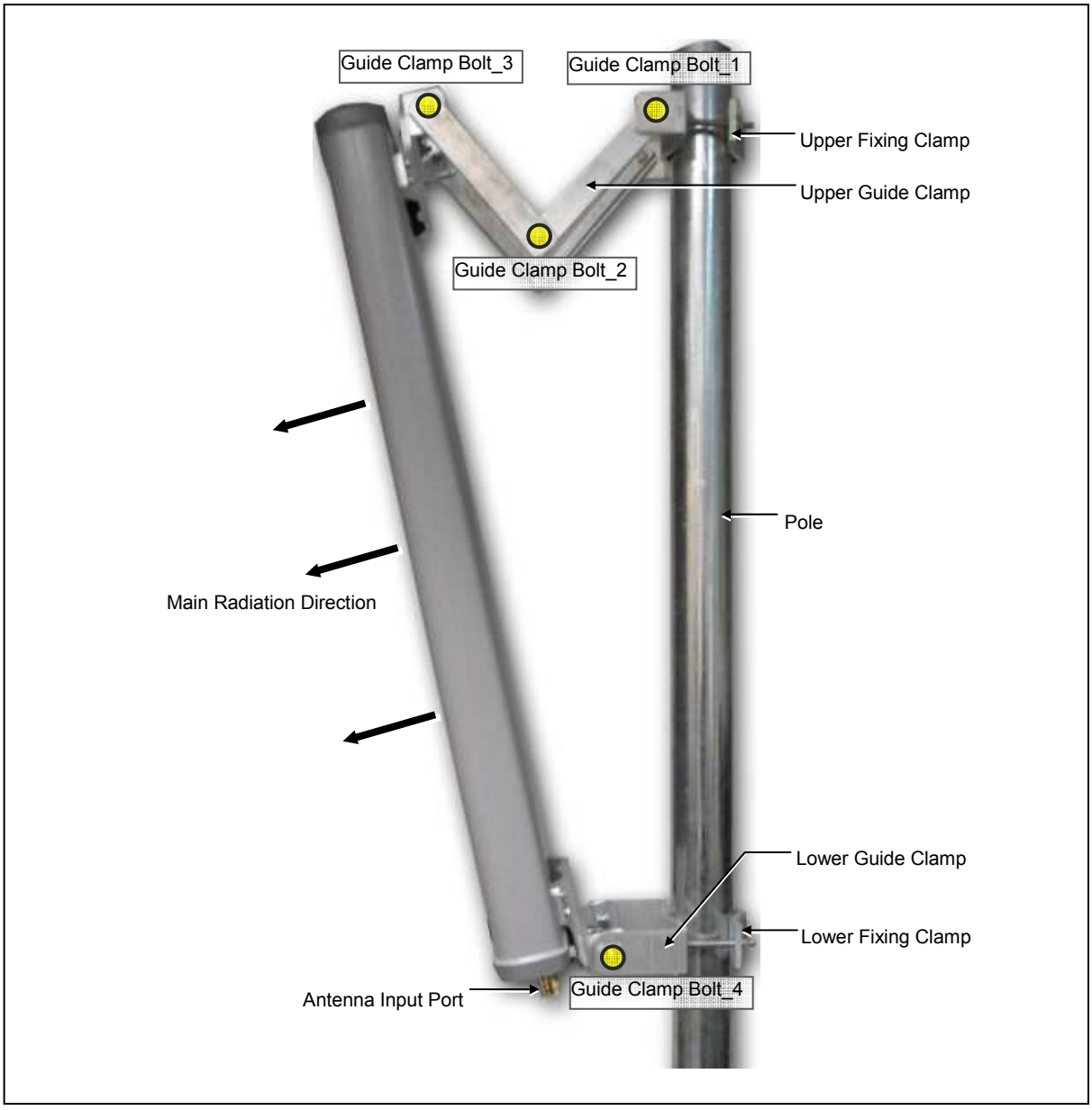
- Sector antennas should be installed vertically. (±1°)
- Antenna is the precise material, so be careful not to make damage or form change.
- When moving antenna, use the tool suitable to rating. In addition, use the rated carrying device which is at least 200 % or more than antenna considering the stability.
- Be careful not to give too much strength to the antenna.
- If it rains, suspend connecting the feeder cable and antenna.
- Fix it after adjusting the direction of antenna exactly.
- Distance between steel tower and antenna and the distance between send-receive antennas are based on the antenna layout.
- Attach the antenna on the position specified in the drawing.
- Install the antenna not to make a feature change of the antenna considering the direction of the radiation
- Connect the antenna not making the alien substance flowed so that Passive Inter-Modulation Distortion (PIMD) is not affected.
- Measure VSWR of all antennas and the value should be within the regulated value.

Sector Antenna Installation

The method of sector antenna installation is as follows.

1. Put up an antenna pole and insert the sector antenna into the antenna pole using a fixing clamp.
2. Set the antenna's up/down tilt to 0° and fix the fixing clamps at the top and bottom.
3. Adjust the tilted angle of the antenna by taking the signal strength into account. The bolts on the upper and lower guide clamps must be loose as to allow angle adjustment of the antenna.
4. After adjusting the antenna angle, tighten up the 4 loose bolts on the upper and lower guide clamps.

Figure 48. Sector Antenna



When you install the antenna, the antenna must be within the protective angle (left/right side 45° each from the central axis) to prevent the antenna from lightning damage.

Appendix D Installing Feeder Cable

Cautions When Installing Feeder Cable

Follow these guidelines when installing the feeder cable (GPS/RF cable).

- Put a plate to work to minimize damage to the surface of the feeder cable. If there is external damage of the feeder cable, cut the damaged part and rework the wiring.
- After connecting the antenna to the feeder cable, finish the connection part of the contracted pipe using the contracted tube.
- Attach labels to both ends of the feeder cable.
- Tightly connect the cabinet, antenna, and lightening arrestor to the feeder cable to prevent generating a reflected wave.
- Maximize the curvature radius. Refer to Table 34. Curvature Radius of Feeder Cable for Outdoor through Table 36. Curvature Radius of LDF4-50A.

Table 36. Curvature Radius of Feeder Cable for Outdoor

Specification			Allowed Radius of Curvature	Remark
LS Feeder Line	HFC-12D	1/2 in.	125 mm	Outdoor
	HFC-22D	7/8 in.	250 mm	
	HFC-33D	1-1/4 in.	380 mm	
	HFC-42D	1-5/8 in.	510 mm	
RFS Feeder Line	LCF12-50	1/2 in.	125 mm	
	LCF78-50	7/8 in.	250 mm	
	LCFS114-50	1-1/4 in.	380 mm	
	LCF158-50	1-5/8 in.	500 mm	

1/2 in. 7/8 in. 1-1/4 in. 1-5/8 in.

Table 37. Curvature Radius of Feeder Cable for Indoor (Based on LS Feeder Line)

Specification			Allowed Radius of Curvature	Remark
LS Feeder Line	HFSC 6D	1/4 in.	25 mm	Indoor
	HFSC 10D	3/8 in.	0.98 in. (25 mm)	
	HFSC 12D	1/2 in.	1.26 in. (32 mm)	
	HFSC 22D	7/8 in.	4.92 in. (125 mm)	
RFS Feeder Line	SCF14-50	1/4 in.	0.98 in. (25 mm)	
	SCF38-50	3/8 in.	0.98 in. (25 mm)	
	SCF12-50	1/2 in.	1.26 in. (32 mm)	
	UCF78-50	7/8 in.	4.92 in. (125 mm)	

Table 38. Curvature Radius of LDF4-50A

Specification	Allowed Radius of Curvature	Remark
LDF4-50A	2 inch (50.8 mm)	Installation
	5 inch (127.0 mm)	Repeated

When installing a feeder line, the radius of curvature of the sections where cables bend must be at least the minimum required radius of curvature. If the radius of curvature for the feeder line installation is less than the allowed minimum, it may affect the performance of the system.

- Ensure that the feeder cable does not interfere with steel towers, ladders, and areas used by people.
- Connect the connector to the antenna in a straight line. After the connection, do not apply excessive force.
- Use the vinyl tape for electricity and heat shrink tubing for the external exposed part of the connector.
- Wrap the self-bonding rubber tape overlapping (keep a distance as the half size of rubber tape) the connector connection part. Wrap the vinyl tape for electricity twice or more and then cover with the jelly-type Heat Shrink tubing.

Connecting the feeder cable connector is a critical process. It must be performed by qualified personnel.

Table 39. Connector Connection Torque Value

Connector	Torque Value
SMA connector	0.18 lbf·ft (2.5 kgf·cm)
TNC connector	0.65 lbf·ft (9 kgf·cm)
N-type connector	1.45 lbf·ft (20 kgf·cm)
Din-type connector	14.46 lbf·ft (200 kgf·cm)
Mini DIN-type connector	8 lbf·ft (110.4 kgf·cm)

Appendix E Connector Assembly

RJ-45 (Shield Type)

The procedure to assemble the RJ-45 (shield type) connector is shown in Figure 49. Assembling the RJ-45 Connector (Shield Type) (1) and Figure 50. Assembling the RJ-45 Connector (Shield Type) (2).

Figure 49. Assembling the RJ-45 Connector (Shield Type) (1)

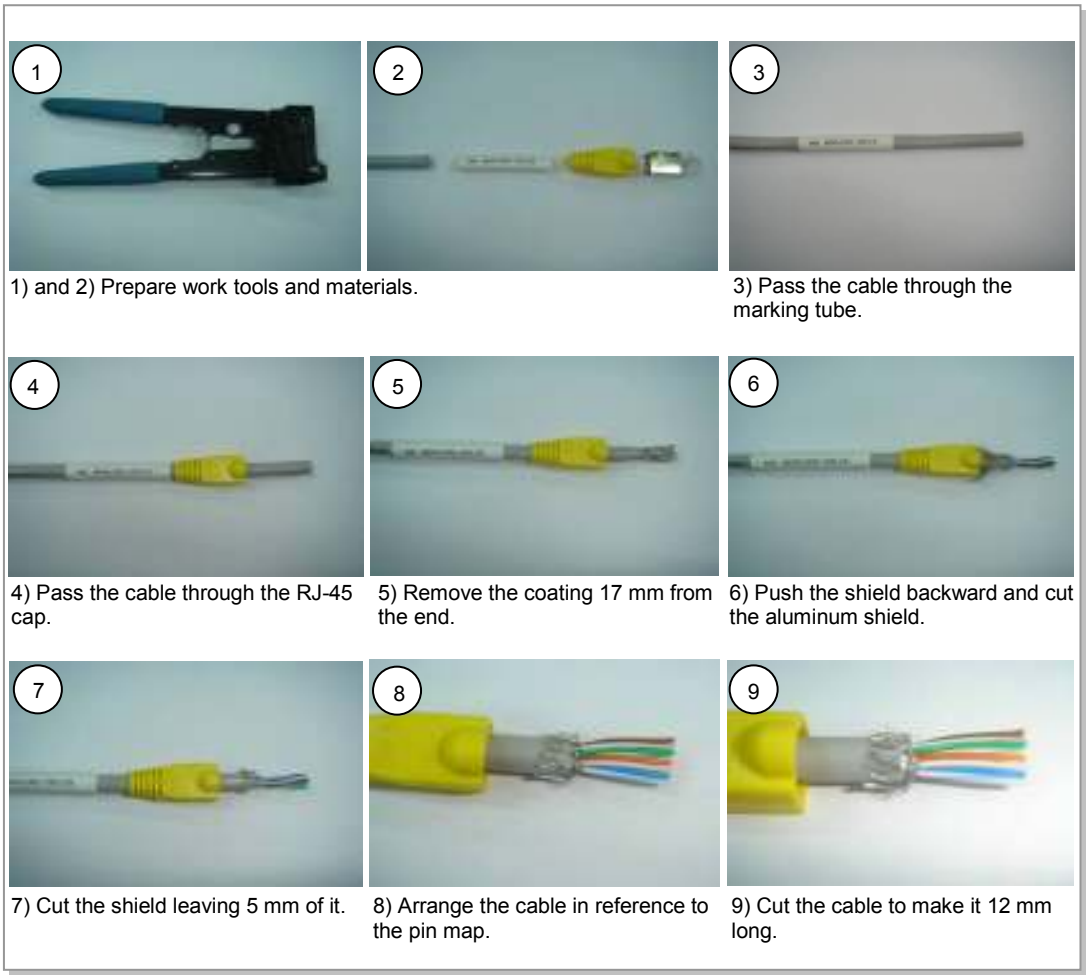
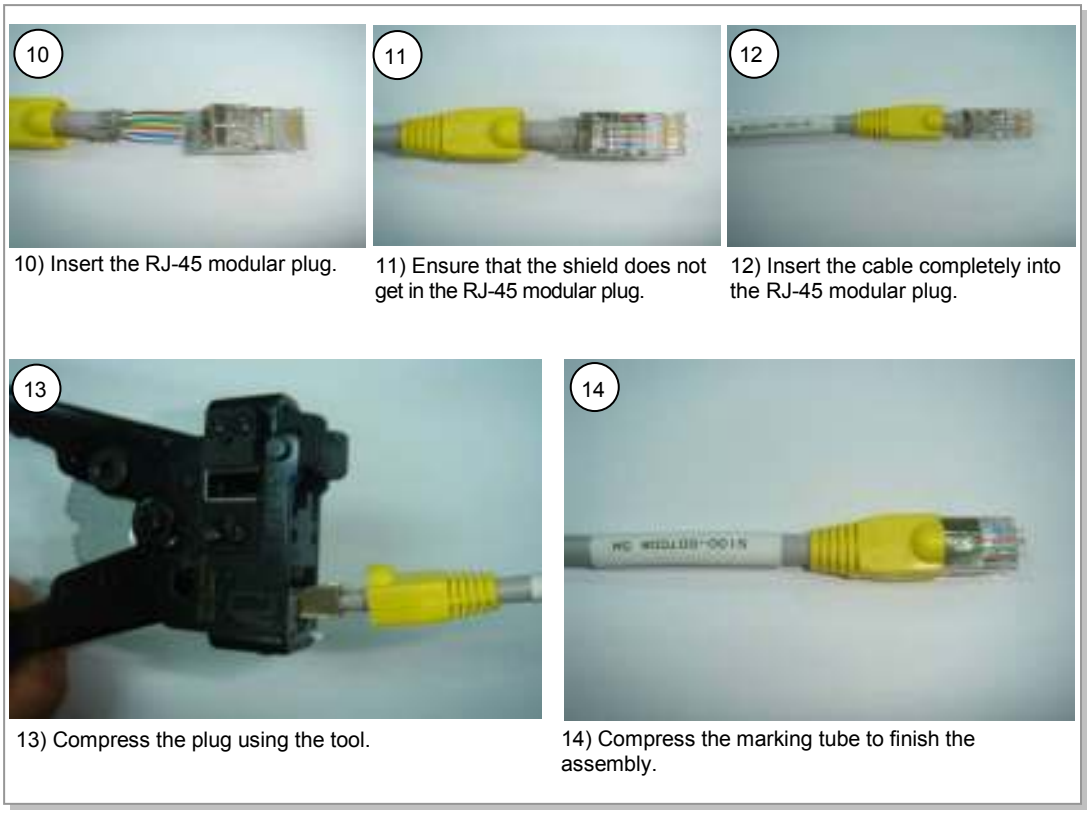


Figure 50. Assembling the RJ-45 Connector (Shield Type) (2)



10) Insert the RJ-45 modular plug.

11) Ensure that the shield does not get in the RJ-45 modular plug.

12) Insert the cable completely into the RJ-45 modular plug.

13) Compress the plug using the tool.

14) Compress the marking tube to finish the assembly.

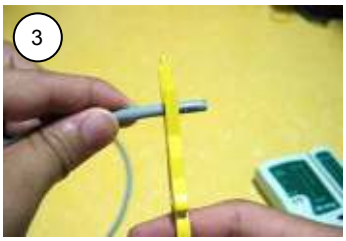
RJ-45 (Normal Type)

The RJ-45 (normal type) connector assembly procedure is shown in Figure 51. Assembling the RJ-45 Connector (Normal Type).

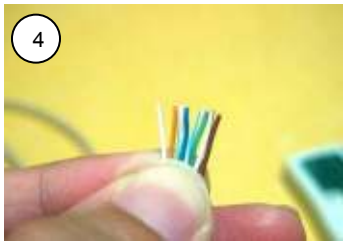
Figure 51. Assembling the RJ-45 Connector (Normal Type)

1) Prepare work tools and materials.

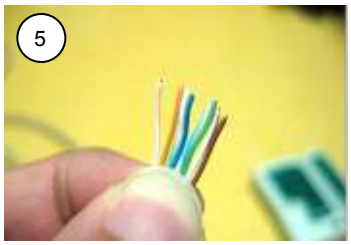
2) Insert the RJ-45 cap to the cable.



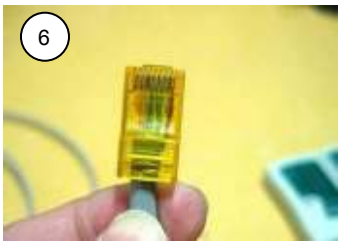
3) Remove the coating 17 mm from the end.



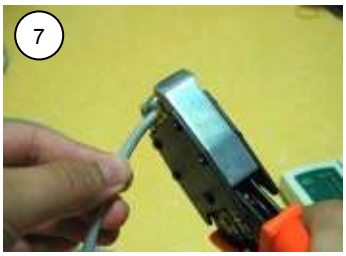
4) Arrange the cable in reference to the pin map.



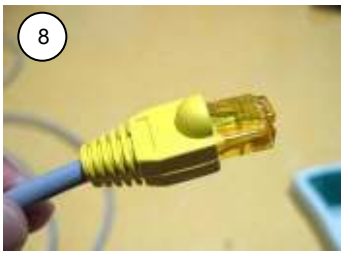
5) Cut the cable to make it 12 mm long.



6) Insert the cable completely into the RJ-45 modular plug.



7) Compress the plug using the tool.



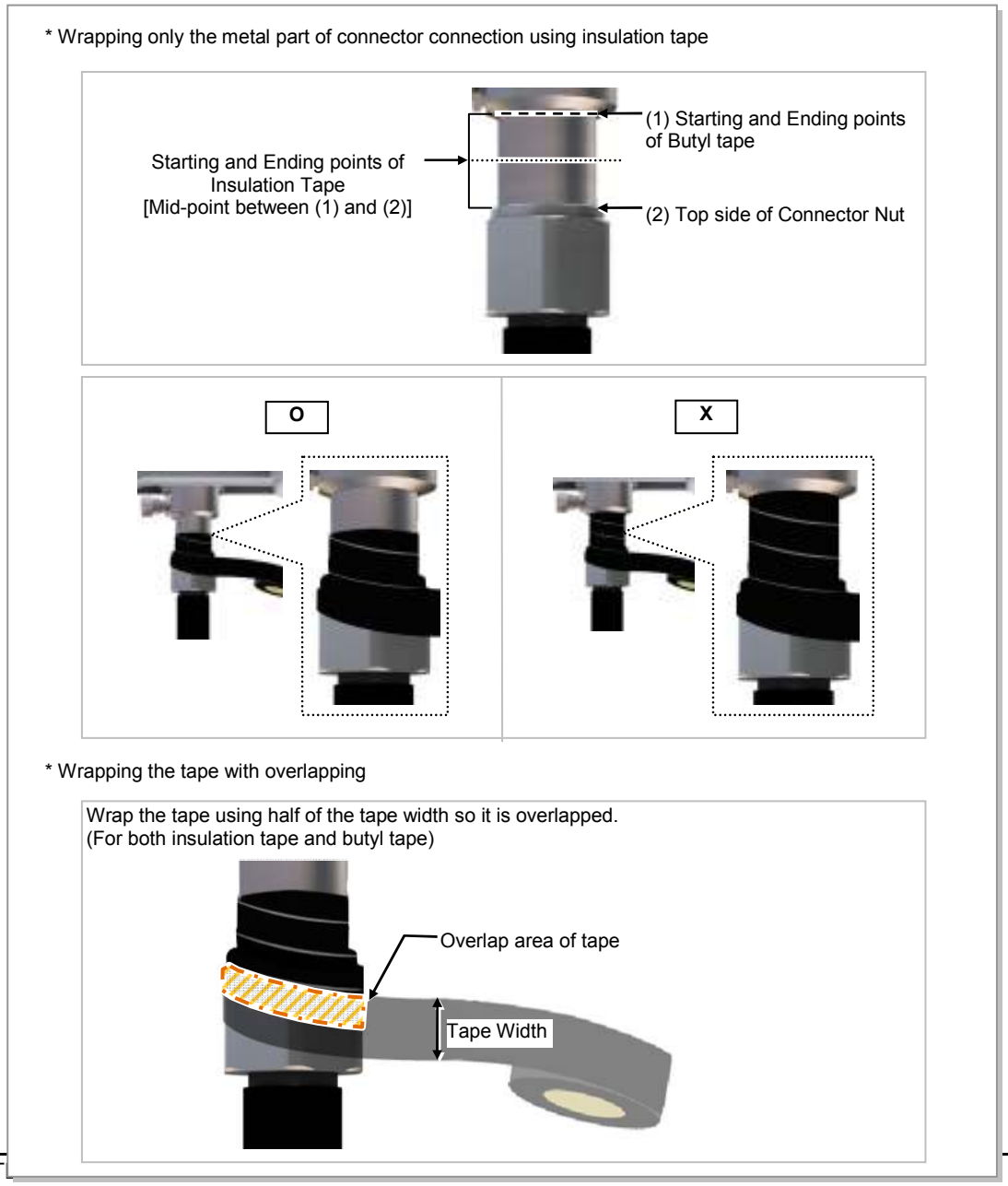
8) Push the RJ-45 cap to the connector.

Finishing the Connector Connection Part by Tape

Check Items

Check the following items in Figure 52. Check Items for Finishing the Connector Connection Part before finishing the connector connection part by tape.

Figure 52. Check Items for Finishing the Connector Connection Part



Appendix F Cleaning Optic Connector

Cleaning Optic Connector

When connecting optical cable to the system, performance of system can be decreased or fails can occur if ferrule section of optical connector is dirty due to dust or foreign material. Therefore, worker should clean the optic connector before connecting optic cable to the system to prevent this phenomenon. This manual describes the method that cleans optic connector when using the IBCTM Brand cleaner.

Caution When Connecting the Optical Cable
Check whether there is dust or foreign material on the cutting section of the connector ferrule before connecting the optic cable, and keep this away from dust or foreign material. If the cable is soiled with foreign material, do not blow to remove them. Make sure to clean the connector in accordance with the cleaning directions below.

When using Optic Connector Cleaner
When using optic connector cleaner, use the products shown in the example below or their equivalents.
Ex) Manufacturer-USCONEC (http://www.usconec.com)
- IBCTM Brand Cleaner (P/N: 9393): For LC-LC and MU Connector Cleaning
- IBCTM Brand Cleaner (P/N: 9392): For SC Connector Cleaning
- IBCTM Brand Cleaner (P/N: 12910): For ODC Connector Cleaning

Manufacturer-TheFibers (www.thefibers.com)
- HuxCleaner 1.25 mm Type: For LC and MU Connector Cleaning
- HuxCleaner 2.5 mm Type: For SC, FC and ST Connector Cleaning

IBCTM Brand Cleaner

Method that uses IBCTM Brand Cleaner is as follows:

IBCTM Brand type Cleaner (P/N 9393)

Method that uses IBCTM Brand Cleaner (P/N 9393) for LC-LC and MU connector is as follows:

Figure 53. Optic Connector Cleaner (IBCTM Brand Type Cleaner: P/N 9393)

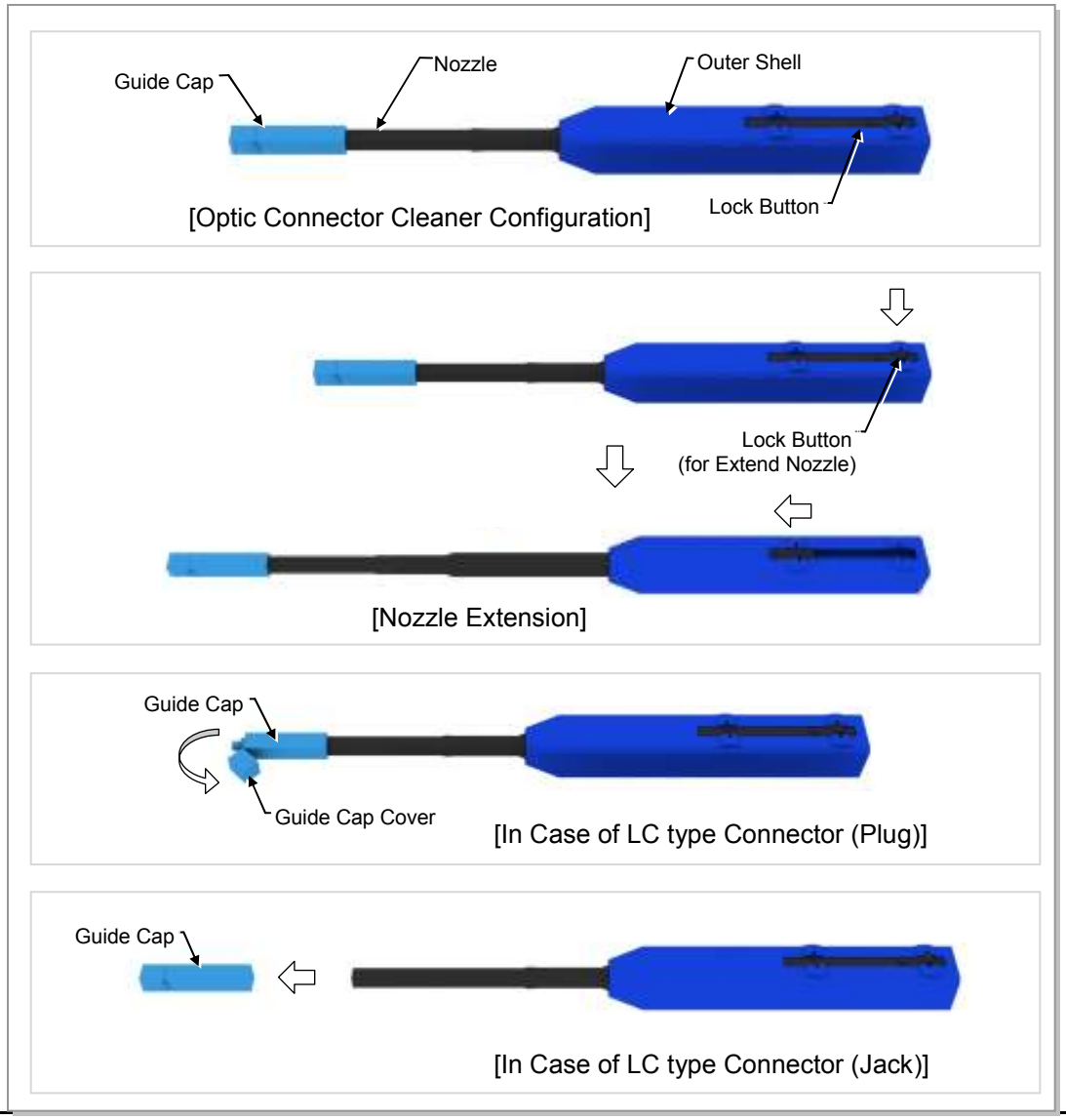


Figure 54. Optic Module Cleaning (LC type Jack)

1) To clean the optic module, remove the guide cap from the cleaner (P/N: 9393).

[IBC Brand Cleaner: P/N 9393]

2) Insert a cleaner guide cap to every ferrule of the optic module. Clean it by pushing the outer shell toward the nozzle until you hear the sound of the detergent being sprayed. (Repeat once or twice.)

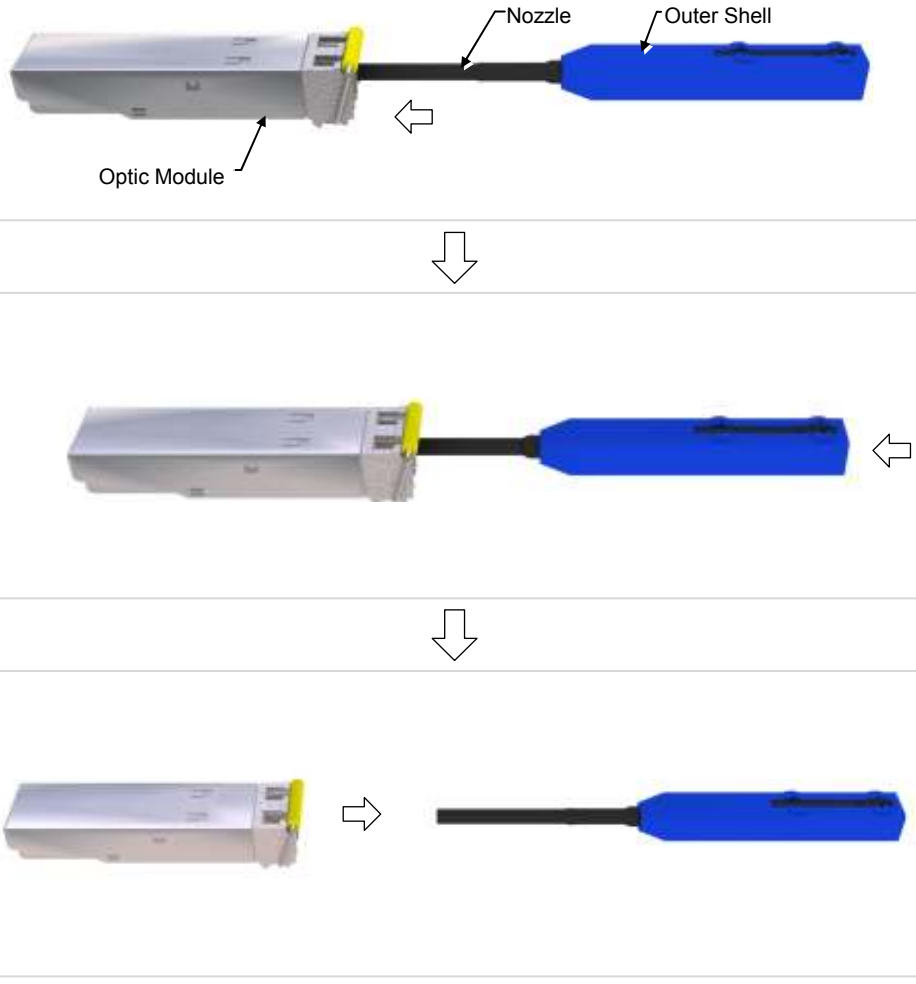
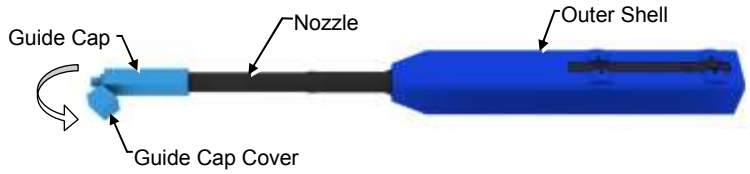


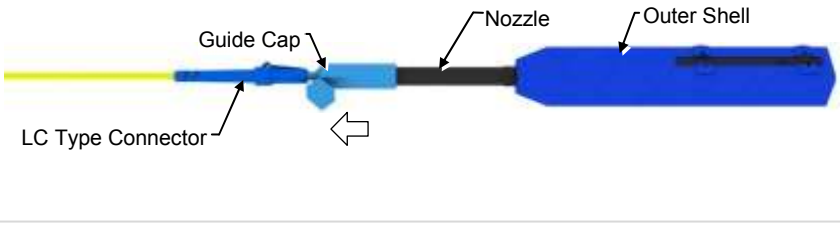
Figure 55. Optic Cable Connector Cleaning (LC type plug)

1) To clean the optic cable connector, open the guide cap cover from the cleaner (P/N: 9393)



[IBC Brand Cleaner: P/N 9393]

2) Insert a cleaner guide cap to every ferrule of the optic cable connector. Clean it by pushing the outer shell toward the nozzle until you hear the sound of the detergent being sprayed. (Repeat once or twice.)



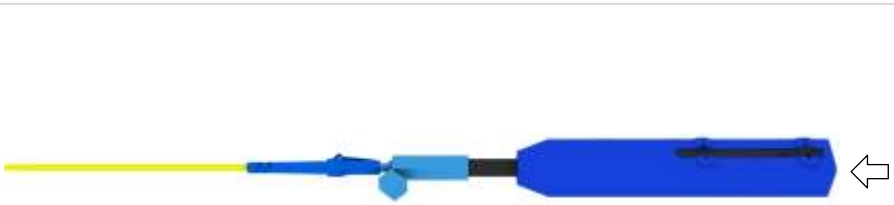
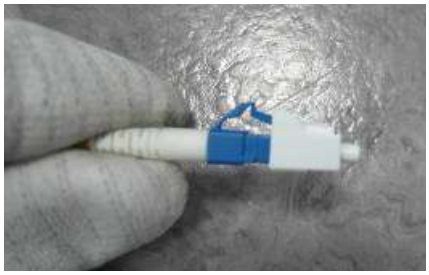


Figure 56. Measuring the Optical Output and Connecting the Optic Connector

1) Check the optical output again using an optic power meter.

2) If the optical output measurement result meets the reference value, clean the connector again and connect it. If the measurement result does not meet the reference value, discard the cable, replace it with a new cable, and then clean the new one and connect it to the system



[LC/PC Plug]

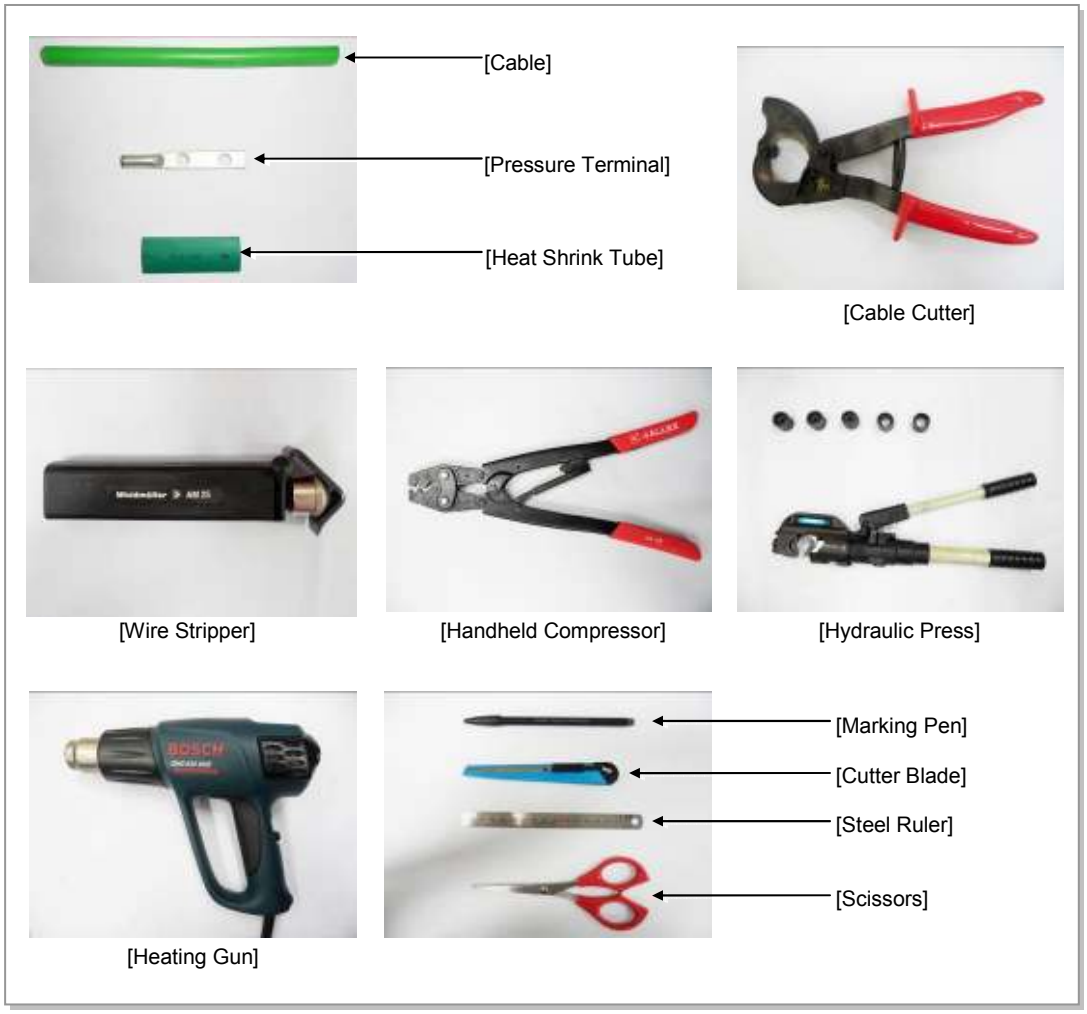
[Optic Power meter]

Appendix G Pressure Terminal Assembly

Preparations

To connect a pressure terminal to a cable, prepare the items listed in Figure 57. Preparations.

Figure 57. Preparations



Pressure Reference Table

Refer to the following tables and figures to assemble a pressure terminal to a cable.

Table 40. Pressure Reference Table for Pressure Terminal

Category	Copper tube length of a pressure terminal		Number of pressure points
	mm	In.	
Hand	11 mm or less	0.43 in.	1
Hand	12~15 mm	0.47~0.59 in.	2
Hand	16~23 mm	0.63~0.91 in.	3
Hand	24~32 mm	0.94~1.26 in.	4
Hand	33 mm or more	1.3 in. or more	5
Hydraulic	30 mm or less	1.18 in. or less	2
Hydraulic	31~47 mm	1.22~1.85 in.	3
Hydraulic	48~63 mm	1.89~2.48 in.	4
Hydraulic	64 mm or more	2.52 in. or more	5

Figure 58. Pressure Reference Drawing (Handheld Compressor)

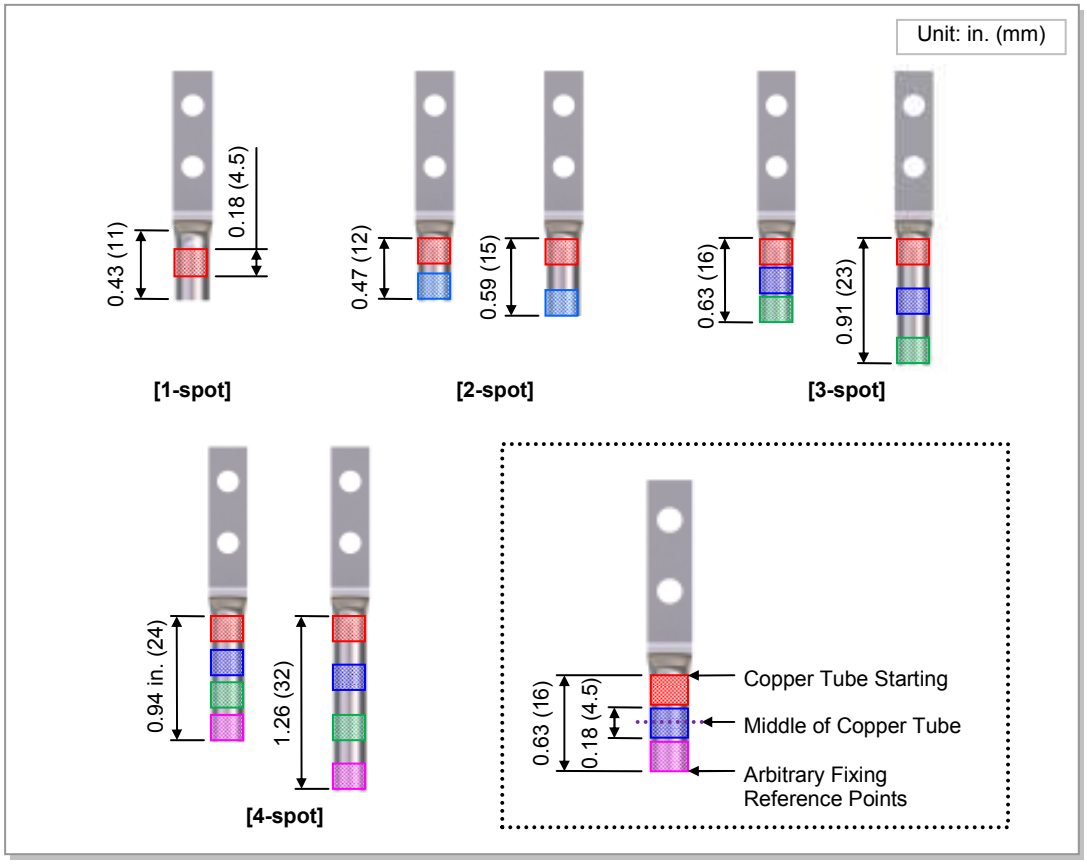


Figure 59. Pressure Reference Drawing (Hydraulic Press)

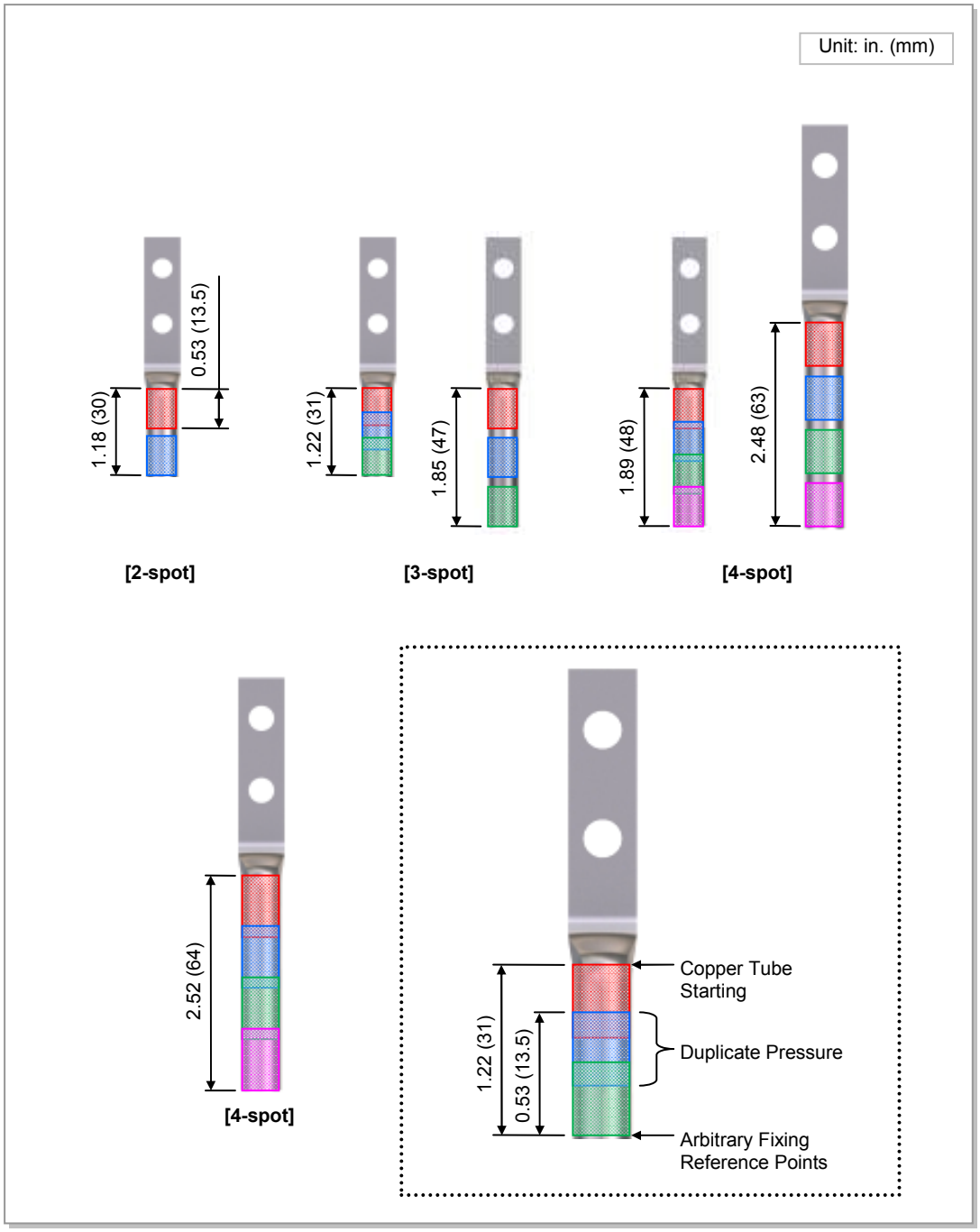


Table 41. Compressor Specifications per Cable Thickness

Cable Size (mm^2)	Press Size		
	Small Handheld Press	Large Handheld Press (AK-38, 100)	Hydraulic Press (IZUMI Hexagonal Dies)
2.5	2	X	X
4	2	X	X
6	5.5	X	X
10	8	8	X
16	14	14	16
25	22	22	25
35	38	38	35
50	X	60	50
70	X	80	70
95	X	100	95~300

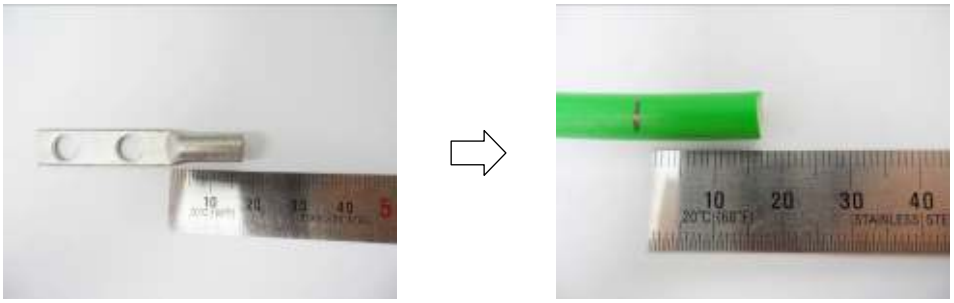
Assembling Pressure Terminal

Use the following figures for assembling a pressure terminal to a cable.

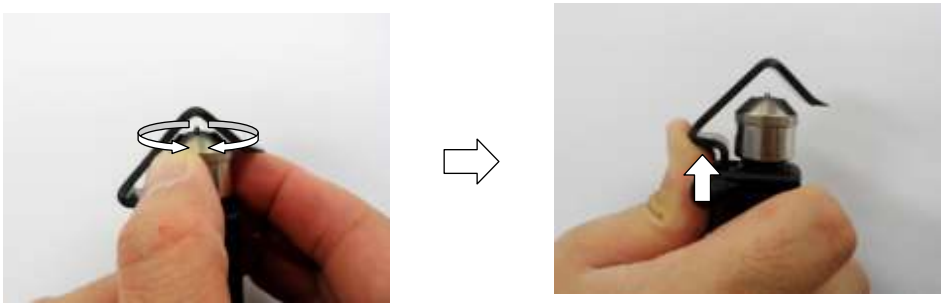
Strip the Cable Sheath

Figure 60. Stripping Cable Sheath (1)

1) Mark the cable, after checking the inside length of a pressure terminal.



2) Adjust the length of the cutter blade according to the sheath thickness of the cable.
3) Push the clamp with your thumb to secure a space for the cable.



4) Put the cable into the clamp, locate the blade on the marking position, and push it into the sheath.
5) Align the stripper perpendicular to the cable and rotate it more than two laps.

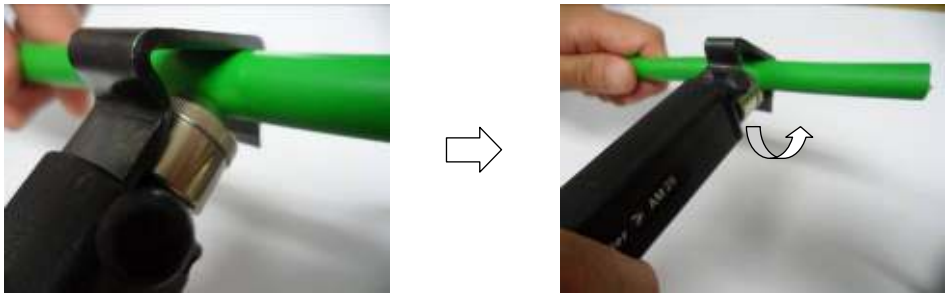
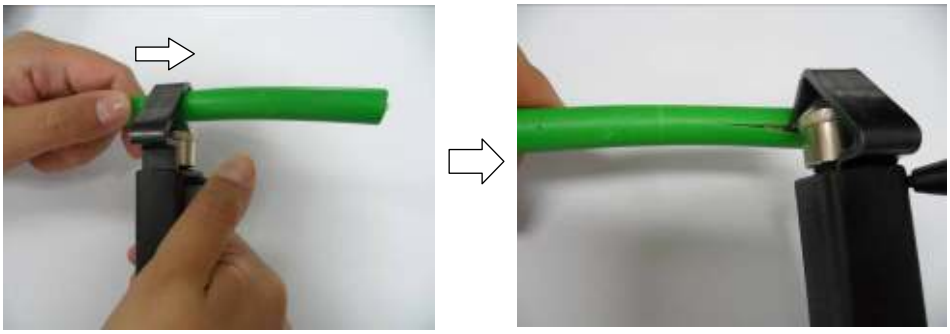


Figure 61. Stripping Cable Sheath (2)

6) Push the lever of the stripper to the right to turn its blade at 90°.

7) Move the stripper to the end of cable while maintaining the stripper perpendicular to the cable.



8) Remove the sheath.

A wire stripper is used differently depending on its manufacturer or type. Therefore, refer to the user manual enclosed with the product.

The specifications and cautions for the wire stripper described in this manual are:

· Vender: Weidmuller
· Model: Weidmuller-AM25 (Order No-9001080000)
· Specifications: For outer diameter 6-24 mm
PVC sheath up to 4.5 mm
sheath cutting depth

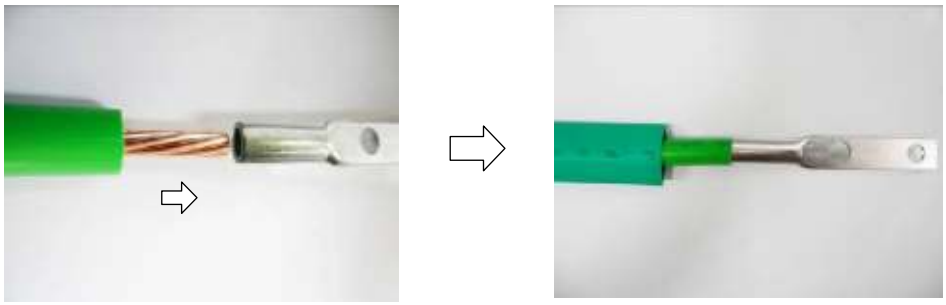
- To prevent the cutter blade of the wire stripper from touching the cable conductor, adjust the length of the cutter blade by checking the cable sheath thickness.
- Make sure that the cutter blade goes into the cable sheath completely.
- Rotate the wire stripper perpendicularly to the cable.

[X] **[O]**

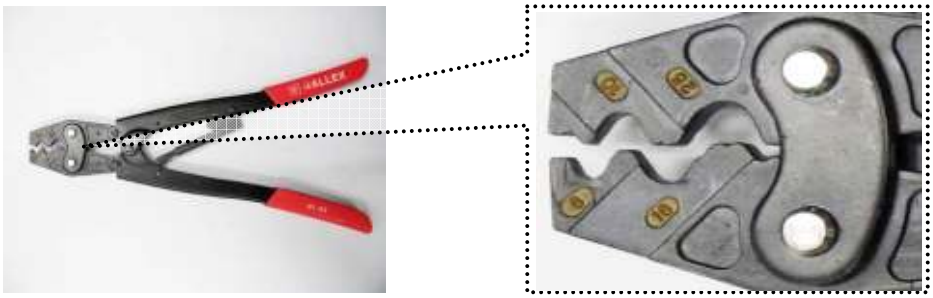
Fixing Pressure Terminal (Handheld Compressor)

***Figure 62.** Fixing Pressure Terminal–Handheld Compressor (1)*

1) Insert the conductor of the cable with the sheath stripped to the internal end of pressure terminal.
For a ring type pressure terminal, push it in until the conduct comes out 1 mm from the end of the terminal.



2) From the holes of the handheld compressor, select one that fits the pressure terminal.



3) Insert the pressure terminal in the selected hole.
4) Press the compressor to fix the pressure terminal and cable temporarily so the position can be changed later.

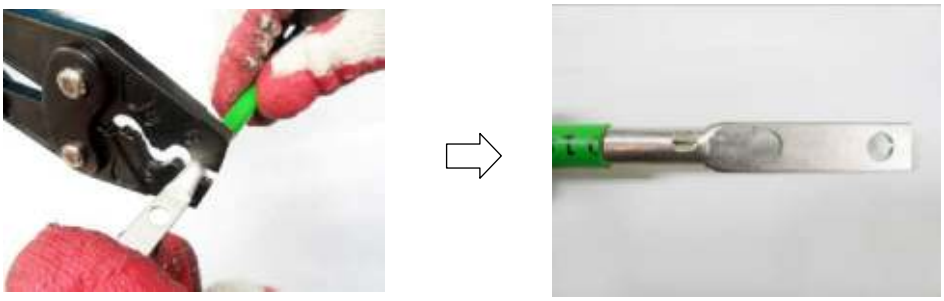
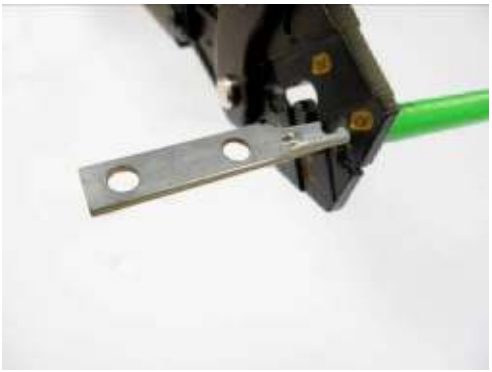
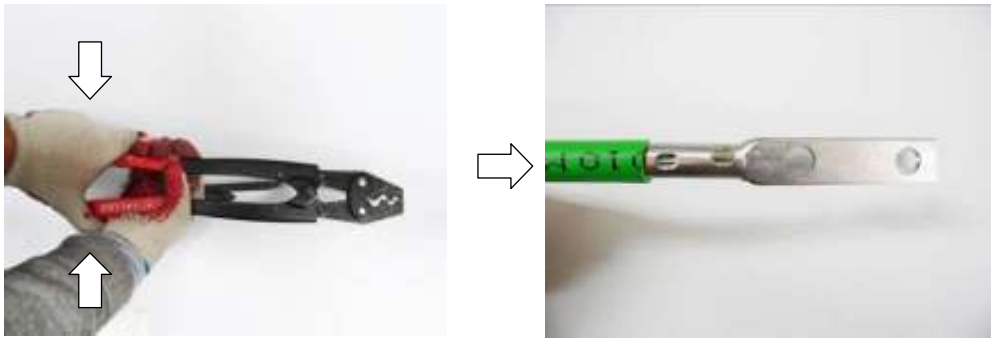


Figure 63. Fixing Pressure Terminal–Handheld Compressor (2)

5) Align the cable to the hole and firmly compress the pressure terminal to fix it securely.



6) Separate the pressure terminal from the handheld compressor. To unlock the compressor, press the handle down until hearing a clicking sound.



A handheld compressor is used differently depending on its manufacturer or type. Therefore, refer to the user manual enclosed with the product.

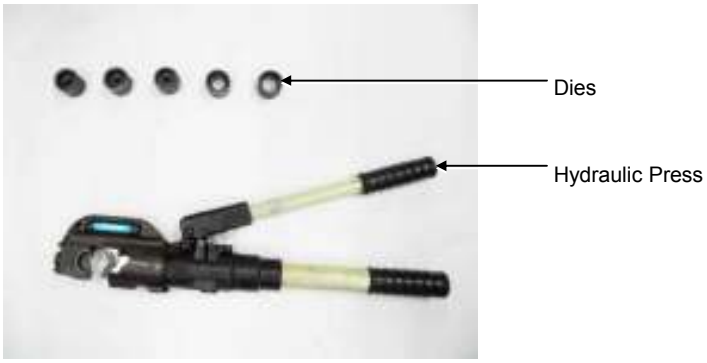
The specifications and cautions of the handheld compressor described in this manual are:

- Vender: GALLEX
- Model: GL-2045A-22
- Specification: 5.5 mm^2, 8 mm^2, 14 mm^2, 22 mm^2 (JIS)
  6 mm^2, 10 mm^2, 16 mm^2, 25 mm^2 (DIN)

Fixing Pressure Terminal (Hydraulic Press)

Figure 64. Fixing Pressure Terminal–Hydraulic Press (1)

1) Among the dies of the hydraulic press, select one that fits to the pressure terminal.

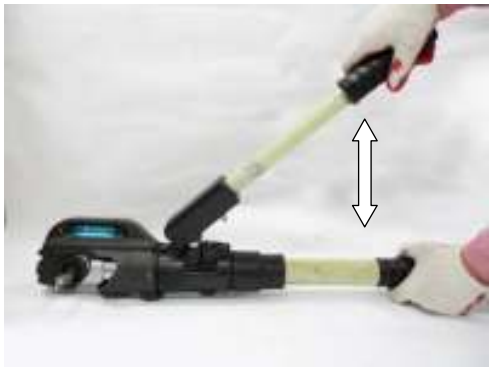


2) Assemble the dies to the pressing area of the compressor.

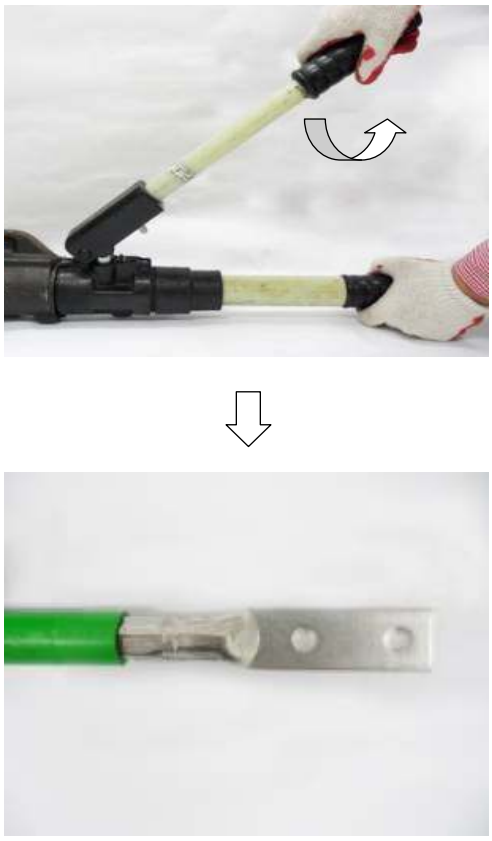
3) Insert the pressure terminal into the pressing area and fix it slightly by aligning it to the end of cable sheath.

Figure 65. Fixing Pressure Terminal–Hydraulic Press (2)

4) Move the compressor lever up and down to press the pressure terminal firmly.



5) Turn the top compressing lever clockwise and then push it down. When the pressing area of compressor is loosened, remove the pressure terminal.



A hydraulic press is used differently depending on its manufacturer or type. Therefore, refer to the user manual enclosed with the product.

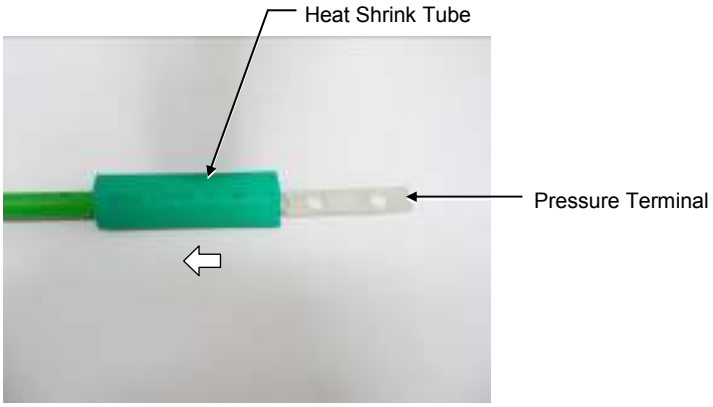
The specifications and cautions of the hydraulic press described in this manual are:

- Vender: IZUMI
- Model: IZUMI-EP-510B
- Specification: Circular 32~160 (SQ)
  Hex 14~325 (SQ)

Assembling Heat Shrink Tube

Figure 66. Assembling Heat Shrink Tube

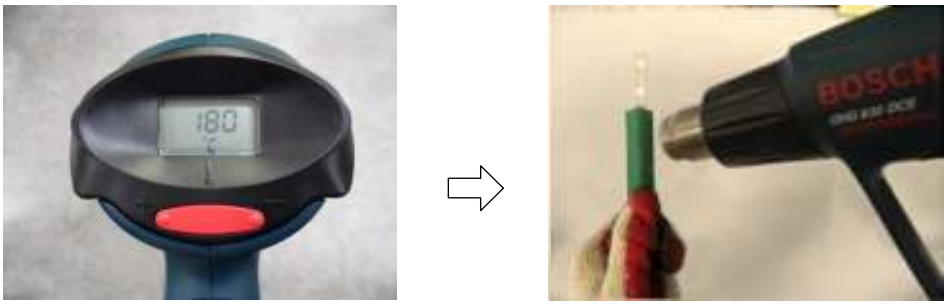
1) After assembling the pressure terminal, move the heat shrink tube insert the cable to the end of pressure terminal copper tube.

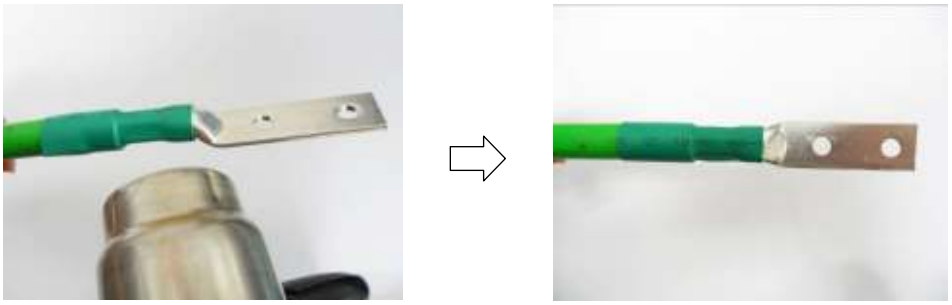


2) Set the temperature of the heat gun to 180-200°C.

3) Cover the entire copper tube of the pressure terminal with a heat shrink tube.

4) Rotate the heat gun 360° to apply heat evenly to shrink the tube.
(Because the pressure terminal and the cable are hot due to the heat of the heating gun, be careful not to burn yourself.)





Appendix H Standard Torque

When you tighten the bolt to prevent the equipment and bolt from damage, refer to the standard torque values in Table 42. Standard Torque Value for Tightening Bolts and Table 43. Brass Bolts Torque Value. When the torque value for each connection part is defined already, refer to the defined value.

Table 42. Standard Torque Value for Tightening Bolts

Bolt Spec.	Torque Value (kgf·cm)	Torque Value (N·m)	Torque Value (lbf·ft)
M3	4.08~6.12	0.40~0.60	0.29~0.44
M4	9.52~14.28	0.93~1.40	0.69~1.03
M5	20.0~30.0	1.96~2.94	1.45~2.17
M6	33.28~49.92	3.26~4.90	2.41~3.61
M8	82.4~123.6	8.08~12.12	5.96~8.94
M10	166.4~249.6	16.32~24.48	12.03~18.05
M12	292.0~438.0	28.64~42.65	21.11~31.67

Table 43. Brass Bolts Torque Value

Bolt Spec.	Torque Value (kgf·cm)	Torque Value (N.m)	Torque Value (lbf·ft)
M6	29.98 ± 10%	2.94 ± 10%	2.17 ± 10%
M8	64.26 ± 10%	6.3 ± 10%	4.16 ± 10%

Torque value can be different depending on the material, characteristic, and specification of the equipment and fastener. Make sure to check the proper torque value for each specification of the equipment and fastener.

LTE TDD Outdoor Pico eNB
Installation Manual

Document Version 1.0