3 Equipment Room

About This Chapter

This part describes the requirements for the site selection, installation space and position, construction of the equipment room, and working environment.

3.1 Requirements for the Site Selection
To ensure that equipment runs reliably in the long term, you should select a proper site. Site selection is subject to the technical requirements of network planning and telecommunication equipment. In addition, the factors such as water sources, landform, earthquake, electric power, and transport must be considered.

3.2 Space and Location Requirements of the BTS3012
The equipment layout must be reasonable, feasible, and neat. The BTS3012 cabinet installation modes are single-cabinet installation, multi-cabinet installation, and BTS3012-BTS312 cabinet installation.

3.3 Requirements for the Construction of the Equipment Room
The equipment room consist of a switch room, a control room, and an auxiliary room. Usually, the control room has the area equal to or larger than 20 m^2 [215 ft^2]. Limited to the actual conditions, switch rooms and control rooms can be combined. Many factors must be considered for the construction of an equipment room, such as cabling (shortest routing of antenna cables), bearing capacity, power supply, and entrance of transmission cables.

3.4 Requirements for the Working Environment
The requirements for the working environment consist of the climatic, waterproof, ESD, biological, air cleanness, and mechanical stress requirements.

3.1 Requirements for the Site Selection

To ensure that equipment runs reliably in the long term, you should select a proper site. Site selection is subject to the technical requirements of network planning and telecommunication equipment. In addition, the factors such as water sources, landform, earthquake, electric power, and transport must be considered.

The specific requirements for site selection are as follows:

- Away from flammable and explosive materials
- At least 3.7 km from salt water such as an ocean and a salt lake

  If this is impossible, construct air-tight equipment rooms that are equipped with the refrigeration air conditioning system and that are not made of saline soil. In addition, equipment rooms should be equipped with optimum protection devices that are adaptive to the atrocious environment.
- Away from a transformer substation
- Away from a livestock farm

  If this is impossible, the site should be located on the windward side of a livestock farm.
- Away from pollution sources.
  - At least 5 km from heavy pollution sources such as a smelting plant and a coal mine
  - At least 3.7 km from moderate pollution sources such as a chemical plant, rubber plant, or electric plating plant
  - At least 2 km from light pollution sources such as a food product factory and a leather product factory
  - The site should be 15 m away from the residents' houses.

  If these pollution sources cannot be avoided, the site should be located on the windward side of the pollution sources. Ensure that equipment rooms are of high quality and equipped with optimum protection devices.
- The site should be constructed away from the following places:
  - Earthquakes and strong noise occur regularly
  - Places, such as a industrial boiler and a hearting boiler, that are not exposed to intense heat, dust, or toxic gases, such as industrial boiler and heating boiler
  - Places with low air pressure
  - Roads or sand fields. If this is impossible, the windows and doors must not face such pollution sources.
- Keep the air vent of the room away from the exhaust of urban waste pipes, big cesspools, and sewage treatment tanks. Keep the equipment in a positive pressure state to prevent the entry of corrosive gases.
- The site should be established firmly, wind resistance, and leakage protection.
- The site should be located on the second floor or higher. If this is impossible, the site must be placed at least 600 mm [23.62 in.] above the recorded flood level.

NOTE

The site should not be exposed to fungus, mildew, rodents (such as rats), or insects (such as cockroaches).

3.2 Space and Location Requirements of the BTS3012

The equipment layout must be reasonable, feasible, and neat. The BTS3012 cabinet installation modes are single-cabinet installation, multi-cabinet installation, and BTS3012-BTS312 cabinet installation.

Installation Requirements

- You must not install more than one cabinet on one precast slab.
- You can install the cabinet side by side or back to back. For the moistureproof purpose, the cabinet must be at least 10 cm away from the wall.

  NOTE

  Avoid installing the cabinet against the wall.
- The cabinets can be installed side by side.
- At least 0.8 m wide of space must be reserved in front of the cabinet.
- The cabinet must be as close as possible to the feeder window to reduce the length of the feeder.
- The levelness of the cabinets must be checked using a level bar. All the cabinets in the same row must be in a horizontal line.
- According to different positions of the installation holes, the BTS3012 cabinet base is categorized into base A and base B. The installation modes vary with the bases.

Single-Cabinet Installation

Figure 3-1 shows the installation of a single BTS3012 cabinet with base A.

Figure 3-1 Installation of a single BTS3012 cabinet with base A (in mm)

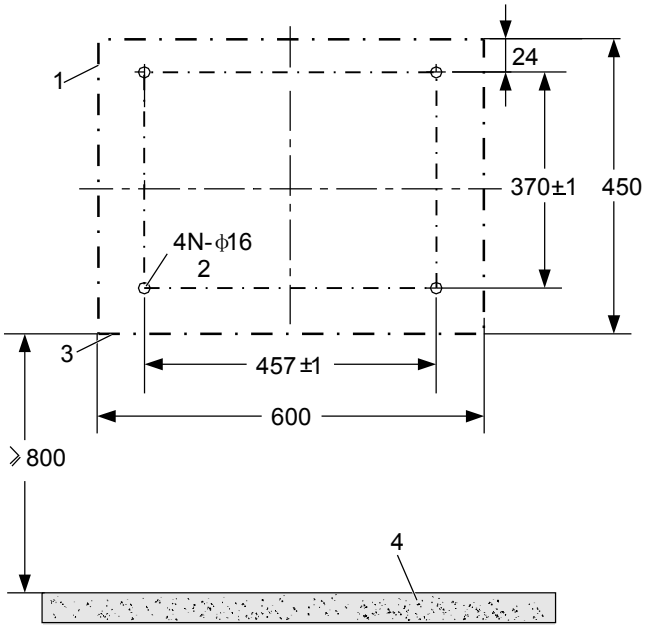
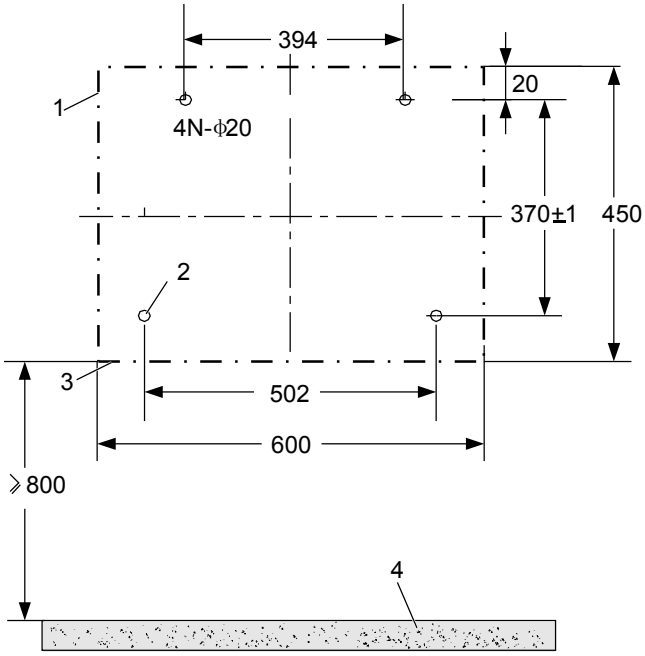


Figure 3-2 shows the installation of a single BTS3012 cabinet with base B.

Figure 3-2 Installation of a single BTS3012 cabinet with base B (in mm)

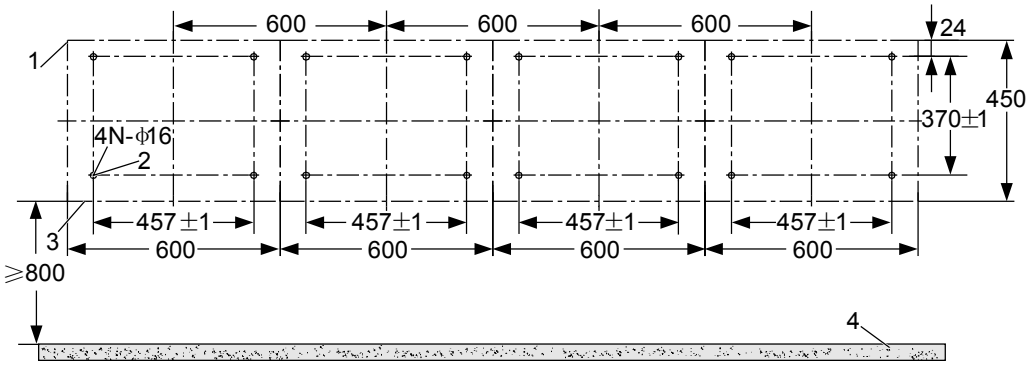


(1) Outline of the cabinet
(2) M12 expansion bolt hole
(3) Front of the cabinet
(4) Inner wall or reference object

Multiple-Cabinet Installation

Figure 3-3 shows the installation of multiple BTS3012 cabinets with base A.

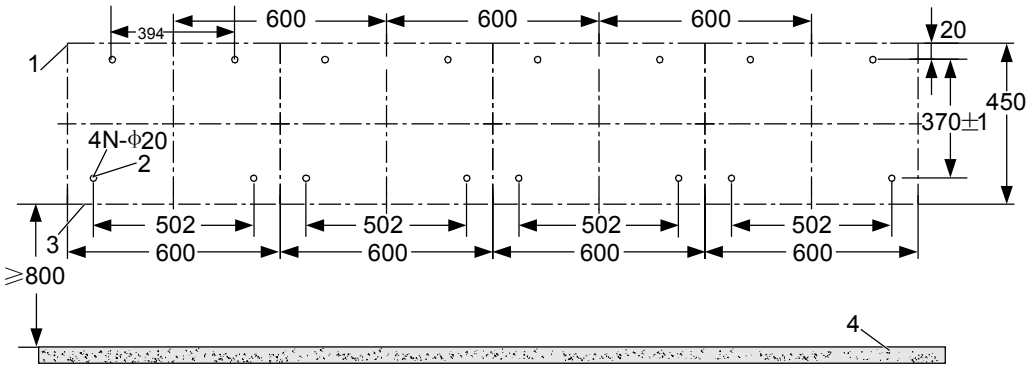
Figure 3-3 Installation of multiple BTS3012 cabinets with base A (in mm)



(1) Outline of the cabinet
(2) M12 expansion bolt hole
(3) Front of the cabinet
(4) Inner wall or reference object

Figure 3-4 shows the installation of multiple BTS3012 cabinets with base B.

Figure 3-4 Installation of multiple BTS3012 cabinets with base B (in mm)



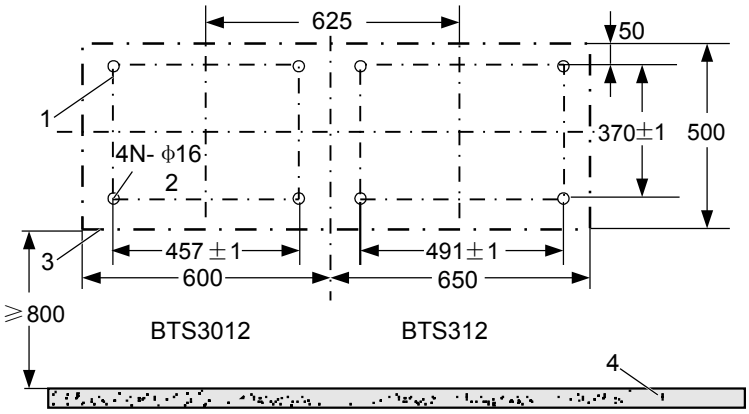
(1) Outline of the cabinet (2) M12 expansion bolt hole

(3) Front of the cabinet (4) Inner wall or reference object

BTS3012-BTS312 Cabinet Installation

Figure 3-5 shows the installation of BTS3012 and BTS312 cabinets with base A.

Figure 3-5 Installation of the BTS3012 and BTS312 cabinets with base A (in mm)

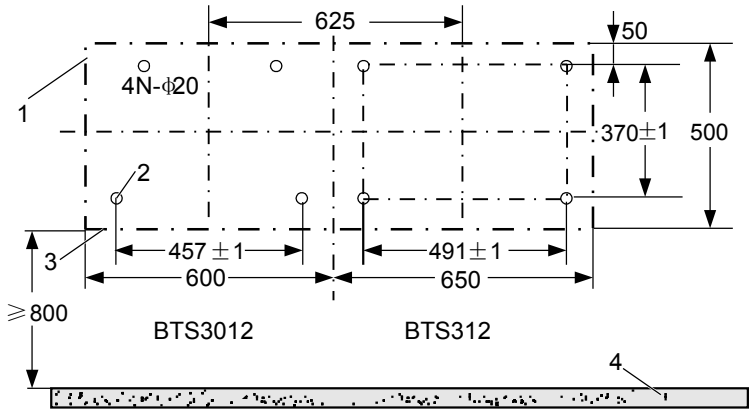


(1) Outline of the cabinet (2) M12 expansion bolt hole

(3) Front of the cabinet (4) Inner wall or reference object

Figure 3-6 shows the installation of BTS3012 cabinets and BTS312 cabinet with base B.

Figure 3-6 Installation of the BTS3012 and BTS312 cabinets with base B (in mm)



(1) Outline of the cabinet
(2) M12 expansion bolt hole
(3) Front of the cabinet
(4) Inner wall or reference object

3.3 Requirements for the Construction of the Equipment Room

The equipment room consist of a switch room, a control room, and an auxiliary room. Usually, the control room has the area equal to or larger than 20 m^2 [215 ft^2]. Limited to the actual conditions, switch rooms and control rooms can be combined. Many factors must be considered for the construction of an equipment room, such as cabling (shortest routing of antenna cables), bearing capacity, power supply, and entrance of transmission cables.

Requirements for the Area

The requirements for the area of the equipment room are as follows:

- Easy for future capacity expansions
- Easy for feeder window installation and feeder distribution
- Easy for installation and maintenance of the equipment
- Convenient for the doors of cabinets to open and close

The actual area of the equipment room depends on the capacity of terminals. For specific requirements, consult Huawei survey engineers during the layout planning.

Requirements for the Height

The minimum height of the equipment room refers to the net height below the beams or ventilation pipes.

For the convenience of installing cabling racks and routing cables and pipes, the requirements for the height of the equipment room are as follows:

- For over-head cabling, the minimum height is 3.5 m [11.48 ft].
- For under-floor cabling, the minimum height is 3 m [9.84 ft].

Requirements for the Bearing Capacity

The bearing capacity of an equipment room depends on weight of the equipment, area of the equipment base, installation position, and structure of the equipment room. The bearing capacity of the equipment room must be tested by a structural engineer. If the bearing capacity does not meet the requirements, take proper measures for better bearing capacity.

Requirements for the Passageway

The requirements for the passageway of the equipment room are as follows:

- The transmission passageway should be more than 1.5 m [4.92 ft] in width and more than 2.5 m [8.20 ft] in height.
- All means of escape in the equipment room should be kept unobstructed, and escape signs should be written at the locations where people are easy to see.
- The doors of the equipment room should be more than 2 m [6.56 ft] in height and more than 1 m [3.28 ft] in width.
- The elevator should be more 2.4 m [7.87 ft] in height.

Requirements for the Internal Partition Wall

The partition wall, located between the equipment and the door of the equipment room, is used to prevents dusts.

Requirements for the Doors and Windows

The requirements for the doors and windows of the equipment room are as follows:

- The doors should be convenient for transportation. Each door should have its lock and key.
- The doors and windows should be sealed with anti-dust rubber strips.
- For the windows exposed to sunlight, use colored glass or apply reflecting paper on the windowpane. If the sunlight in the room is enough, you may paint or block the windows.
- The doors and windows should be installed firmly. Doors and windows should be dustproof.

Requirements for the Roofs and Walls

The requirements for the roofs and walls of the equipment room are as follows:

- The roofs and walls must be strong enough, heat-insulating, and anti-leakage.
- If there are antenna mast and cabling holes in the roof, ensure that the roof is waterproof and strong enough.
- The walls can be applied with lusterless paint, rather than with atomization-prone paint.
- The roofs and walls should be light-colored.
- The roofs should be waterproof and dustproof, and their decoration materials should be impossible or difficult to burn.

Requirements for Fire Protection

The requirements for the fire protection are as follows: For the buildings with fire resistance rating 1 or 2, the space between buildings should be at least 6 m [19.68 ft]. For the buildings with fire resistance rating 3 or 4, the space between buildings should be at least 7 m [22.96 ft].

The requirements for the fire protection inside the equipment room are as follows:

- Keep flammable and explosive materials away from an equipment room.
- Fire extinction facilities must be available on the construction site. Alarm devices, such as smoke sensors and temperature sensors, must be functional.
- Attach distinctive marks on the sockets of different voltages.
- Install safety covers on the reserved mounting holes in the floor.
- If possible, install automatic fire extinguishers. In addition, put portable extinguishers along the aisle of an equipment room.
- The water pool for fire extinction must be able to hold enough water to put out fire both outside and inside the room (assumed that the fire lasts for two hours). Place fire hydrants in a place of easy access (such as in the corridor or in the stair hall) rather than inside the room.

Requirements for Shockproof

The intensity requirement of shockproof design of the room must be one degree higher than the local intensity requirement. For those buildings that do not meet the requirement, reinforce them.

Requirements for Lightning Protection and Grounding

The requirements for lightning protection and grounding are as follows:

- Install grounding networks or lightning protection bands at the parts of the building that are easily to be stricken by the lightning.
- Install lightning rods or lightning protection cables at the top of projecting objects, such as chimneys and antennas.
- The cross-sectional area of the down-leads should be a minimum of 2 mm^2 [0.003 $in.^2$], and the length of the down-leads should be a maximum of 30 m [98.40 ft]. The impulse resistance of the grounding device should be a maximum of 10 ohms.
- The outdoor cables and metallic tubes should be grounded before they are led into buildings. Use a lightning arrester at the entrance of aerial cables into buildings.
- Construct the buildings with reinforced concrete.
- Use the components (such as walls, or reinforcing steel bars inside columns) of buildings as the down-lead wire. These components must have good electrical contact to ensure potential equality.
- The joint grounding system should interconnect the working ground, the protection ground, the grounding system of the building, and the grounding system of the industrial frequency AC power supply.
- The grounding resistance of the joint grounding system must be a maximum of 10 ohms. If other resistance requirements must be met, apply the lowest resistance to all equipment.
- For high buildings or buildings in areas where lightning strikes are frequent, connect the metallic windows of the buildings with the down-lead wires, and the install horizontal lightning protection band for the building.

Requirements for Antistatic

The absolute value of the electrostatic voltage in the equipment room must be less than 1,000 V. To meet the requirement, take the following measures:

- Train the operation personnel on ESD protection.
- Control the humidity in the room to reduce the impact of static electricity.
- Ensure that the floor of an equipment room is antistatic and grounded well.
- Wear antistatic shoes and uniforms in the room.
- Prepare antistatic tools, such as antistatic clothing, antistatic wrist straps, antistatic tweezers, and extraction tools.
- Ground all conducting devices (including computer terminals) in the room, and set up antistatic worktables.
- Keep non-antistatic materials (such as common bags, foams, and rubbers) at least 30 cm [0.98 ft] away from boards and ESD-sensitive devices.

Requirements for Anti-Interference

Interference sources may produce stray signals. The stray signals affect the quality of communication and even the normal operation of base station devices.

The following are possible interference sources:

- Corona discharge of transmission lines
- Electromagnetic interference caused by a transformer
- Various kinds of switch apparatuses
- Waveform distortion in operating large equipment
- Radio-frequency interference
- Natural interference, such as the terrestrial magnetic field and extraneous radiation

The interference, no matter from the outside devices or from inside devices, transmits through capacitance coupling, inductive coupling, electromagnetic wave radiation, electric conduction of common resistance (including the grounding system), and electric conduction of various conducting wires (power cables, signal cables, and output cables).

When external noises exceed the anti-interference capacity of the integrated circuit of equipment, the equipment does not operate normally.

It is impossible to eliminate or shield all interference sources. You can, however, reduce interference as follows:

- Eliminate the interference from high frequency interference signals

  The high frequency interference signals come from the coupling of the primary coil to the secondary coil of a power transformer through a distributed capacitor.

  - Choose a proper power transformer.
  - Install a lowpass filter at the entrance of power cables.
- Eliminate the interference from the grounding system.

  Interference signals transmit to circuits through common impedance coupling of the grounding system.

  - Do not connect the grounding cables (such as signal grounding cables, power grounding cables, protection grounding cables, and shielding grounding cables) as a loop.
  - Do not connect distributed capacitors as a loop.
- Prevent against the electromagnetic interference from ambient environments and lines. In addition, ensure that the base station is grounded, shielded, and wave-filtered properly.

NOTE

- In high frequency electromagnetic field (external interference), a high longitudinal voltage may be inducted in the sheath and the core of the communication cable.
- Because of the asymmetry of the core, the longitudinal voltage may generate lateral noise voltage at the end of the core. The noise voltage causes interference.
- If the metallic sheath is grounded, the longitudinal voltage drops greatly, and the interference voltage is reduced.
- In some multiple-use buildings, there may be more than one high frequency transmitter, whose influence on base station equipment must comply with the requirements specified in the related EMC standards.

- Decrease the voltage or current of interference sources.
- Reduce the length of cables or the space between conductors.
- Place insulating and interfered conductors directly on the grounding surface.
- Choose dedicated grounding return cables to avoid common impedance.
- Twist signal cables and return cables to counteract some external electromagnetic interference.
- Keep the equipment room away from electromagnetic interference. The density of electric field must be a maximum of 300 mV/m. The density of magnetic field must be a maximum of 11 GS.

Requirements for Dustproof

The requirements for dustproof are as follows:

- The density of the dust with the diameter greater than 5 micron should be less than 3×10^4granule/m^3.
- Dust granule should be non-conductive, non-magnetic, and non-corrosive.

To meet the requirements for dustproof in the equipment room, do as follows:

- Airproof the doors and windows. Outer windows should be equipped with double glass and doors should be equipped with sealing strips.
- Ensure that the shoes and clothes that are used in the equipment room are clean.
- Isolate the control room and the switch room by aluminum alloy glass. To avoid dust or other possible interference, do not allow people to frequently enter the switch room.
- If possible, increase the humidity of the equipment room, because moisture can reduce static attachment.

Requirements for Illumination

The requirements for illumination in the equipment room are as follows:

- Do not expose the equipment room to direct sunshine. Under direct sunshine, circuit boards and other components are prone to get aged or deformed.
- The average illumination should be 150–200 LX, without dizzy light. Usually, daylight lamps are used.
- The batteries should be equipped with the explosion-proof lamps that have not very strong light.
- The emergency lighting system should be installed for the equipment room.

- For base stations that have large capacity or great influence, prepare a DC power supply as the standby lighting system.

Requirements for the Air Conditioner

For a large-sized switch room, the dedicated air conditioner with a humidifier should be installed.

- To ensure stable power supply, you can use two ways of AC mains supply or install an electrical machine.
- For a large-sized equipment room, install three air conditioners (at least two air conditioners), one of which serves as a standby. The required number of air conditioners is determined by the actual temperature. Therefore, this can reduce the continuous working time of a single air conditioner, save electric energy, and increase reliability.
- For a middle-sized equipment room, use two air conditioners so that they can work alternately.

Calculate the capacity of the air conditioner based on the area of the equipment room and the heat productivity of the equipment. For the calculation method, see relevant engineering design specifications.

The following equation is used for calculating the heat productivity of the equipment room:

Q = 0.86 x (V x A–W) (kilocalorie/hour)

In this formula:

- Q: Heat productivity of a base station
- V: Voltage of DC power supply (V)
- A: Average power consumption in busy hour (A)
- W: Effective radiating power of the antenna end (W)
- 0.86: Conversion coefficient of electrical energy every watt to heat energy

The requirements for the air condition in the equipment room are as follows:

- Humidity: 30% RH to 75% RH (50% RH to 60% RH preferred)
- Temperature: 18°C to 28°C (20°C to 25°C preferred)

NOTE

If the equipment room has other telecommunication devices, heat productivity of these devices should be taken into consideration.

3.4 Requirements for the Working Environment

The requirements for the working environment consist of the climatic, waterproof, ESD, biological, air cleanness, and mechanical stress requirements.

Climatic Requirements

Table 3-1 and **Table 3-2** list the climatic requirements.

Table 3-1 Requirements for temperature and humidity

Temperature		Relative Humidity
Long-term	Short-term	5% RH to 95% RH
–5℃ [–41°F] to +45℃ [–113°F]	–10℃ [–50°F] to +55℃ [–131°F]	

NOTE

- Meausurement points of the temperature and humidity
  1.5 m [4.92 ft] above the floor and 0.4 m [1.31 ft] in front of the cabinet (no protection boards in front or at the rear of the cabinet)
- Long-term working condition:
  The BTS is operational for long term.
- Short-term working condition:
  The BTS is operational for less than 15 days with no damaged hardware.

Table 3-2 Climatic Requirements

Item	Range
Altitude	⩽ 3,000 m [9,840 ft]
Temprature change rate	⩽ 3℃/min [37.40 °F/min]
Solar radiation	⩽ 1,120 W/m^2
Heat radiation	⩽ 600 W/m^2
Wind speed	⩽ 50 m/s [164 ft/s]
Air pressure	70 kPa to 106 kPa

Requirements for the Biological Environment

The working environment of the BTS should meet the following biological requirements:

- The environment is not conducive for the growth of fungus or mildew.
- There are no rodents such as rats.

Requirements for Air Cleaness

The working environment of the BTS should meet the following requirements for air cleanness:

- There is no explosive, conductive, magneto-conductive or corrosive dust in the air.
- The density of chemically active materials complies with the requirements listed in **Table 3-3**.
- The density of chemically active materials complies with the requirements listed in **Table 3-4**.

Table 3-3 Requirements for chemically active materials

Chemically Active Material	Unit	Density
Suspended dust	mg/m^3	⩽ 35
Deposited dust	mg/m^2•h	⩽ 0.2
Sand	mg/m^3	⩽ 30
• Suspended dust: diameter ⩽ 75 μm • Deposited dust: 75 μm ⩽ Diameter ⩽ 150 μm • Sand: 150 μm ⩽ Diameter ⩽ 1000 μm		

To improve the air cleanness, pay attention to the following:

- Seal the windows and doors of the equipment room. For example, attach double-layer glass and draught excluder strip to the exterior windows and doors respectively.
- Keep the shoes and work clothes clean.
- Keep the relative humidity in the equipment room high in an allowed range to reduce electrostatic adherence of the dust.
- Avoid expose the product to corrosive gases.
- Do not smoke in the equipment room.

Requirements for Corrosive Gases

The site must be free from the corrosive gases such as the SO_2, H_2S, and NH_3. **Table 3-4** shows the limits of the density of the corrosive gases.

Table 3-4 Limits of the density of the corrosive gases

Chemically Active Material	Unit	Density
SO_2	mg/m^3	⩽ 0.30
H_2S	mg/m^3	⩽ 0.10
NH_3	mg/m^3	⩽ 1.00
Cl_2	mg/m^3	⩽ 0.10
HCL	mg/m^3	⩽ 0.10
HF	mg/m^3	⩽ 0.01
O_3	mg/m^3	⩽ 0.05
NO_x	mg/m^3	⩽ 0.05

The site selection must meet the following requirements:

- The equipment room must be constructed away from the district with high-density corrosive gases, for example, chemical factories.
- The air inlet must not face the pollution source.
- Professional companies must be invited to supervise periodically the working environment.

Requirements for Mechnical Stress

Table 3-5 lists the requirements for mechanical stress.

Table 3-5 Requirements for mechanical stress

Item	Sub-Item	Range		
Sinusoidal vibration	Offset	⩽ 3.5 mm [0.14 in.]	-	-
	Accelerated speed	-	⩽ 10.0 m/s^2	⩽ 15.0 m/s^2
	Frequency range	2 Hz [2 c/s] to 9 Hz [9 c/s]	9 Hz [9 c/s] to 200 Hz [200 c/s]	200 Hz [200 c/s] to 500 Hz [500 c/s]
Unsteady impact	Impact response spectrum II	⩽ 250 m/s^2 [820 ft/s^2]		
	Static payload	⩽ 10 pa		

NOTE

- Impact response spectrum refers to the maximum acceleration response curve generated by the equipment under specified impact excitation. Impact response spectrum II means that the duration of semi-sine impact response spectrum is 6 ms.
- Static payload refers to the capability of the equipment in package to bear the pressure from the top in normal pile-up method.

Requirements for Communication

Communication must be available in the equipment room.

Requirements for Electromagnetic

Table 3-7 lists the requirements for electromagnetic.

Table 3-6 Requirements for electromagnetic

Environmental Electromagnetic Effect		Environmental Electromagnetic Effect Parameter
Low frequency magnetic field	Frequency (Hz)	50 Hz [50 c/s] to 20000 Hz [20000 c/s]
	Ampl. A/m (rms)	10 to 0.025

Environmental Electromagnetic Effect		Environmental Electromagnetic Effect Parameter
Amplitude modulation RF electric field	Frequency (Hz)	0.009 to 1000
	Ampl. A/m (rms)	3
Pulse modulation RF electric field	Frequency (GHz)	1 to 20
	Ampl. V/m (peak)	3

To suppress the interference signals, pay attention to the following:

- Keep away from power transformers, high-voltage wires, and high-current equipment.

  For example, keep at least 20 m [65.60 ft] away from AC power transformers and at least 50 m [164 ft] away from high-voltage wires.
- Keep away from high-power broadcast transmitters.

  For example, keep at least 500 m [1640 ft] away from high-power broadcast transmitters.
- If there are any mobile transmitters in the communications building, you should take shielding measures even if the interference of the transmitters meets the requirements.

Requiremetns for the Environment Control System

The environment control system consists of the timing control, temperature monitor, anti-theft alarms, smoke alarms, and backup power control parts. It must meet the following requirements:

- Adjust automatically the working time and working mode of the air conditioner according to the measured temperature.
- Detect the intrusion, over-high temperature, AC power failure, smoke, and fires, and transfers the alarm information to the O&M center, which realizes unattended maintenance.

Table 3-7 lists the requirements for the environment control system.

Table 3-7 Requirements for the environment control system

Item	Requirement
Timing control	According to the preset time, the system controls the timing converter to automatically convert the working states of the air conditioners. The air conditioners work in turns, and thus the energy is saved and the life span of the air conditioners is prolonged.
Temperature monitor	Detects in real time the temperature and gives alarms when the temperature exceeds the thresholds.
Anti-theft alarm	Detects in real time the intrusion into the equipment room. The dual-mode detection annunciator (infrared and microwave) is recommended.
Smoke alarm	Detects in real time the smoke or fires in the equipment room.

Item	Requirement
Power and backup power control	● Automatic charge When the battery detection circuit detects power insufficiency, the system enters the automatic charge state. ● Charge protection Protects the batteries in case of abnormal power supply or over-high charge current. ● Discharge protection Cuts off the load when the battery charge level drops and the life span of the battery is affected. The system enters the battery state when there is a power failure. When the mains supply becomes available, the system changes back to the mains supply state and the charge state.