

OPERATOR'S MANUAL

for the

m-Comm system

(ATEX Certified version)

SAFETY WARNING

Intrinsically Safe certified equipment must be operated and serviced in the manner prescribed in this manual, in addition, handheld unit replacement batteries must be as stated and the plug-in-earpiece must be as supplied by RMT.

The system is only to be used by suitably trained and competent persons.

The operator's manual should be read and understood before the system is used.

All cautionary notes (marked ) should be observed during use.

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m-Comm system

OPERATOR'S MANUAL (ATEX approved version)

1. GENERAL

1.1 General Description

The m-Comm voice link is designed particularly for confined space and rescue applications. The system employs advanced low frequency monofilar (single wire) guide propagation techniques to achieve its flexibility and dependability.

The basic system comprises:

- Rugged handheld unit(s),
- Portable base unit,
- Rapid dispenser reel holder/arrangement and,
- Lightweight guide wire.

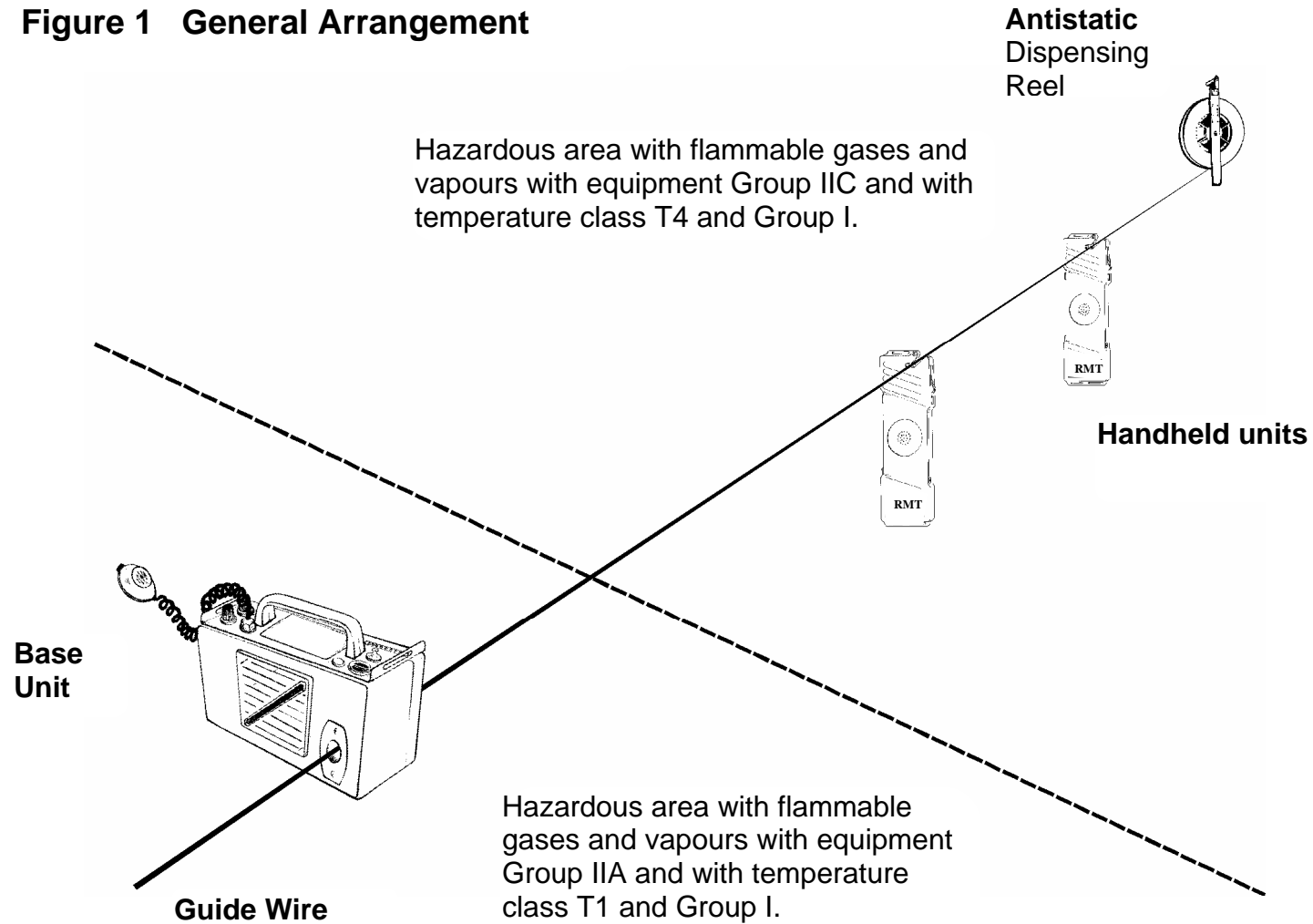
A typical system arrangement is shown overleaf, Figure 1. Setting up is intuitive; simply pay out the guide wire on entering the confined space, clip-on the handheld unit and press the PTT button to talk. The handheld units receive and transmit from any point along the guide wire (to within a few metres from the ends of the guide wire) providing telephone quality speech, even from users wearing full face breathing masks. The units have a typical battery life of over 8 hours.

The m-Comm system is ideally suited for use in:

- long tunnels, mines, and similar confined spaces.
- subterranean civil structures including tunnels,
- sewers, culverts and accessible pipe structures.

Generally, the system offers a practical alternative where conventional radios are ineffective. The compact lightweight design and use of inductive coupling also confer significant advantages over field telephones and plug-connected systems.

Figure 1 General Arrangement



1.2 Certification/Approvals Information

The m-Comm system is approved to ATEX standard for intrinsically safe (I.S.) equipment, including for use in mining. The handheld unit is approved to EEx ia I(H₂)/IIC T4, Group I and II standards and the base unit is approved to EEx ia I/IIA T1, Group I and II standards. See Appendix I. for further information.





NOTE, the Handheld unit is certified for use in atmospheres containing hydrogen. Whereas, the Base unit is restricted to explosive atmospheres containing propane or methane, i.e., I/IIA gasses only. The base unit must not be used in any location where the atmosphere composition is unknown.

1.3 Certificate details:

HANDHELD UNIT markings,

SIRA03ATEX2573X C € 0518

 II 1  G I M1

EEx ia II C T4 Ambient temperature -5 °C to +40 °C

EEx ia I (H₂)

Year of manufacture and serial number

NOTE.

1. Change battery in safe area only.
2. Use only authorised earpiece.
[to be approved/completed]



BASE UNIT markings,

SIRA03ATEX2572X C € 0518

 II 1 G  I M1

EEx ia II A T1 Ambient temperature -5 °C to +40 °C

EEx ia I

Year of manufacture and serial number

NOTE.

- 1 The rechargeable battery must only be charged in a safe area and from a source limited to 0.66A or less.



2 Use only authorised fist or telephone type handset. Under certain extreme circumstances, the non-metallic handset used with this equipment may generate an ignition-capable level of electrostatic charge. Non-conductive solid materials should only be used if charging mechanisms capable of generating hazardous potentials will not occur either during normal operation (including maintenance and cleaning) or even in the case of rare malfunctions. Additionally, the equipment shall only be cleaned with a damp cloth.

The use of m-Comm equipment in countries other than within the European Community is not automatically permitted by the above certificates, even in an emergency. See Appendix I.

1.4 Key Features of Equipment

The following diagrams show the location and function of the various controls and facilities of the handheld and base station unit.

Figure 2 Handheld unit

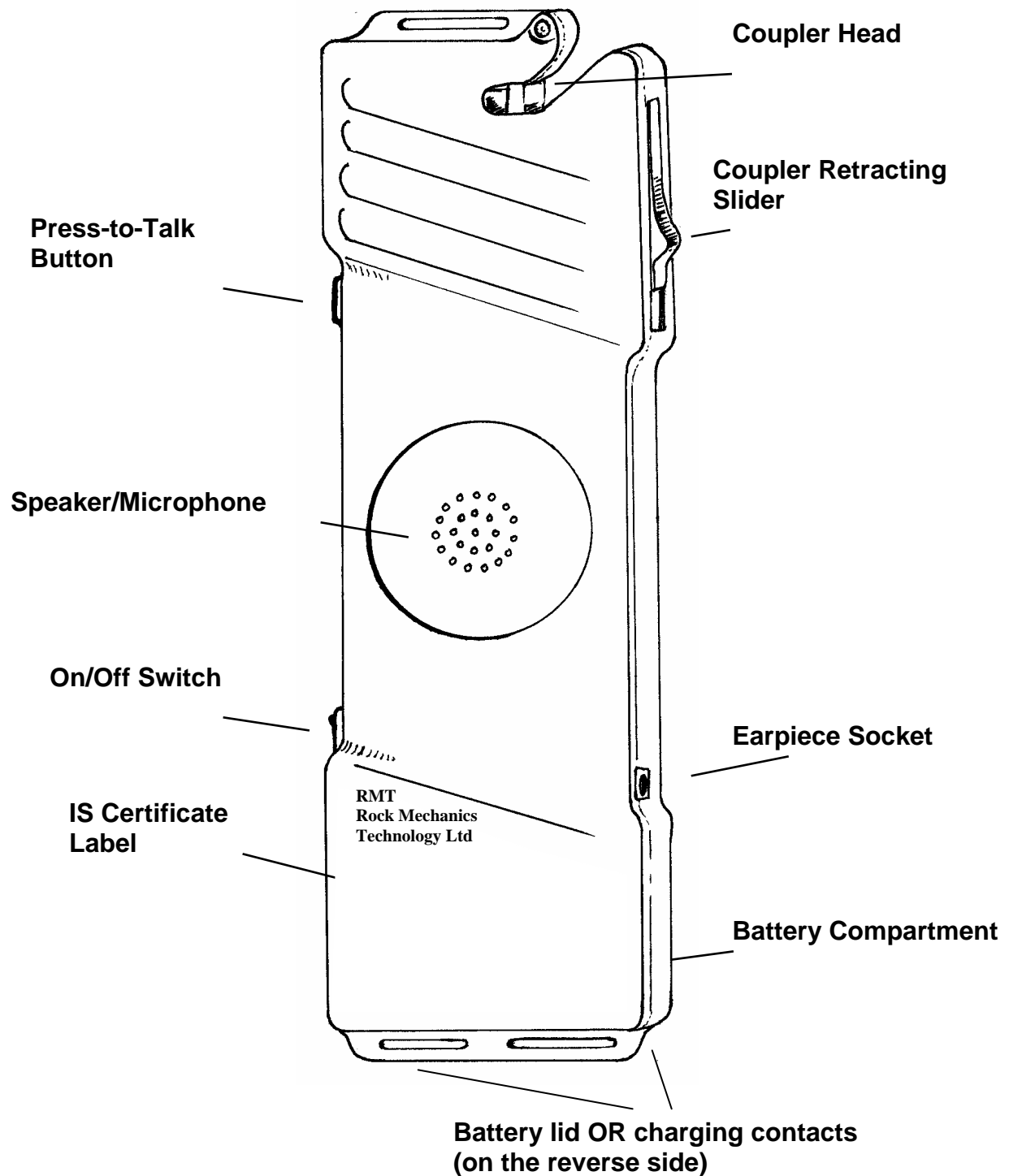
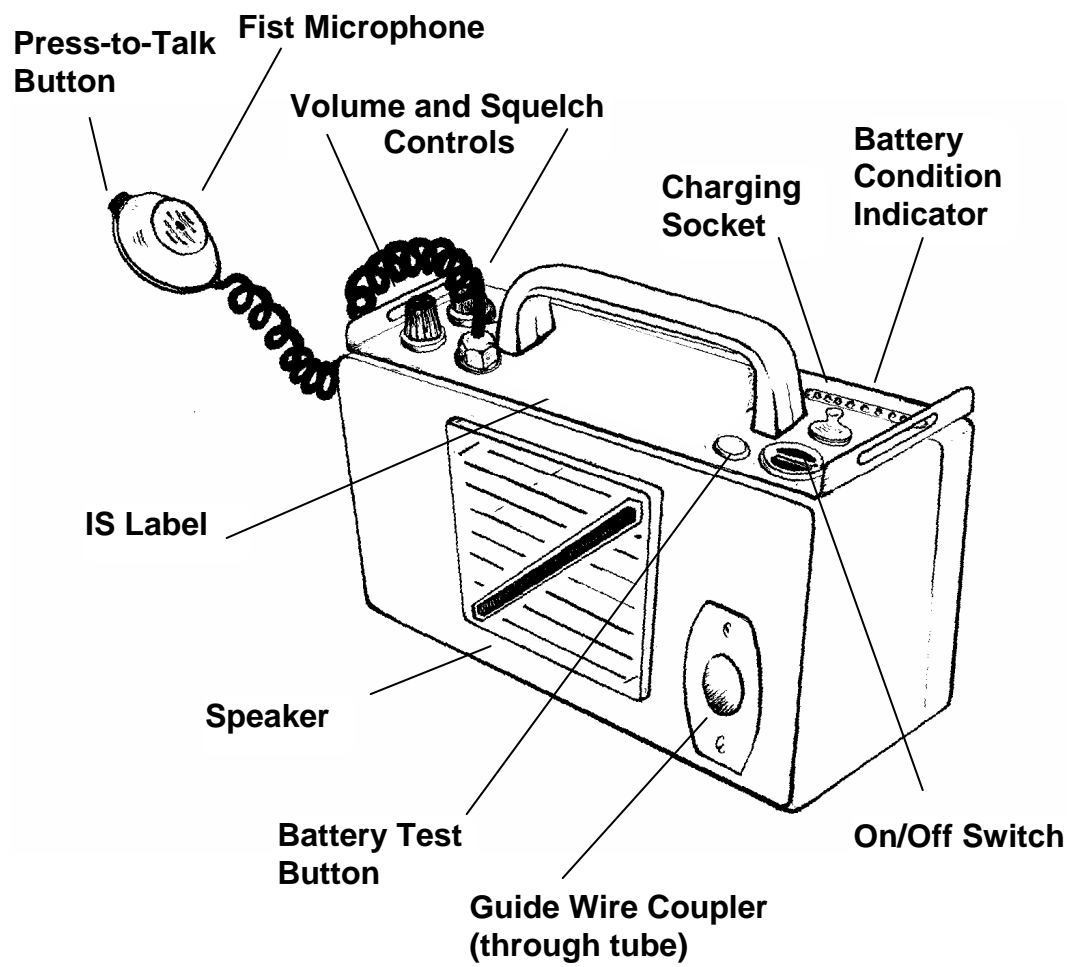


Figure 3 Base Unit



2. OPERATION

Though the m-Comm system is simple to use it is advisable that all operators familiarise themselves with the following operational instructions, hazard warnings and product care tips.

2.1 PRE-OPERATIONAL CHECKS AND STORAGE

In applications where the risk assessment has identified the need for a communications link with the person(s) in the confined space then the pre-operational checks listed in 2.1.1, 2.1.2 and 2.1.3 are considered essential.

2.1.1 Handheld Unit Battery Recharging or Replacement

Handheld units are supplied as either rechargeable or a replaceable battery. Therefore first check which handheld version you have by reading the label on the battery compartment, reverse side to the main label. If you see the word BATTERY in large letters it is a battery replacement version. Alternatively, the words 'Recharge battery in safe area' indicate you have a rechargeable version. Rechargeable batteries are not a user serviceable item

Charging handheld unit battery

It is recommended that the battery be recharged before each operation.

The rechargeable power pack version of the m-Comm handheld unit has an RMT purpose built charger cradle and an intelligent/fast charger. The recharging operation can only be carried out in fresh air. The charger operation is automatic, i.e., the battery will receive the correct charge regardless of how discharged the battery was. Place the handheld in the cradle and with the charger plugged into the mains power supply the red LED will change from flashing to continuous illumination. When charging is complete the LED will revert to flashing. Appendix II provides more information on the fast charger supplied with all m-Comm products (also recommended for base unit recharging). The battery charger should not be taken into any hazardous area.



Fitting a replacement battery

NOTE the replacement batteries for the handheld unit must be a PP3 alkaline type manufactured by Duracell only. No other type is permitted.



The handheld battery compartment fasteners can only be opened with a special screwdriver, supplied with every replaceable battery version handheld unit. Check that this screwdriver forms part of the mobile kit, also that spare replacement Duracell PP3 batteries are included. Batteries must only be changed in a safe area and under no circumstances should replacement batteries be taken into a hazardous area unless installed in a handheld unit.



Each time a battery is replaced, check the condition of the battery connection terminals for damage and looseness. Loss of tension in the battery terminals could lead to connection problems.

Check that the coupler slider opens and closes fully and no part of the ferrite appears broken. See section 2.1.3 below for further checks with the ring-tester.

2.1.2 Base Unit Battery Charger

The base unit is only fitted with a rechargeable battery. The condition of the battery can be monitored at any time by pressing the battery test button:

green LED light = fully charged,

orange LED light = **normal**,

red LED light = needing recharging.

It is recommended that the battery be recharged before each operation using the fast intelligent charger, supplied by RMT. The charger can be supplied with either a fixed plug for the base unit or an adapter plug making it possible to use the charger for both handheld and base units but not at the same time. The charger operation is automatic with one indicator LED to show the operator when the charging is completed. When the charger is plugged into the mains supply the LED will be flashing. When the handheld unit is placed in the cradle and makes contact the LED changes to steady glow, and when fully charged it reverts to flashing. Appendix II provides more information on the fast charger supplied with all m-Comm products.

The battery charger should not be taken into any hazardous area.



2.1.3 Pre-operational Communications Checks

Check that all the units communicate with each other before each operation by placing each handheld, in turn, within close proximity (about 30 cm) of the base unit and establishing twoway communication. This check will result in some audio feedback (howl/whistles) but it quickly confirms operational functionality.

Ring-Tester

Additionally, an RMT 'ring-tester' can be used (in a safe area only) to check the transmitter output level. If ok the LEDs will be illuminated. The ring-tester has to be clipped into the handheld unit's coupler first, see picture overpage. Its LEDs will only light up when:



the handheld unit is switched on,
press-to-talk button is operated and
battery voltage is within its normal working range.

Essentially, this ring-tester checks the condition of the retractable ferrite coupler. Therefore should you fail to obtain any light from the LEDs with a new, or fully charged, battery, having cleaned the retractable coupler jaws, then the unit should be taken out of service and returned to the manufacturer for further checks.

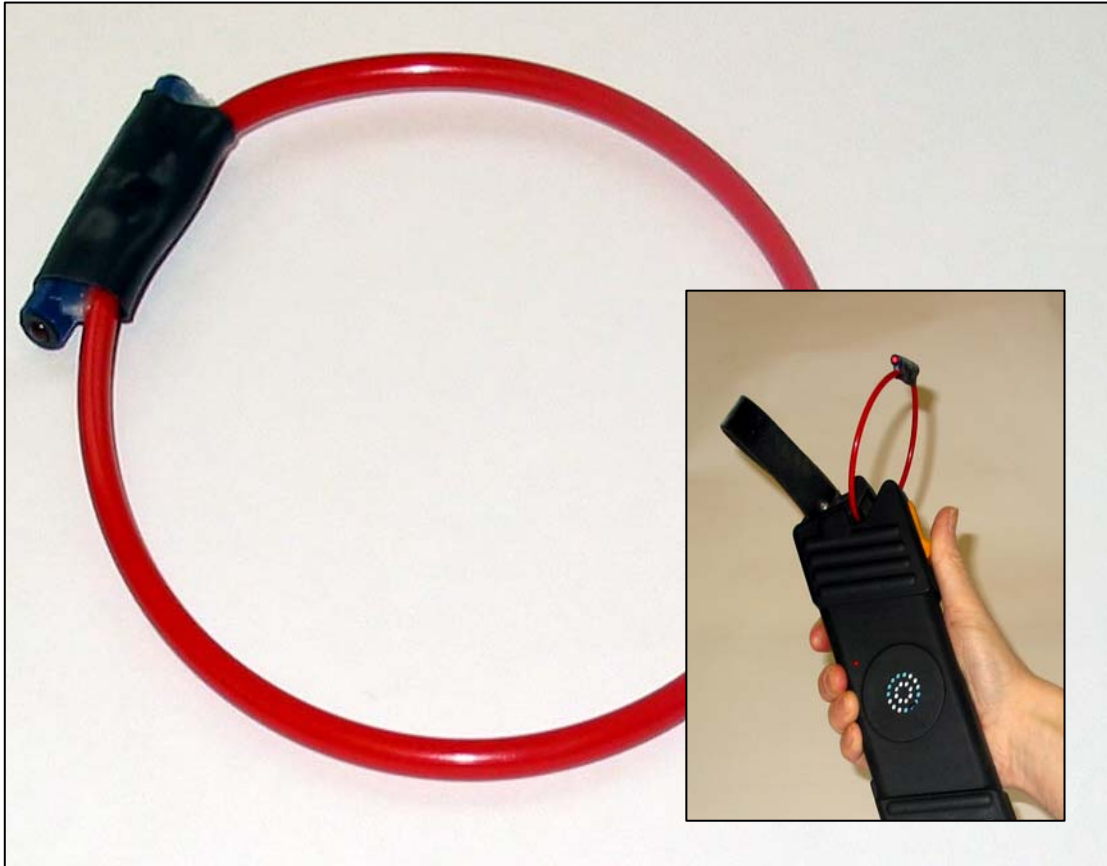


Figure 4. Photograph of the Ring – Tester.

2.1.4 Guide Wire and Reels

The guide wire for the application should be checked for breaks or any damage to the insulation. Have the guide wire professionally repaired after any temporary field repair. Ensure the wire is not tangled on its reel, particularly when using stainless steel wire. The best way to check this is by un-reeling the wire onto suitable open ground first. All wire reels used for hazardous area deployment must be an approved antistatic type.



2.1.5 System/Kit Transportation

It is good practice to have all the m-Comm products stored and transported to the site as a kit, thus ensuring that all the necessary ancillary equipment are available when needed. A ruggedised waterproof carrying case can be

purchased from RMT to house and transport the full m-Comm emergency kit. The carrying case must not be taken into any hazardous area.



2.1.6 Cleaning and Storage

After use, the equipment should be functionally checked, as in 2.1.3 above, and cleaned. If any part of the equipment seems damaged or is not functioning as normal have it checked immediately and, if necessary, returned to the manufacturer for repairs. Do not attempt to open the units for cleaning or inspection. This will violate the products' I.S. certification and any manufacturer warranty.



Cleaning should be carried out with a wet cloth and/or low pressure air line to remove all fine dust/dirt from around all the buttons, switches, control knobs and mechanical slider parts. Dried mud can be washed off with tap water. Oily dirt can be removed by adding mild detergent to the cleaning water.

All items of the m-Comm system should be stored in dry conditions and not be exposed to elevated temperatures.

2.2 OPERATIONAL PROCEDURES

The m-Comm system is designed and made to accommodate most eventualities in emergency and confined space operations. The simplest configuration is a single line connecting two people or locations. More complex arrangements may involve a branched line with a number of handheld units. The base unit is more restricted than the handheld unit in the type of flammable atmospheres into which it can be deployed. Also note, the guide wire must be wound onto an approved anti-static plastic reel, as supplied by RMT. Whichever system arrangement is employed it is recommended that the following general deployment procedures and location checks be adopted.



2.2.1 Base Location

On site, the first task is to establish a suitable location for the base unit. In most cases this will be in fresh air but should there be a need to enter a tunnel or confined space check for the flammable gasses present first. The base unit is only approved for flammable atmospheres in Group IIA, temperature class T1, e.g., atmospheres containing methane gas.



2.2.2 Base Location Line Connection

Historically, m-Comm was designed for the single guide wire to be earthed at the base location. Earth or ground point means the same thing in the context of this manual. Though this is the simplest arrangement and perfectly adequate in most applications there are instances where it may be difficult to recognise or access a good earth point. Thus, in general applications it is advisable to use the non-earth arrangement, as shown below.

Non-earthed Arrangement

When an earth/ground point is difficult to establish, as when in a concrete lined tunnel always use the non-earth option, dubbed 'earth-free' or 'twin wire launcher' arrangement. With this arrangement the first 100 m of the line is made up of a twin wire section. One end only of the twin wire is passed through the base unit and then connected (plug) to the second wire. No connection to earth is needed. At the other end of the twin wire launcher section one wire only is connected to the normal single guide wire, see diagram below. Handheld units can be clipped around the twin wire launcher and guide wire sections at any point.

The person entering the confined space will automatically unreel the guide wire, and twin wire launcher if fitted, as he/she progresses. A second reel of wire will have to be carried in when an excursion distance of over a kilometre is anticipated.

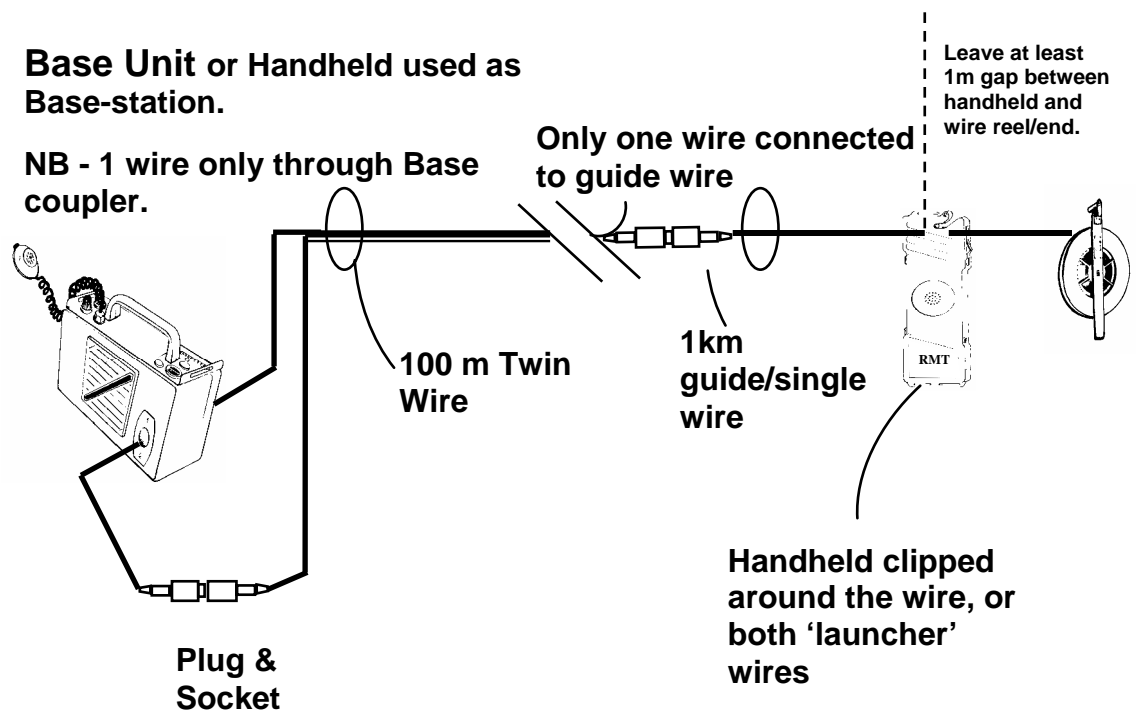


Figure 5. Twin wire launcher, single wire operation arrangement

The twin wire launcher can be regarded as part of the communicating wire and should be wired as part of the first reel. This allows for rapid deployment at any site: no searching for an earth point and connections to be made.

An extra boost to the signal can be made by connecting the free end of the twin wire launcher (at the junction to the single wire) to earth, if a suitable earth point is readily accessible.

Earthed Line Arrangement

When there is access to drive a spike into, preferably, wet or at least moist ground, then the simpler earthed wire end arrangement is an option. Thread the single wire end (with plug) through the base unit and connect to an earth or ground point. There must be at least 10 metres of loose wire between the earth point and the base unit. This 10 metre long wire need not be laid in a straight line.

An earth or ground in this instance is a good electrical connection to the surrounding strata or subsoil. Making a good conducting path to the surrounding strata is dependent on a number of factors:

- a) Finding an accessible ground point, preferably into moist earth or into water.
- b) An earth spike and a 'crocodile' clip will help.
- c) Avoiding clipping onto metal placed in dry or rocky ground or cast in concrete.

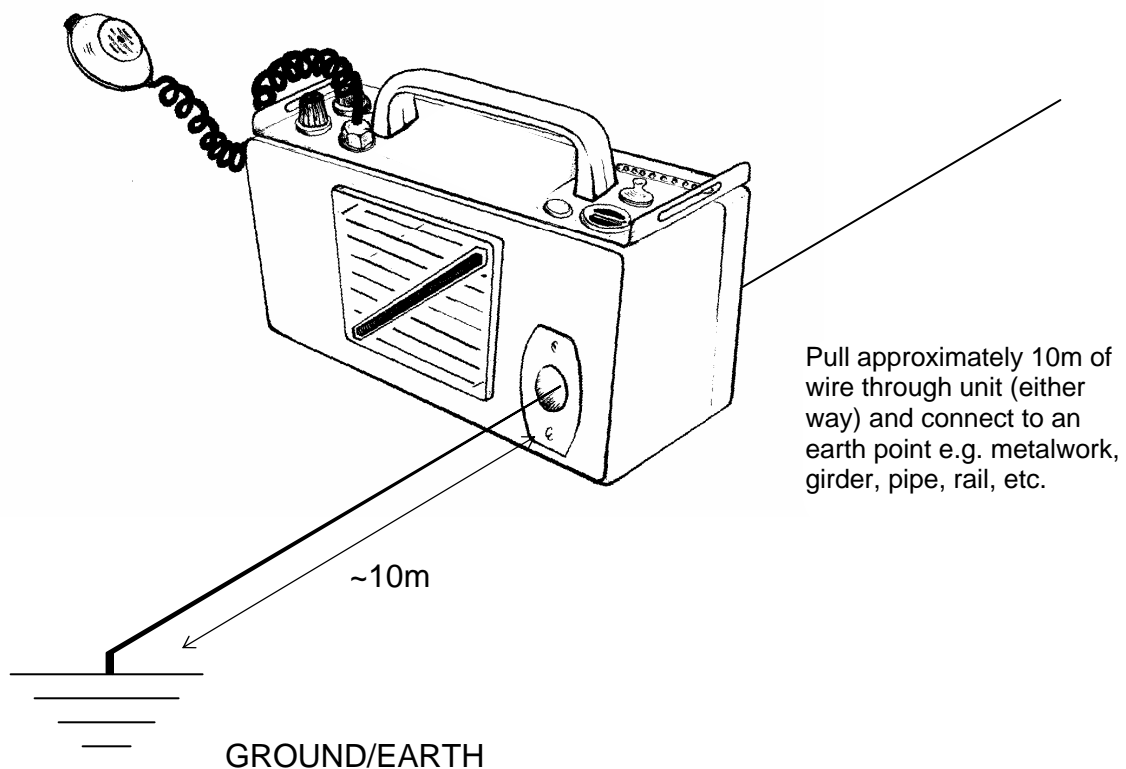


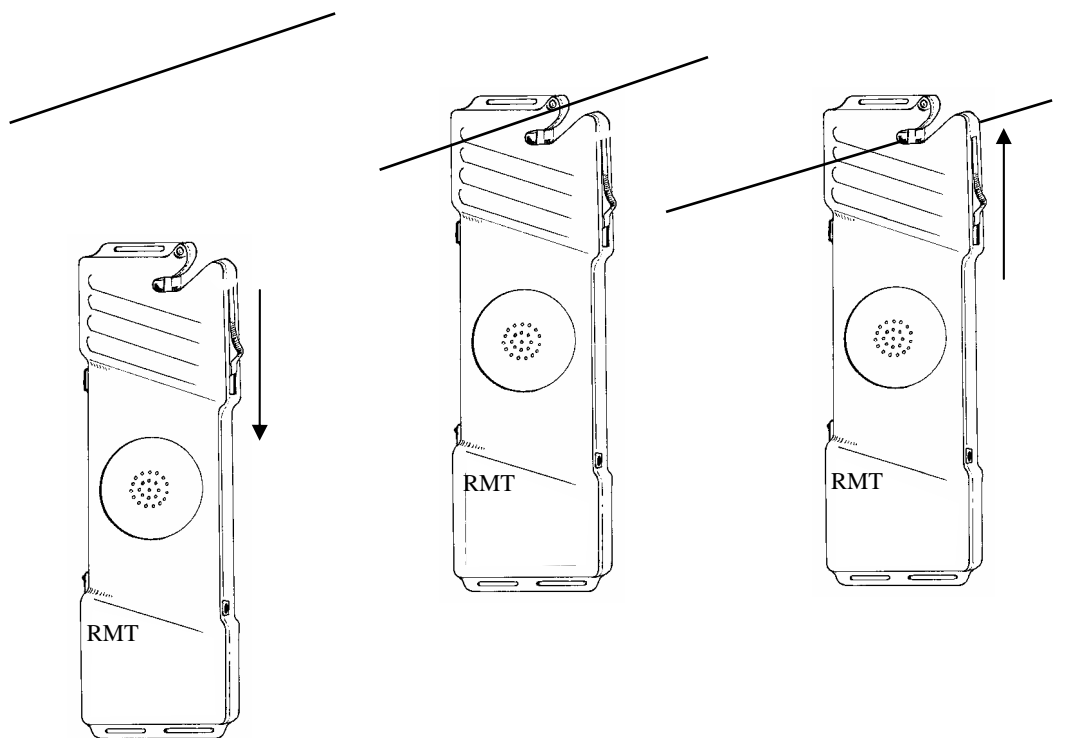
Figure 6. Earthed wire/line, single wire operation arrangement

2.2.3 Coupling onto the Guide Wire

Both base and handheld units must be properly coupled to the guide wire for reliable communications. For the base unit the wire is simply threaded through the unit as described in the above arrangements. Handheld units can be clipped around both wires of the twin wire launcher section for normal two-way communications.

The handheld unit has a retractable coupler to permit clipping onto the guide wire, as shown in the following sequence of diagrams:

If possible, ensure that the handheld is clipped 3 metres or more from the reel end.



1) Retract slider with thumb

2) Place guide wire into coupler jaw


3) Release slider ensuring that the wire is not trapped

Figure 7 . Handheld Unit, illustrating the wire clipping operation

Do not force the coupler closed – this could break the internal coupler parts. If the slider appears to be tight check that the wire is not trapped between the coupler jaws. Should you find that the coupler tends to jam open, without any wire in the jaws, then have the unit checked and/or serviced.

2.2.4 Base Unit Operation

It is advisable to take time to familiarise yourself with the on/off switch and press-to-talk button on the fist microphone and more importantly the squelch (mute) and volume controls. The squelch controls the muting level, i.e., it reduces the background noise when in the receiving mode and automatically turns the output sound level up when a signal is received. If, on switch-on, the unit emits a loud hissing noise then rotate the squelch knob clockwise until it abruptly reduces (but no further). The squelch control may need frequent adjustments at some locations.

NOTE, the squelch setting is critical since too high a level setting, i.e., too far clockwise, will reduce receiver sensitivity, possibly resulting in the base unit not responding to a handheld call. There is a fail-safe arrangement on the intrinsically safe approved unit whereby the mute level does not reduce the background noise to zero and hence a return signal will be heard (at low volume) should the squelch be incorrectly set. 

Volume control can be adjusted to suit local conditions.

Check the battery condition by pressing the battery test button:

Green LEDs indicating a fully charged power pack.


Orange LEDs indicates normal operation, with some indication of remaining energy levels.

Red LEDs indicate that the battery should be charged as soon as possible but the unit will continue to function, albeit for a short time and at reduced performance.

In wet conditions, it is advisable to keep the base unit as dry as possible, particularly the fist microphone. Should the unit accidentally fall into water, retrieve immediately and drain the fist microphone by shaking it vigorously.

2.2.5 Handheld Unit Operation

At a convenient point after entering the confined space, the handheld(s) should be clipped around the guide wire, or the twin wire launcher, to check the system is set up correctly.

To make a call, press the PTT button and speak directly into the handheld unit's speaker/microphone, or align the speaker/microphone with the breathing apparatus facemask speech diaphragm. In noisy locations you should shout into the microphone and listen with the optional plug-in earpiece. Remember, when using the plug-in earpiece, to speak into the speaker/microphone as before. The **earpiece** is a certified component of the system and may be used at any time in conjunction with the handheld. 

NOTE, ensure that the handheld unit is switched on and that the retracting part of the guide wire coupler is fully closed around the guide wire. If a second spare handheld unit is taken in then it is preferable to keep the second unit switched off until required, because

two handhelds operating close together in a tunnel will cause whistling noises due to acoustic feedback.

Whilst the handheld units are robustly designed, the internal coupler ferrite material is relatively fragile. Knocking or dropping the set should be avoided. If the set is dropped or submerged in water it is advisable to retrieve it as soon as possible. Before use, shake the water out of the microphone/speaker grill since the retained water reduces audio volume.

Handheld unit users can check the integrity of the link from the base unit by listening for the link assurance signal or 'integrity pulse/bleep', sent by the base station approximately every 15 seconds.

Should the 'bleep' transmissions stop, first attempt to talk with the base station. At the same time, move about 4 to 5 metres along the wire away from the reel (this sends a stronger signal). Allow the base station time to respond. If no contact is established with base after, say, 50 seconds, assume a broken guide wire. If a second handheld is available, check the integrity of the first handheld by clipping both sets onto the guide wire, at least 20 metres apart, and attempt to communicate both ways. If both units function correctly, this again strongly points to a broken wire between the handheld and base. If link integrity was regularly checked then the break is likely to be close by.

Other, less likely, possibilities are that the base unit has failed or the earth termination has been impaired. It is possible to substitute a handheld for a base unit, temporarily.

2.2.6 Guide Wire Repairs

Emergency guide wire repair is simply a matter of, firstly, knotting the broken ends of the wire together and then making an electrical (copper to copper) connection. The quickest and most secure method of joining the wire ends is to use a proprietary 'Scotchlok' insulation displacement type connector, particularly useful for the stainless steel guide wire option. Alternatively, strip about 25mm of insulation off the wire ends and twist together. These emergency repairs should be made good by the operator or manufacturer.

Note that the guide wire must be insulated for correct operation of the system. The use of bare copper or steel wire is not recommended.

2.2.7 Communications Protocol

It is expected that one base unit and one handheld will be clipped onto the guide wire and will be left switched on, i.e. in a standby/listening mode.

NOTE, the system is designed for only one person to talk (transmit) at any one time. Therefore, discipline is needed to avoid two people talking at once.

Protocols using an initial identity 'team A' to base' and 'over' should be practised to avoid confusion.

If a situation arises where three, or more, independent locations need to communicate over the same guide wire then it is necessary to adopt a strict code of 'one party speaking at a time' preferably under the control of the base station.

2.2.8 Prolonged Confined Space Operations

When a confined space/underground operation lasts for longer than 12 hours, provision should be made for replacing/recharging batteries. A replacement set of communications equipment, if available, is one convenient way but more often batteries will have to be changed and/or recharged in a safe area.

NOTE, handheld batteries must not be changed in a hazardous area and replacement batteries should under no circumstances be taken into any hazardous area.



The base and/or rechargeable handheld units have to be taken to a safe zone/area (in fresh air) and have their batteries recharged. An 80% recharge can be achieved in approximately 1 hour with the RMT supplied fast battery charger.

2.2.9 Guide Wire Retrieval

The reel holder and reels are ergonomically designed in order to make deployment and retrieval of the guide wire as practical as possible. Deployment requires no explanation but the technique of winding in and ensuring tight neat layering of the wire in the plastic reel is best illustrated in the following three steps:

Step 1

The reel holder is designed to be conveniently held like a fishing rod, right or left hand. First place the reel holder handle comfortably just above your belt line, as shown in Figure 8 below.



Figure 8

Step 2

With the handle firmly placed across your stomach, grip the reel stem with a cupped hand, extending, preferably gloved, finger and thumb to guide and tension the wire.

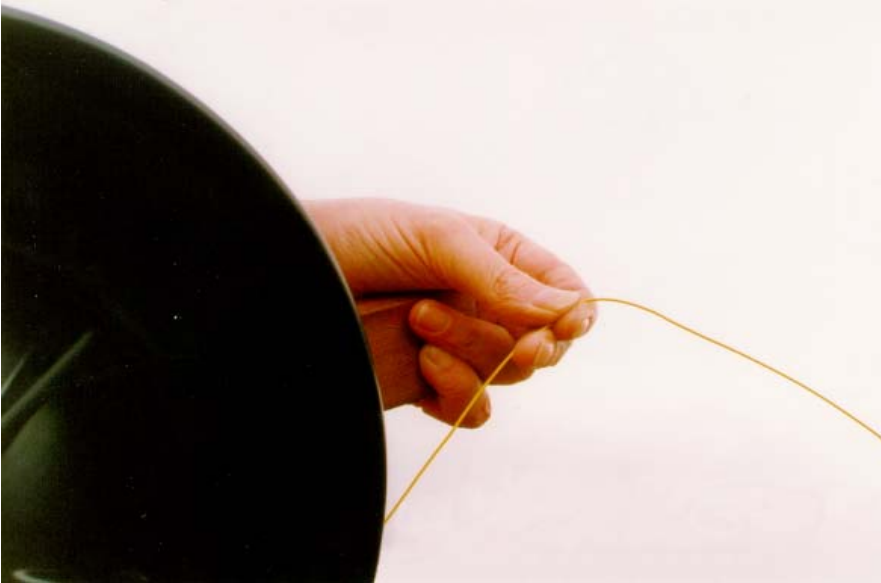


Figure 9

Step 3



Figure 10

With your free hand, again preferably gloved, wind in the wire. Left handed operation is equally simple, turn the handle left to right, grip the stem with the right hand and rotate the reel spokes with the left hand fingers.

2.2.10 Overcoming Poor Signal Problems (Single Wire Arrangement)

There may be times in an emergency where due to low battery, damaged equipment or under adverse conditions it important to be able to maintain communication.

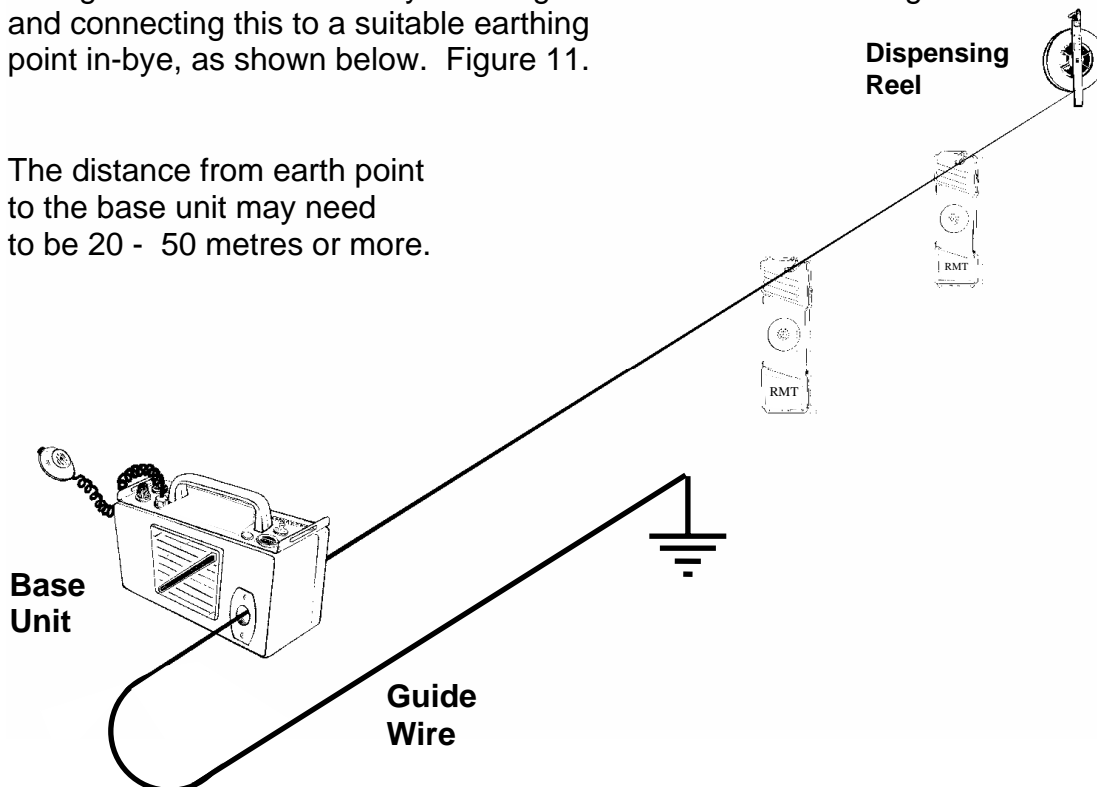
These notes provide practical assistance for users of single wire systems on how to:

- improve communications through flooded spaces/tunnels,
- overcoming reception problems where high levels of electromagnetic (EM) noise are present, or
- extending working range.

When the system is used outside its intended subsurface or confined spaces environment, then there may be occasions when the system picks up stray (EM) noise. This EM interference can result in poor signal reception. It should be noted that failure to close the jaws of the handheld would also cause poor communication, as will a build up of dirt between the sliding jaws, or low battery voltage.

Should the user experience EM interference problems, first relocate the base unit and, if used, earth connection. A higher than normal squelch setting (the squelch control having to be advanced more clockwise than usual) is usually an indication of high interference pick-up. If however the base station has to be located near live electrical equipment (e.g.substation) which can cause EM noise, then it is possible to negate this interference by doubling back the free end of the guide wire and connecting this to a suitable earthing point in-by, as shown below. Figure 11.

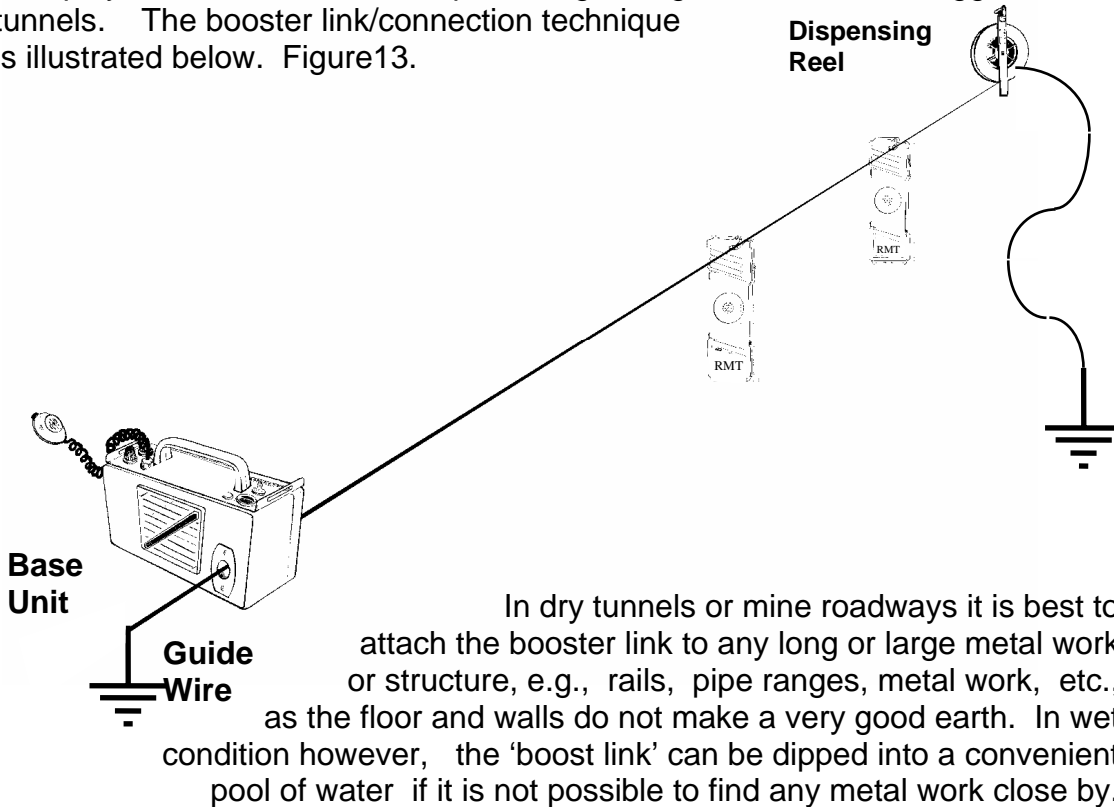
The distance from earth point to the base unit may need to be 20 - 50 metres or more.



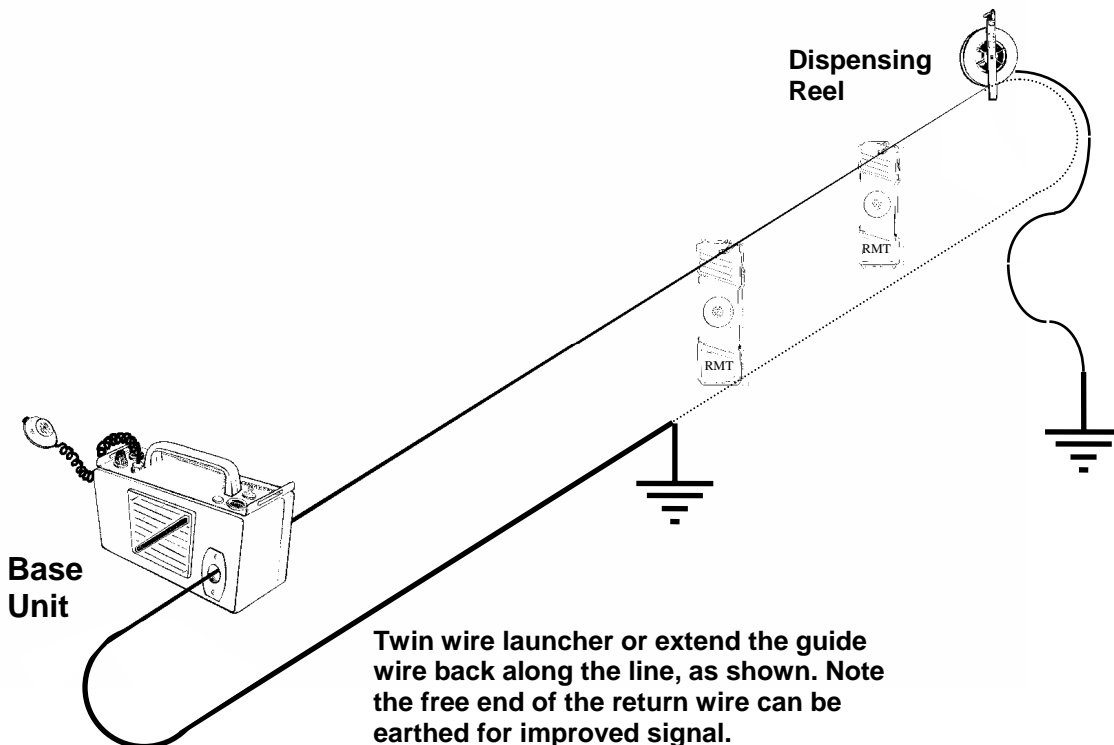
Alternatively and particularly helpful in wet conditions , the handheld operators can boost their signal by temporarily connecting the wire reel plug point to a suitable earthing point with the short 'boost connector', depicted below. Figure 12.



This simple expedient will also help the handheld units in confined spaces boost their signal output and thus extend range under abnormal circumstances. This ploy is also effective in compensating for signal loss in water logged tunnels. The booster link/connection technique is illustrated below. Figure13.




For abnormally high interference problems both ploys are applied. In the extreme, a full loop can be deployed to overcome very high interference or high signal absorption, such as, experienced when transmitting through more than 300 metres of water logged or flooded tunnel where the line may be completely submerged. Figure 14.



2.2.11 Overcoming Poor Signal Problems Check List

Many of the single wire problems can be overcome by employing a loosely twisted pair of wires for the guide line, supplied by RMT. The downside of a double wire is increased cost, weight and less convenient for rapid deployment. A good compromise is to use the twin wire launcher and single wire arrangement.

Overcoming Poor Signal Problems - Checks and Suggestions

1. Check that the jaw of the handheld coupler is closing properly.
2. Confirm that the handheld battery was changed or recharged prior to use. (Note; the battery must only be changed or recharged in a safe zone) 
3. If using an earthed wire option, connect the base guide wire end to different earth point and assess the improvement.
4. Consider using an earth free or twin wire launcher arrangement.
5. Re-site the base station away from electrical equipment if still energised, move at least 20 - 50 m.
6. Instruct the handheld user to move further away from the reel and earth the reel end using the short earthing 'boost connector', if possible.
7. When operating in water-filled tunnels ensure the insulation on the wire is intact. Also, when the guide wire runs, or partly runs, for distances of over 300 m in shallow water earth both ends of the single wire using two 'booster connectors'.
8. Report incidences of poor reception, including details of site and disposition of equipment to:

Mr D C Lewis, Technical Manager,

**Rock Mechanics Technology Limited,
Bretby Business Park, Stanhope Bretby, Ashby Road,
Burton-on-Trent, Staffs, DE15 0QD, United Kingdom.
Tel.: +44 (0) 1283 522 201, Fax.: +44 (0) 1283 522 279
e-Mail: rmt@rmtltd.com, Website: www.rmtltd.com**

3. SYSTEM DESCRIPTION

The system was originally designed to provide rapid high integrity speech communications in underground rescue operations. By exploiting a monofilar mode inductive communications technique many of the problems of confined spaces communications can be overcome, e.g., the limitation and unpredictability of radio propagation.

The basic system is illustrated in Figure 1 and consists of a base unit, lightweight guide wire and handheld units. Any unit can be operated at any point along the wire provided they are at least a few metres from the end of the guide wire. Units operated close together, i.e., normal talking distance, would naturally suffer from acoustic feedback

The portable base unit functions in a similar manner to a handheld but is designed to provide additional operational and safety features, such as, squelch/mute adjustment, volume control, and a 'bleep' transmission at 15 second intervals which confirms system integrity to the handheld users.

3.1 SYSTEM DETAIL – HANDHELD UNIT

The handheld unit consists of a low frequency transceiver circuit board, microphone/speaker insert, power supply and a ferrite coupler arrangement all housed in a purpose-designed antistatic plastic case, as illustrated in Figure 2. The unit has an on/off switch, press-to-talk button and a 3.5 mm diameter socket for an approved plug-in earpiece for use in noisy surroundings.

3.1.1 Transceiver Circuitry

The transceiver circuitry for the handheld unit employs specialised micro- electronic circuitry. The integrated transmitter and receiver design is based on minimum power consumption, optimum component count, minimal controls (switches, etc.), high stability philosophy to meet intrinsic safety and reliability requirements.

Features of the transmitter design include:

- Progressive action limiter to permit acceptance of wide dynamic range speech with maximum intelligibility and minimum intermodulation products.
- High stability VCO frequency modulator with low sensitivity to supply and temperature variation.
- Carefully tailored audio pre-emphasis to compensate for face mask 'treble' deficiency.
- Power-down switching of complete transmitter stage to ensure minimum power drain.

The highly sensitivity receiver relies on a classical up-converter, double superheterodyne design. The intermediate and local oscillator frequencies are selected to avoid harmonic interference from intermodulation products. In order to achieve maximum component integration, selected cellular radio integrated circuits are used. Selected devices can provide 0.2 μV sensitivity in receiver circuits without additional r.f. amplification. The receiver input stage is designed to handle a wide range of input signal levels, i.e., from sub-micro volt to several volts.

3.1.2 Coupler Head

The ferrite coupler arrangement for the handheld unit has a sliding member to allow fitment of any wire up to 6mm diameter. The sliding, or retracting, action of one ferrite section over the other is intended to achieve self-cleaning between the mating faces. The efficiency of signal coupling depends on maintaining clean mating faces of the ferrite.

The ferrite coupler sections are a form of ceramic material. Though ceramics are well known for their hardness and durability they are susceptible to fracture, particularly when subjected to direct high shock loading. Hence design measures have been taken to extensively shroud and protect the coupler. The handheld unit will still function if a coupler ferrite is cracked but with much reduced effectiveness.

3.1.3 Power supply

The power supply uses either an alkaline 9 Volts IEC 6F22 (PP3) battery or a rechargeable nickel metal hydride 8 cell power pack. The following table, provides an indication of the typical operational life of the approved battery type used in the IS handheld unit. Please note that only alkaline PP3 batteries of Duracell manufacture may be used within the set. No other type is permitted.



Approved Batteries	Battery life (in hours)		Typical use*
	Receive Mode	Transmit Mode	
Alkaline	15	6	12

* The general assumption for estimating 'typical' battery life is that handheld will only be transmitting for approximately 20% of the time.

The rechargeable power supply provides similar operational life but in very cold conditions, i.e., below zero, the rechargeable power pack provides marginally better performance. Hence if the units are required to work in freezing conditions then it is advisable to employ the rechargeable version of the handheld units.

3.2 SYSTEM DETAIL - BASE UNIT

The base unit consists of two low frequency transceiver circuit boards, speaker, rechargeable nickel metal hydride battery, battery state indicator and a toroidal coupler all housed in carbon-loaded polyester case. The unit has a carrying handle, leather shoulder strap, an on/off switch, battery test button, battery charge socket, volume and squelch/mute control and a fist microphone which includes a press-to-talk button, as illustrated in Figure 3.

The fast intelligent battery charger, supplied by RMT, is highly recommended to enhance the longevity and reliability the base unit's power pack. RMT can not be responsible for the results of using any other battery charger.

3.2.1 Transceiver Circuitry

The transceiver circuitry for the base unit is functionally the same as for the handheld (see section 3.1.1) but with the extra operational and safety features of squelch/mute and volume control, battery condition indicator, recharging facility and an automatic line proving signal, a short 'bleep' transmitted every 15 seconds. The line proving signals are suppressed during normal transmissions.

3.2.2 Coupler Arrangement

The base wire coupler is of a closed design, unlike the handheld, which has an opening and clipping action. The guide wire has to be passed through the 16 mm diameter tube located in the base unit. Threading the single guide wire or one loop of the twin wire launcher through the base unit is normally the first action in setting up a base station.

3.2.3 Power supply

The base unit is equipped with a 10 cell, 12 volt rechargeable nickel metal hydride battery with a standard charging regime of 80 mA for 16 hours. The recommended charger is the Mascot multi-cell fast charger which can give reliable and predictable charge whatever the initial state of the battery. See Appendix II for fast charger details.

Typical battery life is as follows:

	Battery life (in hours)		
	Receive Mode	Transmit Mode	Typical use*
Nickel metal hydride rechargeable battery	18	4	10

* The general assumption for estimating 'typical' battery life is that the base unit will only be transmitting for approximately 20% of the time.

4. SPECIFICATION

SYSTEM

Range: Up to 5 kilometres underground with copper guide wire.

Coupler opening: 6 mm dia.

Operational temperature range: -5 to 40 °C

HANDHELD UNIT

Approvals: EEx ia IIC T4, amb temp -5 C to +40 °C, EEx ia I(H2)

 I MI  II I G

Power source: Duracell PP3 type alkaline battery or rechargeable Ni-MH (not interchangeable)

Battery life: 10 hours typical operation*

Case material: Nylon6/6 with glass/carbon fibre reinforcement


Environmental protection: Water immersible

Weight: 700 g

Dimensions: 270 x 80 x 35 mm

BASE UNIT

Approvals: EEx ia I T1, amb temp -5 C to +40 °C, EEx ia I

 I MI  II I G

Power source: 12V rechargeable Ni-MH battery

Battery life: 10 hours typical operation*

Case material: Fibre-glass reinforced polyester with graphite added

Environmental protection: Splash proof

Weight: 3kg

Dimensions: 220 x 95 x 160 mm


*Operational duty: 80% receive, 20% transmit.

All equipment manufactured to BS EN ISO9001:2000.


5. ACCESSORIES

m-Comm is normally supplied as a complete kit which consists of three handheld units, one base unit with shoulder strap, a battery charger(s), one reel holder and two reels with customer specified wire. Examples of accessory items include; heavy duty carrying case for the kit, extra earpieces, and special wires, e.g., high tensile/high temperature wires.

Supplied with the Handheld and Base Units are:

- * Intelligent fast battery charger (not approved for taking into any flammable atmosphere) 
- * Charger cradle for the rechargeable option of the handheld (not approved for taking into any flammable atmosphere)
- * Tamper-proof screwdriver for battery replacement option
- * Standard guide wire dispenser
- * Standard 1km antistatic plastic reels, twin wire launcher.

Supplied as optional extras.

- * Heavy duty, waterproof carrying case (not approved for taking into any flammable atmosphere) 
- * Guide wire (to meet specific application)
- * Approved plug-in earpiece

Requests for other attachments or accessories not listed above will be considered subject to their practicality and that they do not compromise the equipment certification and approvals.

6. SERVICE, REPAIRS AND SPARE PARTS

It is recommended that safety critical and heavily used products should be serviced at least once a year. Customers that have products with rechargeable batteries are reminded that such batteries have a limited life. Their life can be estimated by counting the number of charge-discharge cycles, normally given by the cell manufacturers as 800 to 1000, e.g., a unit charged five times a week would be expected to last 4 years. The manufacturer's service, repair and spare parts organisation can be contacted at:

Rock Mechanics Technology Limited,
Bretby Business Park, Stanhope Bretby, Ashby Road,
Burton-on-Trent, Staffs, DE15 0QD, United Kingdom.
Tel.: +44 (0) 1283 522 201, Fax.: +44 (0) 1283 522 279
e-Mail: rmt@rmtltd.com, Website: www.rmtltd.com

Overseas

System users outside United Kingdom should consult the Appointed Distributor/Agent for their country/region regarding repairs and spare parts facilities. The Distributor/Agent will advise on the best course of action to take.

Equipment sent to the UK for repair should be sent, freight pre-paid, to the address shown above. A copy of the Invoice and of the Packing Note should be sent simultaneously by airmail to expedite clearance through UK Customs. A repair estimate showing freight return and other charges will be submitted to the sender, if required, before work on the unit commences.

APPENDIX I

APPROVAL/CERTIFICATION DETAILS

The ATEX Approvals granted by SIRA Certification Service, Hazardous Area Centre, Rake Lane, Eccleston, Chester, CH4 9JN, UK., are detailed below.

For use in territories outside EC countries it is recommended that users contact the appropriate National Body responsible for certification/approval for advice on any further local approvals that may be required.

Instructions specific to hazardous area installations **(Reference European ATEX Directive 94/9/EC, Annex II, 1.0.6.)**

The equipment is certified for use in ambient temperatures in the range of -5°C to +40°C and should not be used outside this range.

Installation shall be carried out in accordance with the applicable code of practice by suitably trained personnel.

The equipment is not intended to be repaired by the user. Repair of this equipment shall be carried out by the manufacturer in accordance with the applicable code of practice.

If the equipment is likely to come into contact with aggressive substances, then it is the responsibility of the user to take suitable precautions that prevent it from being adversely affected, thus ensuring that the type of protection is not compromised.

Aggressive Substances - e.g. acidic liquids or gases that may attack metals or solvents that may affect polymeric materials.

Suitable Precautions - e.g. regular checks as part of routine inspections or establishing from the material's data sheet that it is resistant to specific chemicals.

The system has been designed and certified in accordance with ATEX standards, 100a Directive 94/9/EC. The equipment is supplied in compliance with the following ATEX labelling and approvals.

Handheld Unit

The apparatus gas group and temperature class for the handheld unit are approved for an atmosphere containing hydrogen. Whilst the gas group and temperature class cover a wide range of flammable materials, checks should be made that the certification is appropriate to the hazardous atmosphere. The handheld units must not be used in atmospheres containing carbon disulphide or ethyl nitrate.

Approval number: SIRA03ATEX2573X C € 0518

⊕ II 1 G ⊕ I M1

EEx ia II C T4 Ambient temperature -5 °C to +40 °C

EEx ia I (H2)

Year of manufacture and serial number



NOTE.

The certificate number has an 'X' suffix that indicates that the following special conditions of certification apply;

1. Change battery in safe area only.
2. Use only authorised earpiece.

Base Unit

The base unit, which is intended for use in safe zones, is restricted to atmospheres containing methane and propane i.e., the equipment may be used in a hazardous area with flammable gases and vapours with apparatus Group IIA and with temperature class T1 and Group I.

Approval number: SIRA03ATEX2572X C € 0518

⊕ II 1 G ⊕ I M1

EEx ia II A T1 Ambient temperature -5 °C to +40 °C

EEx ia I

Year of manufacture and serial number

The following instructions apply to equipment covered by certificate number Sira 03ATEX2572X:



NOTE.

The certificate number has an 'X' suffix that indicates that the following special conditions of certification apply;

- 1 The rechargeable battery must only be charged in a safe area and from a source limited to 0.66A or less.
- 2 Use only authorised fist or telephone type handset. Under certain extreme circumstances, the non-metallic handset used with this equipment may generate an ignition-capable level of electrostatic charge. Non-conductive solid materials should only be used if charging mechanisms capable of generating hazardous potentials will not occur either during normal operation (including maintenance and cleaning) or even in the case of rare malfunctions. Additionally, the equipment shall only be cleaned with a damp cloth.

Licence to Manufacture

SIRA Certification Services,

Notification Number M184

APPENDIX II

Fast Ni-Cd and Ni-MH charger information

MASCOT type No.8715

Technical specifications 2-10 cells

Battery capacity 500-850 mAh

Max. 10 W

- *AC/DC fast charger for NiMH/NiCd batteries*
- *Linear*
- *For charging of 500-850 mAh (typical R6/AA) NiMH/NiCd batteries*
- *-.V sensing to interrupt charging when batteries are fully charged*
- *Protected against reversed polarity*
- *Thermal fuse in transformer, thermal protection in regulator, protected against reversed polarity and short circuit proof*
- *LED indicates charging*
- *Exchangeable output plugs*

Technical specifications - 2-10 cells

Input voltage:	230 VAC +6/-10%, 50/60Hz
Resetting:	A new charging cycle starts by reconnecting battery at output, and not by reconneting the mains voltage
Switch frequency:	39 kHz
Temperature range:	-20°C to +35°C
Efficiency, approx:	55 %
Insulation class:	II
Electrical safety:	EN 60065, EN 60950
EMC standards:	
• Emission:	EN 50081-1
• Immunity:	EN 50082-1
Dimensions ex plug (LxWxH):	100 x 51 x 63 mm
Weight:	450 g

Manufacturers Operational Instructions

APPENDIX III

Mines Rescue Communication (m-Comm) System: Risk Assessment

Summary of Findings

This assessment examines the hazards concerned with the use underground of the Mines Rescue Communications System manufactured by RMT. The major hazard identified is the possibility of the apparatus igniting an electro-explosive device (detonator). It is concluded that there is a very low probability of an inadvertent firing of an electro-explosive device. A range of operational precautions are identified to reduce risk to the lowest practicable level.

Mines Rescue Communication (m-Comm) System:
Risk Assessment: Summary

Major Hazards

Possible Hazard	Hazard Analysis	Suggested Controls	Notes
Detonation of normal sensitivity electro-explosive devices (EED's)	Hazard occurs due to the establishment of a single wire toroidal coupling within the Mines Rescue Communications System.	Primarily through training, hazard awareness and restricting the use of the apparatus to authorised staff.	see later
Ignition of Methane	Base Unit is certified to operate in a Group I (CH ₄) atmosphere.	Base Unit to be employed at fresh air base where atmosphere is measured to have low CH ₄ concentration. Equipment to be fully maintained and inspected prior to use to ensure no physical damage present.	
Ignition of Hydrogen	Handheld Unit is certified to operate in a Group I (H ₂) atmosphere.	Equipment to be fully maintained and inspected prior to use to ensure no physical damage present.	

Mines Rescue Communication (m-Comm) System:
Risk Assessment: Summary

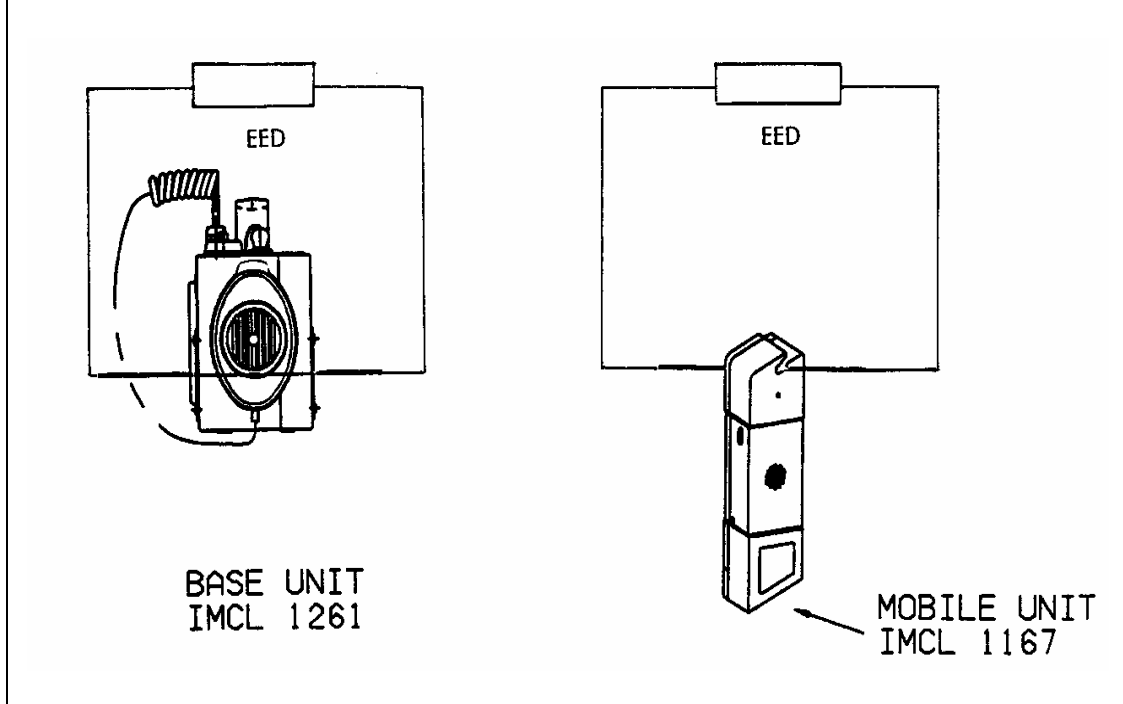
Occupational Hazards

Possible Hazard	Hazard Analysis	Suggested Controls	Notes
Manual Handling	Not considered to be a significant hazard. Equipment is compact and lightweight.	Purpose-designed carrying case to be used. This has suitable handle, rounded corners and is deformable.	
Slipping & Falling	Communications guide wire could become tangled around feet or legs.	Wire deployment training will minimise any risks of tripping.	

Detailed Risk Assessment

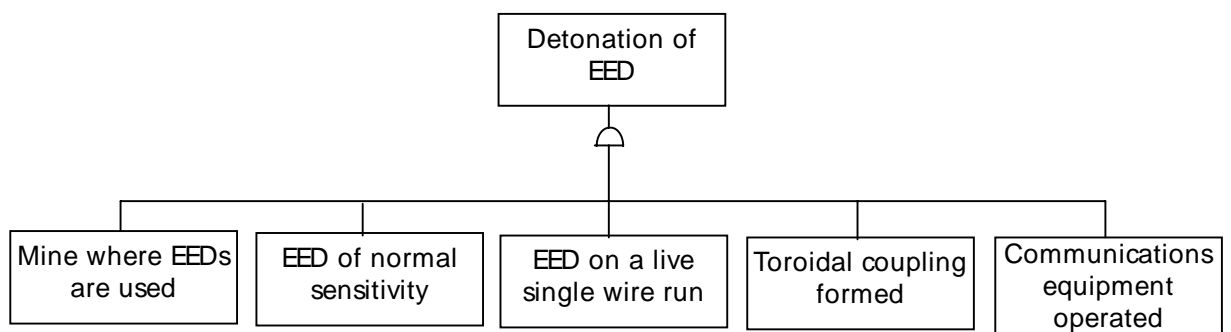
Major Hazard:-

Detonation of normal sensitivity electro-explosive devices (EEDs) due to the establishment of a single wire toroidal coupling with the apparatus of the Mines Rescue Communications System. By single wire toroidal coupling, we mean that the apparatus must be connected **directly around** one limb of a **continuous loop circuit** formed by one or more EEDs. Diagrammatically this is shown as follows:



Hazard Analysis

For the above hazard to be realised, all the factors shown in the following diagram must occur together at the same time and location.



Not one of the above factors occurring on its own will realise the hazard. Each of the factors highlighted above is discussed further in the following sections.

1. Mines where EED's are used

This hazard only exists in underground mines where drilling and blasting operations are practised. It is noted that in coal and other safety lamp mines, the *Coal & Other Safety Lamp Mines (Explosives) Regulations, 1993* place additional regulatory controls on shotfiring (e.g. Regulation 26 controlling shotfiring cables).

2. Use of EED's of Normal Sensitivity

In the UK, EED's of normal sensitivity have a no fire current of $0.3A_{RMS}$, with an associated probability of detonation at this current of no greater than 10^{-4} (BS 6657:1991). A limit of 0.06A has been stipulated for induced EED current by the UK Health & Safety Executive. This provides a safety factor of 5 based on a standard 'no-fire' current.

In tests conducted by RMT, the currents induced by using the apparatus of the Mines Rescue Communications (m-Comm) System under 'worst case' situations (i.e. a single EED configured as a loop with a total circuit resistance of 0.9 ohms) together with a higher resistance circuit (1.8 ohms) were as follows:-

	$R=0.9\Omega$	$R=1.8\Omega$
Base Rescue Station	0.59A	0.46A
Mobile Unit	0.25A	0.21A

It can be seen that the induced currents for 1.8 ohms are lower than the values obtained for 0.9 ohms. Iron wire detonators, as used in Gypsum Mines for example, have an equivalent circuit resistance of 3 ohms, and therefore the induced current will be lower.

Although the currents induced in the tests are above the HSE stipulated level of 0.06A, and that of the Base Unit is higher than the standard no-fire current of 0.3A, the practical use of the rescue communications system must be considered.

When used, the Base Unit will only be used outbye of the emergency or simulated emergency in a safe area, such as a fresh air base. Here it is extremely unlikely that there will be any 'live' shotfiring cables around in which to induce current.

The Handheld Unit is used further inbye and may, in its use, be brought into an area where live shotfiring cables are present. Under worst case situations, the induced current is 0.25A which is marginally below the no-fire current of 0.3A. However, the hazard of detonation of an EED being realised still requires further conditions to be satisfied.

3. Using EED's in a Single Wire Run

The shotfiring cable can only be considered live during small periods of the total production cycle and that is only when charging up the face to be blasted and the EEDs are connected or in the process of being connected to the shotfiring cable. At all other times the EEDs should be stored in a locked container until such time as is necessary for them to be removed.

For this hazard to be realised, the shotfiring cable must be on a single wire run. Most cables are of a twin wire run and therefore they would have to be deliberately unwound.

One exception to this, is the *Magnadet* type of detonator circuit. This consists of a single wire run primary circuit which toroidally links a number of twin wire detonator loops. However, these circuits are frequency selective, tuned to circa 15-18 kHz. The Mines Rescue Communication System employs a carrier frequency of 36kHz. This difference in tuning together with the inherently higher 'no fire' current of the *Magnadet* primary circuit will further reduce the risk of inadvertent detonation.

4. Forming a Toroidal Coupling and Loop Circuit

The induced current described in (2) above can only be induced by a toroidal coupling being formed between either the Base Unit or the Handheld Unit and a single run of live shotfiring cable described in (3). A toroidal coupling formed around both wires of an EED circuit or a balanced twin wire will have no effect as no current will be induced.

In order to induce this current so that there can be a risk of detonation, a single run of live shotfiring cable has to be inserted into either of the units. Similarly, a continuous loop has to be formed at the electrical exploder end of the two wires, although it is noted that shorting out the cable in this way is a requirement of the Approved Code of practice of the Coal and Other Safety Lamp Mines (Explosives) Regulations, 1993.

When used properly, the Base Unit will be located in a safe area or a fresh air base away from such shotfiring equipment. Furthermore, the Base Unit has a closed coupler design which cannot be clipped around an arbitrary cable. The cable end would need to be 'threaded' through the unit and then pulled through. As a result, the probability and hence, risk, of somebody *unintentionally* inserting a single wire live shotfiring cable into the Base Unit is extremely low.

The Handheld Units, when used correctly, will be taken inbye along with the wire dispensing reel and coupled continuously onto the trailing communications guide wire. If live shotfiring cables do exist inbye, then,

unless disturbed by the emergency incident, the cables should, in compliance with Regulation 26 of the Coal and Other Safety Lamp Mines (Explosives) Regulations 1993, be suspended and/or supported off the floor and consequently not in the proximity of the communications equipment.

In most circumstances they will be stored out of the way, since the normal practice is to wind the detonator cables in and out before and after every blast. The probability, and hence risk, of someone *unintentionally* inserting a live single wire shotfiring cable into the Mobile Unit is again, extremely low.

5. Communications Equipment Deployed and Activated

The Mines Rescue Communications Equipment has to be in use underground for there to be a hazard. The equipment is only to be used in an emergency or simulated emergency situation by professional Mines Rescue Brigadesmen who are trained in its use. Where the system is in use within a mine using EED's, all the situations highlighted in (1)-(4) have still to be present and then the System has to be activated.

Summary of Analysis and Controls

It can be seen from this risk assessment, that a detonation of an EED by the Mines Rescue Communications system will only occur if a series of events all occur together at the same time and location. From the analysis, it has been demonstrated that the likelihood of one of these events occurring is small, let alone all five occurring together.

It can be concluded therefore that when used properly the risk of detonation of normal sensitivity electro-explosive devices (EED's) due to the establishment of a single wire toroidal coupling within the Mines Rescue Communications Equipment can, based on this risk assessment, be considered to be as low as is reasonably practicable.

In fact, the only realistic foreseeable situation where all these five events could occur together is in a malicious act of intent by some person with knowledge of the equipment and its operation.

Despite this, the following provisions for safe use are recommended:-

1. The equipment should under no circumstances be connected around any cable associated with shotfiring;
2. All personnel who use the equipment should be fully trained in its correct operation and safe use and, through this training, be made aware of all hazards associated with the equipment;
3. The dedicated communications cable used with the equipment should not be white in colour since this is the colour of shotfiring cable identified in the UK Coal and Other Safety Lamp Mines Explosives Regulations, 1993;

4. During deployment of the apparatus, checks should be made by a responsible person to ensure that the apparatus is only to be connected to the dedicated communications guide wire.
-

For further information on this product or its use, please contact:

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