

**GEOQUIP**



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The Leader in Perimeter Protection Solutions

**GW400k SENSOR MANUAL  
FOR BUILDING APPLICATIONS**

**PROVEN PERIMETER PROTECTION**



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**guardwire**

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## 1.1 GENERAL

The Guardwire system is an advanced intrusion alarm system based on a microphonic sensor. The sensor is attached to the fabric of the building to be protected and detects intruders penetrating through the fabric of the building by either gross or impact attack.

The audio outputs generated by the sensor and associated analysers provide valuable additional information to personnel on alarm causes and assists in the discrimination between possible nuisance alarms and types of intrusion.

## 1.2 PRINCIPLE OF OPERATION

The Guardwire sensor detects the vibrations caused by an attempted intruder breaking into a building either by gross or sustained attack and converts them into electrical signals which are processed by the analyser. This, in turn, “decides” whether the signals constitute an attempted break in and, if so, an alarm is activated. The relay output is normally connected to some form of annunciator unit which, in turn, operates alarm bells or other indicators.

Care must be taken to ensure that the sensor is positioned and fixed correctly to enable it to respond to the vibrations caused by an intrusion. The sensor must be fixed to the protected surface as closely as possible so that the *maximum* amount of signal is generated by the sensor in response to the intrusion attempt. The installation notes in this manual are designed to

ensure that, as far as possible, the above conditions are satisfied.

Most problems experienced on site stem from a lack of understanding of the principle of operation of the system and consequential installation errors. It is vital that this manual is read thoroughly and understood prior to system installation.

**IMPORTANT**

**The most critical feature of any Guardwire system is the quality of the sensor installation.**

### 1.3 FABRIC OF BUILDINGS

Building fabrics fall into the following broad categories.

1. Roof Protection
2. Wall Protection
3. Internal Cage Protection

**IMPORTANT**

**The specific installation techniques for each type of fabric, as described in the following sections, must be carefully observed.**

If in **any** doubt as to the suitability of a particular fabric and sensor configuration to provide the required level of intrusion detection please **contact Geoquip Ltd for further advice.**

## **1.4 STATEMENT OF COMPLIANCE**

The equipment described in this manual complies with all relevant sections of EMC Directive 89/336/EEC introduced in January 1996.

Specifically, the equipment has been tested to the following standards:

BS EN 50082-1 1992 - Generic Immunity Standard  
and

BS EN 50081-1 1992 - Generic Emission Standard

While the system complies with the standards listed above, it is still possible that certain high level interference sources can have an adverse effect on the system performance. The guidelines detailed later in this manual should be followed to minimise such problems.

A technical report detailing these tests and procedures is available from Geoquip Limited on request.

Additionally, to satisfy the requirements for CE marking of the product, the equipment complies with all other relevant standards for this type of equipment.

## 2.1 PRE-INSTALLATION CHECKLIST

To ensure that the condition of the building does not compromise the performance of the GW400k, the following checklist should be studied and any necessary repair work carried out on the building prior to commencement of the installation.

1. Ensure that the fabric of the building is intact. Areas which have suffered damage, vandalism, or other deterioration, must be replaced or repaired.
2. Ensure that the same fabric type is used throughout each zone. Sections of different types of fabric will produce different responses, making it difficult to optimise the system settings.

### **IMPORTANT**

**Different building materials within the area to be protected will require separate analysers to ensure optimum system response.**

**Regardless of the type of material to be protected, the analyser(s) and the sensor must be installed on the *inside* of the building.**

3. Ensure that there are no overhanging branches of trees in contact with the building, particularly on roofs and that the building is generally free from vegetation which can muffle vibrations caused by intrusion attempts.
4. Ensure that metalwork fixed to the building, such as signs are firmly fixed and do not vibrate or rattle in bad weather conditions.

5. Ensure that sensor installed in roofs is away from sources of vibration such as extractor fans.
6. Ensure that doors and roller shutters are secured so that they cannot rattle when closed.

## 2.2 ELECTRICAL INTERFERENCE

When planning the location of sensor runs, care must be taken to avoid placing the sensor close to sources of electrical interference, particularly any device which may produce alternating magnetic fields. Such devices include motors, contactors, transformers, and power cables carrying large currents.

Normally the sensor will reject such stray interference, however, if the interference is sufficiently strong, the audio quality may suffer and in extreme cases, false alarms may be produced. Power cables which are steel wire armoured are sufficiently well screened by the armouring to minimise any interference problem, but it is good practice to allow a separation between the sensor and the power cable of at least 1m. sensor running parallel to power cables for distances greater than a few metres must be avoided.

Particularly powerful sources of electrical interference include electrified rail lines and electric fence units, the supply wiring of which tend to radiate broad band electrical interference.

If there is doubt about the suitability of Guardwire sensor for use where high levels of electrical interference may exist, contact Geoquip Ltd for advice.

A site trial or use of a field strength meter are the usual ways to confirm that there will be no problem and this can usually be carried out by, or under instruction from, Geoquip Ltd.

**IMPORTANT**

**All personnel involved with installation of sensor must understand that it is a sensitive vibration detection device and is to be handled accordingly.**

**3.1 SENSOR HANDLING**

1. Removal of the sensor from a reel must always be carried out by placing the reel on a proprietary dereeler. Failure to do this may allow kinks to form in the cable that will cause internal damage. Refer to Figure 1. Ensure that the sensor is not subjected to jerking or tugging while being paid off the reel.

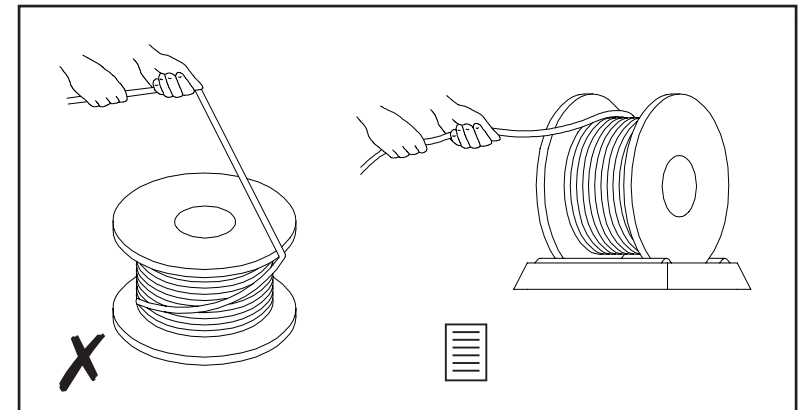


Figure 1

2. Sensor deployed and ready for fixing to the building must be protected from damage by persons walking on it or vehicles driving over it. Figure 2 illustrates typical maltreatment of sensor which must *not* occur. Sensor subjected to such severe

treatment will be damaged beyond repair and will prove costly to replace as sensitivity can only be verified following attachment to the building fabric.

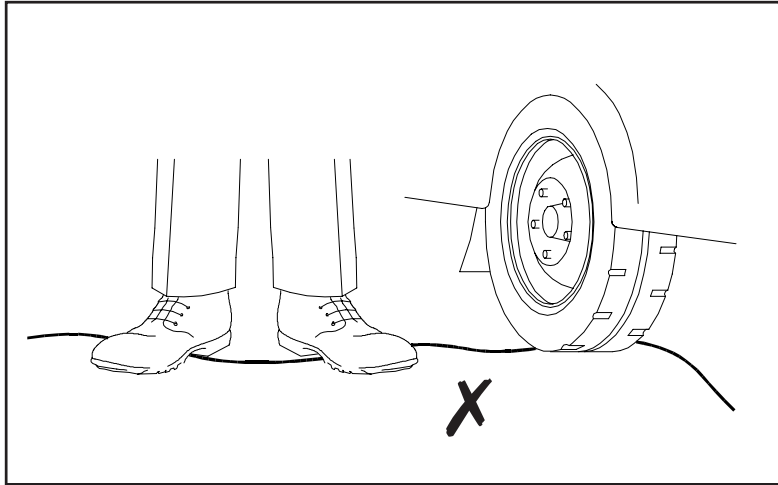


Figure 2

3. When fixing sensor within buildings, the tightest bend radius of the cable must not be less than 100mm (4"). Note that this applies to the bend radius after installation. Refer to Figure 3.

When it is necessary to pull the sensor round bends during the installation process, the bend radius must be sufficiently large to avoid exceeding the maximum permissible tension as described in the next paragraph.

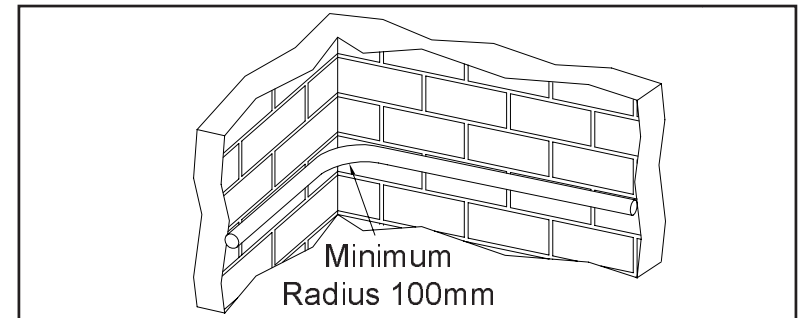


Figure 3

4. The maximum tension which can be applied to the sensor should not exceed 6 kg (13 lb). Tension in excess of this can cause internal damage which may not be obvious from the condition of the outer sheath. Refer to Figure 4.

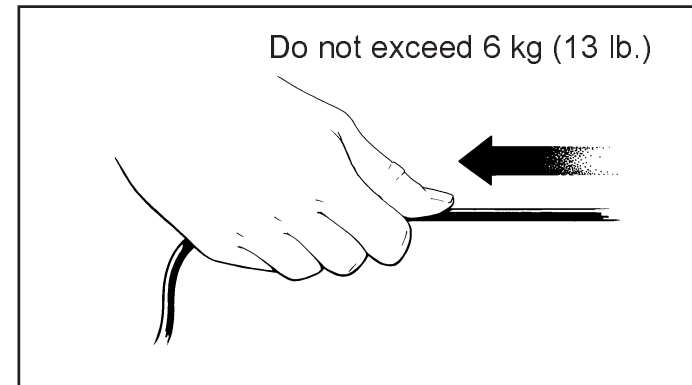


Figure 4

#### 4.1 SENSOR PLACEMENT

On walls and internal cages the optimum height for mounting sensor is 1m above floor level. This offset towards the lower half provides better detection of intrusion which is more likely to occur on the more accessible lower areas.

#### 4.2 END OF LINE OVERLAP

Where the end of line of two adjacent zones meet it is recommended that the sensor runs overlap for approximately 2m. This overlap will ensure that the system integrity is not affected by any discontinuity of the sensor. Similarly when the sensor exits the analyser box it is recommended that the cable is looped horizontally in the opposite direction to the zone for about 1m before returning to continue to the end of line. See Figure 5.

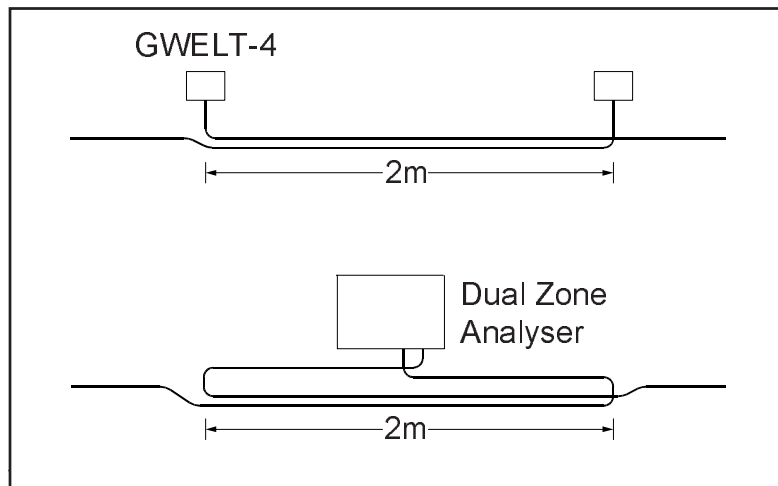


Figure 5

In cases where there is a double run, the sensor zones should overlap where the cable is vertical prior to it looping back to begin the return run.

### 4.3 NON-SENSITIVE SECTIONS

In many cases, there will be areas within a sensor zone where, for various reasons, it is not necessary or desirable to provide active sensor coverage.

For instance, if a zone is split by a opening or other obstruction, a section of “dead” cable can be inserted in the zone at this point to be re-connected to the sensor at the other side of the obstruction. Another application of “dead” cable would be to provide an interconnection between sensor on a building zone and an analyser mounted remotely from the building, perhaps in another building or other protected area.

The correct “dead” cable is available from Geoquip Ltd, part number GQFC-1. This cable comprises an overall drain wire and two twisted pairs of wires, each with individual foil screens. This cable is **not** suitable for outdoor use or direct burial.

The junction between the sensor and the “dead” cable is made within a weather-proof GWJB-1 junction box. This junction box provides an integral tamper switch to force a sensor tamper condition if the lid is removed.

**It is important to ensure that the interconnection of the sensor and the “dead” cable conforms to the table overleaf.**

GW400k Sensor Conductors		GQFC-1 Dead Cable Conductors
Red Wire	to	Red Wire
Black Wire	to	Green Wire
Green/Yellow Wire	to	Drain Wire
Yellow Wire	to	Black Wire
Blue Wire	to	White Wire

Adhere to this schedule at all times when jointing sensor to non-sensitive cable. Failure to comply with this will compromise the security of the system. See Figure 6.

Provided that the cables are terminated correctly and moisture is excluded from the joint, almost any number of such sections can be inserted in a zone.

#### 4.4 SENSOR INSTALLATION

The following general recommendations apply to most types of building fabric and must be adhered to when installing Guardwire sensor.

1. Starting at the beginning of the zone, place the reel on a proprietary dereeler.
2. Walk towards the end of the zone while paying the sensor off the reel and allowing it to lie on the floor. Refer to Figure 1 on page 7.

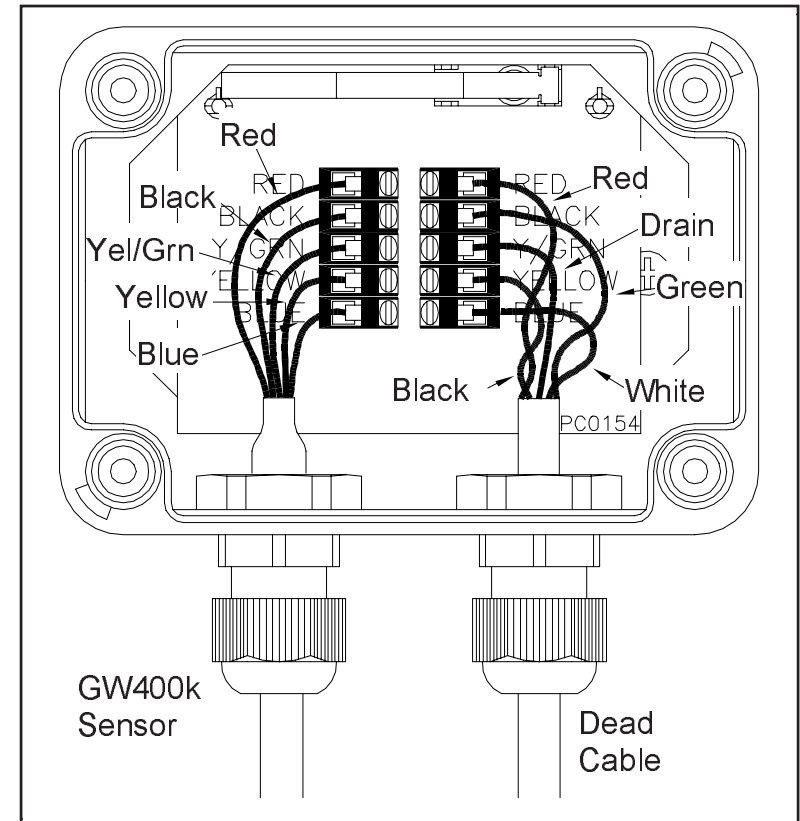


Figure 6

3. On reaching the other end of the zone, leave any remaining sensor on the reel until fixing of the sensor to the building is completed. Do not cut off any remaining sensor as more may be required as fixing progresses.
4. Starting at the beginning of the zone fix the cable to the building fabric working towards the reel, paying

off additional sensor as necessary. Leave sufficient spare cable at both ends of the zone to make the sensor terminations.

**IMPORTANT**

**Sensor terminations must only be fitted *after* installation of the sensor on the building. Ensure that the cut ends of sensor are sealed against moisture using electrical insulation tape until the cable terminations are fitted.**

**4.5 NAIL CLIPS**

Nail or “P” clips, as shown in Figure 7, should not be used to fix the sensor since contact between the sensor and the protected surface will only occur at the clip and this will be insufficient for reliable intrusion detection. In additional use of such fixings also increases the likelihood of sensor damage which will prove costly to rectify as sensitivity can only be verified at the end of the installation.

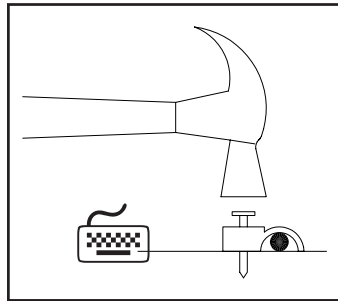


Figure 7

**4.6 COPING WITH SENSOR DAMAGE**

In the event that damage, whether accidental or intentional, is inflicted on the sensor, the damaged section should be replaced with a new short section. The new section should be inserted using either GWJB-1 or GWJB-FAC junction boxes, dependent on

the cable type, at either end of the cable to ensure proper connections. Figure 8 shows the arrangement of the damaged sensor replaced with a new section.

If cable damage has occurred, resulting in exposure of the inner conductors of the sensor to moisture for a period exceeding a few days, it is advisable to cut out a section of sensor at least 5m on either side of the damage to eliminate the effects of moisture penetration due to capillary action.

The new section of sensor can be prepared off site, using the following method, and moved into place when completed.

1. Terminate the ends of a suitable length of sensor as described in Section 11.2.
2. Loosen the glands on the junction boxes and pass the sensor end into the box so sufficient length is available on the tails to be wired into the terminal blocks. Ensure that the sensor is passed through the correct gland to correspond to the position of the terminal block, i.e. through the left gland to connect to the left terminal block at the right hand end of the sensor and vice versa at the left end. Tighten the gland by hand so that the rubber sealing ring grips the sensor jacket and not the heatshrink sleeves.
3. Connect the sensor tails to the terminal blocks ensuring that the cable tail colours match the screen printing on the PCB. Figure 6 shows sensor

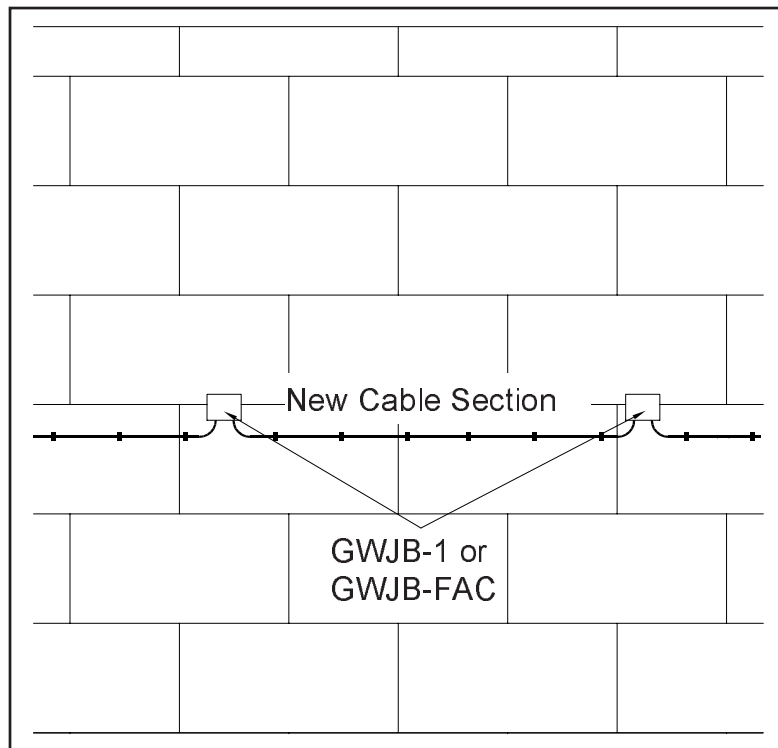


Figure 8

wired to the left hand terminal block of a junction box.

4. Cut out the damaged section of sensor from the building fabric and terminate the ends of the remaining sensor in the same manner as above. To ensure that no moisture enters the open sensor ends this step should only be carried out *immediately* prior to fixing the new section.

5. Position the boxes just above the line of the sensor and fix to the wall. Ensure that the new section of sensor is at the same height and tension as the original. Do not over tighten the screws when mounting the box as in extreme circumstances this can cause distortion and the lid may not fit properly.
6. Connect the tails of the existing sensor to the junction box terminal blocks, ensuring that the sensor tail colours match the screen printing on the PCB.
7. Replace the box lids, taking care not to overtighten the lid screws and verify that the tamper switch in each box operates by listening for the click of the switch action when the lid is screwed down. Retest the entire zone to ensure that the sensor detects simulated impact and continuous modes of attack.

## 5.1 GENERAL

Sensor can be installed on the roof to detect gross attack ie an intruder breaking through the roof. It should not be used to detect people solely walking on the roof.

## 5.2 SENSOR INSTALLATION

Most industrial roofs are constructed of cladding fixed to 'Z' shaped purlins. On these roofs the sensor should be laid in the purlin trough. The sensor should be girder clipped to the upright of the section at the ends of the purlins. See Figure 9.

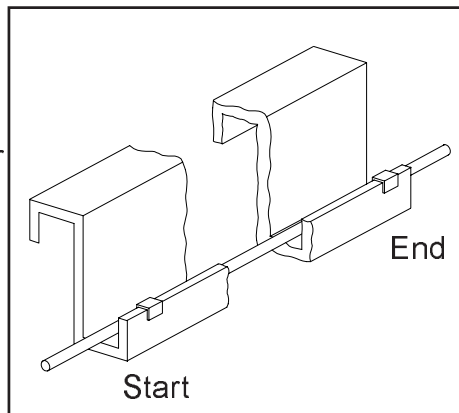


Figure 9

If the trough of the purlin contains obstructions which prevent the sensor from lying flat, eg pipes, the sensor should be girder clipped to the upright of the section every 200mm to lift it clear of the obstruction. See Figure 10.

### IMPORTANT

**Sensor must not be installed in purlins containing electrical cables. In this instance the adjacent purlin should be used.**

Figure 11 shows two incorrect installations. The left picture shows sensor clipped to the outside of the purlin allowing it to sag between clips. The right picture shows the sensor laid on top of pipes and cables. In both cases the sensor is not in direct contact with the purlin which result in loss of sensitivity and hence reduction of detection.

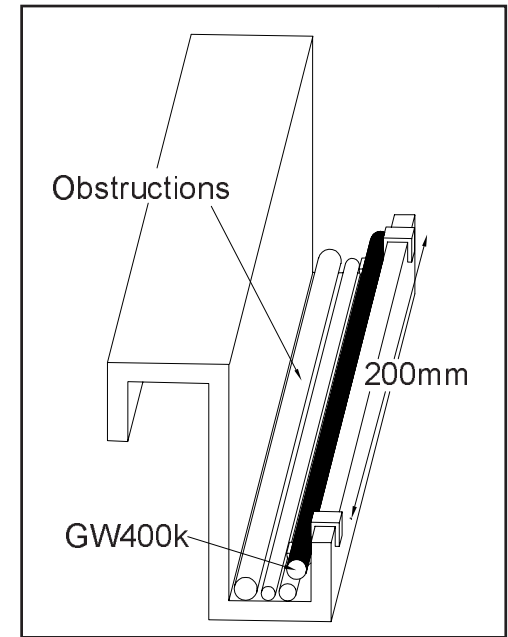


Figure 10

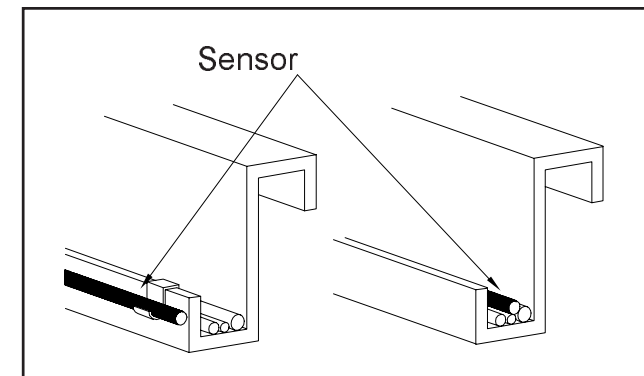


Figure 11

When installing sensor in roofs it may be necessary, for ease of installation, to install short sensor runs within a zone. These separate lengths should be joined using GWJB-1 junction boxes. See Section 4.3 for details of the junction boxes.

### 5.3 AREA OF DETECTION

Reliable detection can normally be obtained up to 1.5m either side of the sensor. If the purlins are spaced at 1.5m centres or less, as usually is the case, then the sensor only needs to be run on every other purlin. In all cases however, the maximum distance between the sensor runs must not exceed 3m. See Figure 12.

If the purlins are either full of obstructions or inadequately spaced the sensor can be installed in

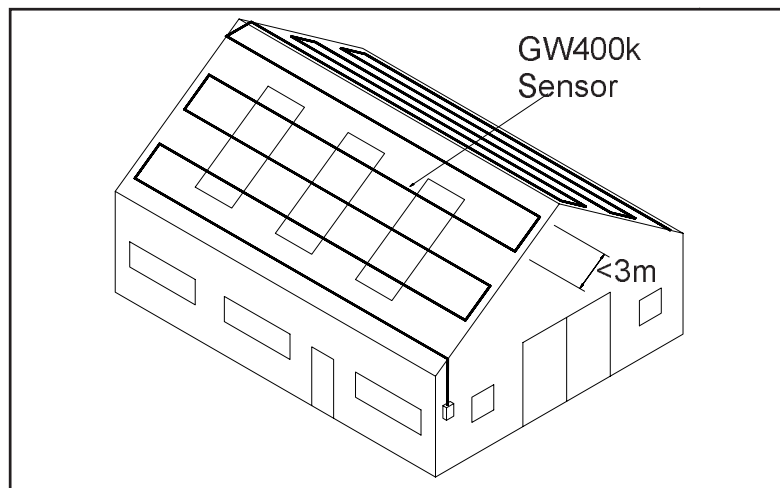


Figure 12

metal conduit. If this method is used see Section 10 for details on installing sensor in conduit.

#### 5.4 STARTING POINT

It is most likely that an intrusion will happen at the edge of a roof rather than in the middle. For this reason place the first run of sensor on the lowest purlin

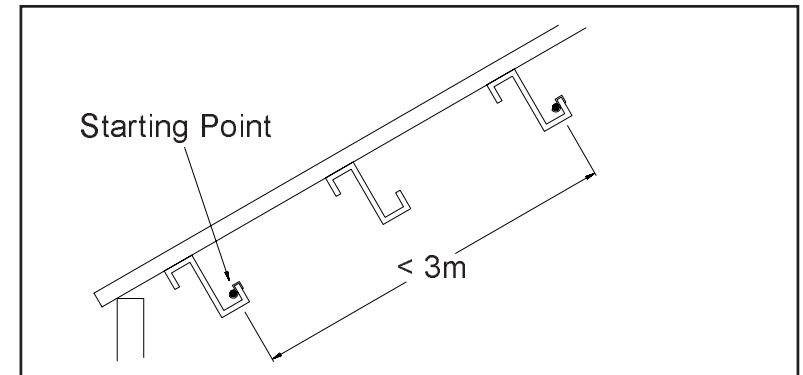


Figure 13

i.e. nearest to the eaves of the building and work upwards towards the apex of the roof. See Figure 13.

#### 5.5 SKYLIGHT PROTECTION

Skylights, vents, and other roof openings must be given special consideration when planning roof installations, the most common type of roof opening being clear plastic skylights. These are vulnerable to penetration by intruders using blow lamps to cut through the plastic and thus gain access. The recommended method of protecting openings is to cover the inside of the vulnerable area with a 3mm

diameter weldmesh and to attach the sensor to this in a large loop. The sensor should be attached to the grill using GQTY-1 plastic cable ties. Although the grill is a different material from the roof since the sensor covering the skylight will, in most cases, only constitute a very small part of the zone it is not necessary for it to have a separate analyser.

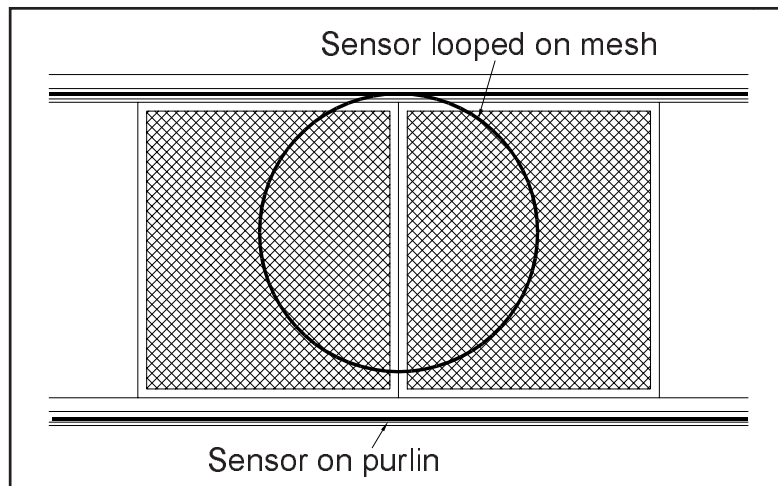


Figure 14

Figure 14 shows an example of a skylight protected using this method.

## 5.6 SITING THE ANALYSER

When installing sensor in roofs it is important to situate the analyser in an easily accessible position to enable any necessary adjustments to be made. It may therefore be necessary to insert a section of GQFC-1

feeder cable as a dead section between the analyser and the start of the zone. The GQFC-1 cable and the sensor should be joined together using a GWJB-1 junction box. See Section 4.3.

### **5.7 ALTERNATIVE ROOF TYPES**

If the construction of the roof is significantly different from that described above, then either test the response of the fabric using a short test zone or contact Geoquip Ltd for further advice.

## 6.1 GENERAL

In the majority of industrial buildings the outer walls consist of brick or blockwork up to a height of 2-3m. Between the top of these walls and the roof is an inner cladding or plasterboard skin. The outside of the wall is usually covered with metal cladding from ground to roof level. Figure 15 shows a typical cross-section.

Since such walls are made from widely different materials the sensor should be configured in two separate zones each with the sensitivity correctly adjusted.

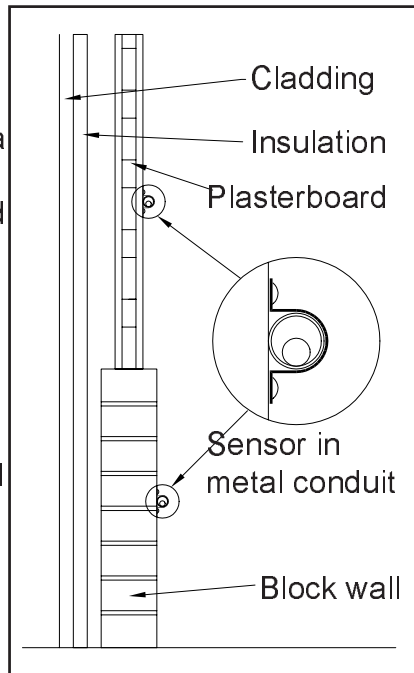


Figure 15

## 6.2 SENSOR INSTALLATION

To ensure uniform detection and physical protection from damage the sensor should always be run in either

1. 12mm (1/2") aluminium security conduit
2. 20mm galvanised conduit

## 3. GW400kFAC sensor

**IMPORTANT**  
Under no circumstances should the sensor be clipped directly to the protected surface

## 6.3 AREA OF DETECTION

Reliable detection of an unsophisticated attack such as smashing through the block or brickwork can normally be obtained up to 1.5m on either side of sensor run on a flat, uniform surface. If sophisticated methods of intrusion, such as careful removal of mortar from

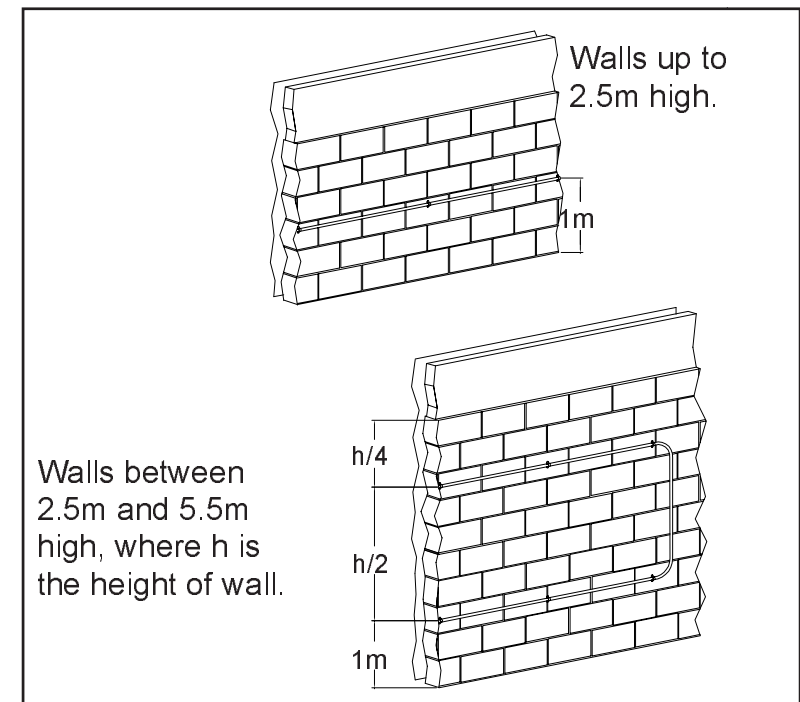


Figure 16

between the bricks or blockwork are anticipated, extra runs of sensor may be required. Contact Geoquip Ltd for further advice.

#### **6.4 SITING THE SENSOR**

The optimum height for mounting the sensor is 1m above ground level. This offset towards the lower half of the wall provides better detection of intrusion which is more likely to occur at lower levels. Consideration should be given as to whether intrusions are likely to occur at other points because of particular site conditions and if such areas are envisaged then the sensor should be configured to provide adequate coverage.

On walls greater than 2.5m high additional runs will be required to provide adequate coverage. Figure shows how walls up to 5.5m can be protected by having a cable run 1m above ground level and another run half the wall height up from that.

## **7.1 GENERAL**

Plasterboard is commonly used in industrial buildings above the level of the block or brick walls up to the eaves of the roof. The plasterboard forms the inner skin of the wall construction while the outer skin comprises a corrugated metal cladding.

On such surfaces, the sensor should be installed in light gauge metal conduit fixed directly to the plasterboard. This will ensure sufficient mechanical contact between the surface and the sensor cable. Refer to Section 10 for further guidance on the use of conduit.

## **7.2 AREA OF DETECTION**

When installed in conduit on plasterboard surfaces in accordance with the recommendations, the system will offer adequate protection against unsophisticated intrusion attempts ie gross or impact attack up to 1.5m on either side of the sensor line.

## **7.3 SITING THE SENSOR**

When siting the sensor on plasterboard, the presence of any structural steelwork in contact with the plasterboard should be considered as this will reduce the detection characteristics of the sensor. This is an important consideration since of the relative ease of cutting through plasterboard without causing vibrations detectable by the the sensor. When siting the sensor remember that most intrusions are likely to occur at the lower levels of walls so the sensor should normally be

sited with an offset towards the lower, more accessible areas. **It is not acceptable to site the sensor purely on the basis of ease of installation.**

Inevitably, there will be sites where there is a type of wall that is not described in the preceding text. Obtain advice from Geoquip Ltd *before* commencement of any installation work on non-standard walls.

## 9.1 GENERAL

Many industrial buildings have additional physical security in the form of wire cages or enclosures to protect and isolate high value goods from casual access by site personnel. Figure 17 shows a typical example. Guardwire sensor is easily deployed and highly effective in protecting such enclosures.

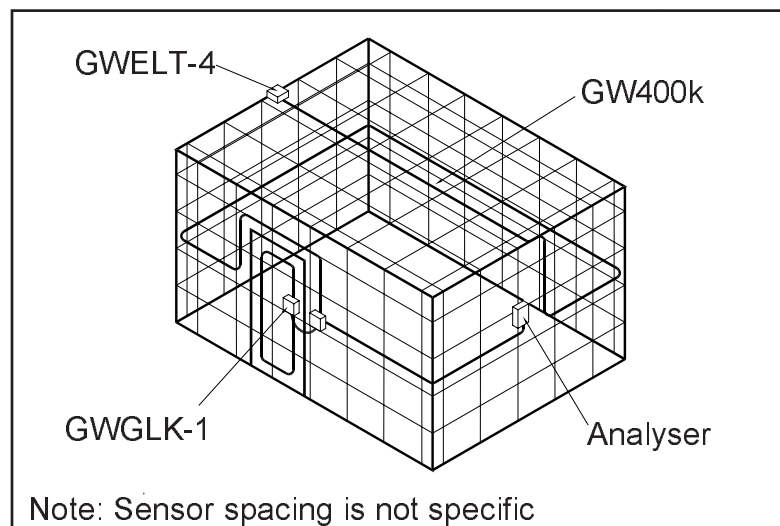


Figure 17

## 9.2 SENSOR INSTALLATION

Fix the sensor directly to the wire mesh panels of the cage by means of GQTY-1 plastic cable ties as shown in Figure 18. The cable ties must be placed at 200 mm (8") intervals to ensure close contact between the sensor and the mesh. In areas where the cable may be subject to mechanical damage, it should be

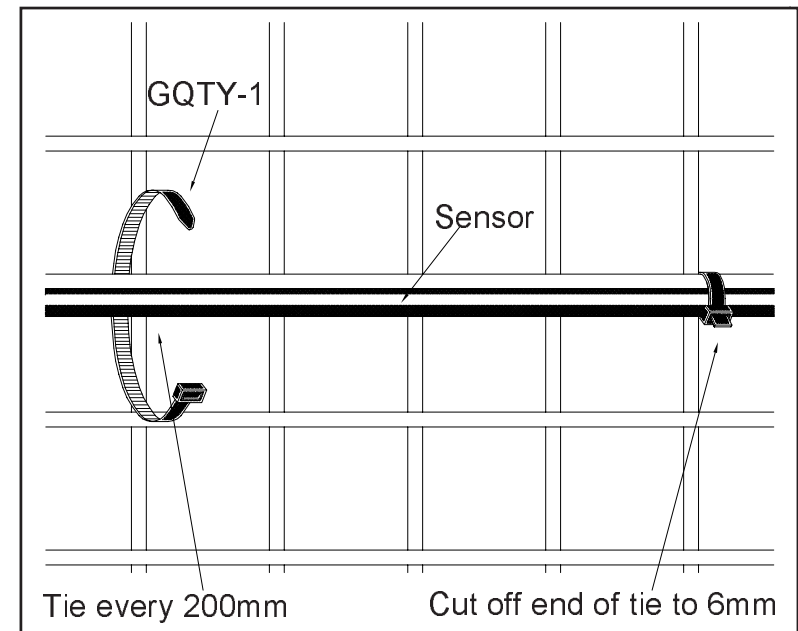


Figure 18

mounted inside light gauge metal conduit. The conduit can be fixed to the mesh of the cage by plastic tiewraps, or for additional security from damage, GQTY-4 wire ties. Alternatively conventional saddles mounted to plates positioned on the rear side of the mesh could be used. Whatever method is used it is important to ensure that close mechanical contact between the conduit and the mesh is achieved. Refer to Section 10 for further guidance on the use of conduit.

### 9.3 AREA OF DETECTION

Adequate detection can be obtained up to 1.2m on either side of the line of the sensor so a 2.4m high

panel can be protected with one run of sensor. If the cage wall is higher than this, the sensor should be doubled back along the mesh so that the two runs are a quarter of the height of the cage from the top and bottom to ensure effective detection. Roofs of such internal cages should be treated in the same way as the walls, with the same areas of coverage applying.

## 10.1 GENERAL

In areas where the sensor requires additional protection, e.g. against vandalism or damage from vehicles etc, it can be run inside either flexible or rigid conduit. Conduit may also be used where other fixing methods are not suitable.

In both cases the conduit must be installed over the whole of the zone length to prevent dissimilar responses occurring. If it is considered uneconomical to install conduit over the whole zone length, the zone should be split into two separate zones, each with its own analyser.

## 10.2 FLEXI-ARMoured CONDUIT

Flexi-armoured conduit (FAC) is available from Geoquip Ltd in two versions ie GWFAC and GWFAC-HS, both of which can be provided either excluding or including the GW400k sensor. They are both made from 316 grade stainless steel and provide protection against the sensor being cut whilst being easier to install than rigid conduit. Due to its construction the GWFAC-HS is more rigid and is therefore harder to cut and less flexible than the GWFAC.

In general therefore, the GW400kFAC-HS should be used where long straight sections are required eg on walls. Conversely the GWFAC should be used to contain the GW400k where short flexible sections are required eg for additional protection of the sensor between purlins in a roof.

Both types of flexi-armoured conduit are available in either 50 or 100m reels. If longer zone lengths are required then sections can be joined using the GWJB-FAC junction box. These junction boxes have special glands to facilitate the flexible conduit and because of these the sensor must be inserted into the gland prior to termination. For further details on terminating cable with GWJB-FAC boxes see the Guardwire Accessories Installation Manual supplied with the box.

### 10.3 INSTALLING THE FAC

When installing FAC on cages it should be fixed using a GQTY-4 stainless steel tie-wrap every 1m with GQTY-1 tie-wraps every 200mm in between.

When installing FAC on walls it should be fixed every 1m with a saddle. Between these it should be fixed

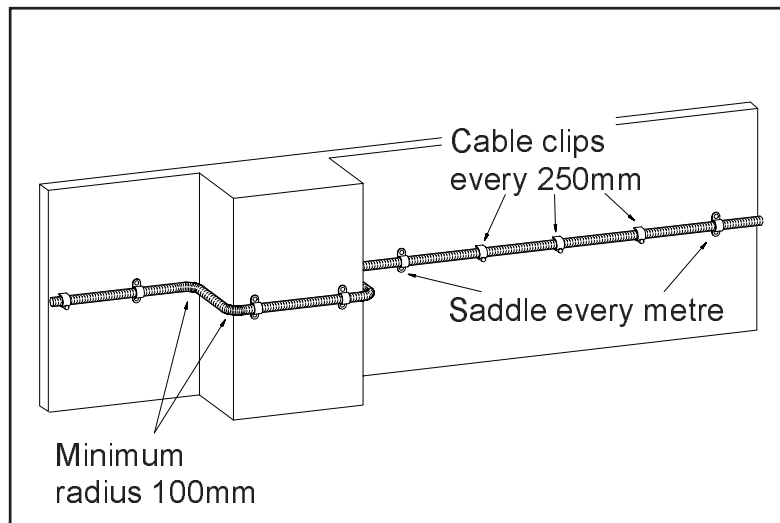


Figure 19

every 250mm using either nail clips or saddles depending on the fabric of the wall. See Figure 19. The FAC is supplied with three clips and one saddle per metre.

#### 10.4 RIGID CONDUIT

When installing sensor in rigid conduit follow the instructions below.

1. The normal conduit used in indoor applications is 12mm aluminium. The 20mm galvanised steel conduit can be used although the cost of this may be prohibitive. Do not use plastic conduit or trucking.
2. All cut ends of conduit must be de-burred prior to installation of sensor in the conduit. Wherever possible, brass ferrules or other smooth lead-in components must be used.
3. Pull-through points must be provided at intervals not exceeding 25m (80ft). If the length includes 90° bends, additional pull-through points may be needed.
4. Where bends are required, long, smooth, radius bends

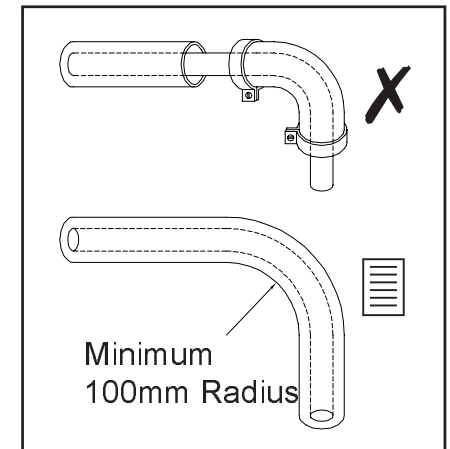


Figure 20

must be used to prevent cable damage. Do not use conduit elbows or sharp bends. Such components will cause damage to the sensor during installation as the bend radius is less than the recommended minimum radius of 100mm (4"). See Figure 20.

5. Where the sensor is required to protect surfaces where obstructions are present such as wall pillars or supporting steelwork, the simplest method of maintaining a straight run of sensor and conduit is to drill through the obstruction with a 10 mm hole and butt the ends of the conduit up to the hole, having first placed rubber bushes on each end of the conduit. It is not necessary to pass the conduit through the hole. If it is not possible to drill through the obstruction, then the conduit must be fixed round the obstruction using smooth bends and straight couplings. Figure 21 shows typical examples.

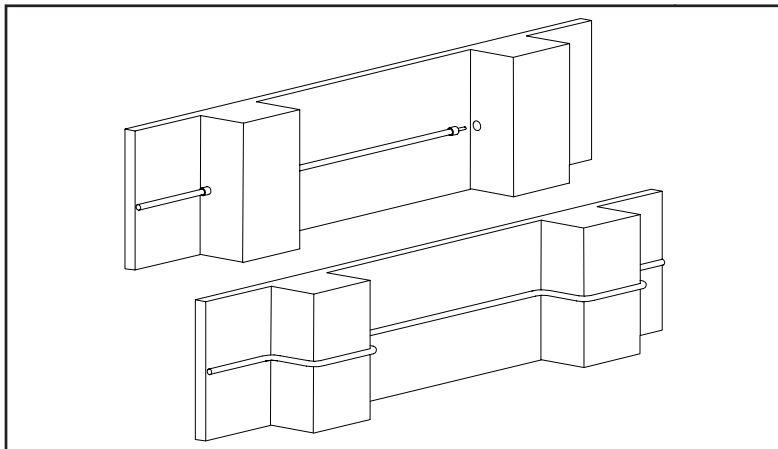


Figure 21

6. The maximum length of sensor handled while installing in rigid conduit should not exceed 100m (320ft). Longer zones should be made up by jointing the sensor at appropriate intervals. This will eliminate excessive handling of the sensor when pulling each 25m (80ft) length of sensor into the conduit. No performance degradation will occur by adding joints provided that they are made in accordance with the instructions in Section 4.3.

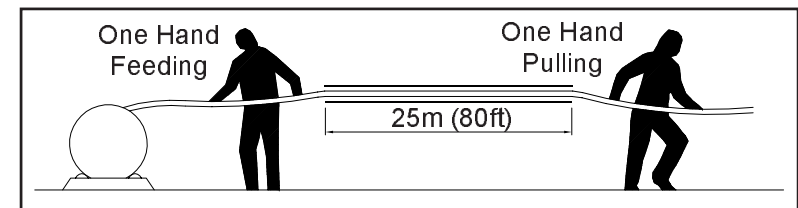


Figure 22

7. When feeding the sensor into the conduit, one person must feed it into the conduit to prevent the cut end of the conduit from damaging the jacket whilst another person pulls it through from the other end. See Figure 22.
8. Conduit can be fastened to cages by means of GQTY-4 stainless steel wire ties.
9. When installing rigid conduit on walls do not use spacer saddles as these prevent direct contact between the conduit and the wall. The saddles should be at a maximum interval of 1m (3ft). Where the surface is irregular or uneven, additional

saddles will be necessary to ensure close contact with the wall surface.

### 11.1 GENERAL

Correct termination of the sensor with all joints properly sealed to exclude moisture is an essential part of the installation. If moisture penetrates into the sensor, it is impossible to remove and will result in poor long-term efficiency. To ensure resistance to moisture penetration at terminations use the adhesive coated heat-shrink sleeving provided for all sensor terminations.

#### **IMPORTANT**

**To ensure satisfactory long-term performance of the system, it is vital that only termination kits supplied by Geoquip Ltd are used. Terminations are only to be fitted on completion of the sensor installation.**

Use a hot-air gun for all heat-shrink operations specified in the following sections. Do **NOT** use a naked flame to shrink any heat-shrink components.

The following equipment list is recommended to ensure that installation engineers are fully equipped to carry out sensor terminations.

1. "Stanley" type craft knife or similar.
2. Gas hot-air gun. (Black & Decker or similar)
3. Small side cutters.

4. The termination kit provided with the equipment.

## 11.2 TERMINATION PROCEDURE

Refer to Figure 23 when reading these instructions.

1. Carefully cut all the way round the jacket 100mm (4") from the end and then put a longitudinal slit to the end. Strip back the outer jacket of the sensor to expose the drain wire and the underlying aluminium foil screen. It is important not to nick or damage the drain wire or the underlying aluminium screen.
2. Cut off 125mm (5") of green/yellow earth wire from the termination kit provided and strip the insulation 25mm (1") back from one end. Twist and solder the bared end of the earth wire to the drain wire so that the insulation on the earth wire is snug against the point at which the drain wire emerges from the sheath of the cable. Cut off excess wire at the twist to expose 12mm (1/2") of exposed twisted wires. Fold this twist back so it lies along the outer sheath of the sensor.
3. Carefully untwist the aluminium foil screen from the sensor without disturbing the underlying layer of clear "Mylar" tape. The lie of tape will determine whether it will be easier to unwind the tape from the cut end or from the point where the sheath was cut back to. If it is necessary to unwind the tape from the sheath end, a small pair of side-cutters will help in unpicking the first part. Ensure that the foil tape is removed cleanly at the sheath/core junction.

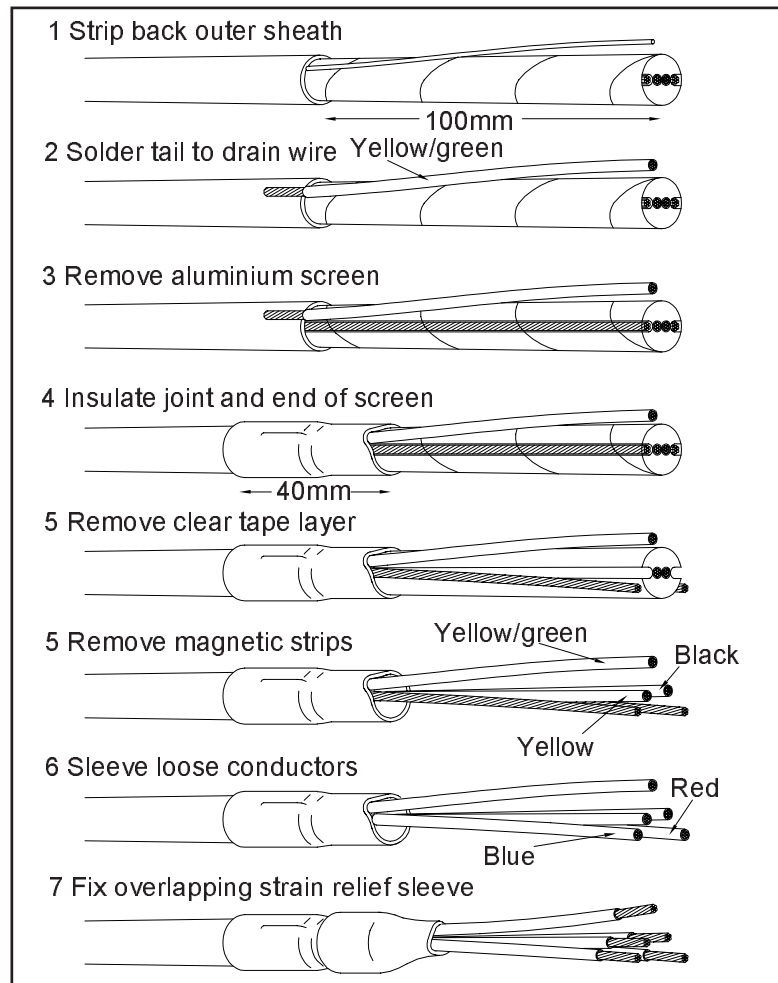


Figure 23

4. Slide the 40mm (1.5") length of black heatshrink over the junction of the sheath and core of the sensor. 20mm (3/4") of sleeving must cover the sheath and the earth wire connection while the remainder covers the sensor core. Apply heat from

a hot-air gun to shrink the sleeving round the core and sheath.

5. Visually inspect the finished shrink to verify that there is a ring of melted adhesive at the ends of the sleeving to provide a good seal between sensor and sheath.
6. Cut through the clear "Mylar" tape at the junction of the heatshrink sleeving and the sensor core and remove. It may be easier to unwrap from the inner end rather than the cut end.
7. Break off the semi-circular magnetic strips to expose the inner conductors.
8. Identify the bare wire which lies immediately next to the black insulated wire and slide on a piece of red heat-shrink sleeving over it. Ensure that the end of the sleeving is pushed down to where the bare wire emerges from the core. Repeat this step with the other bare wire using a piece of blue heat-shrink sleeving.
9. Slide the 25mm (1") length of black heat-shrink over the junction of the first heatshrink and the insulated cables. The heatshrink should be centrally positioned over this junction. Apply heat from the hot-air gun to shrink the sleeving round the previous sleeving and insulated wires.
10. Visually inspect the second sleeve to verify that the insulated sleeves are gripped by the outer heat-

shrink sleeving and that a melted ring of adhesive is present at both ends of the sleeve.

- 11.Strip off 12mm (1/2") of the insulation on all of the wires to facilitate connection to the termination blocks.

This completes the termination of the sensor at the analyser end.

### **12.1 TERMINATION BOXES**

Only GWELT-4 termination kits should be used for end-of-line terminations. These kits comprise of a waterproof box containing a printed circuit board, onto which the sensor is connected and a mounting kit. The use of the box and PCB enables easy access to the end of line termination for maintenance, testing and fault finding.

### **12.2 TERMINATION PROCEDURE**

1. Terminate the end of the sensor as described in Section 11.2.
2. Loosen the gland on the box and pass the sensor end into the box until sufficient length is available on the tails to be wired into the terminal blocks. Tighten the gland by hand ensuring the rubber sealing ring grips the jacket and not the heat-shrink sleeves.
3. Position the box just above the line of the building mounted sensor and clamp the box to the building fabric using the holes provided. Do not over tighten the screws as in extreme circumstances this can cause distortion of the weatherproof seal arrangement.
4. Connect the sensor tails to the terminal blocks ensuring that the tail colours match the screen printing. See Figure 24.

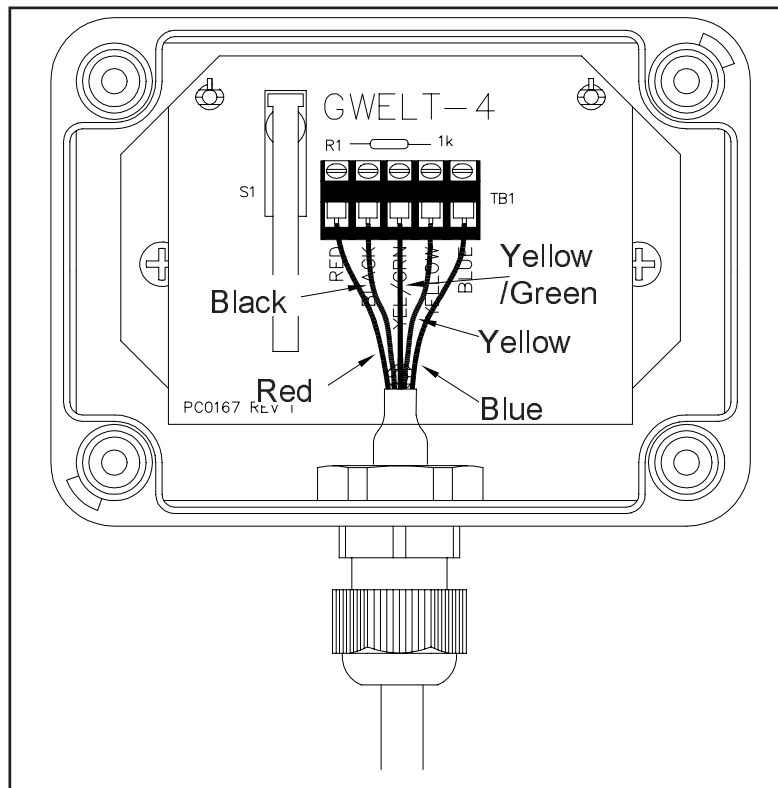


Figure 24

5. Replace the box lid, taking care not to over-tighten the lid screws and verify by listening that the tamper switch operates when the lid is screwed down.

This completes the end-of-line cable termination.

### 13.1 GENERAL

After the sensor has been terminated at both ends it must be tested prior to connection to the analyser. Testing the sensor will indicate any incorrect terminations or damage which may have been inflicted on the cable during installation.

All lengths of sensor dispatched from Geoquip Ltd are fully tested to ensure optimum performance when installed correctly.

**IMPORTANT**

**The sensor must be disconnected from the analyser before taking any measurements**

### 13.2 TEST PROCEDURE

To carry out the following tests, the installation engineer requires a multi-meter capable of reading resistance values up to at least  $1\text{M}\Omega$ . Refer to Figures 25 and 26.

1. Set the multi-meter to read resistances on the  $200\Omega$  range. At the analyser end measure the resistance of the loop formed by the red and yellow wires (M1, Figure 26) and note the value.
2. Again, at the analyser end measure the resistance of the loop formed by the black and blue wires (M2, Figure 26) and note the value.

Schematic representation of sensor connections

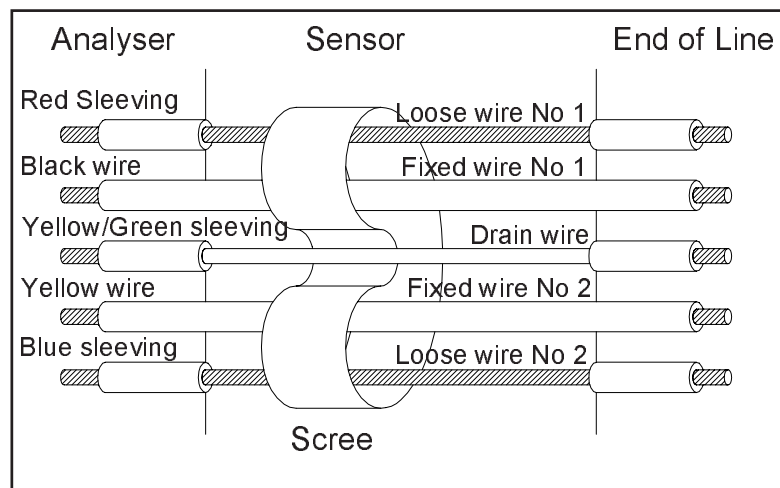


Figure 25

Schematic presentation of meter resistance readings

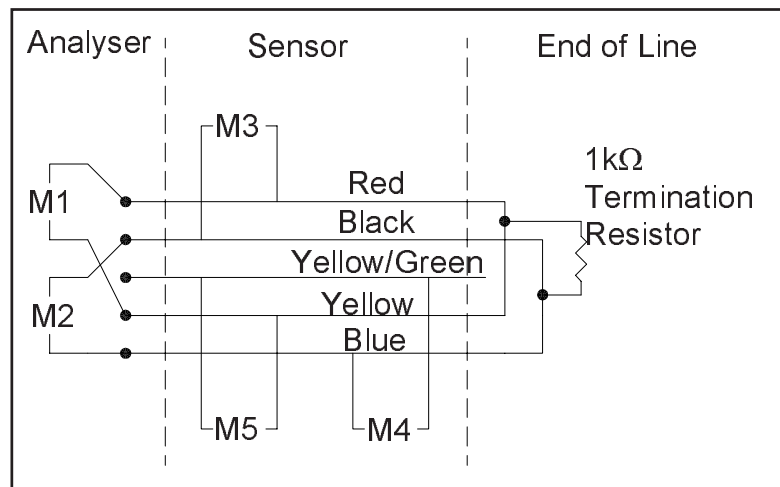


Figure 26

3. Compare the resistance values obtained from steps 1 and 2 above. In a properly terminated cable the difference between the two readings should be less than 5%.
4. Estimate the sensor length from the readings obtained using the formula shown below.

$$\text{Cable length in metres} = \frac{\text{Average loop resistance}}{16} \times 100$$

or

$$\text{Cable length in feet} = \frac{\text{Average loop resistance}}{5} \times 100$$

NB The Loop Resistance must be entered in Ohms.

5. At the analyser measure the resistance between the red wire and the black wire. (M3, Figure 26)  
This value should be 1kΩ plus the average loop resistance obtained from steps 1 and 2.
6. Set the meter range to 2000kΩ range and check that the resistance between the green/yellow earth wire and the yellow wire is greater than 1MΩ (M5, Figure 26). Repeat this test to verify no leakage between the blue wire and the earth wire (M4, Figure 26).
7. At the end of line termination box disconnect the red and the yellow/green wires from the terminal block and short together. Set the multimeter to the 200Ω range and check the resistance between the red and the yellow/green wires at the analyser. The

resistance obtained should be  $21.2\Omega$  for every 100m of cable using the sensor length calculated above. Once this test has been performed reconnect the red and green/yellow wires to the end of line termination block.

If all the above tests are satisfactory, the sensor can be connected to the analyser. If a problem is experienced in obtaining the results described above, refer to Section 14 of this manual for guidance on fault-finding.

Readings M1 and M2 taken on the  $200\Omega$  range.

Reading M3 taken on the  $2k\Omega$  range.

Readings M4 and M5 taken on the  $2000k\Omega$  range.

The following lists indicate a number of possible problems and methods of overcoming these problems.

Fault finding on Guardwire systems can be separated into two main categories as shown below.

### **14.1 INSTALLATION RELATED PROBLEMS**

<b>SYMPTOM</b>	<b>POSSIBLE CAUSE</b>	<b>REMEDY</b>
Apparent lack of response when testing or commissioning the system.	Inadequate coverage of protected area caused by wide spacing of sensor runs.	Increase number of sensor runs to comply with recommended installation requirements.
Excessive audio noise or interference when monitoring audio output.	Sensor runs parallel to power cables or other sources of electro- magnetic interference such as transformers, high power cables, etc.	Re-site sensors to maintain recommended spacing between sensor and sources of interference. Contact Geoquip Ltd for further advice.

<b>SYMPTOM</b>	<b>POSSIBLE CAUSE</b>	<b>REMEDY</b>
Variation in response to test impacts on the same zone.	Sensor installed on different types of fabric on the same zone.	Ensure that sensor is installed only on one type of fabric per zone.
	Internal damage to sensor during installation.	Contact Geoquip Ltd. for further advice.
Excessive false alarm rate under bad weather conditions.	Loose or vibrating sections of roof fabric, roof lights, vents, or external roof mounted structures.	Locate problem area using audio monitoring facility and tighten up loose sections.

SYMPTOM	POSSIBLE CAUSE	REMEDY
False alarms occur at regular intervals.	Air-conditioning or heating systems start-up. Access via doors adjacent to protected area. Factory lighting controlled via time switch.	Locate cause using audio monitoring facility and reset system controls to accept more <i>Events</i> before alarm condition occurs or re-route sensor cable to avoid sources of regular vibration.

## 14.2 SENSOR RELATED PROBLEMS

SYMPTOM	POSSIBLE CAUSE	REMEDY
Analyser indicates tamper fault.	Sensor damaged, incorrectly connected to analyser, or incorrectly terminated.	Remove sensor from analyser terminal block and insert wire links and 1k $\Omega$ resistor as per in Figure 27. If the fault persists, return the analyser for repair. If it clears, reconnect the sensor and follow the tests in Section 13.

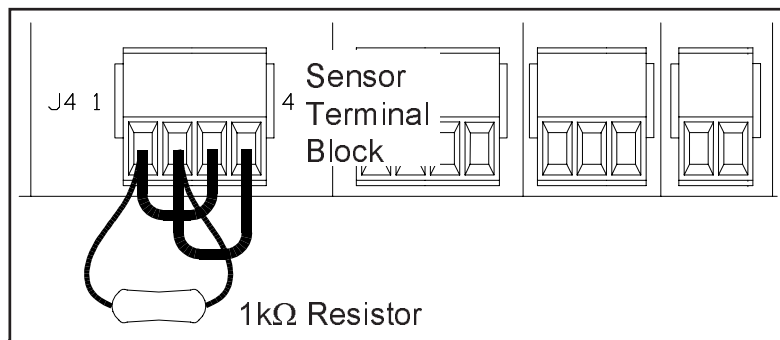


Figure 27

SYMPTOM	POSSIBLE CAUSE	REMEDY
Resistance measurement between red and black conductors less than 1k $\Omega$ .	Short-circuit between each loop in sensor caused by damage to sensor or incorrect connection of sensor sections. Incorrect or poorly made end termination.	Locate position of short-circuit using a multimeter to obtain the loop resistance between affected conductor. Distance to short-circuit can be estimated knowing that the resistance of a loop is typically 16 $\Omega$ per 100m.

<b>SYMPTOM</b>	<b>POSSIBLE CAUSE</b>	<b>REMEDY</b>
Open-circuit measurement found where loop resistance should be indicated.	Broken conductors in sensor or incorrect jointing of sections. Incorrect junction box or end of line termination.	Inspect terminations and joints to ensure correct termination procedure has been followed. If a broken conductor in the sensor is identified, contact Geoquip Ltd for advice on how to locate point of breakage.

<b>SYMPTOM</b>	<b>POSSIBLE CAUSE</b>	<b>REMEDY</b>
Resistance reading less than 1MΩ between earth wire and internal conductors.	Damage to sensor, incorrect or poorly made terminations.	Inspect terminations to ensure correct termination procedure has been followed. Inspect sheath for damage which may allow moisture in. Replace damaged section.

Use only approved parts supplied by Geoquip Ltd in all installations. Use of other items may impair long term reliability and in some cases may invalidate warranty conditions.

The following accessories and spare parts are available from Geoquip Ltd.

PART NO.	DESCRIPTION	APPLICATION
GW400k	Guardwire Sensor	Microphonic sensor used with Geoquip Ltd analysers.
GW400kFAC	Guardwire Sensor protected by flexible stainless steel conduit	Used to expediate installation where conventional 12mm aluminium conduit may be specified.
GW400kFAC-HS	Guardwire Sensor protected by high quality flexible stainless steel conduit	As above but less flexible with even higher resistance to cutting.

PART NO.	DESCRIPTION	APPLICATION
GWELT-4	Sensor Termination Kit	Used to terminate the GW400k Sensor. It comprises a watertight, tamperproof box containing the end-of-line termination.
GWELT-FAC	Sensor Termination Kit	As above except for use with GW400k-FAC.
GWGLK-1	Gate/door Loop Kit	Comprises two watertight, tamperproof, junction boxes and prewired interconnecting cable to simplify installation of sensor on hinged doors or gates.

PART NO.	DESCRIPTION	APPLICATION
GWGLK-2	Gate/door Loop Kit	As above except for use with GW400kFAC
GWJB-1	Junction Box	Used to connect sections of sensor together or sensor to non-sensitive cable. Integral tamper monitoring provided.
GWJB-FAC	Flexi Armoured Junction Box	As above except for use with GW400kFAC.
GQAMP-1	Audio Amplifier (Battery Powered)	To assist in identifying sources of false alarms.
GQFC-1	Feeder Cable (Internal Use)	Used for non-sensitive sections in sensor runs or to join sensor to an analyser.

PART NO.	DESCRIPTION	APPLICATION
GQTY-1	Cable Tie Wraps	Used to attach sensor to cages and grilles. N.B. These tie wraps will break when used with tie wrap guns and therefore such guns should not be used.
GQTY-4	Stainless Steel Wire Ties	Used for attaching GW400kFAC or steel conduit containing GW400k sensor to wire mesh.