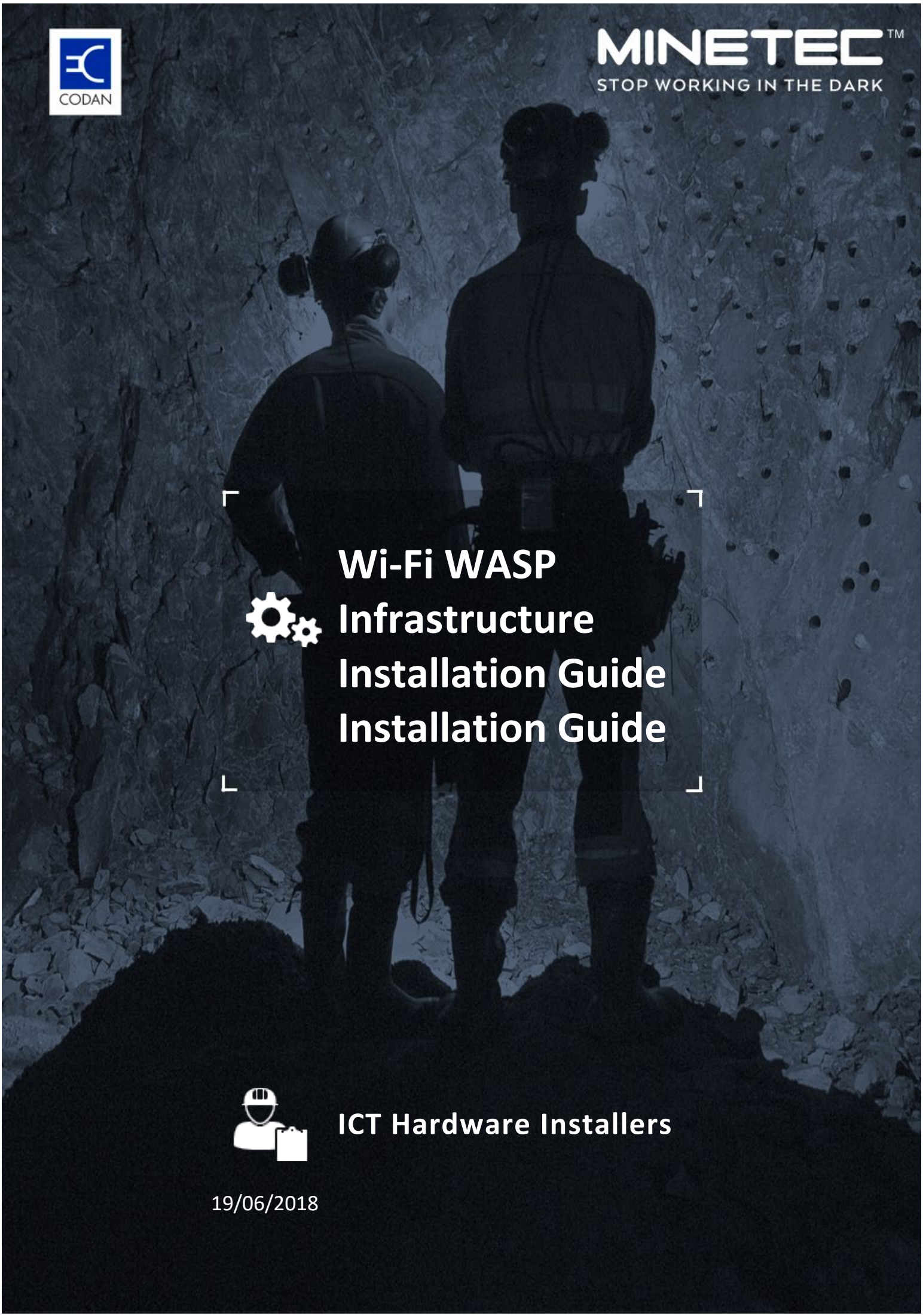
CODAN
MINETEC™
STOP WORKING IN THE DARK
Wi-Fi WASP
Infrastructure
Installation Guide
Installation Guide
ICT Hardware Installers
19/06/2018

Currency

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- Minetec Standard Terms and Conditions of Sale.
- Minetec Software Licence Terms and Conditions.
- Minetec Warranty Statement.

Compliance

Labels located on the exterior of each device indicate the regulations with which the device complies.

Minetec systems and devices comply with the appropriate laws and regulations in Australia and New Zealand. Minetec systems and devices comply with the appropriate laws and regulations of the countries and regions as described in the product data sheets and any associated Compliance Supplement. For any third-party devices refer to the vendors manuals for regulatory statements.

It is important to install and operate the devices and systems according to the guidelines in this document to maintain conformity with regulations, standards and directives.

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Responsible use

This document describes a Minetec system, including how to operate or troubleshoot hardware and/or software. The procedures and guidelines are not prescriptive and do not include operational and safety processes that may apply at your site. As such, responsible use of the procedures and/or guidelines in this document is only achieved by aligning with and/or being incorporated within the Contractor's own operational and HSE policies, guidelines and procedures.

Safety precautions

To prevent damage to the devices product and to ensure the correct operations, please read these precaution statements before installing or troubleshooting any devices.

CAUTION
Do not attempt to service any device unless both qualified and authorised my Minetec in writing, and as indicated in this document.

- If applicable, disconnect devices from all power sources before cleaning. Do not use liquid or spray detergents for cleaning. Use a soft, lint-free cloth to wipe screens and a damp cloth to wipe the exterior of any device. Do not use paper towels to clean the screen.
- Minimise the exposure of devices to ultraviolet light for extended periods (eg direct sunlight) as this can damage the device surfaces (eg make them more brittle).
- Keep the device away from excessive moisture and extreme temperatures.
- Do not subject the device to sudden and severe temperature and/or humidity changes. This could cause moisture condensation inside the unit, which could damage the device. In the event of moisture condensation, allow the device to dry out completely before use.

General safety

To ensure your own personal safety and prevent electrical damage and/or fire, please read these safety statements before installing any devices. Use extreme care and caution when installing or removing devices.

CAUTION
Do not attempt to service any device unless you are experienced, qualified and authorised by Minetec in writing, and as indicated in this document.

Always use care when handling or operating Minetec devices.

For all devices:

- Dropping a device or letting it fall could cause damage resulting in a potential electrical or fire hazard and/or voiding the warranty.
- Some devices may get hot in use and could pose a potential fire or burn hazard. Do not place anything on top of the device or drop objects on the device.
- Make sure the voltage of the power source is correct before connecting any device to the power source. The incorrect voltage may pose an electrical and or fire hazard.
- To prevent damage, fire and/or electrical shock, note all cautions or warnings on a device.
- Never pour any liquid on to or into any device. Depending on the device, this may cause damage resulting in fire and/or electrical shock.
- For product warranty, safety and performance reasons, only authorised and qualified service personnel should open any device.

- Although all Minetec wireless devices meet established standards for exposure to RF energy, use additional common-sense precautions to minimise potentially harmful RF radiation. For example, increasing the distance from an RF source reduces the exposure.
- Unless qualified and authorised, never attempt to disassemble, repair or make any modifications to the device. Disassembly, modification or any attempt at repair could cause damage to the device and even bodily injury or property damage and will void the warranty.
- As some Minetec devices can get hot and/or are a source of RF radiation, do not store or carry flammable liquids, gases or explosive materials in the same compartment as the device, its parts or accessories.
- If any of the following events occur or are suspected, immediately have the device checked by qualified and authorised personnel:
    - A power cord or plug has damage (if applicable).
    - A device has obvious signs of breakage or tampering.
    - A device has physical damage (eg due to dropping or crushing).
    - A device has water or any other liquid damage (eg due to submersion, high-pressure spray).
    - A device does not work as expected after using these guidelines.

Cabling precautions

The installer must have the appropriate training, competency and accreditations for the site before handling or installing Ethernet or optical fibres.

To prevent electrical shock and/or fire, consider the following:

- Route all cables so that people cannot step on them.
- Ensure cables are not under strain when connected.
- Ensure the cables have no kinks or sharp bends. The installer shall adhere to specified minimum cable bending radius for DC, optic fibre and Ethernet cable.
- Protect lead wires from abrasion and chafing by using wire loom or conduit, and route away from moving parts, hydrocarbons and high-temperatures areas.
- Protect all cabling using conduit.
- Secure using P-clamps and/or cable ties at suitable distances to minimise vibrational flexing and maximise bend radii. The installer shall adhere to specified cabling support methods and cable support spacing.
- Use cable glanding for structural penetrations (eg holes through sheet metal).
    - Power/RS232 conduit is 16 mm diameter.
    - Power only conduit is 13.3 mm diameter.

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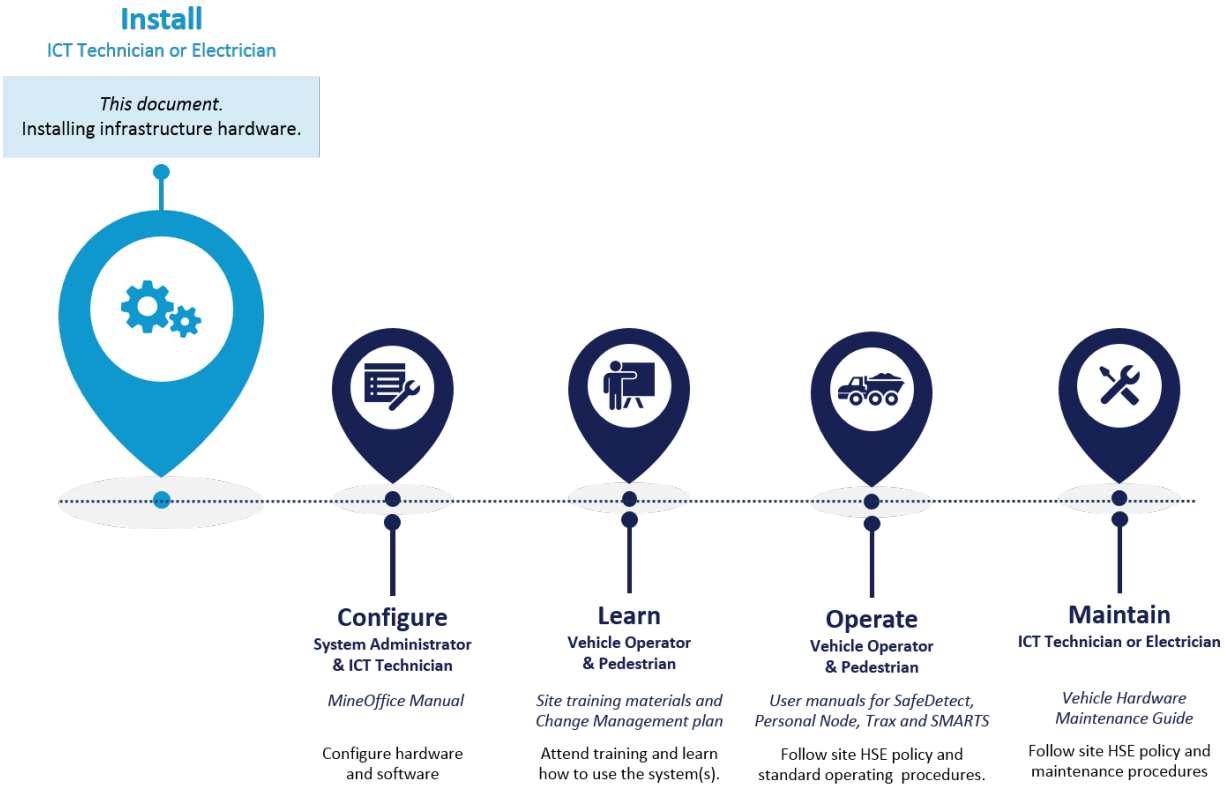
1 ABOUT THIS DOCUMENT

This document describes the Minetec system infrastructure installation to be undertaken. Minetec Wi-Fi WASP™ Bridges ('Bridges'), Wi-Fi WASP™ Access Points ('Access Points' or 'AP') and ICT Cabinet will be fitted in pre-determined mine site locations to enable tracking/zoning of vehicles, visualisation of vehicles and task management.

This document covers the physical mounting and electrical power connection of:

1) Wi-Fi WASP Bridges.
2) Wi-Fi WASP Access Points.
3) ICT Cabinet.

This document does not cover the network configuration of any of the above devices. Providing the network design is available before delivery of devices, each device will be pre-configured at the factory. On delivery to site, it would be prudent for the hardware installers to confirm the network configuration of each device before installing it. If any further configuration or firmware updates are required, it is much easier to perform this in the workshop or office where the MineOffice server is located with a mesh gate or similar.



If site-specific Work Instructions (WI) or Standard Operating Procedures (SOP) exist for any of the tasks described in this section, use those documents in preference to these guidelines.

Site Work Instructions take precedence over these guidelines provided they:

- Are current and complete.
- Are approved by the Mine Operator.
- Are specific to site.
- Do not conflict with the safety instructions within these guidelines.
- Do not conflict with any manufacturer specifications.

The English version of this document takes precedence over any translated versions.

Exclusions:

This document excludes firmware configuration. Refer to the relevant configuration manuals if applicable.

1.1 Document revision

Document information		
Release Date	Document Version	Notes
1/10/2017	0.1	Initial draft
3/10/2017	0.2	
22/05/2018	0.3	Updated for WIFI WASP hardware.
19/02/2019	1.0	GA1 aligned release.

1.2 Reference material

In addition to any Work Instructions that are specific to the site and the following documents support and supplement the information in this document.

Document	Notes
Wi-Fi WASP™ Access Point Assembly Guide	Delivered with device
Wi-Fi WASP™ Bridge Assembly Guide	Delivered with device
Vehicle Hardware Installation Guidelines	As supplied by Minetec
ICT Cabinet Assembly Guide	TBC
Wi-Fi WASP™ Access Point Data Sheet	On request
Wi-Fi WASP™ Bridge Data Sheet	On request
MineOffice User Manual	As supplied by Minetec
Detailed Design	Site specific, as supplied by Minetec

1.3 Audience

Installation of hardware is a specialist task that is to be performed by trained and competent personnel. It is essential that the technician installing the equipment has knowledge and experience in the installation of general electronic and/or communications systems on mining equipment. In some cases more than one technician may be required to install the kit.

The intended audience for this document includes, but is not limited to:

- Technically qualified and authorised people who will install Minetec hardware, and have appropriate accreditations for installing cabling.
- Electricians experienced with ICT hardware installation.
- ICT Technicians.

1.4 Notes and icons

Throughout this document, the following icons and text formats have the meanings as indicated:

Notes in this style highlight important general information.

Caution notes in this style may have an impact on the safety or wellbeing of personnel and/or equipment.

Tips in this style provide helpful process tips.

Best practice notes in this style advise a recommended course or approach where several options may be available.

This symbol indicates that the device, or a related procedure, represent a potential electrical shock hazard.

1.5 Work Instructions

The guidelines in this document are generic and are intended to guide for an ad-hoc installation of hardware. Site-specific Work Instructions provide detailed installation steps and any critical information such as attachment techniques, fasteners used and electrical cable routing specific to your site.

Site-specific Work Instructions supersede the equivalent guidelines in this document.

2 GUIDELINES

2.1 Wiring and power

Before commencing installation, ensure all relevant onsite permissions have been obtained and all required hardware and cabling is available.

This section describes general wiring and connection considerations for all equipment. All wiring should be installed in accordance with AS/NZS 4871- Electrical Equipment for Mines and Quarries. Other standards or directives may also apply.

It is the responsibility of the Mine Operator to comply with the appropriate electrical and communications codes and regulations that apply to the site.

Note that corresponding and equivalent standards may apply in different countries.

When wiring and making connections, note that:

- The power connector must be easily accessible.
- Protect the lead wires from abrasion and chafing by using wire loom or conduit, and route away from moving parts and areas where high temperatures may occur.

The power requirements for each device are show in Table 1 below. Care should also be taken to ensure all device connectors are clean and free from dirt before connection.

Ensure the area is clear and free from hazards and all safety precautions have been taken in line with Company policy. All electrical wiring must only be performed by qualified and competent persons.

Table 1 Voltage and fusing for each device

Device	Min voltage Vdc	Max voltage Vdc	Limits Vdc	Recommended Fusing
Access Point	12	48	9-59	Unserviceable Internal fusing
Bridge	12	48	10-60	Min 1.5A
ICT Cabinet	12	48	TBC	TBC

2.1.1 Access Point power consumption

The following information is a guide only and does not represent a specification.

Access Point tests provided the following results for nominal and peak power consumption under the load conditions indicated. Power consumption is typically 7.5 W typical at 48V dc with a range of 7-10 W dependent on load and voltage. See the table below for examples.

Power	Context	Input Voltage	Load condition
7.7W	Nominal	48 Vdc	2x Ethernet connection, 1x Wi-Fi client, 1x WASP Client.
10W	Peak	48 Vdc	2x Ethernet connection running Ethernet traffic, 1x Wi-Fi client with traffic, 1x WASP Client, 100% CPU load.

2.1.2 Bridge power consumption

The following information is a guide only and does not represent a specification.

Pre-production Wi-Fi WASP Bridge tests (using unmodified Rev D PCB) provided the following maximum values at steady state (current draw tending to fluctuate from max to around 90% of max at about 50% duty cycle). Power consumption is typically 5.2 W at 12 Vdc typical with a range of 4.8-5.8 W dependent on load and voltage. See the table below for examples.

Power	Input Voltage	Load condition
5.16 W	12 Vdc	1x Wi-Fi client, 1x WASP Client.
4.8 W	24 Vdc	1x Wi-Fi client, 1x WASP Client.
5.28 W	48 Vdc	1x Wi-Fi client, 1x WASP Client.
5.7 W	57 Vdc	1x Wi-Fi client, 1x WASP Client.

2.2 Cables and connectors

To prevent damage to the cables and connectors and to ensure the correct operations, ensure you read the cable and connector manufacturer specifications.

In addition to items specified by the manufacturer, pay attention to:

- Minimum bending radius
- Max number of repetitive bends
- Chemical resistance
- Cable support methods and specification
- Low smoke non-halogen jacket
- Crush load
- Ingress rating
- Operational temperature range
- Abrasion resistance.

2.3 Hardware

To prevent damage to the devices product and to ensure the correct operations, please read these precaution statements before installing or troubleshooting any devices.

CAUTION
Do not attempt to service any device unless both qualified and authorised my Minetec in writing, and as indicated in this document.

- Disconnect devices from all power sources before cleaning. Do not use liquid or spray detergents for cleaning. Use a soft, lint-free cloth to wipe screens and a damp cloth to wipe the exterior of any device. Do not use paper towels to clean the screen.
- Minimise the exposure of devices to ultraviolet light for extended periods (eg direct sunlight) as this can damage the device surfaces (eg make them more brittle).
- Keep the device away from excessive moisture and extreme temperatures.
- Do not subject the device to sudden and severe temperature and/or humidity changes. This could cause moisture condensation inside the unit, which could damage the device. In the event of moisture condensation, allow the device to dry out completely before use.

2.4 Wireless hardware

Hardware to be located and orientated to minimise noise and optimise signal radiation.

Wireless hardware is susceptible to RF noise. Avoid installing nodes and cabling near common RF noise generators, such as high voltage cables, electric motors, solenoids and other antennas.

To minimise noise, wherever possible, cabling should be separated from noise generators by at least 600 mm. If this cannot be achieved cables should cross at 90 degrees, which will assist in minimising noise coupling.

Wireless hardware use antennas (external or internal) and require a minimum clearance of 100 mm from metal surfaces.

For best performance and integrity, follow these guidelines when installing wireless hardware:

1) Check all supplied parts required for the installation are available.
2) Do not cross-thread or force a thread when screwing an antenna to a device.
3) Antennas use knurled threaded connectors and should be finger tightened. Do not use tools.
4) Once attached, an antenna is vulnerable to physical damage until the device is installed.
5) Check and confirm any external antennas are screwed in fully to the device. Antennas are shipped loose in the box and may be easy to overlook.
6) Determine a physical mounting location that meets the following criteria:
   - Wireless hardware has an effective view (line-of-sight preferred).
   - In sub-zero weather cables and conduits should not be permitted to flex.

3 PLANNING

When completing the Planning phase for a site installation, consider the items listed below. There may also be other, site-specific considerations to take into account.

When planning the installation, ensure:

- **Engineering drawings:** Engineering drawings have been received and are available, and that they include schematics and proposed layouts.
- **Installation standards:** Follow site-wide standards for cabling all Access Points ie all devices use the same ports for power and/or Ethernet connectors.
- **Infrastructure hardware labelling:** Follow the hardware labelling conventions outlined in the project *Detailed Design* document (supplied by Minetec), summarised below.

3.1 Infrastructure hardware labelling

It is recommended to use the following labelling convention for hardware:

X.Y.Z, where:

X = Hardware device
Y = Level or area code
Z = Incremental numbering of the specific device type with increments starting at 1 on each level

Example: If a Minetec Access point was mounted underground on level 301 and was the first access point, the label would be: A.301.1.

Table 2 Hardware device nomenclature

Device	ID letter
Access Point	A
Bridge	B
ICT Cabinet	I
Sensor station	SS
Server	MO
Ethernet Switch	S
Ethernet Cable	E
DC power cable	P
Optic fibre cable	F

3.2 Physical device preparation

Complete the following preparation for Access Points and Bridges:

- Attach the device antennas making sure to use self-amalgamating tape or similar removable sealant. All sealed connections must be reversible.
- If mounting to a threaded rod, ensure a hole of the correct size is drilled to the device bracket if one doesn't already exist. Remove the bracket from the device before drilling new holes in the bracket.
- If using a threaded rod, attach the bracket using lock nuts to prevent accidental rotation of the device.
- If using a mesh mount (Figure 2 on page 10), attach the device and bracket to any required additional mount, making sure all bolts are secure.
- Irrespective of the mounting technique used, maintain the vertical orientation of antennas, pointing downwards.
- Label all ports appropriately. Refer to the *Best Practice* note below.
- Rollup the excess cable and cable tie together ready for installation.

Determine a site-wide standard for cabling all Access Points, ie all devices use the same ports for power and/or Ethernet connectors.
Label all ports appropriately with upstream (away from power booster) and downstream (closer to power booster).

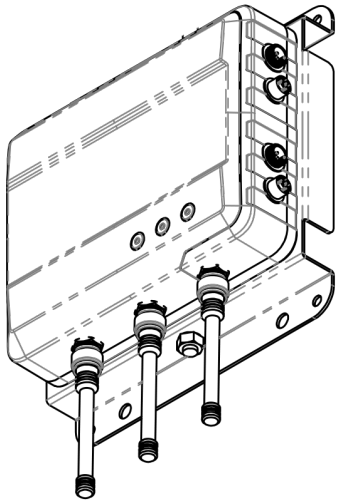
4 INSTALLING INFRASTRUCTURE

This section outlines installation guidelines for the various infrastructure components of Minetec systems. At the end of each section, a basic power-on check is outlined to ensure the devices are connected and working properly.

4.1 Wi-Fi WASP™ Access Point

Access Points, shown in Figure 1 below, act as data aggregation points that calculate and store location information. Access Points also acts as a wireless gateway for the Minetec network. Multiple Access Points can be power cable daisy-chained to form a segment up to 1km long. Each unit can be up to 100m apart, therefore, a segment can have up to a total of 10 Access Points.

Figure 1 Access Point with standard bracket



The mounting options for Access Points are:

- Using a threaded rod to bolt to the backs or wall. See Figure 3 on page 10.
- Bolt directly to the wall using a custom mount eg 'C'-channel bracket.
- Attach with 4x stainless steel cable ties (one per corner) to mesh (mesh mount). See Figure 2 on page 10. Mesh mounting is only recommended for temporary installations.

Note that an Access Point with standard bracket weighs approximately 3kg.

A maximum of 10 Access Points can be daisy-chained to form a single segment.

Figure 2 AP Mesh mount

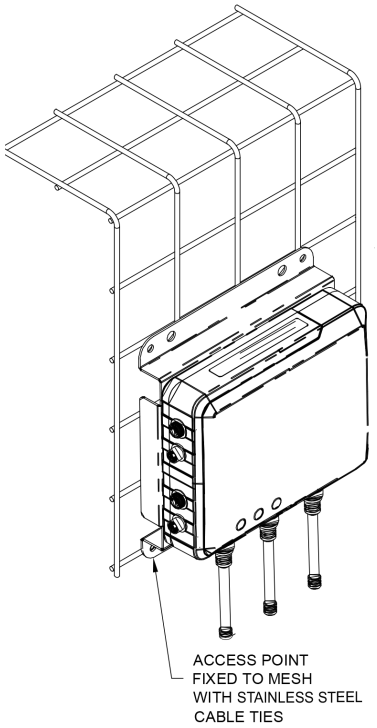
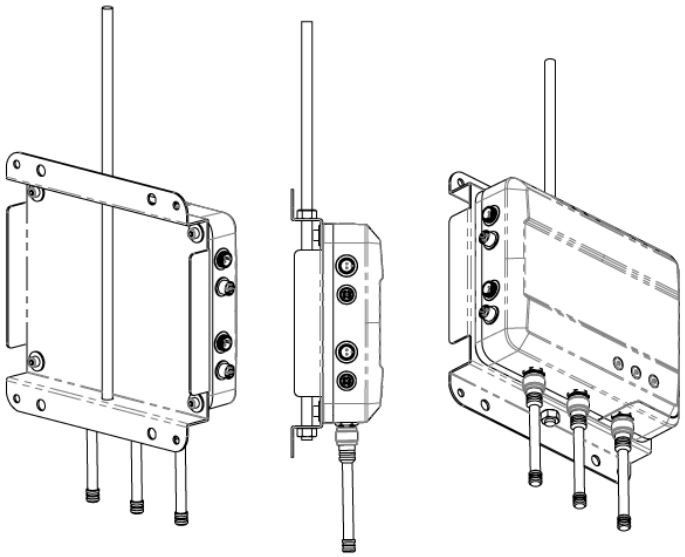


Figure 3 AP Threaded rod mount



4.1.1 Before you start

Before commencing work, plan and prepare for the installation ensuring that you read, understand and perform the appropriate planning and preparation steps including, but not limited to:

- Guidelines on page 4.
- Planning on page 7.
- All electrical work to be done by qualified, authorised and deemed competent persons.
- The work area is clear and free from hazards.
- All relevant onsite permissions and permits to work have been obtained.
- All safety precautions are in line with Mine Operator policy.
- All required hardware and cabling is available.

4.1.2 AP installation

Before performing the steps in this guide, ensure all site operational, EHS and/or maintenance practices are followed including, but not limited to the 'permit to work' system, isolation of stored energy and use of the appropriate PPE.

If site-specific Work Instructions exist for any of the tasks described in this section, use those Work Instructions instead of these guidelines.

Guide 1 Installing a Wi-Fi WASP™ Access Point

For best performance and hardware integrity, follow these guidelines to install an Access Point.

Step	Action/Response	Comments
1) Install the mounting option.	• If using a threaded rod, drill and install the rod to the verified position and allow Chemset (or other suitable adhesive product) to set. • If using a different mounting option, install any required mounts to the device bracket. Mesh mounting is only recommended for temporary installations.	Use the approved detailed design documents and drawings for reference when commencing installation. Note that an Access Point with standard bracket weighs approximately 3kg. For example, see Figure 2 on page 10 and Figure 3 on page 10.
2) Attach the device.	Attach the Access Point to the mounting being sure to orientate for optimal antenna coverage. Ensure all nuts and bolts are secure. The device antennas to face downwards.	• If using threaded rod, attach the Access Point to the threaded rod using the appropriate nuts and washers. Use lock nuts to prevent the device from rotating. • If using a mesh bracket, attach to the mesh in the verified position using a minimum of 4x stainless steel cable ties (one per corner) as nylon can perish.
3) Check power is off	Ensure the power cables to be connected are not live.	
4) Install the cables.	Install power and Ethernet cables per the detailed design and following the cable safety and cable precautions.	See Wiring and power on page 4. If using Minetec cables, no termination is required as cables are supplied pre-terminated.
5) Connect the cables.	Connect the power and/or Ethernet cables per the detailed design: • 2-pin connector is power only. • 8-pin connector is Ethernet. Rollup the excess cable and cable tie together according to site procedures.	There are eight connections on the device. There are 2x power and 2x Ethernet connections on each side of the Access Point. See Cables and connectors on page 5.
6) Check cables and connections.	Check all connections, cables and anchor points.	Do this before connecting to power.
7) Perform power-on check.	Follow on-site operational and HSE practises before applying power. The power source will either be the ICT cabinet, another Access Point or a battery (eg if power not yet available).	When power is turned on, all LEDs should turn solid green to indicate the device is working correctly and ready to use. Refer to 4.1.3 on

Step	Action/Response	Comments
	When ready, complete a basic power-on check.	page 12 for expected LED states when connected to power.
8) Mark up.	Mark up (red line) installation drawings to indicate any changes to installation locations (cabling or AP).	Installation of the device is now complete.

4.1.3 AP power-on check

A short time after the power is turned on, each of the LEDs should display Normal operations at indicated in Table 3 below. Abnormal operation LED states are also detailed.

Table 3 AP LED states

LED	LED activity	Description (default behaviour, all voltages nominal)
Network	Solid green	Wireless network available to devices.
	Off	Wireless network unavailable (eg reconfiguring network or fault). Confirm Power LED OK.
System	Flashing green	Device OK. The flash cycle frequency changes during start-up and with data load.
	Off	Device fault if Power LED is solid green ('Voltage OK'). Confirm Power LED OK.
Power	Solid green	Voltage OK, 12 Vdc <= Vin <= 55 Vdc
	Off	Extreme low input voltage (V_{IN} <6 Vdc). Check power supply.
	Solid orange	Under voltage (6 Vdc < V_{IN} < 12 Vdc). Check power supply.
	Solid red	Over voltage (55 Vdc < V_{IN}). Check power supply.

Figure 4 Access Point LEDs

4.2 Wi-Fi WASP™ Bridge

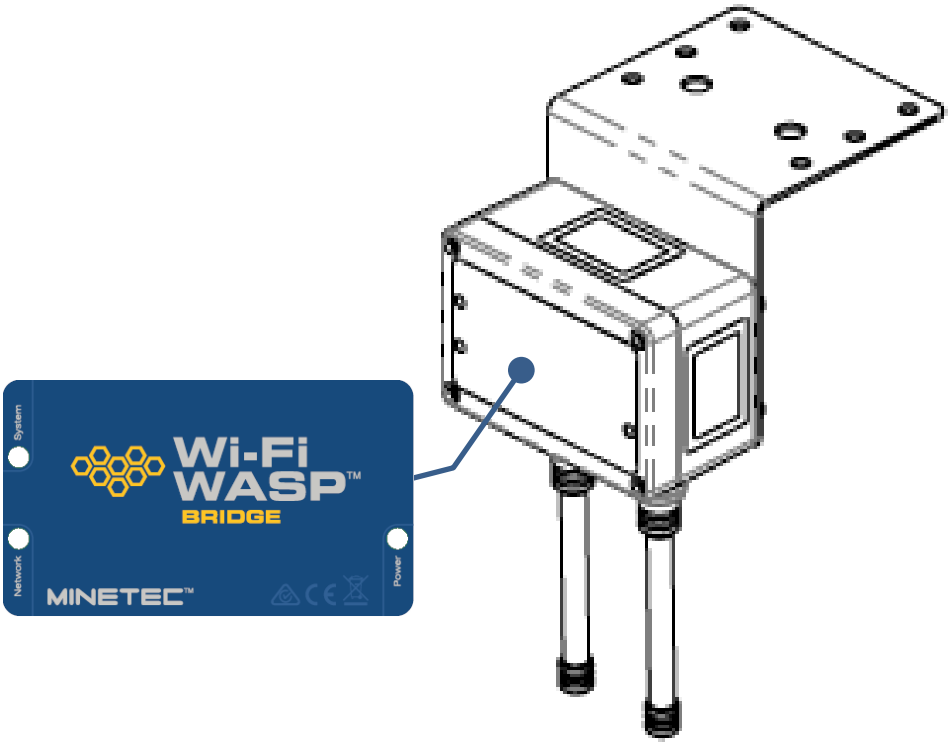
Bridges are installed in known, and fixed locations around a mine. See Figure 5 on page 14. Bridges communicate with Mobile Nodes, installed on vehicles, and Access Points installed throughout the mine site.

Each Bridge comes with a right-angled mounting bracket, pre-bolted to the unit. This allows for numerous mounting options, depending specific site conditions and policies. The mounting options are:

- Bolting directly to the backs or wall using a custom auxiliary bracket.
- Attaching with stainless steel cable ties to mesh (Figure 7 on page 15).
- Using a Threaded Rod to bolt to the backs or wall (Figure 8 on page 15).

When considering mounting options, ensure space between the Bridge and the wall to allow the power cable to be connected.

Figure 5 Bridge with standard bracket



4.2.1 Before you start

Before commencing work, plan and prepare for the installation ensuring that you read, understand and perform the appropriate planning and preparation steps including, but not limited to:

- Guidelines on page 4.
- Planning on page 7.
- All electrical work to be done by qualified, authorised and deemed competent persons.
- The work area is clear and free from hazards.
- All relevant onsite permissions and permits to work have been obtained.
- All safety precautions are in line with Mine Operator policy.
- All required hardware and cabling is available.

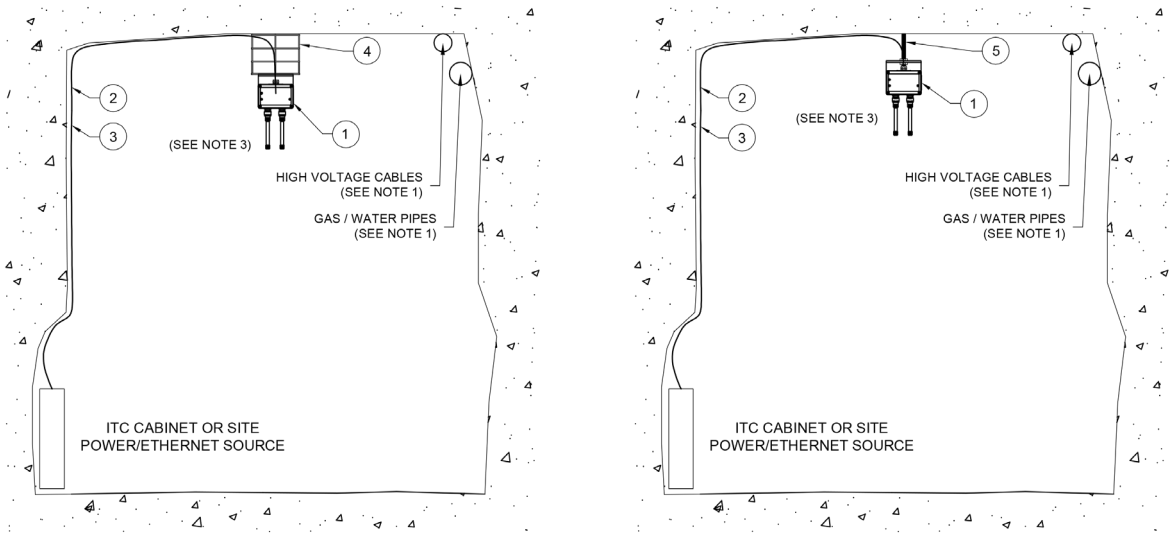
Before commencing installation of Bridges, ensure you:

1) Confirm the intended location of the Bridge facilitates effective communication with Mobile Nodes. Typically, Bridges are installed either on the side or in the middle of a tunnel, with the antenna facing down, as shown in Figure 6 on page 15.

For troubleshooting purposes, it is preferred that the LEDs visible from ground level.

2) Confirm the physical mounting location matches the location specific in the *Detailed Design* document, supplied by Minetec.

Figure 6 Typical Bridge arrangement



NOTES:
1. LOCATION SHOWN OF HIGH VOLTAGE CABLES AND GAS / WATER PIPES ARE INDICATIVE ONLY. EXACT LOCATION IS DETERMINED BY OTHERS AND MAY DIFFER ON SITE.
2. STANDARD 100MTR CABLES AND ANTENNAS SUPPLIED WITH THE BRIDGE UNIT.
3. ORIENTATE AS PICTURED SO BOTH ANTENNAS HAVE OPTIMAL LINE OF SIGHT DOWN THE TUNNEL. ANTENNAS TO FACE DOWN.
4. REFER DRAWING MT.E.00003.18.01-DGN.SYS.00100 POWER CABLE - ACCESS POINT/BRIDGE.
5. REFER DRAWING MT.E.00003.18.01-DGN.SYS.00101 ETHERNET CABLE - ACCESS POINT/BRIDGE

Figure 7 Bridge mesh mount

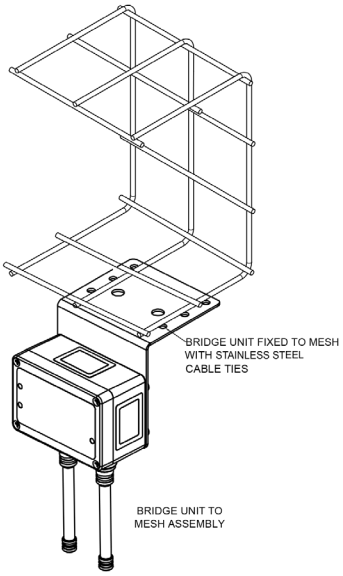
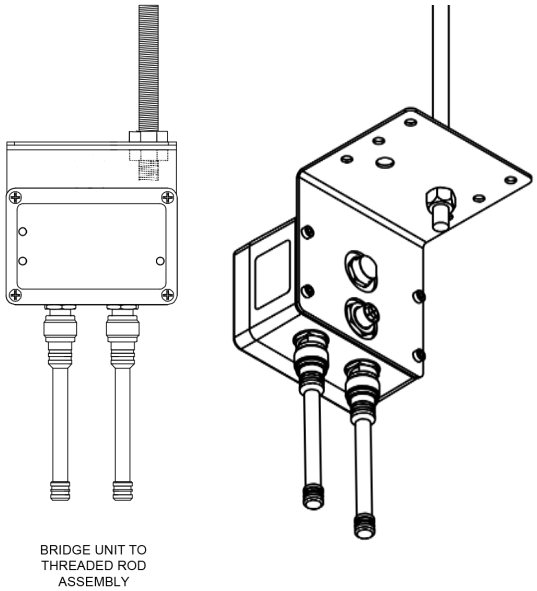


Figure 8 Bridge threaded rod mount



4.2.2 Bridge installation

Before performing the steps in this guide, ensure all site operational, EHS and/or maintenance practices are followed including, but not limited to the 'permit to work' system, isolation of stored energy and use of the appropriate PPE.

If site-specific Work Instructions exist for any of the tasks described in this section, use those Work Instructions instead of these guidelines.

Guide 2 Installing a Wi-Fi WASP™ Bridge

For best performance and hardware integrity, follow these guidelines.

Step	Action/Response	Comments
1) Install the mounting option.	Confirm the mounting option. If using a threaded rod, drill and install the rod to the verified position and allow Chemset (or other suitable adhesive product) to set. If using a different mounting option, install any required mounts to the device bracket. Mesh mounting is only recommended for temporary installations.	Use the approved detailed design documents and drawings for reference when commencing installation. For example, see Figure 7 on page 15 and Figure 8 on page 15.
2) Attach the device.	Attach the Bridge to the mounting point being sure to orientate correctly with the antenna facing down.	• If using threaded rod, attach the Access Point to the threaded rod using the appropriate nuts and washers. Use lock nuts to prevent the device from rotating. • If using a mesh bracket, attach to the mesh in the verified position using stainless steel cable ties as nylon can perish.
3) Check power is off	Ensure the power cables to be connected are not live.	
4) Install the cables.	Run the cable to the nearest planned Access Point and secure with cable ties. Install power and Ethernet cables per the detailed design and following the cable safety and cable precautions.	See Wiring and power on page 4. If using Minetec cables, no termination is required as cables are supplied pre-terminated.
5) Connect the cables.	Connect the power and/or Ethernet cables per the detailed design: • 2-pin connector is power only. • 8-pin connector is Ethernet. Rollup the excess cable and cable tie together according to site procedures.	There are two connections on the device. There is one power and one Ethernet connection.

Step	Action/Response	Comments
6) Check cables and connections.	Check all connections, cables and anchor points.	Do this before connecting to power.
7) Perform power-on check.	Follow on-site operational and HSE practises before applying power. The power source will either be the ICT cabinet, another Access Point or a battery (eg if power not yet available). When ready, complete a basic power-on check.	When power is turned on, all LEDs should turn solid green to indicate the device is working correctly and ready to use. Refer to 4.2.3 for details for expected LED states when connected to power.
8) Mark up.	Mark up (red line) installation drawings to indicate any changes to installation locations (cabling or Bridge).	Installation of the device is now complete.

4.2.3 Bridge power-on check

The Bridge must be in the coverage area of the tracking system or a dedicated testing installation.

Check the status of the Bridge LEDs described in Table 4 on page 18 to ensure that the device is functioning correctly.

Figure 9 Bridge LEDs

Table 4 Bridge LED states

LED	LED activity	Description (default behaviour, all voltages nominal)
Network	Solid green	Device has joined a network.
	Off	Device has not joined a network. Confirm Power LED OK. Bridge fault if Access Point network is available and in range for wireless connection.
System	Flashing green	Device OK. The flash cycle frequency changes during start-up and with data load.
	Off	Device fault if Power LED is solid green ('Voltage OK'). Confirm Power LED OK.
Power	Solid green	Voltage OK.
	Solid orange	Under voltage (10 Vdc < V_{IN} < 12 Vdc). Check power supply.
	Solid red	Over voltage (57 Vdc < V_{IN} < 60 Vdc). Check power supply.
	Off	Invalid input voltage (V_{IN} <10 Vdc or V_{IN} > 60 Vdc). Check power supply.

4.3 ICT Cabinet

The ICT Cabinet (Figure 10 on page 19) converts long range power (240Vac) and network (fibre) to short range power (24Vdc) and network (Ethernet). The mounting options for ICT Cabinet are:

- Wall mount.
- Hanging frame with chain and eye bolts.
- Custom made stand.

4.3.1 Before you start

Before commencing work, plan and prepare for the installation ensuring that you read, understand and perform the appropriate planning and preparation steps including, but not limited to:

- Guidelines on page 4.
- Planning on page 7.
- All electrical work to be done by qualified, authorised and deemed competent persons.
- The work area is clear and free from hazards.
- All relevant onsite permissions and permits to work have been obtained.
- All safety precautions are in line with Mine Operator policy.
- All required hardware and cabling is available.

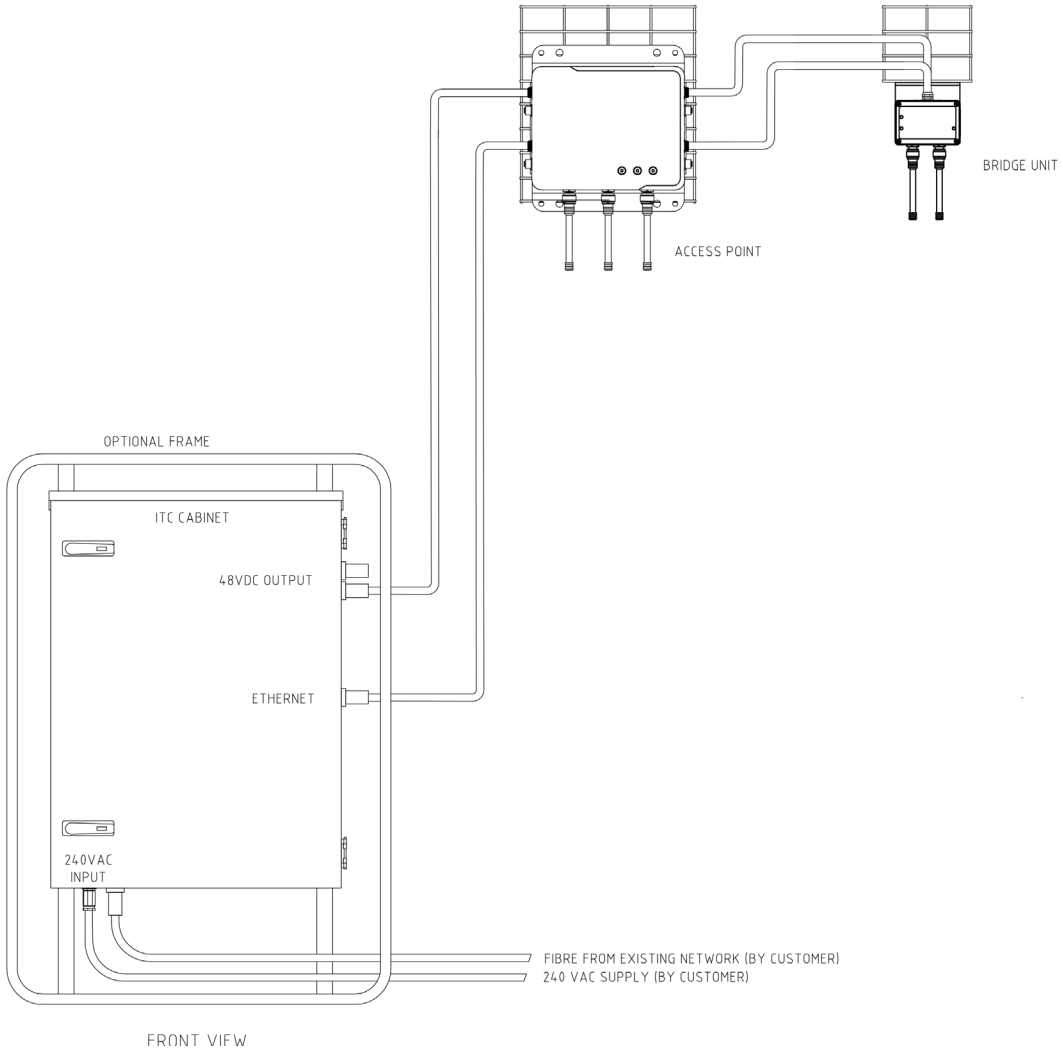
Before going underground, complete the following preparation on the cabinet:

- If using a hanging frame, attach the ICT Cabinet to the frame, making sure all bolts are secure.
- If mounting to a threaded rod, attach the reo bar to the top and bottom of the ICT Cabinet.
- Ensure the correctly sized and placed holes have been drilled in the reo bar.
- Ensure the location meets the following criteria:
    - Fibre and 240Vac power in close proximity.
    - Device/s to be supplied are in close proximity.
    - Greater that 600mm from any high voltage cables.
- Prepare the power and Ethernet cables:

- Measure the distance to the first Access Point and Bridge and Ethernet points allowing for some slack.
- Use the power and Ethernet cables prepared for the Access Point.
  - Terminate the Ethernet cable with the provided Ethernet connector in a straight through configuration.
  - 240Vac power wiring will be handled by the site electrician.
- Protect the cables in a protective sleeve according to site standards. Typically a solid nylon conduit with end boots fitted is acceptable.

- Connect the power, Ethernet and earth connections. Install the batteries once in position as these will add significant weight.

Figure 10 ICT cabinet schematic



4.3.2 ICT Cabinet installation

Before performing the steps in this guide, ensure all site operational, EHS and/or maintenance practices are followed including, but not limited to the 'permit to work' system, isolation of stored energy and use of the appropriate PPE.

If site-specific Work Instructions exist for any of the tasks described in this section, use those Work Instructions instead of these guidelines.

Guide 3 Installing an ICT Cabinet

For best performance and hardware integrity, follow these guidelines when installing an ICT Cabinet.

Step	Action/Response	Comments
1) Install the mounting option.	Confirm the mounting option. • If using a threaded rod, drill and install the rod to the verified position and allow Chemset (or equivalent) to set. • If using a different mounting option, install any required mounts to the cabinet. Mesh mounting is only recommended for temporary installations.	Use the approved detailed design documents and drawings for reference when commencing installation.
2) Attach the ICT cabinet.	Attach the cabinet to the mounting point.	• If using a hanging frame, attach with chain from an eye bolt. • If using threaded rod, attach to the threaded rod using the appropriate nuts and washers.
3) Check power is off	Ensure the power cables to be connected are not live.	Power supply to the cabinet should be positively isolated and tagged.
4) Install and connect the cables.	• Install power cable from the Access Points and connect to the cabinet Gateway power port. • Connect Bridge power cable and run to the power injection point. • Run the Ethernet cable and connect to the ICT Cabinet Ethernet port.	Secure all cables with cable ties.
5) Check connections.	Check all connections, cables and anchor points are secure.	Perform this before connecting to power.
6) Perform power-on check.	When all devices connected, perform a power-on check.	Refer to Section 4.3.3 on page 21.
7) Mark up.	Mark up (red line) installation drawings to indicate any changes to installation locations (cabling or Bridge).	Installation of the device is now complete.

4.3.3 Power-on check

The ICT Cabinet must be connected to the system network before a power-on check can be completed.

Ensure all the circuit breakers are up and providing power to the devices.

Check the status of the power LED and Ethernet link LEDS on the Cisco Switch in Figure 11 below to confirm the unit is working correctly. The SFP (if using fibre) should have a flashing green light when data present and each Ethernet port with an active device connected will also have a green flashing light.

If the SFP port doesn't have an active green light there may be an issue with the fibre connection back to the network. If the connected Ethernet ports don't have an active green light and the Ethernet cables have tested positive, then there may be a fault with the ICT cabinet.

Figure 11 Cisco Switch

5 TROUBLESHOOTING

If the troubleshooting procedures in this section do not help resolve an issue, contact Minetec.

Contents

If unsure about any of the troubleshooting steps contact Minetec Support for advice or assistance.

5.1 Wi-Fi WASP™ Access Point

The troubleshooting steps below cover the physical installation of an Access Point only.

Typical causes of failure include, but are not limited to:

- Damage.
- Environment.
- No power/inadequate power.
- Corrupted firmware.
- No network available.
- Invalid credentials to connect to a network.
- No MineOffice/Minetec services operating on network.

Check for	Test	Action for failed test
1) Physical damage	Visually inspect the device for obvious physical damage and ensure that it appears to be in good physical order.	Contact your supervisor to arrange a replacement using the RMA Procedure on page 26.
2) Environmental problems	Is there any water around or under the connector?	Dry out connections and mitigate further water intrusion. Clean and dry the device and restart it if no obvious permanent damage.
	Is the device dry? Is the device covered in dirt or dust?	
3) Power supply	If connected, one or more AP LEDs should be on.	All LEDs are off if input voltage is out of range. Check input voltage is within limits: >=10Vdc and <60Vdc.
	Is the power connector plugged in?	Connect cable.
	Is the power source active?	Perform power source troubleshooting.
	Is 12-48 Vdc available from the source?	
	Is the power cable/connector free of damage?	Replace cable.
4) Ethernet	Is the connector plugged in?	Connect cable.
	Is the cable/connector free of damage?	Replace cable.
5) Internal fault	LED states OK?	Refer to Table 3 on page 12.
6) Unresolved	If the problem is not resolved after performing the above tests and actions.	Contact your supervisor to arrange a replacement using the RMA Procedure on page 26.

Warranty is void if the device has been opened.

5.2 Wi-Fi WASP™ Bridge

The troubleshooting steps below cover the physical installation of a Bridge only.

Check for	Test	Action for failed test
1) Physical damage	Visually inspect the device for obvious physical damage and ensure that it appears to be in good physical order.	Contact your supervisor to arrange a replacement using the RMA Procedure on page 26.
2) Environmental problems	Is there any water around or under the power connector?	Dry out connections and mitigate further water intrusion if no obvious permanent damage.
3) Power supply	Does the daisy-chain segment where the device is located have power?	Check Bridge for power using Table 4 on page 18
	Is the connector plugged in?	Connect cable.
	Is the power source active?	Perform power source troubleshooting.
	Is 12-48 Vdc available from the source?	
	Is the power cable free of damage?	Replace cable.
4) Internal fault	LED states OK?	Refer to Table 4 on page 18.
5) Unresolved	If the problem is not resolved after performing the above tests and actions.	Contact your supervisor to arrange a replacement using the RMA Procedure on page 26.

Warranty is void if the device has been opened.

5.3 ICT Cabinet

This table only covers the installation and mounting of an ICT Cabinet.

Check for	Test	Action for failed test
1) Physical damage.	Visually inspect the device for obvious physical damage and ensure that it appears to be in good physical order.	Contact your supervisor to arrange a replacement using the RMA Procedure on page 26.
2) Environmental problems.	Is there any water around or under the power connector?	Dry out connections and mitigate further water intrusion.
3) Power supply.	Is the required power supply available?	Perform power source troubleshooting.
	Is the power cable free of damage?	Replace cable.
4) Unresolved.	If the problem persists after performing the above tests and actions.	Contact your supervisor to arrange a replacement using the RMA Procedure on page 26.

6 SUPPORT

Help using software or hardware

If you need help with using Minetec software or hardware, in the first instance, contact your Supervisor or the person who delivered your training.

Hardware faults and software bugs

Supervisors/System Administrators

Please refer to the Minetec Operational Support Plan for details on the level of support to be provided to your site.

Contact Minetec Support Services before returning any hardware, either via the online support portal or the details provided on the back cover.

If the device or the application does not behave as expected perform the troubleshooting steps in the Troubleshooting section(s). If the device or application is still not performing correctly, report the fault to your Supervisor to lodge a request for a Return Materials Authorisation (RMA) number and complete the RMA form.

To ensure Minetec support personnel can identify the issue quickly, the report should include the following items:

- Username.
- Time of occurrence.
- Brief description of problem.
- Steps taken before the problem occurred.
- If applicable, a screenshot of the error message or visual indication of unexpected behaviour.
- Description of the expected behaviour (as perceived by you).

RMA Procedure

Devices identified as faulty should be returned to Minetec Support after obtaining a Return Materials Authorisation (RMA) reference number. Without the RMA a device may not be accepted. Each separate item of kit requires an individual RMA number.

The procedure to return a faulty item is:

1) Perform the troubleshooting steps in this document as appropriate for the device(s) and establish that a fault exists.
2) Contact Minetec Support Services for the RMA reference number.
3) Complete the RMA form with as much detail as possible indicating the test performed. Note that you can reference specific tests with the number in the first column of each troubleshooting table.
4) Return the device(s) and RMA form(s) to Minetec.

7 GLOSSARY

Term	Detail
Access Point	A Wi-Fi WASP™ Access Point provides standard Wi-Fi access to third-party devices and provides a bridge between standard Wi-Fi and WASP network operating in the 5.8 GHz band. Daisy-chained Access Points provide ranging data backhaul and communications over a serial Ethernet backbone.
AP	Wi-Fi WASP™ Access Point
Bridge	The Wi-Fi WASP Bridge calculates the distance between itself and each detectable Mobile Node or Personal Node with an accuracy of better than one metre using the WASP positioning system in the 5.8 GHz band. A bridge provides a 'wireless bridge' between the WASP proprietary mesh network and a standard 2.4 GHz Wi Fi system.
Guideline	Steps to perform a task intended to align with and /or incorporate within the Mine Operator's own documentation to comply with site operational and safety strategies.
Hazard	A hazard is a source of danger. The hazard is a physical system with kinetic or potential energy that could inflict harm or damage. The source of energy could be, for example, chemical energy, electrical energy, gravitational potential energy etc. In the context of SafeDetect, each moving vehicle is a hazard. To be 'detected' as a hazard the vehicle must be fitted with SafeDetect. ⚠ In SafeDetect, the term 'hazard' refers to vehicular hazards and excludes any other mine site hazards (chemical, electrical etc.).
HSE	Health, Safety and Environment or equivalent system (eg OHS, EHS) at your site.
ICT	Information and Communications Technology is an extended term for information technology (IT) and includes telecommunications.
LED	Light Emitting Diode
Mine	A surface or underground mine. Note that Minetec hardware products are suitable for hard-rock mines or surface mines. ⚠ Minetec products are not suitable in mines with a combustible atmosphere.
Mine Operator	The company that operates a mine on a day-to-day basis. This may be a Mine Contractor or the owner operating as an Owner-Operator.
MineOffice	MineOffice is the management tool for configuring all Minetec software and wireless-enabled hardware products. Accessible via a web interface, MineOffice is used to set-up and configure Minetec hardware as well as all desktop and mobile apps within the Minetec software suite. As appropriate, firmware and software updates can be performed over the air or via an Ethernet network. MineOffice also enables centralised monitoring and diagnostics of Minetec products.
mm	millimetre
Mobile Node	The Minetec Mobile Node is a vehicle-mounted, low-power tracking[1] and proximity[2] detection device specifically designed for harsh mining environments. Also, see entry for Node. In general, LVs would have one mobile node installed whereas HVs would typically have two mobile nodes installed.
Person	Relates to all people exposed to a potential unwanted event scenario PUE 1 Equipment to Person from the EMESRT Performance Requirement (PR-5A). In the context of TRAX and SafeDetect, a person must be wearing a Personal Node. Also, see entry for Vehicle.
Personnel	Personnel are people in a surface-based or underground mine. Personnel include, but are not limited to: • Vehicle and Fixed Plant Operators.

[1] In the TRAX™ solution, nodes enable high-precision positioning and continuous tracking of mining personnel and vehicles, respectively.
[2] In the SafeDetect™ proximity detection solution, nodes communicate with nearby SafeDetect equipped vehicles, providing audible/visible alarms to personnel and Vehicle Operators (via display devices), improving the safety of personnel and mobile assets.

Term	Detail
	• Fitters and Maintenance crew. • Sub-contractors and Visitors. • System Administrators and ICT technicians. In the context of this document, all personnel use Minetec hardware and/or software.
PPE	Personal Protective Equipment
Procedure	Steps to perform a system task using Minetec hardware or software. Generally, these steps describe how the Minetec system works and are independent of the Mine Operator's own documentation. Procedures may be incorporated in site procedures if appropriate.
RF	Radio Frequency covers electromagnetic wave frequencies that lie in the range extending from around 3 kHz to 300 GHz. RF current is carried via coaxial transmission lines.
SMARTS	Minetec's SMARTS is the integration of asset, task and KPI management. It is a mine development and production scheduling system providing tools for the planning, execution, reporting and evaluation of operational and maintenance tasks in a mine. SMARTS provides intuitive and real-time visibility of individual tasks within the mining cycle and the ability to modify tasks in response to real-time issues.
System Administrator	The System Administrator (or simply, Administrator) has high-level system access to make changes to the software configuration and databases. Administrative functions, including the set-up and configuration of the hardware, software and infrastructure, are performed by the System Administrator. The Administrator would typically be an on-site mining engineer. A trained ICT technician may also perform some of the hands-on Administrator functions. The System Administrator may other roles (eg Scheduler, Mine Administrator)
TRAX	Minetec's TRAX combines wireless data communications and high-precision wireless tracking. TRAX uses the CSIRO Wireless Ad-hoc System for Positioning (WASP) including Time of Arrival (ToA) techniques for accurate ranging. TRAX provides accurate locations even in the harsh environment of an underground mine. The combination of tracking and real-time data communications provides the capability to locate, communicate and facilitate mining operations.
Vdc	Voltage, direct current
Vehicle	Vehicles are mobile equipment that are driven and operated an on-board Vehicle Operator, an on-board computer (viz. autonomous) or a remote operator. In all cases the vehicle has self-contained drive and steering systems. In the context of the TRAX and SafeDetect systems, a vehicle must have at least one configured Minetec Mobile Node. In the context of the SafeDetect system, all vehicles are exposed to potential unwanted event scenarios PUE 1 Equipment to Person and PUE 2 Equipment to Equipment from the EMESRT Performance Requirement (PR-5A). ✱ Vehicles without suitably configured Minetec equipment are not covered by the Minetec system and are outside the scope of this document.
W	watt
WASP	Wireless Ad-hoc System for Positioning is a system developed by CSIRO and productised by Minetec used to locate personnel and vehicle assets with sub-metre precision in an underground mining scenario. WASP technology has been deployed by Minetec as part of the TRAX system for locating and tracking in underground mines.
Wireless	Wireless networking in general with bands other than the standard Wi-Fi.
Work Instruction	A document providing detailed instructions on how to perform a specific task. The instructions typically contain sections/steps for preparation, isolation and safety, installation or commissioning, testing and handover or post work instructions. Photographs and/or diagrams should be included for positive identification of components and locations. Work Instructions are typically created by the Mine Operator to align generic Minetec procedures and guidelines with on-site HSE policies and procedures.

For all support requests contact Minetec Service Support:
Toll Free: 1800 MINETEC (Australia only)
Phone: +61 8 9259 4955
Email: support@minetec.com.au
Minetec Pty Ltd | Unit 2 | 29 Wellard Street | Bibra Lake·| Western Australia | 6163 | Australia

Returns with a valid RMA should be sent to:
Minetec Pty Ltd | 2 Second Avenue | Mawson Lakes | South Australia | 5095 | Australia