

HEAT MAT ICE AND SNOW SYSTEMS

Roof heating system method statement

Location: Midlands – snow-drift mitigation system

Date: 6th June 2024

Contractor: ABC Contracting

Contact: Adam Driver

Installation of Heat Mat's roof heating system.

Roof Fixing Installation Process

The following procedure describes the steps to install the heating cables onto the roof itself; they do not cover the creation of a panel to power the heating system in any detail and this should be considered separately.

This document should be read in full before proceeding with any installation and if you have any questions on the information contained within please contact Heat Mat's Technical Support Team on 01444 247 020 or tech@heatmat.co.uk

It is vital that at every stage of the installation on the roof the correct safety precautions are taken to ensure the safety of those installing the system at height and also the safety of anyone walking below the roof.

Roof condition

Heat Mat's ice and snow melting systems for roofs and gutters are often retro-fitted onto existing buildings where the roof surface may not be in the best condition. The condition of the roof, valleys and gutters should be assessed before starting the installation with particular attention paid to the following areas:

- **Structural integrity** – the structure must be solid and structurally sound without any loose sections where movement can occur.
- **Physical surface condition** – any detritus, dust, loose dirt, roof gravel or vegetation on the roof should be power washed off or removed in some other way before starting with the installation. The roof surface should be entirely clear of any of loose substrate.

- **Undesirable coatings** – if the structure is coated in any grease or oil (most commonly seen in food facilities where extractor fans expel onto the roof surface) you must clean the roof with a solvent based de-greaser on a rag in the location where each fixing is going to be placed. This would normally be carried out as the fixing is positioned.
- **Roof suitability** –if the roof, valley or gutter is very smooth or has a polished surface you may need to provide a key for the adhesive to bond to. If required, the points where the fixings will be placed can be either sanded or scored.
- **Adhesion test** – before starting to fit the main system you should test the 3M hybrid adhesive on a small section of the roof to ensure that it bonds as desired. Please review the detailed instructions later in this document about how to do this and we recommend securing three fittings to each surface you are testing, leaving them for 48hours, and then verifying that they are correctly secured.

Marking out the location of where the heating cables will be laid

The heating cables need to be installed at regular intervals between the cable runs and cables may be spaced between 40mm and 150mm centre to centre depending on the cable output and desired outcome (see specification for the individual job to confirm exact cable spacing).

The cables will be secured onto the roof using a marine grade stainless steel fixings held to the roof surface with a 3M hybrid adhesive. Before the installation of the cables can start you will need to mark out the parallel lines where the cables will run and mark the regular intervals where you will be placing the cable fixing.

These fixings are spaced between every 0.5m and 5.0m depending on the individual project; **in this project the spacing is every meter**, and alternate rows should be staggered by 0.5m to minimise the risk of heating cables touching.

- If there is any detritus, dust, loose dirt or vegetation on the roof this should be power washed off or removed in some other way before the lines are marked out.
- If the roof has any grease or oil coating (most commonly seen in food facilities where extractor fans expel onto the roof surface) clean the roof with a solvent based de-greaser on a rag in the location where each fixing is going to be placed. This would normally be carried out as the fixing is positioned.
- In rare occasions on very smooth or polished surfaces you may need to provide a key for the adhesive to bond to. If required, the points where the fixings will be placed can be either sanded or scored.
- Calculate the cable-to-cable distance for the runs so that these can be marked out. This distance would normally be provided by Heat Mat, but please note that this is an approximate distance between cable runs and, in most circumstances, going 10% above or below this measurement will not present any problems.
- We recommend using a chalk line, laser line or similar to obtain your straight line to be marked onto the roof. Alternatively, some roof skins already have straight lines that you can follow instead.
- Once the lines are marked out you need to space your roof fixings along these lines at the appropriate distance apart and staggered as previously described. There are many methods that can be used to achieve this result and you should choose whatever works best for you on site.

Installation of the cable fixings

The adhesive will be placed beneath each fixing as you move along the lines on the roof, and if required you will need to de-grease or score the roof surface at this point.

At the end of this process all fixings will be in place on the roof and after approximately 48 hours they should be firmly fixed and the cables can now be secured to them.

- **Before fixing the bulk of the roof fixings we strongly recommend that 5 sample fixings are fixed in place using the hybrid adhesive to confirm that there are no issues of compatibility between the adhesive and the roof skin, and to confirm if any scoring of the surface will be required.**
- The adhesive should be used so that each 290ml dispenser fixes around 58 fixings (5ml per fixing, roughly the size of a 50p piece). A sealant gun should be used to dispense the hybrid adhesive.
- The adhesive has a best before date marked on it. If you have stored the adhesive for a long time since order and it is out of date, we can offer the following advice; in our tests the adhesive has always worked acceptably for our installation process 12 months after its expiry date, so we feel comfortable confirming it should work correctly 6 months after the expiry date and probably for much longer. Please be aware however that once the tube seal has been punctured we strongly recommend it is not used for longer than 24 hours after it was opened.
- The first run of fixings would normally be placed 50mm from the wall or edge of the roof and then at 1m or 2m intervals in the direction the cable will be laid. Please note that the cable will usually end up sitting in the saddle of the fixing (for most 7mm cable installations), therefore it is important to place these in the correct direction.
- The lines of fixings should be spaced at the intervals specified, and the fixings should be staggered cable run to cable run so that they are alternately placed 1m from the edge, then 0.5m from the edge, then one meter from the edge etc.
- Glue down the stainless-steel fixing with the 3M adhesive along the route that the cable is going to be placed. We suggest placing a 'blob' of adhesive onto the roof, and then pushing the fixing down into this. Please see the images and instructions at the end of these instructions for more information.
- Enough adhesive should be applied to allow it to pass through the holes within the fixings; this will provide a secure bond to the roof reducing the risk of any fixings moving or pulling away from the adhesive.
- The glue must not be applied in temperatures below 10°C, or above 30°C and will take approximately 72 hours to fully dry; the dry time can be affected by changes in the external air temperature therefore the fixings should be checked to ensure they are fully affixed prior to installing the cables. If a fast installation is required, the adhesive is normally 90% cured within 48 hours.
- Do not apply on wet surfaces.
- Once the adhesive is hardened the cables can be run out along the line of fixings and a cable tie should be used to hold them in place.

Installing the heating cable onto the roof

The heating cables will now be run out onto the roof in position to be cable tied onto the fixings. If required, this operation can be carried out in damp conditions without any issues.

An electrician should test each of the heating cables before they are run out onto the roof to confirm that their resistance is as expected. In the case of constant-Wattage cables an Ohms test should be carried out between the Live and Neutral and the reading should agree with that shown on the cables marking label. For all cables an insulation resistance test should be carried out. If any readings are not as expected, please contact Heat Mat for advice.

For constant-Wattage cables, please note when the cables have been installed all heating cable and the connections (cold tail connection and end termination) must end up on the roof itself in the open air to allow them to dissipate their heat. No cable or connections can be touching or crossing, and they must not have any insulative material above or below them. The connections themselves must not be secured with cable ties or similar and although they must be kept straight, they must be able to move freely.

- **Once the glue for the fixings has hardened (normally around 48 hours later) the heating cables can start to be laid.**
- The cables are not particularly malleable when they are very cold, and we suggest that they are not installed in temperatures below 10°C. If the cables must be installed in temperatures below 10°C we recommend that they are stored in a room heated to at least 20°C for a minimum of 12 hours before installation.
- In extreme low temperatures (-5°C or less) the cables can be directly powered to heat them up and ensure they are more malleable. This can only be done once they are entirely unrolled, and no cables sections are crossing or touching in any way. If warming up a cable in this way we recommend powering it via a 30mA protected 230V supply for 15 minutes, then disconnecting this supply which it starts to be installed, and then re-heat it as required. A qualified electrician should be employed to carry out this procedure.
- If the cables are being installed in wet conditions care should be taken to ensure that the end of the coldtail connection does not become wet, as this could lead to moisture ingress into the coldtail leading to later failure of the heating cable.
- We suggest planning the installation to calculate where each heating cable will be placed, what area it will cover and where the cold tail will end up. In normal circumstances we would recommend terminating all of the coldtails in the same area to ensure a simple electrical connection.
- In the case of the 7mm Black system the cables should ideally be laid between the saddles of the fixings, and we recommend that teams of two people should work to install these. All other cables will normally be laid beside the saddle fixing.
- The heating cables can be placed onto a cable dispenser or hand spooled, and the cable should be installed coldtail first and then working away from where the electrical connections will be made.
- Firstly, ensure that there is enough coldtail available to run back to where the electrical connections will be made.
- **The connection between the coldtail and the heating cable must not be bent, crushed or strained at any point and this must be laid flat on the roof surface.**

- In the case of a trace heating cable being installed ensure that you provide the trace heating cable with a cold tail/electrical supply lead of a sufficient length.
- The connection between the cold tail and the heating cable should be placed onto the roof in the heated area and should be secured in place with a fixing either side of the connection, with the connection remaining entirely flat and unbent. A fixing should be placed 30mm from each end of the rubberised connection and the cable should be cable tied in place at that point so that it does not easily slip through the cable tie. Under no circumstances should any cable ties be used to secure the actual connection itself.
- **If multiple cables are being installed, the rubberised cold tail connections should be installed at least 100mm from each other and any other heating cables.**
- You should then continue to lay a run of heating cable from one side of the roof to the other with the cable fairly taut and being held in place with the cable ties.
- The cable should then be secured onto the fixing by using the appropriate zip ties and then the next run of the cable should be laid out.
- You should then repeat this process until you are close to the end of the heating cable. If the heating cable is not going to be able to complete a full run we suggest laying the last section of the cable in a way that will allow two equal length short runs of heating cable to be laid.
- This is achieved by running the remaining heating cable out from the edge of the heated area for half of its length, and then curving it back along where the adjacent run of heating cable will be laid and running the remaining cable back to the edge of the heated area.
- This results in the end termination of the cable being placed at the edge of the heated area, and also ensures that you do not paint yourself into a corner when fixing the cables on to the roof.
- The end termination is another rubberised section, and this must not be directly secured to the roof itself, but the final cable tie holding the cable in place should be 30mm from the end of this termination to prevent it moving excessively.
- When you lay the next heating cable there will be a section of the roof that now has two parallel runs of heating cable that have not been completed and you will fill these in with your first run of the new heating cable.
- When you get to installing your last heating cable, we suggest you remeasure the area of the roof that you have to still cover to ensure that it will fit appropriately. If the cable looks like it will be up to 20% too large or too small for the area then you can alter your cable-to-cable spacings to accommodate this, or in the case of too large a cable you can extend it onto another section of roof if desired rather than changing the cable to cable spacing.
- **If the final cable appears to be more than 20% too large or too small for the remaining roof area please contact Heat Mat to discuss your options.**
- In the case of constant-Wattage cables including the 7mm Black cable It is important that none of the heating cables are covered with any type of insulative material or have insulative material below them, and that no cables are touching or crossing as this could lead to them burning out.
- In the case of trace heating cables, it is not an issue if cables cross or touch, but we would still recommend ensuring they are not covered with insulative materials.
- Although the heating cables will bear normal pedestrian traffic, we recommend walking on them as little as possible during the installation process, and care must be taken not to kick or catch the cables or to drop anything onto them.
- Factory made heating cables have a coldtail connection between the coldtail and heating cable, and also an end termination at the end of the cable. On trace heating cables irreparable and non-periodically checkable connections also have these connections which you would normally make yourself on site with the supplied connection kit. In all cases these connections should be

IPX7 rated and must not sit for sustained periods of time in pools of water. They can be submerged during precipitation events but must not for instance sit in a pool of rainwater trapped in a gutter for days on end. For this reason we recommend that the connections are secured slightly up the sides of gutters if water is likely to stand in the gutter for significant lengths of time.

Installing the heating cable into gutters and valleys

To ensure the smooth egress of meltwater any valleys, gutters and downpipes will need to be heated to ensure there are no ice dams.

A trace heating cable will most commonly be used to protect these areas, however for very large roofs or wide valleys and gutters a constant-Wattage cable may be used instead.

When installing trace heating cables you must be aware that each type of cable has a maximum single-run length and this is associated with the switch on temperature of the cable. Please see the individual specification of your project for more details.

- Whichever type of heating cable is being used to protect the gutter/valley it will be held in place in the same method as the roof heating cables; 3M hybrid-adhesive and marine grade stainless steel fixing. We recommend one fixing for every meter or so of heating cable.
- If there is more than one run of the cables, they should be spaced out to the distance specified for the project.
- If trace heating cables are being used it is fine for them to touch and overlap, but if a constant-Wattage cable is being used these must not touch or overlap.
- For most installations the heating cable will run 1m down into the downpipe before returning back on itself. For some projects suspension beams and chains will be supplied if required to guide the cables.
- Trace heating cables can be cut to length as noted in the instructions supplied for those products. The end terminations and coldtail connections on trace heating cables are made as an irreparable and uncheckable connection, and our general advice is to connect the coldtail before the cable is fitted on the roof.
- A suitable length and rating of coldtail should be connected to the trace heating to power it.

System Controls

System controls are normally installed into a panel located inside the building, or in a suitably IP-rated enclosure on the roof.

- There are a wide variety of heating controls that can be used to monitor and operate your roof or gutter heating system. We recommend reading the individual instructions for the products you have on site, however we can offer the general advice on these controls.
- If the control gear is going to be mounted in an area where it is open to the elements it is important to ensure that they are in a suitably IP rated enclosure – usually this would mean IP67 as a minimum.
- If using Heat Mat's IP67 rated 20Amp controller which is supplied in its own IP67 enclosure it is vital that the appropriate seals are fitted as this is installed – seals are usually provided with the system.
- If using one of Heat Mat's Din-rail mounted controllers, manufactured by OJ Electronics, these should be mounted either indoors, or in a suitably rated enclosure outside. Please note that all these Din-rail mounted controllers use Volt-free contacts so must be wired appropriately.
- Various sensors are used to monitor the roof heating system. We would always recommend installing an air temperature sensor or a sensor monitoring the roof surface temperature between two heating cables.
- For systems using a moisture sensor this should be placed in a low point of the gutter/roof where meltwater will run. It is vital that this sensor is placed with the brass section uppermost so that it can obtain the correct moisture reading.
- Heat Mat's recommendation is that a manual override is added to all systems by the installer.
- **We strongly recommend using a qualified electrician to install the controllers and to ensure that they are suitable protected from the elements.**
- **All systems should be fitted with 30mA protection and our interpretation of S.753 of the 18th Edition is that it could be construed to apply to roof heating systems. It is therefore vital that the installer and or individual signing the system off satisfies themselves that it is compliant.**
- **Based on the above guidance we recommend that no more than 4.25kW of heating cable is powered via any one contactor, and the power supply through each contactor should have its own 30mA protection. In most installations this means that each of the heating cables will require a dedicated 20A contactor and 30mA protection.**

System Testing

The system testing is normally carried out by the electrician in charge of the installation supported by Heat Mat's commissioning team.

- There are a number of tests that should be carried out to confirm a system will operate as required, and please call Heat Mat's technical support team on 01444 247020 to discuss these. In short, the main methods are as follows.
- To test that a system is heating correctly direct power can be supplied to the heating cables for a period of no more than 5 minutes to ensure that the cables heat as expected, which can be seen through a thermal imaging camera or felt by touch. Please note that the cables must be fixed in their final positions before carrying out these tests as the cable must not be spooled up when power is supplied to it.

- To test controller settings the controller can be set to heat at the current ambient temperature, and any moisture sensors present should have water poured over them. This should force power to the system but please note the caveats about ensuring the system is fully installed.
- If the controller is not capable of being set to the current ambient temperature, then most controllers have a forced heat function that can be used to test that the system heats as expected.
- Once testing is complete, we recommend setting the system to power up at perhaps 2°C when moisture is present, although speak to your client about their desired setup. For systems that are being controlled simply on a manual override you should make sure your client is aware that it will not heat automatically and must be manually turned on.

Along with this document a copy of the 6mm and 7mm Cable Instructions should have been supplied to you (please refer to pages 17 and 18 as well as any additional technical information you may require), and also trace heating instructions if these are pertinent to your installation. Instructions for each controller will be included in the packaging of those items.

If you have any queries on your installation please call Heat Mat's Technical Support Team on 01444 247020 or email tech@heatmat.co.uk

Ongoing maintenance

The main maintenance requirement is to ensure that the system is not being covered in detritus/leaves that could cause cable to overheat. Our recommended maintenance regime is as follows:

- **Annually** - Check for detritus above the heating cables visually on an annual basis after local leaf-fall. At the same time visually check all cables for any damage to them or movement of them during the year.
- **Periodically as required** – carry out periodical electrical tests on the heating cables and connections as required by local legislation. At the same time as these tests are carried out we recommend checking that the sensors are free of dirt and detritus.

Additional information – monitoring systems

Ice and snow mitigation systems are fitted for a wide variety of reasons, the most common being to prevent snow drifts, to prevent snow and ice building up and falling off the building, and to ensure the smooth egress of meltwater from the building.

To monitor the efficacy of the roof mounted mitigation system we recommend the placement of CCTV on the roof so that it can monitor the build up of any ice and snow, and then appropriate action can be taken if there is an indication that the system is being overwhelmed. Optical CCTV works well for this purpose, and infra-red cameras can be used to verify the roof temperature and that the cables are heating as expected. When using optical CCTV a 1m measure/ruler can be placed in an upright position on the roof to calibrate any snow that is building up.

For snow load mitigation systems specifically laser measurers, and strain gauges within the roof itself, can be used in addition to the above.



Further detail on how to fix the heating cables

The heating cables are attached to the roof via marine-grade stainless steel fixings. These fixings sit on the roof surface, attached with a proprietary 3M adhesive, and the cables are held in place with UV-stable cable-ties. In the case of the 7mm black roof heating cable the cable can sit in the saddle of the fixing and is then cable-tied in place. As an option for the 7mm cable if desired, and in the case of 8mm and larger cables and most trace heating cables the cable sits beside the fixing outside of the saddle, and is then cable tied to the side of the fixing.

- The adhesive should not be installed in temperatures of below 10°C as this will slow down the curing process. Although some moisture is required for the adhesive to cure in outdoor conditions the air will always contain enough to allow the process to continue. We recommend that the adhesive is Ideally the adhesive should not be subjected to heavy rain or similar in the first 48 hours of curing.



- If the roof has loose dirt, dust, vegetation etc. on it this should be power-washed off to present a clean surface. If the roof has any grease or oil coating (most commonly seen in food facilities where extractor fans expel onto the roof) clean the roof surface with a solvent based de-greaser on a rag, beneath where each fixing is going to be placed.
- Place a generous amount of adhesive onto the roof surface (approximately 5ml) covering an area approximately the size of a 50p piece.



- Push down the stainless-steel fixing into the adhesive twisting it slightly backwards and forwards to ensure a good bond; the aim is for some of the hybrid-adhesive to push up through the holes as this will provide better adhesion. We strongly suggest using gloves for this operation to prevent the adhesive sticking to your skin. It is also important not to use too much adhesive as this could lead to the saddle becoming blocked preventing the cable tie from being able to pass through it.
- As cables are being fixed every meter on this project rectangular fixings will be used as an alternative to the octagonal ones shown in these images. The rectangular fixings have the saddle on a 45 degree angle.



- Allow at least two days for the adhesive to dry before installing the cables, and ideally 72 hours if possible. Usually, the cables can sit within the saddle, and a suitably outdoor rated UV-stable zip tie should be used to secure the cable in place. This zip tie should not be over-tightened and should allow the cable to move backwards and forwards through the saddle as it heats up and cools down.
- Due to the close nature of the runs of heating cables in this installation it is recommended that the cable ties are used to prevent the cables slipping backwards and forwards too much. To this end we suggest looping the cable tie through only one side of the fixing and tightening it to the point where a few kg of force is required to pull the cable through the cable tie.

The specific 3M advice on the use of their hybrid adhesive is as follows:

Surface Preparation:

Surfaces to be sealed or bonded must be clean, dry and be free from grease, mould release, oil, water/condensation and other contaminants that may affect the adhesion of the sealant. Abrading with 180 to 220 grit abrasive followed by a solvent wipe will improve the bond strength. Suitable solvents include 3M™ Citrus Based Adhesive Remover, 3M™ Scotch-Weld™ Solvent No. 2 or methyl ethyl ketone (MEK).

When using solvents, use in a well ventilated area. Extinguish all sources of ignition in the work area and observe product directions for use and precautionary measures. Refer to product label and MSDS for further precautions. Always pre-test solvent to ensure it is compatible with substrates.

Application:

Puncture seal in nozzle and knock out the thin seal at cartridge bottom before placing in a pneumatic caulking gun. (For flex packs cut off the small crimp at the end and then place in caulking gun barrel with the open end up). Assemble tip and retaining ring on gun, cut tip to desired size. Product should be used within 24 hours after seal is punctured and should be pressed firmly into the joint to ensure adequate contact of the sealant with the substrate.

Apply product when temperatures are between 5° C and 35° C. In cold weather, store the product at about 20 °C before use. Do not apply on frozen surfaces or wet surfaces.

Do not apply over silicones or in the presence of curing silicones.

Avoid contact with alcohol and solvents during curing.

Sealant can be tooled immediately after applying to give desired appearance, such as using a putty knife to smooth the joint with soapy water.

Avoid any contact with non-cured hybrid sealant during curing.

Commissioning information

Details to be completed once the commissioning visit has taken place.

Commissioning includes setting and testing of the controls and sensors, thermal images of heating cables, confirmation of positioning of sensors on roof, layout of panel etc. Thermal drone surveys can be carried out if desired.

Contact details

Heat Mat who designed the system can be contacted on 01444 247020 and at Tech@heatmat.co.uk, or through www.heatmat.co.uk

The lead designer was David Green Dave@heatmat.co.uk – 07717 478329

Support provided by Andy McNally Andym@heatmat.co.uk and Andrew Hill Andrew@heatmat.co.uk



Bespoke system installation details – SAMPLE ONLY

The details of the heating cables supplied for this generic project are as follows:

- 13 x **ICE-7.0-SPEC** – 150m 7.0mm roof heating cable with 15m external coldtail
 - 200m x **ACC-CAB-EX28** – 28W/lm external grade Ex trace heating cable
 - 2,250 x **ICE-FIX-SPEC** – marine grade stainless steel roof fixings
 - 40 x **ICE-FIX-SPEC** – proprietary 3M roof fixing hybrid adhesive
 - 3 x **FRO-48A-STAT** – 11kW snow melting controller
 - 8 x **FRO-GUT-SENS** – gutter moisture detectors
 - 4 x **FRO-TEM-SENS** – external temperature sensors
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- 6 of the **ICE-7.0-SPEC** are to be installed on the lower roof section, at a spacing of approximately **57mm apart** (taken from cable centre to cable centre)
 - 7 of the **ICE-7.0-SPEC** are to be installed on the lower roof section, at a spacing of approximately **55mm apart** (taken from cable centre to cable centre)
 - The edge of the roof to the east and above the heated areas will need protection to prevent snow cornice building up and falling onto the heated area below. 27m of **ACC-CAB-EX28** has been specified to protect this area running in a zig-zag pattern above the entire length of roof.
 - This cable should be fixed between the edge of the roof and 500mm into the roof, running zig zags at 45 degrees to the roof edge – this will lead to 1.4m of cable being used for every 1m progress along the roof edge. Fixings should be placed at each of the points where the cable turns.
 - 36m of **ACC-CAB-EX28** has been specified to protect the gutters beneath this zig-zagging heating cable, and to runs of the heating cable should be placed into the gutter spaced equidistant from the edges. Enough additional cable has been allowed for to reach 1m down each downpipe and then back again.
 - 137m of **ACC-CAB-EX28** has been specified to protect the gutters to the west of the heated roof area, and three runs of the heating cable should be placed into the gutter spaced equidistant from the edges, or in the case of the open walkway area just three runs of cable on this section of roof. Enough additional cable has been allowed for to reach 1m down each downpipe and then back again.
 - One **FRO-48A-STAT** should be used to control the zig-zagging heating cable and the gutter heating system on that section of roof. 2 x **FRO-GUT-SENS** should be installed in the gutter on that section of roof and 1 x **FRO-TEM-SENS** should be positioned at a suitable point for monitoring air temperature. The moisture sensors should be wired into the controller for zones 1 and 2, ports 15 and 16 for one, and ports 19 and 20 for the other. The heating elements of the sensor should be wired into ports 11 and 12. The air temperature sensor should be wired into ports 13 and 14.
 - One **FRO-48A-STAT** should be used to control the lower section roof heating cable and the gutter heating system on the entire section of the two lower roofs. 2 x **FRO-GUT-SENS** should be installed in the gutter on that section of roof, 2 x **FRO-GUT-SENS** should be positioned on the heated roof equidistant between heating cables, and 2 x **FRO-TEM-SENS** should be positioned at a suitable point for monitoring air temperature. A moisture sensors for each zone should be wired into the controller for zones 1 and 2, ports 15 and 16 for one, and ports 19 and 20 for the other. The heating elements of the sensor should be wired into ports 11 and 12. The air temperature sensors should be wired into ports 13 and 14 for one, and 17 and 18 for the other. The additional moisture sensor for each zone should be left uninstalled.

- One **FRO-48A-STAT** should be used to control the upper section roof heating cable. 2 x **FRO-GUT-SENS** should be positioned on the heated roof equidistant between heating cables, and 1 x **FRO-TEM-SENS** should be positioned at a suitable point for monitoring air temperature. The moisture sensors should be wired into the controller for zones 1 and 2, ports 15 and 16 for one, and ports 19 and 20 for the other. The heating elements of the sensor should be wired into ports 11 and 12. The air temperature sensor should be wired into ports 13 and 14.
- To simplify the installation of the heating cables we suggest that they are laid out according to the diagram below – one cable along the top of each of the raised seams, and then once cable in the centre of each of the 5 panels of the roof in between the raised seams. This will bring the installation close to the suggested distance between heating cables.



- As no scale diagram has been provided for this project the image below can be used to confirm the areas that we have noted in this document. Please note, the gutter heating system for the roof protection system is not shown separately.

