

PENTAIR

Raychem

WINTERGARD WET ROOF & GUTTER DE-ICING

DESIGN, INSTALLATION AND MAINTENANCE GUIDE

WINTERGARD WET



The Problem

Rooftop snow, melted in sunlight or from the building's interior heat, trickles down to the cold roof edge and freezes again, forming ice dams and icicles—creating four potential hazards.

- **Interior Structural Damage** – Ice dams on roof edges lead to water ingress.
- **Exterior Damage to Gutters** – Frozen gutters are heavy, leading to distortion or breakage.
- **Falling Icicles** – Icicles pose a threat and a liability to people and property.
- **Slippery Walkways** – Overfilled gutters allow water to fall on the ground and refreeze.

One Simple Solution

A WinterGard Wet self-regulating heating cable system eliminates icicles and ice dams safely and efficiently. A professional-quality electric heating cable, WinterGard Wet heating cable can be cut and spliced to fit the layout of any roof line. Installed on a roof or inside gutters and downspouts, WinterGard Wet heating cable creates a drainage path for melting snow, adjusting its heat output as the ambient temperature fluctuates. When the gutter is dry, the system automatically cuts back its power output so it won't ever overheat or burn out.

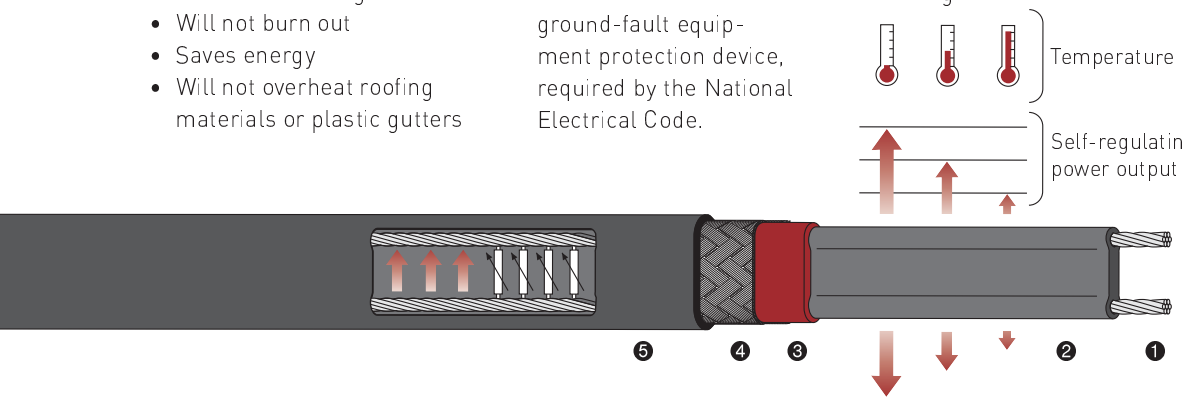
Simple and Reliable

- Can be overlapped
- Can be cut to length
- Will not burn out
- Saves energy
- Will not overheat roofing materials or plastic gutters

- The H908 Plug-in cord set reduces installation costs by utilizing an existing power outlet, eliminating the need to hardwire. The H908 also includes a 27-mA ground-fault equipment protection device, required by the National Electrical Code.

- Reduce the amount of heating cable required by tracing only problem areas such as the roof edge above a walkway or the north side of a building.

- Trace only the gutters and downspouts. It is not always necessary to serpentine heating cables on the roof eave. If ice dams are not located on the eave, installing heating cables only in the gutters and downspouts may be sufficient.



Parallel Circuitry

Current flows between the two bus wires independently at each point along the heating cable.

Self-Regulation

The conductive polymer heating core regulates its power output in response to the temperature.

Heating Cable Construction

1. Nickel-copper bus wires
2. Self-regulating conductive core
3. Insulating jacket
4. Tinned-copper braid
5. Outer polyolefin jacket



H612250

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INTRODUCTION

Overview

WinterGard Wet heating cable is a professional-grade, self-regulating electrical cable that can be used for roof and gutter de-icing. This guide provides complete design and installation instructions for a WinterGard Wet system that will provide drain paths for the following applications:

- Roofs made from all types of standard roofing materials, including shake, shingle, rubber, tar, wood, metal, and plastic.
- Gutters made from standard materials, including metal, plastic, and wood.
- Downspouts made from standard materials, including metal and plastic.

The guide does **not** provide information for using a WinterGard Wet system for the following applications:

- Preventing snow movement on roofs—WinterGard Wet cable will not keep snow or ice from falling off the roof. Snow fences or snow guards should be used to eliminate snow movement.

  For the names of manufacturers of snow guards or snow fences, contact Pentair Thermal Management at (800) 545-6258.
- Clear accumulated snow off a roof and/or reduction of snow load—WinterGard Wet cable is designed to provide a continuous path for melt water, not to clear accumulated snow.

If your application conditions are different, or if you have any questions, contact Pentair Thermal Management at (800) 545-6258.

The roof and gutter de-icing systems covered in this guide are for normal winter conditions. For extreme winter conditions with snow fall accumulations of 9 inches or more and ambient temperatures below 0°F contact Pentair Thermal Management at (800) 545-6258.

Safety Guidelines

The safety and reliability of any heat-tracing system depends on the quality of the products selected and the manner in which they are installed and maintained. Incorrect design, handling, installation, or maintenance of any of the system components could damage the de-icing system or the roof and may result in inadequate de-icing, electric shock, or fire. To minimize these risks and to ensure that the system performs reliably, read and carefully follow the information, warnings, and instructions in this guide.

This symbol ⚠ identifies particularly important safety warnings that must be followed.

Codes and Approvals

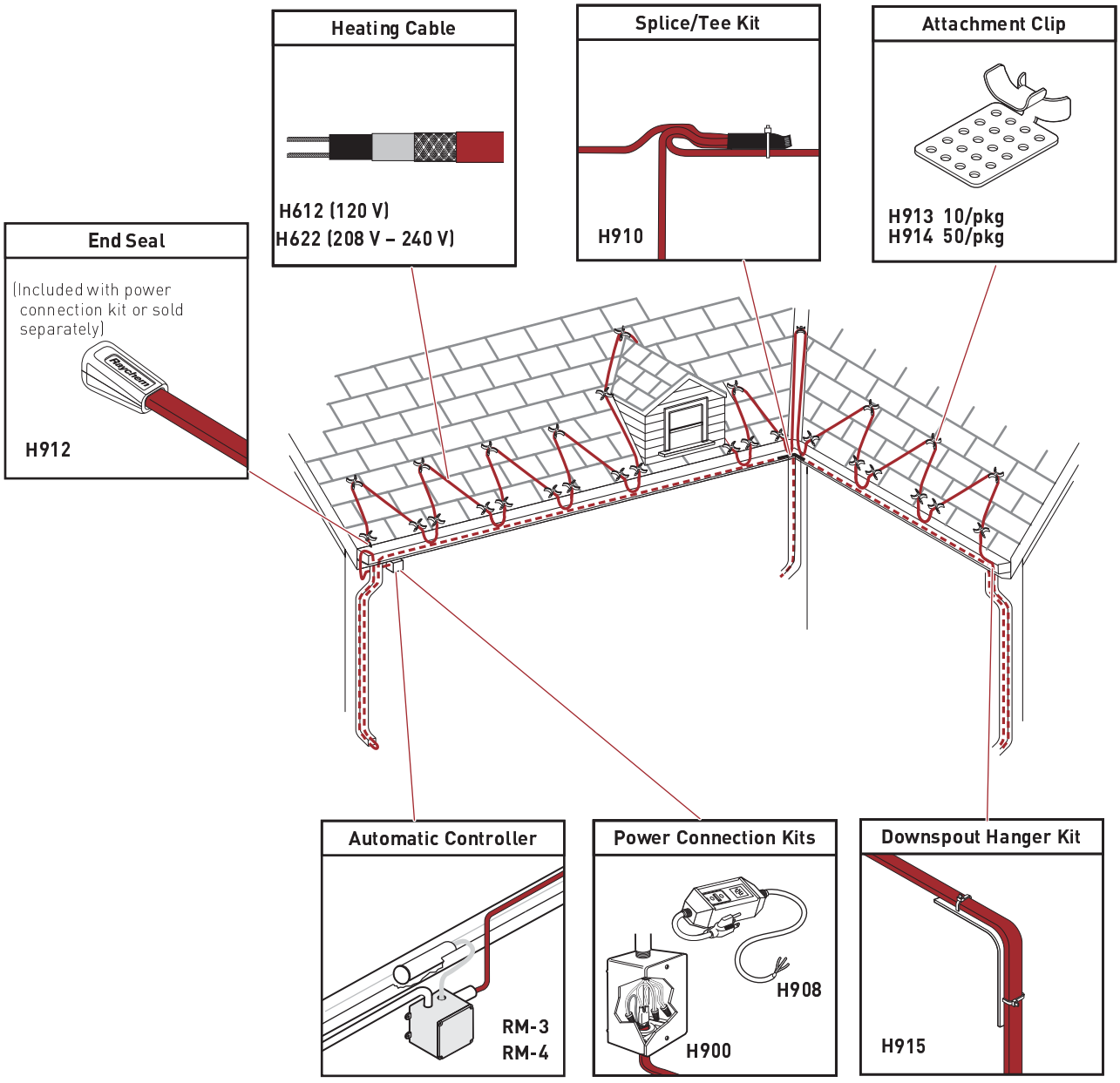
Installation of a WinterGard Wet system is governed by Article 426 of the National Electrical Code (NEC) and Part I, Clause 62-300, of the Canadian Electrical Code (CEC). Pentair Thermal Management, the NEC, and the CEC all require the use of ground-fault protection of equipment to reduce the risk of fire caused by damage or improper installation. All installations must also comply with applicable local codes and standards.

The WinterGard Wet roof and gutter de-icing system is UL Listed and CSA Certified for use in nonhazardous areas, and specifically for roof and gutter de-icing.

WinterGard Wet System Description

Ice dams can cause water ingress into buildings and generate dangerous icicles. A WinterGard Wet system can help prevent ice dams and icicles by maintaining a continuous path for melt water to drain from the roof. As long as a heated path from the roof to a safe discharge area is maintained, ice dams will not form. The WinterGard Wet system can be used on roofs and valleys and in downspouts and gutters made from all types of standard roofing materials, including metal, plastic, wood, shake/shingle, rubber, and tar.

The WinterGard Wet system is intended to provide drain paths. A typical system includes the following:



DESIGN GUIDELINES

How to Use These Guidelines

When using the WinterGard Wet Design and Installation Guide, follow these steps:

1. Determine the cable layout for the roof, gutters, and downspouts–Step 1 below.
2. Determine the attachment methods you will use – "Step 2. Attachment Methods" on page 11.
3. Select the type of control you will use – "Step 3. Control" on page 16.
4. Select accessories – "Step 4. Accessory Selection" on page 18.
5. Determine electrical requirements – "Step 5. Electrical Design" on page 19.

After you have reviewed this guide, use the "Design Worksheet" on page 30 to complete the design of your project.

Step 1. Heating Cable Layout

LAYOUT OVERVIEW

Heating cable layout depends primarily on the roof type. The following sections show typical layouts on standard roof types.

Roof type/area	Page
Sloped Roof—Shingle Roof	4
Sloped Roof—Standing Seam–Metal	5
Flat Roof	6
Sloped Roof Without Gutters	7
Valleys	8
Roof/Wall Intersections	8
Gutters	9
Downspouts	10

Important: The heating cable must be in contact with snow or ice to work effectively. Do not install the heating cable under the roofing or the roofing materials.

Figure 1 and Figure 2 below illustrate several important terms:

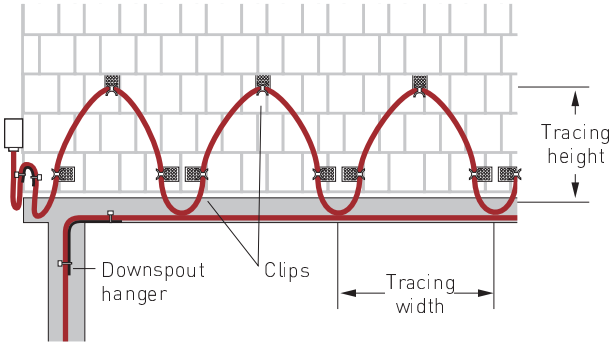


Figure 1 Front view of roof with WinterGard Wet system

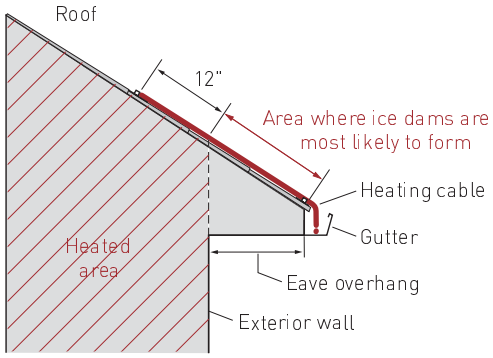


Figure 2 Side view of WinterGard Wet system

SLOPED ROOF—SHINGLE ROOF

For sloped roofs, ice dams may form at the roof edge. To maintain a continuous path for melt water runoff, route the heating cable in a serpentine pattern as shown in Figure 3 below and follow the appropriate attachment recommendations in Step 2. Additional heating cable may be needed for other gutters, downspouts, and valleys.

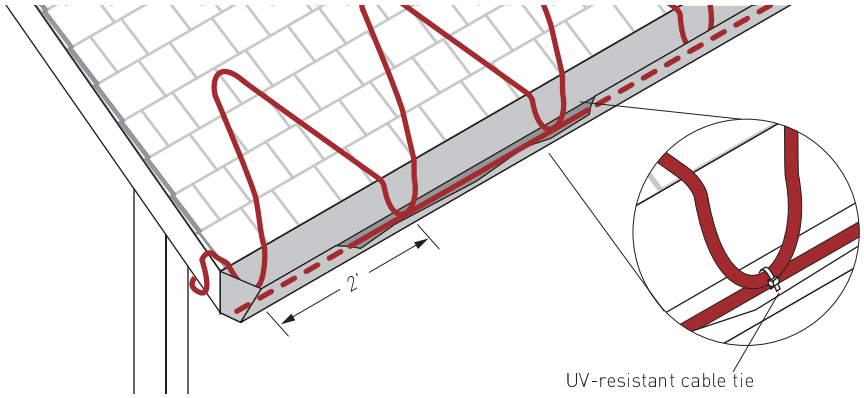


Figure 3 Layout in a serpentine pattern

Note: Attachment methods are purposely not shown in Figure 3. For attachment methods, proceed to "Step 2. Attachment Methods" on page 11.

- Run heating cable up the roof until it is approximately 12 inches past the exterior wall into the heated area (see Figure 2 on page 3).
- Install the heating cable on the roof in a serpentine pattern as shown in the illustration above.
- Add 6 inches of heating cable for each foot of roof edge to extend the heating cable on the roof all the way down to meet with the run of heating cable in the gutter. This will ensure that you have a continuous path where the melted water can flow. Attach the heating cables together with UV-resistant cable ties.
- For gutter deeper than four inches, additional cable will be needed, contact Pentair Thermal Management at (800) 545-6258.

TABLE 1 WINTERGARD WET HEATING CABLE LENGTH FOR ROOF DE-ICING

Eave overhang[1] distance	Tracing[2] width	Tracing[2] height	Length of heating cable (per foot of roof edge)
None	2 ft	12 in	2 ft
12 in	2 ft	24 in	2.8 ft
24 in	2 ft	36 in	3.8 ft
36 in	2 ft	48 in	4.8 ft

1. See Figure 2
2. See Figure 1

Other Considerations

- Use a snow fence or snow guards (not shown) to prevent snow from sliding. Do not extend the heating cable above the snow fence.
- It is not always necessary to run heating cables on the roof. If you do not experience ice dams on the roof, installing heating cables only in the gutters and downspouts may be sufficient.

SLOPED ROOF—STANDING SEAM-METAL

For sloped standing-seam metal roofs, ice dams may form at the roof edge. To maintain a continuous path for melt water to run off, route the heating cable along the seams as shown in Figure 4 and follow the attachment recommendations in Step 2. Additional heating cable may be needed for downspouts and valleys.

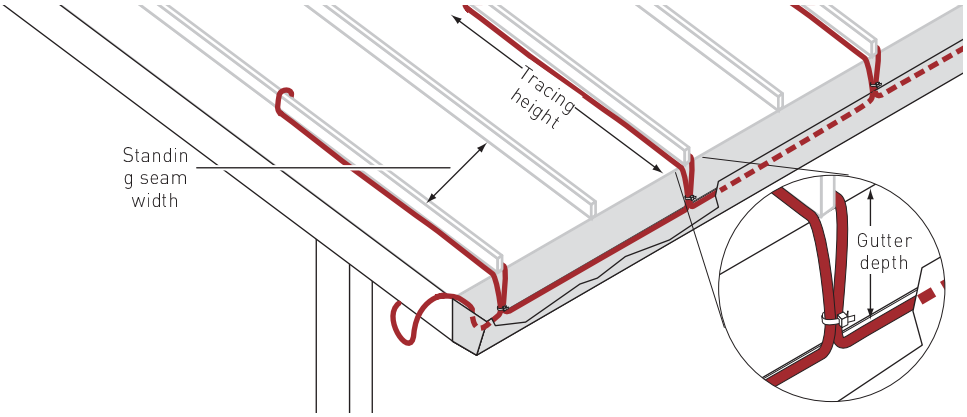


Figure 4 Layout on a standing seam roof

Note: Attachment methods are purposely not shown in Figure 4. For attachment methods, proceed to "Step 2. Attachment Methods" on page 11.

- Run the heating cable up the seam until it is approximately 12 inches past the exterior wall and over a heated area (see Figure 2 on page 3).
- Run the heating cable up one side of the seam, loop it over to the other side, and return it to the bottom of the gutter. Continue along the bottom of the gutter to the third seam and repeat the process (see Figure 4). If the metal roof panels are more than 24 inches wide, trace every seam along the roof edge.
- Add 6 inches of heating cable for each foot of roof edge to extend the heating cable on the roof all the way down to meet with the run of heating cable in the gutter. This will ensure that you have a continuous path where the melted water can flow. Attach the heating cables together with UV-resistant cable ties.

Note: For large commercial building with standing seam roofs contact Pentair Thermal Management at (800) 545-6258.

TABLE 2 WINTERGARD WET HEATING CABLE LENGTH FOR STANDING SEAM ROOFS

Eave overhang distance	Standing seam width	Tracing height	Length of heating cable (per foot of roof edge)
0 in	18 in	12 in	2.5 ft
12 in	18 in	24 in	2.8 ft
24 in	18 in	36 in	3.6 ft
36 in	18 in	48 in	4.3 ft
0 in	24 in	12 in	2.0 ft
12 in	24 in	24 in	2.4 ft
24 in	24 in	36 in	2.9 ft
36 in	24 in	48 in	3.6 ft

- On a metal seamed roof system, the length of heating cable needed for the roof and gutter can be determined by the formula:
  Heating cable length (ft) = [2 x (tracing height (inches) + gutter depth (inches)/12)] x no. of seams traced + distance along the gutter/roof edge (ft)

Additional heating cable will be needed for accessory connections and downspouts.

Other Considerations

- Use a snow fence or snow guards (not shown) to prevent snow from sliding. Do not extend the heating cable above the snow fence.
- If the roofing materials continue down the fascia, add enough to the heating cable length to allow for this.
- It is not always necessary to run heating cables on the roof. If you do not experience ice dams on the roof or roof damage, installing heating cables only in the gutters and downspouts may be sufficient.

FLAT ROOF

Ice dams may occur on flat roofs at the edge flashing and at drains. Flat roofs are typically pitched toward drains and these paths often become obstructed by snow and ice. To maintain a continuous path for melt water to run off, route the heating cable as shown in Figure 5 and follow the appropriate attachment recommendations in Step 2. Additional heating cable may be needed for downspouts.

Note: For commercial buildings with large flat roofs contact Pentair Thermal Management at (800) 545-6258.

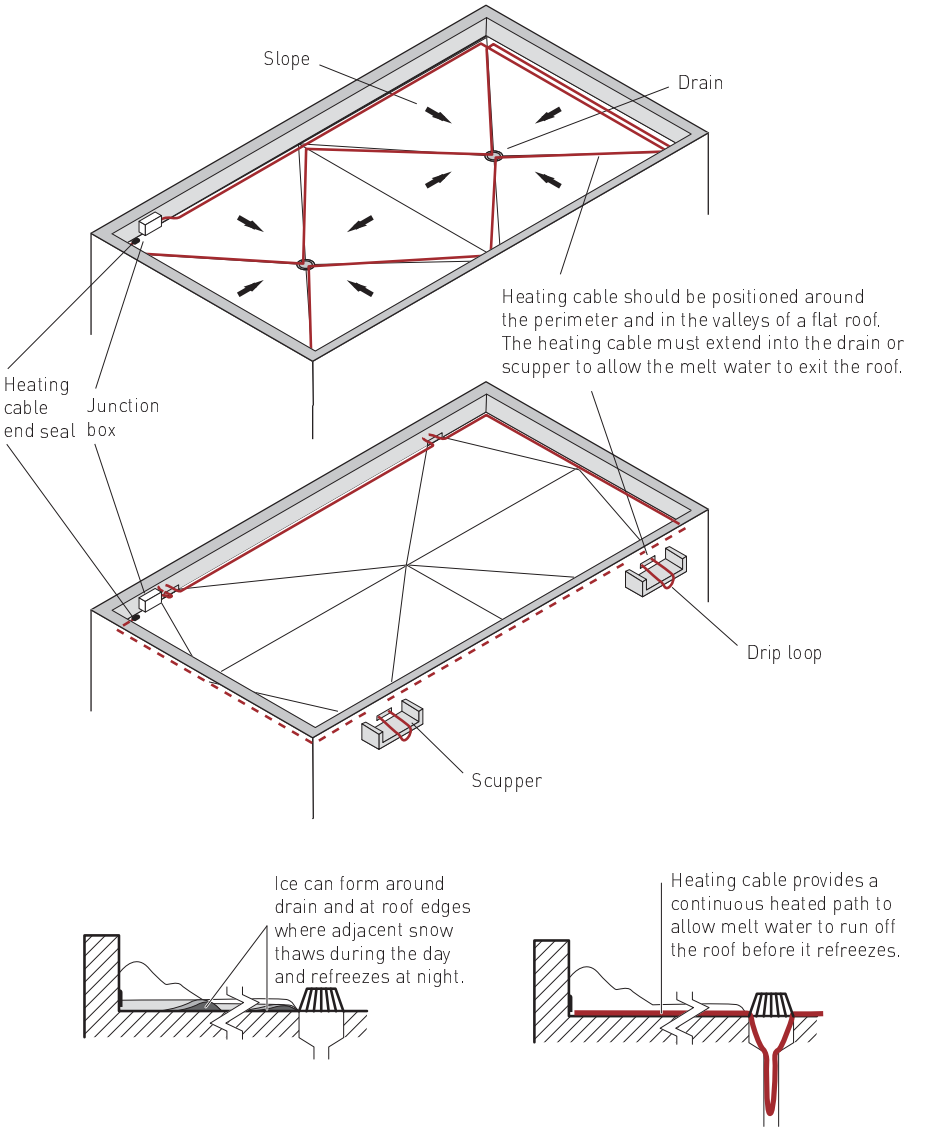


Figure 5 Layout on a flat roof

- Place heating cable around perimeter.
- Trace valleys from perimeter to drain.
- Extend heating cable into internal downspouts at least 12 inches into heated space.
- External downspouts and scuppers must be treated carefully. A path must be provided for the valley/perimeter heating cable to the point of discharge (see Figure 11 on page 10).
- To avoid damage, do not walk on the heating cable.
- For attachment methods, proceed to "Step 2. Attachment Methods" on page 11.

SLOPED ROOF WITHOUT GUTTERS

Pentair Thermal Management recommends a gutter and downspout to provide a continuous path for melt water. When gutters are not used on a building, ice dams may form at the roof edge. To maintain a continuous path for melt water to run off, a drip loop may be used. Drip loops allow water to drip free of the roof edge.

Route the heating cable as shown in Figure 6 below and follow the appropriate attachment recommendations in Step 2. Additional heating cable may be needed for valleys.

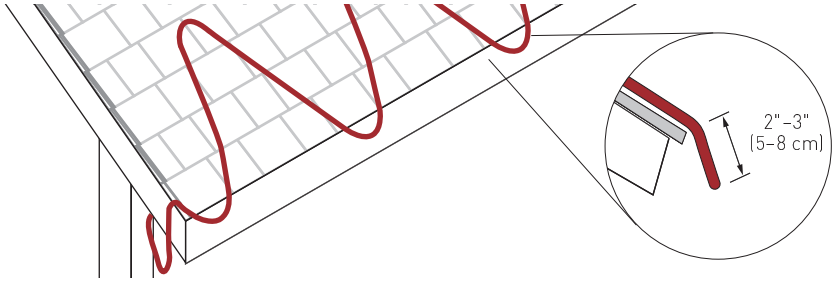


Figure 6 Layout for heated drip loops

Other Considerations

- The drip loop must hang below the lip of the roof as shown in Figure 6.
- Use a snow fence or snow guards to prevent snow from sliding (not shown). Do not extend the heating cable above the snow fence.
- Ice will build up on the surfaces below the drip loop if gutters are not used.
- Ice may also build up on the vertical surfaces if there isn't a sufficient overhang or if there is a strong wind. Use of a gutter system will prevent this ice buildup.
- For attachment methods, proceed to "Step 2. Attachment Methods" on page 11.

VALLEYS

Ice dams may form at the valley on a roof where two different slopes meet. To maintain a continuous path for melt water, run the heating cable up and down the valley as shown in Figure 7 and follow the appropriate attachment recommendations in Step 2. Additional heating cable may be needed for the roof surface, gutters, and downspouts.

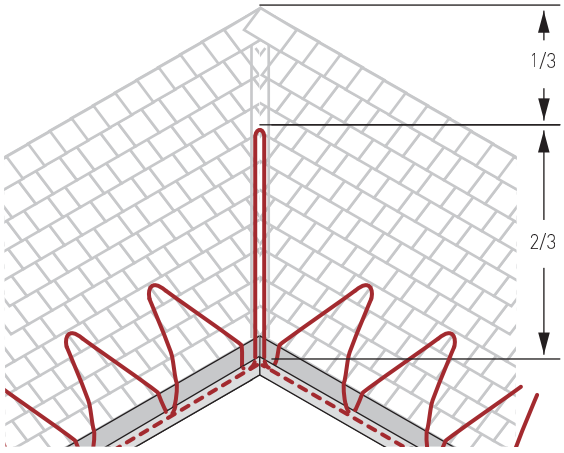


Figure 7 Layout for a valley

- Trace two-thirds of the way up each valley with a double run of heating cable (loop up and back once).
- The heating cable must extend into the gutter. If you don't have gutters, the heating cable should extend over the edge 2 to 3 inches to form a drip loop.
- For attachment methods, proceed to "Step 2. Attachment Methods" on page 11.

ROOF/WALL INTERSECTIONS

Roof/wall intersections can be treated in the same manner as valleys. Snow has a tendency to collect at this interface. Providing a loop of heating cable two-thirds of the way up the slope will provide a path for the extra melt water in this area to escape.

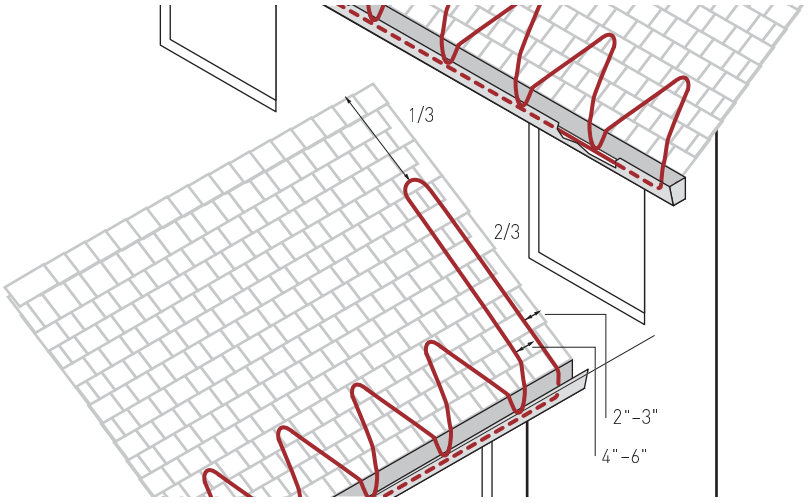


Figure 8 Layout for a roof/wall intersection

- Extend a loop of heating cable two-thirds of the way up the slope adjacent to the wall.
- Position the closest heating cable approximately 2 to 3 inches from the wall. Position the second heating cable 4 to 6 inches from the first.
- For attachment methods, see "Step 2. Attachment Methods" on page 11.

GUTTERS

Ice may accumulate in gutters and at the roof edge. To maintain a continuous path for melt water to run off, route the heating cable as shown in Figure 9 below. Additional heating cable may be needed for the roof surface, downspouts, and valleys.

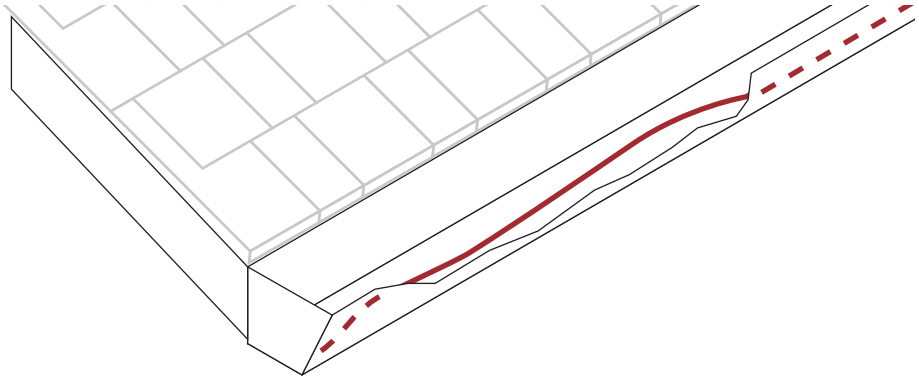


Figure 9 Layout in standard gutters

- Use one run of heating cable in the gutter.
- For gutters 5–6 inches wide, use two runs of heating cable. For gutter wider than 6 inches contact Pentair Thermal Management at (800) 545-6258.
- No attachment to gutter is normally required. If attachment is desired, use a roof clip such as a H913 or H914 clip.
- Continue heating cable down the inside of the downspout. See "Downspouts" on page 10 for more information.

DOWNSPOUTS

Ice may form in downspouts and prevent melt water from escaping from the roof. To maintain a continuous path for melt water to run off, run the heating cable inside the downspout to the end as shown in Figure 10 and Figure 11 below. Follow the appropriate attachment recommendations in Step 2. Additional heating cable may be needed for the roof surface, gutters, and valleys.

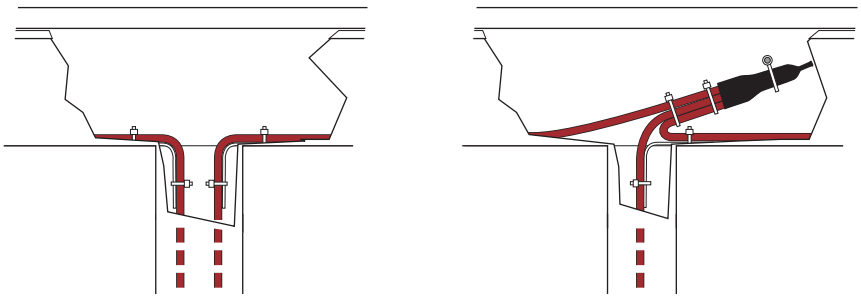


Figure 10 Heating cable at top of downspout

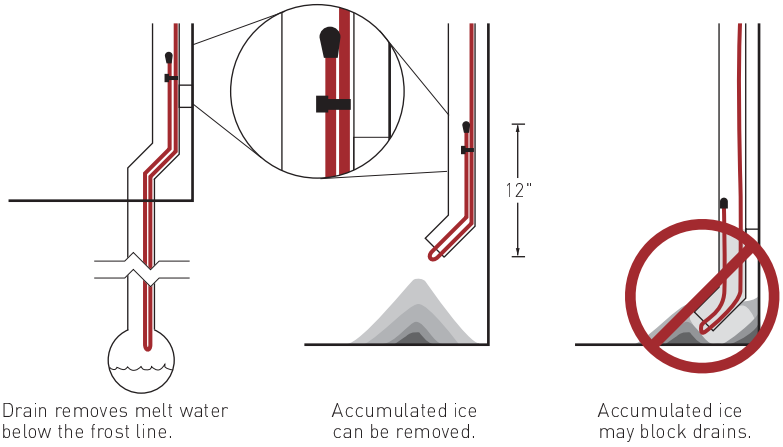


Figure 11 Heating cable at bottom of downspout

- If the downspout ends underground, the heating cable should extend into a heated area or below the frost line.
- For low-water-flow situations, teeing the heating cable so that a single run goes down the downspout is usually sufficient. For high-water-flow situations, where ambient temperatures often fall below 0°F (–18°C), or where it isn't convenient to tee the heating cable, use two runs—by running the heating cable down to the bottom and then back to the top.
- For downspouts that end at grade, leave a small drip loop (no more than one inch of cable exposed) at the bottom of the downspout.
- If a single run of heating cable is used, the end seal should be looped back up at least 12 inches inside the downspout to prevent mechanical damage to the cable or end seal.
- If the downspout ends near the ground, water will refreeze on the ground and build up around the downspout, eventually blocking the opening.

⚠ **WARNING:** To prevent mechanical damage, do not leave the end seal exposed at the end of the downspout. Loop it back up the downspout at least 12 inches.

Note: WinterGard Wet cannot be installed inside any storm drains, or in downspout drains where oil or grease may be present.

Step 2. Attachment Methods

Heating cable attachment methods depend primarily upon the roof type. The following table shows the recommended attachment methods for typical roof materials and roof areas.

TABLE 3 ATTACHMENT METHODS FOR TYPICAL ROOFS

Roof material	Recommended attachment method	Alternate attachment method
Shake/shingle	Mechanical clips (page 12)	
Rubber/membrane	Belt loop (page 14)	
Metal	Mechanical clips (page 12)	Adhesive clips (page 13)* Belt loop (page 14)
Wood	Mechanical clips (page 12)	
Other	Alternative (page 13)	

Area	Attachment method
Gutters	Attachment generally not required (page 15)
Downspouts	Downspout hangers (page 15)
Accessory locations	Drip loops (page 15)
Roof edges with no gutter	Drip loops (page 15)

Note: Do not use adhesives on slate or tile roofs. Please contact roofing manufacturer for a recommended attachment method or contact your Pentair Thermal Management representative.

* Before using adhesives on metal roofs check with the roofing manufacturer.

TABLE 4 ADHESIVE

Adhesive	Description	Color	Approximate tooling time	Curing time	Dispensing equipment
Momentive Performance Materials, Inc RTV167	Neutral-cure silicone adhesive	Gray	20 minutes	48 hours	Caulking gun
SpeedBonder® H3300	Methacrylate adhesive	Tan	15 minutes	24 hours	2 part mixing dispenser
SpeedBonder H4800	Methacrylate adhesive	Light yellow	45 minutes	24 hours	2 part mixing dispenser
Plexus® MA300	Methacrylate adhesive	Yellow	15 minutes	16 hours	2 part mixing dispenser
Plexus MA310	Methacrylate adhesive	Yellow	30 minutes	16 hours	2 part mixing dispenser

Adhesive is not supplied by Pentair Thermal Management. RTV 167 Silicone Adhesive is a neutral-cure silicone adhesive. Contact: Momentive Performance Materials, Inc. at (800) 332-3390 for the name of a distributor. Follow manufacturer's instructions for surface preparation and installation.

ROOF ATTACHMENT METHODS

Mechanical Attachment of Clips

One of the most common attachment methods is to use H913 or H914 roof clips. It can be used on all surfaces that can be nailed or screwed into. The H913 is a package of 10 clips. The H914 is a bulk package of 50 clips.

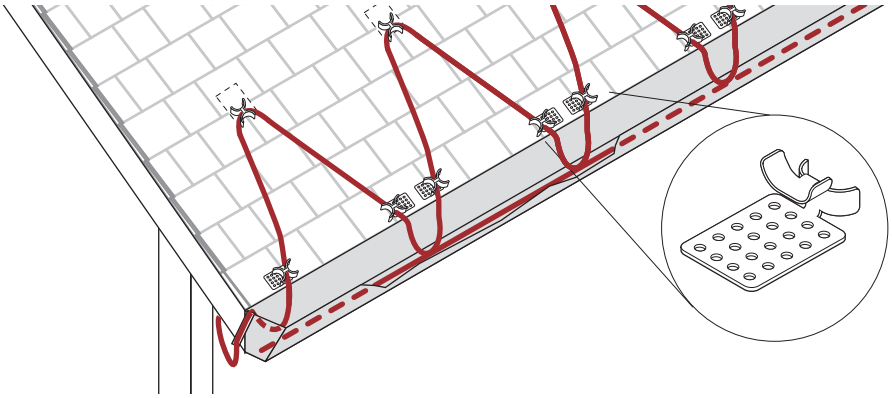


Figure 12 H913/H914 clip attachment

- The roof clips are used to secure WinterGard Wet heating cable. This multipurpose bracket attaches with a screw or nail to many types of roofs and gutters.
- After determining the heating cable layout, fasten the clips to the roof before installing the heating cable in the bracket. Apply sufficient water-sealing material around the clips and nails or screws to prevent roof leaks.
- Thread the heating cable into the clips. Use additional clips wherever the heating cable may be subject to abrasion from movement.
- Use pliers to close the clamps, but be careful not to crush the heating cable.
- The H913 kit is sufficient to attach the heating cable on 7 feet of roof edge. The H914 bulk package of 50 clips is sufficient to attach the heating cable on 35 feet of roof edge using a serpentine layout. Your layout may require additional clips.
- For layouts other than the standard serpentine, use one clip for each 5 to 10 feet of unsupported heating cable and at every change of heating cable direction.
- For shingled roofs, the loops of heating cable being serpentined on the roof should be attached, using a UV-resistant cable tie, to the heating cable run in the gutter.
- For standing-seam roofs, the heating cable should be cable-tied together at the bottom of the seam.

Adhesive Attachment of Clips

For roofs where penetrating attachments are not desired, use the H913/H914 clip attached by adhesive.

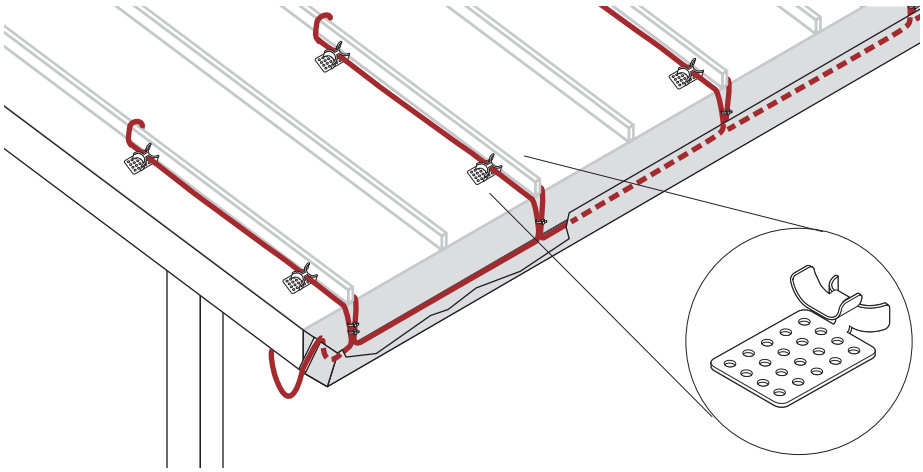


Figure 13 H913/H914 clip on standing seam roof

- The H913/H914 roof clips are used to secure WinterGard Wet heating cable. The clip attaches with adhesive (not supplied by Pentair Thermal Management) to many types of roofs and gutters.
- See Table 4 on page 11 for a recommended adhesive, or contact Pentair Thermal Management for alternatives.
- On a standing seam roof, use four clips on each seam being traced. On a flat surface, use one clip for every 5 to 10 feet of unsupported heating cable and at every heating cable change of direction.
- Follow all recommendations from the adhesive manufacturer with regard to cleaning and preparing the roof surface for the adhesive.
- After determining the heating cable layout, fasten the clips to the roof with the adhesive and allow the adhesive to cure before installing the heating cable.
- After the adhesive has cured, thread the heating cable through the clips. Use additional clips wherever the heating cable may be subject to abrasion from movement.

Note: How well the adhesive holds can be strongly affected by how well the surface to which it will adhere is prepared and by what type of adhesive is used. Be sure to follow the recommendations of the adhesive manufacturer.

Note: Before using adhesives on metal roofs check with the roofing manufacturer.

Alternative Attachment Methods

The H913 and H914 attachment clips were developed as an easy way to provide enough support for the heating cable without crimping, crushing, or otherwise damaging the heating cable and without applying any chemicals or adhesives directly to the heating cable. Other means may be used to attach the heating cable as long as they:

- Do not crush, crimp, cut, or otherwise damage the heating cable. Damage to the heating cable could cause the system to fail, resulting in electric shock or fire.
- Do not apply adhesives or other chemicals directly to the heating cable. Many adhesives will not stick to the outer jacket, which could cause the attachment method to fail and could result in inadequate de-icing.
- Provide enough strength to support the heating cable on the roof and any load from snow that collects on the system. If the attachment method is not strong enough, the heating cable could come loose and fall off.

One method sometimes used is to attach the heating cable with a UV-resistant cable tie to a bracket, rod, or cable that is installed to support the heating cable. The brackets, rods, or cables are then attached to the roof through whatever means are appropriate for the situation and can support the weight of the heating cable.

Belt Loop Approach

With the belt loop approach, strips of roofing materials are fastened to the roof using standard means for that particular type of roof. The heating cable is attached with a UV-resistant cable tie to the loop formed by this material.

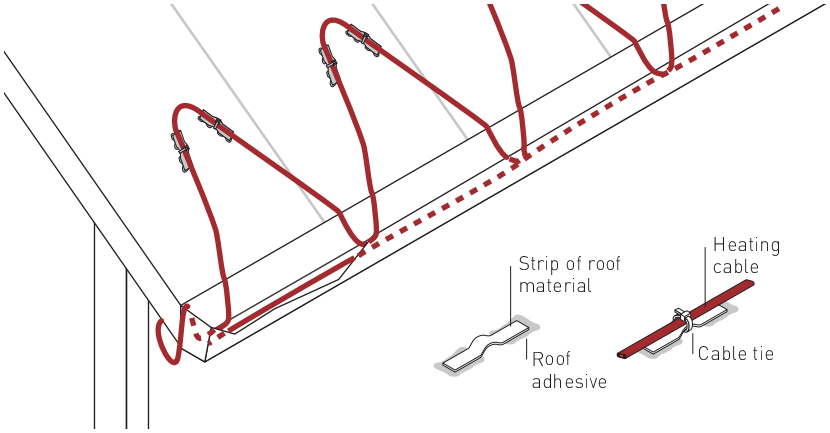


Figure 14 Belt loop approach on a sloped roof

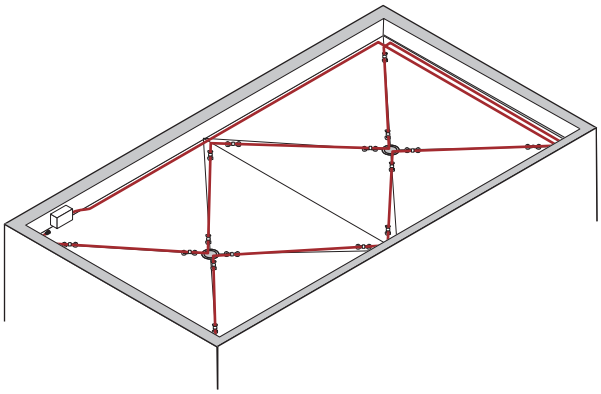


Figure 15 Belt loop approach on a flat roof

- The belt loop method of securing the WinterGard Wet heating cable involves using a small piece of roofing material to form a "belt loop."
- Use at least one belt loop for every 5 to 10 feet of unsupported heating cable and at every heating cable change of direction.
- After determining the heating cable layout, fasten each end using standard means for that particular type of roof. Examples of this would be attaching with solder on a copper roof, adhesive on a membrane roof, or tar on an asphalt roof.
- The heating cable is attached with a UV-resistant cable tie to the loop formed by this material.
- Use additional belt loops wherever the heating cable may be subject to abrasion from movement.

ATTACHMENT METHODS FOR OTHER AREAS

Gutters

The WinterGard Wet heating cable is not normally attached to the gutter.

If attachment is desired, such as in high-wind areas, use H913/H914 adhesive-mounted attachment clips. See Table 4 on page 11 for a recommended adhesive, or contact Pentair Thermal Management for alternatives.

Downspouts

The WinterGard Wet heating cable needs to be attached at the top of each downspout, using one H915 downspout hanger per heating cable. WinterGard Wet attaches to the H915 downspout hanger using cable ties provided in the kit.

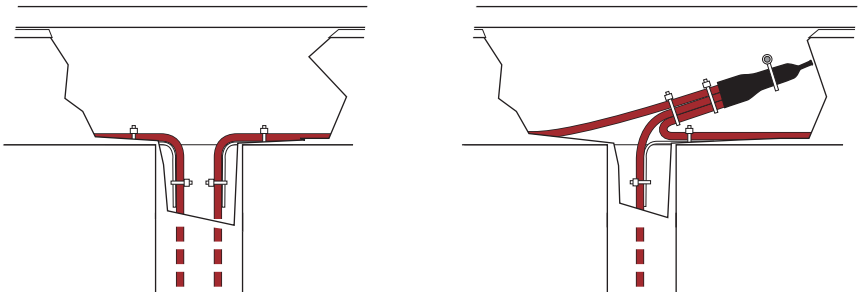


Figure 16 H915 downspout hangers

- H915 downspout hangers protect the heating cable from damage from sharp edges and also provide support for the weight of the heating cable.
- Use two H915 downspout hangers for double-traced downspouts.

Drip Loops

Drip loops are used where power connections are located in the system and at roof edges where no gutter is installed. The purpose in each case is to allow water to drip free of the heating cable.

Roof Edge with No Gutter Where no gutter is installed, a drip loop should be installed at the roof edge to allow melt water to drip free of the roof. No special attachment is necessary for heated drip loops. Use the same attachment as appropriate for your roof type; just make sure the heating cable extends 2 to 3 inches (5 to 8 cm) from the roof edge.

Accessories Drip loops are used where the heating cable enters a power connection (H900) to keep water from tracking into the junction box. No special attachment is necessary.

Step 3. Control

CONTROLLER SPECIFICATIONS

Three control methods are commonly used with roof de-icing systems:

- Manual control
- Ambient thermostat
- Automatic controller

All three methods will require contactors if any significant length of heating cable is being used. The contactor must be sized to carry the load. Each method offers a tradeoff of initial cost versus energy efficiency and ability to provide effective de-icing. If the system is not energized when needed, ice will form. If the system is energized when de-icing is not needed, there will be unnecessary power consumption. Choose the control method that best meets the performance requirements. Contact Pentair Thermal Management for details.

Manual Control

A manually controlled system is operated by a switch that controls the system power contactor. This method requires constant supervision to work effectively.

The type of control you select will affect power consumption and ensure the heating cable is on when needed.

Typical Wiring Schematic

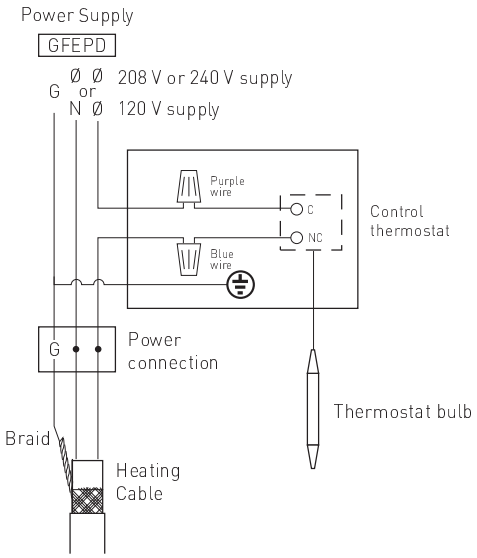


Figure 17 Typical controller wiring—single circuit

Ambient Thermostat

Using an ambient sensing thermostat, such as the DigiTrace AMC-F5, ensures that the roof and gutter de-icing system will be on when the ambient temperature is below freezing. This will ensure the heating cable is energized any time the water might freeze. Table 5 outlines the technical specifications for the AMC-F5 thermostat.

TABLE 5 THERMOSTAT

Characteristic	AMC-F5
Type of sensing	Air temperature
Sensor	Fluid-filled (silicone) bulb and 2.5-ft (0.8 m) capillary
Set point	40°F (4.4°C) nonadjustable
Enclosure	NEMA 4X, UV-resistant thermoplastics
Deadband	2°F to 12°F (1.1°C to 6.7°C) above actuation temperature
Set point repeatability	±3°F (±1.7°C)
Enclosure limits	–30°F to 140°F (–34°C to 60°C)
Electrical rating	22 A at 125/ 250/ 480 Vac
Approvals	UL Listed, CSA Certified

Automatic Controller

With an automatic controller, the roof & gutter de-icing system is automatically energized when both precipitation and low temperature are detected. When precipitation stops or the temperature rises above freezing, the system is de-energized. Table 6 outlines the technical specifications for the RM-3 and RM-4 automatic controllers.

TABLE 6 AUTOMATIC CONTROLLER

Characteristic	RM-3 and RM-4*
Type of sensing	Air temperature & moisture
Sensor	5.56" X 1.12" sensor & 12' jacketed 3 conductor #18 AWG cable
Set point	38°F fixed
Enclosure	NEMA 4X
Electrical rating	RM-3 – 120 V, 24 A resistive, 7 A inductive RM-4 – 208 to 240 V, 24 A resistive
Ground-fault protection	Built-in ground fault equipment protection (GFEP) included with RM-4 only
Approvals	UL and C-UL Listed

*RM-4 should not be used to operate an external contactor.

Typical Wiring Schematic

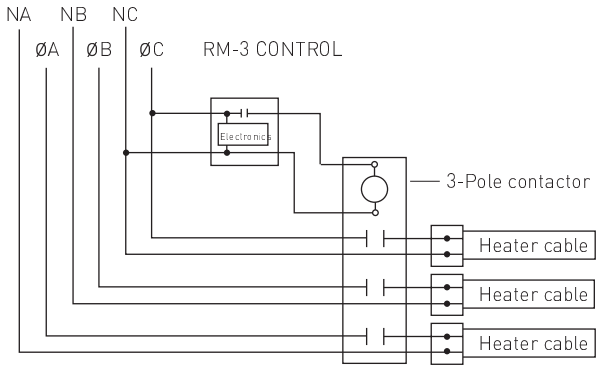


Figure 18 Typical wiring diagram using a RM-3 controller–multiple circuits

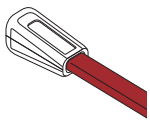
⚠ **WARNING:** Fire Hazard. To minimize the danger of fire from sustained electrical arcing if the heating cable is damaged or improperly installed, and to comply with the requirements of Pentair Thermal Management, agency certifications, and national electrical codes, ground-fault equipment protection must be used on each heating cable branch circuit. Arcing may not be stopped by conventional circuit protection.

Step 4. Accessory Selection

A typical WinterGard Wet system consists of several accessories to seal and power the heating cable, and to attach the heating cable to the roof. The WinterGard Wet heating cable is also supported inside downspouts by using attachment accessories. All of the accessories work together to provide a safe and reliable de-icing system that is easy to install and maintain. The accessories available are listed in Table 7.

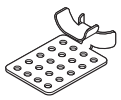
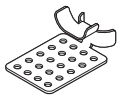
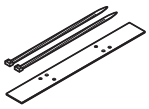
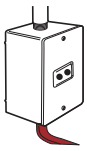
The self-regulating WinterGard Wet heating cable is cut to length at the job site. In order to seal the heating cable from the environment and provide power, Pentair Thermal Management-approved accessories must be used. A power connection kit is required to attach power to one end of the heating cable. An end seal is required—and is provided with each power connection—to seal the other end. Splice and tee kits are also available to connect two or three heating cables together.

TABLE 7 ACCESSORIES

	Description	Catalog number	Standard package	Number of packages required	Heating cable allowance
	Hard-wired power connection for WinterGard Wet systems. Includes gel-filled push-on end seal. Junction box not included	H900	1/pkg	1 kit for each circuit of WinterGard Wet heating cable*	1 ft.
	Plug-in 120 V, 15 A power connection for WinterGard Wet. Built-in signal light and 27-mA GFPD. Includes gel-filled push-on end seal. Maximum 125-foot circuit length capacity.	H908	1/pkg	1 kit for every 125 feet of 120 V WinterGard Wet cable	1 ft.
	Waterproof splice and tee kit. Includes gel-filled push-on end seal.	H910	1/pkg	1 kit for each splice or tee	2 ft.
	Gel-filled push-on end seal.	H912	2/pkg	Necessary only for repair or system testing. End seals are included in power connection and splice and tee kits.	0.5 ft

* Refer to Table 8 on page 20 to determine maximum WinterGard Wet circuit lengths for hard-wired systems.

TABLE 7 ACCESSORIES

	Description	Catalog number	Standard package	Number of packages required	Heating cable allowance
	Roof clip	H913	10/pkg	1 pkg per 7 feet of roof edge when serpentine layout is used.	
	Roof clip	H914	50/pkg	1 box per 35 feet of roof edge when serpentine layout is used.	
	Downspout hanger bracket	H915	1/pkg	1 hanger per cable in downspout or as required for mechanical protection	
	Outdoor-rated junction box with built-in ground-fault protection for hardwire connection of all 120 V 20 A Raychem cut-to-length heating cables. H900 Power Connection Kit must be used with the H921 Junction Box.	H921	1/box	Use one junction box per hard-wired circuit, with H900 kit. The H921 is not necessary if ground-fault equipment protection is provided in circuit breaker.	

Step 5. Electrical Design

DETERMINING THE NUMBER OF CIRCUITS

To determine the number of circuits, you need to know:

- Total heating cable length
- Minimum start-up temperature
- Voltage

Total heating cable length is the amount of heating cable needed for the entire system. This includes all of the heating cable installed on the roof, in the gutters, and in the downspouts, as well as the small amounts of extra heating cable needed to install the accessories.

Choose the start-up temperature based on the lowest temperature at which the system will energize. Turning the system on at a temperature below the chosen start-up temperature may risk tripping the breakers due to start-up currents.

To determine maximum circuit lengths, it is important to select a minimum start-up temperature for the system. Table 8 provides maximum circuit lengths based on minimum start-up temperature, circuit breaker rating and supply voltage. Colder temperature start-up requires shorter maximum circuit lengths. Be sure to design your system for the minimum anticipated temperature. Do not exceed the maximum circuit length specified

Try to design the system using the shorter 0°F start-up circuit length. Use the 32°F start-up circuit length only to optimize the system, reducing the overall quantity of circuits and power connections.

If the total heating cable length exceeds the maximum circuit length for the expected start-up temperature, more than one circuit will be required.

Minimum number of circuits = Total heating cable length divided by the maximum circuit length.

Note: Your specific layout may require more circuit breakers than indicated by this formula.

Select the smallest appropriate circuit breaker size.

A ground-fault circuit breaker with a 27- or 30-mA trip level is required by Pentair Thermal Management and by national electrical codes. The H908 and H921 kits are equipped with built-in 27-mA ground fault circuit protection. Alternatively, use a circuit breaker such as Square D QOEPD, QOB-EPD, or equivalent. Alternate devices providing comparable levels of ground-fault protection may also be acceptable. For technical assistance, contact Pentair Thermal Management at (800) 545-6258.

⚠ **WARNING:** Fire Hazard. To minimize the danger of fire from sustained electrical arcing if the heating cable is damaged or improperly installed, and to comply with the requirements of Pentair Thermal Management, agency certifications, and national electrical codes, ground-fault equipment protection must be used on each heating cable branch circuit. Arcing may not be stopped by conventional circuit protection.

TABLE 8 MAXIMUM CIRCUIT LENGTH IN FEET*

		Maximum heater length (ft) per circuit for minimum start-up temperature	
Heating cable type	**Circuit breaker rating (A)**	**0°F**	**32°F**
WinterGard Wet H612 120 V	15	100	125
	20	125	165
	30	150	200
WinterGard Wet H622 240 V	15	200	250
	20	250	320
	30	305	400

* Maximum circuit lengths are based on the lowest expected start-up temperature.

INSTALLATION GUIDELINES

This section includes the information you need to install the WinterGard Wet system. Follow all of the steps provided here.

Heating Cable Installation

Prior to starting installation:

- Test the heating cable insulation resistance to confirm that the heating cable has not been damaged during shipping (see "Test Methods" on page 23).
- Visually check accessories for damage.
- Make sure that all material is included as indicated on the packing slip.
- Make sure all heating cable circuits will be protected using a ground-fault equipment protection device (GFEPD) with a maximum 30-mA trip level. It is permissible to use a 5-mA ground fault interrupter (GFI) for maximum sensitivity. However, with longer circuit lengths, nuisance tripping may occur even with undamaged heating cable unless a 27- or 30-mA device is used.
- Protect the heating cable ends from moisture and mechanical damage if they will be left exposed before connection.
- Compare the heating cable received with the design voltage required (for example, H612 for 120 V, H622 for 208 V – 240 V) to ensure the cable is right for your application. This is marked on each reel and on the heating cable.
- Compare the design circuit lengths with the heating cable lengths received (also marked on each reel) in order to minimize the need for splicing.
- Ensure that the heating cable required does not exceed the maximum circuit length for the voltage and circuit breaker rating to be used (see Table 8 on page 20).

Note: The heating cable can be cut to length without affecting its power output per foot.

When installing the heating cable:

- Do not pull it over sharp edges.
- Do not use excessive pulling force.
- Do not kink or crush the heating cable.
- Do not walk on the heating cable.
- Do not cover the heating cable with any roof materials.

Heating Cable Damage

If physical damage is found, the entire damaged section must be removed and a new section of heating cable spliced in, using only the Raychem H910 splice kit. Do not attempt to repair the damaged heating cable section. If the damage cannot be found, the complete circuit should be removed and replaced with new WinterGard Wet heating cable.

⚠ **WARNING**: Shock and Fire Hazard. Damaged heating cable or accessories can cause electrical shock, arcing, and fire. Do not attempt to energize damaged heating cable or accessories. Replace them immediately using a new length of heating cable and the appropriate accessories.

Heating Cable Handling

Start by installing accessories in locations indicated on project drawings or as indicated in the Design Guidelines "Step 1. Heating Cable Layout" on page 3.

Once all clips and downspout hangers are in place, and adhesives cured if applicable, the heating cable can be installed.

Start at the end seal and work back. Be sure to leave a drip loop at hard-wired junction boxes so that water will not track down the heating cable into the box. Install heating cable using the layout shown in Step 1 for your application.

- Be sure the heating cable provides a continuous path for water to flow off the roof.
- Be sure to leave drip loops where appropriate.
- Do not exceed the circuit lengths listed in Table 8 on page 20.
- Be sure to loop and secure heating cable at the bottom of downspouts so that the heating cable end seal is not exposed to mechanical damage.
- Use only UV-resistant cable ties when fastening heating cables together or securing them to roof clips and brackets.
- Test installed heating cable for insulation resistance and continuity (see "Test Methods" on page 23).

Power Connection, Splice, and Tee Installation

Once all attachment clips, downspout hangers, and heating cables are in place and tested, accessories can be installed. Install accessories according to installation instructions included in kits.

Use only appropriate Raychem accessories as indicated in the Design Guidelines "Step 4. Accessory Selection" on page 18. Never substitute parts.

Visually inspect for mechanical damage and test the entire circuit for insulation resistance prior to applying power.

Controls and Feed Wiring

The controls and feed wiring must be in place prior to system startup.

WHEN INSTALLING CONTROLS AND FEED WIRING

- Each heating cable circuit must be protected by a ground fault-protection device with a maximum 30-mA trip level. This can be done using a H908 termination kit, a GFEPD or GFCI circuit breaker, or a controller that has integrated ground-fault protection.
- Power the system with the appropriate voltage.
- Add conduit drains at hard-wired power connections so water does not accumulate in junction boxes.
- Be sure any contactor being used is appropriate for the load. If the controller is being used directly, be sure that it is rated for the load and that all requirements for disconnects are followed.
- Test control for proper operation (see "Test Methods" below).
- Two copies of a caution notice indicating the presence of electric de-icing and snow-melting equipment on the premises are packed with each termination kit. One notice must be posted at the fuse or circuit-breaker panel and the other on or next to the on/off control for the cable unit. Both notices must be clearly visible.

Test Methods

INSULATION RESISTANCE (MEGOHMMETER) TEST

The insulation resistance test is critical to ensure the safety and reliability of the heating cable system. This test should be performed as part of the installation of the system, and is useful for troubleshooting an installed system.

⚠ **WARNING:** Shock or Fire Hazard. Disconnect power to all circuits prior to testing.

Using a megohmmeter, test insulation resistance at three voltages—500, 1000, and 2500 Vdc. Significant problems may not be detected if the insulation resistance is tested only at 500 or 1000 volts. First, measure the resistance between the heating cable bus wires and the grounding braid; then, if the heating cable is installed on a metal gutter, downspout, and/or metal roof, measure the insulation resistance between the braid and the metal surface.

Procedure

1. Disconnect all power to the heating cable, thermostat, and contactor.
2. Set test voltage at 0 Vdc.
3. Connect the negative lead (–) to the heating cable metallic braid.
4. Connect the positive lead (+) to both heating cable bus wires.
5. Turn on the megohmmeter and set the voltage to 500 Vdc; apply the voltage for 1 minute. Record the resistance.
6. Repeat step 5 at 1000 Vdc and 2500 Vdc.
7. Turn off the megohmmeter.
8. If the megohmmeter does not self-discharge, discharge phase connection to ground with a suitable grounding rod. Disconnect the megohmmeter.
9. If the heating cable is installed on a metal roof, metal gutter, or metal downspout, repeat these steps with the negative lead (–) connected to the grounding braid and the positive lead (+) connected to the metal roof, gutter, and/or downspout.
10. Reconnect the thermostat or contactor and re-energize the circuit.

Insulation Resistance Criteria

A clean, dry, properly installed circuit should measure thousands of megohms, regardless of the heating cable length or measuring voltage (0–2500 Vdc). The following criteria are provided to assist in determining the acceptability of an installation where optimum conditions may not apply:

- All three insulation resistance values should be greater than 1000 megohms.
- Insulation resistance values for any particular circuit must not vary more than 25 percent as a function of measuring voltage.
- Reading must be steady at measuring voltage.
- If any of the above conditions are not met, consult the "Troubleshooting" section (page 26).

Continuity Test

The continuity test is useful in determining if the heating cable is damaged or was not connected correctly. This test can be performed as part of the troubleshooting procedure.

Note: Some of the heating cable accessories, such as the power connection and splice, and tee kits, which utilize heat-shrink tubings, are not reenterable and will have to be replaced after this test is done.

⚠ **WARNING:** Shock or Fire Hazard. Disconnect power to all circuits prior to testing.

1. Disconnect all power to heating cable, thermostat, and contactor.
2. Twist the two bus wires together at one end.
3. Take a resistance reading from bus wire to bus wire at the other end. The reading should be 3 ohms or less. High readings (above 100 ohms) generally indicate bus wire damage or misconnected components.
4. If there are any tees on the circuit, each leg of the tee must be tested separately.
5. Be sure to untwist the bus wires and install new components on the circuit prior to re-energizing the circuit.
6. Reconnect the contactor or thermostat and re-energize the circuit.

OPERATION AND MAINTENANCE

System Start-up and Operation

Once the system has been installed and tested, it is ready to be powered. A manually controlled system will have to be turned on at each snow storm and turned off when the roof is cleared of all snow. Thermostatically controlled systems will turn on and off automatically.

PRIOR TO SYSTEM START-UP

- Perform a final visual inspection of all circuits.
- Perform a final insulation resistance test of all circuits.
- Instruct owner/user on system operation and maintenance.
- Be sure that owner/user has all applicable installation instructions and operation manuals.

INDICATION OF OPERATION

Some possible indicators of a properly operating system are the following:

- The controller may indicate the circuit is powered.
- Visible paths may show through the snow around the heating cable.
- Cable may feel warm to the touch.
- Water drainage may be visible at the gutter or downspout.

Periodic Inspection/Maintenance

- Perform a visual inspection of the heating cable a least once a year to make sure physical damage has not occurred.
- Check ground-fault protection device for proper operation per manufacturer's recommendations.
- Ensure the gutters and downspouts are free of leaves and other debris prior to each winter season.
- Test all circuits for proper insulation resistance before each winter season (see "Test Methods" on page 23).
- Make sure the control system is functioning before each winter season.

Roof/Gutter Repair and Maintenance

If maintenance is needed on the roof, gutter, downspouts, or other areas close to the heating cable, you should:

- Disconnect power to all heating cable circuits.
- Protect the heating cable from damage during repair work.
- Check for heating cable damage after any repairs or maintenance on roof or gutters. This should include a visual inspection of all heating cables and components, and insulation resistance testing of all circuits.
- Reconnect power to all heating cable circuits.

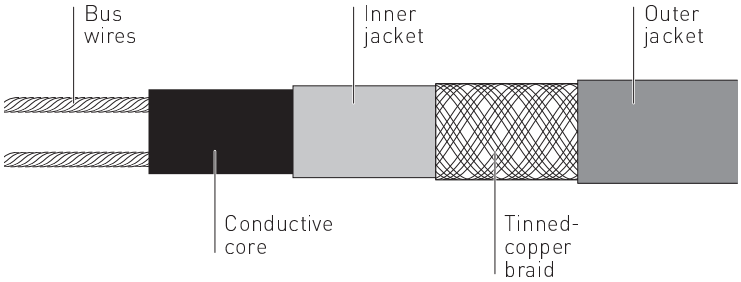
TROUBLESHOOTING

Symptom	Probable Causes	Correction
A. Circuit breaker trips.	Circuit breaker undersized. Circuit length too long. Start-up temperature below design temperature.	Resize the circuit breakers according to Table 8 on page 20.
	Defective circuit breaker.	Replace the circuit breaker.
	Connections or splices may be shorting out. Physical damage to the heating cable.	Do not repower the system until the cause is identified and corrected . To confirm that heating cable is damaged, test the insulation resistance according to the procedure described in "Test Methods" on page 23. Locate and repair incorrect connections or splices. Locate and remove damaged sections of heating cable. To locate shorting problems, follow these steps: 1. Visually inspect the power connection, splices, and end seals for proper installation. 2. Check for visual indications of damage to the cable, especially in any area where there may have been maintenance work. 3. Look for damage at entrances to downspouts, around eaves, and at transitions from roof to gutter. 4. If at this point you have not located the problem, you will need to begin isolating sections of the heating cable to find the general area of damage. (For example, cut the circuit in half and, using a megohmmeter, test both halves to find the damaged section.) Then remove the damaged section of heating cable.
	Bus wires in contact with each other.	Cut off the end seal. Recut the cable end and install a new end seal.
	Excessive moisture in connection boxes or splices	Dry out and reseal connections and splices. Test with a megohmmeter, per installation instructions.
	Nick or cut in heating cable or power feed wire with moisture present.	Locate and replace damaged heating cable or power feed wire.
	Using 5-mA ground-fault interrupter instead of 27- or 30-mA ground-fault protection device.	If no other fault is found, replace circuit breaker with 27 or 30-mA ground-fault protection device.
B. Power output is zero or appears low.	Low or no input voltage.	Check voltage and correct.
	Circuit is shorter than design shows because splices or tees are not connected, or the heating cable has been severed.	Check length of cable installed. Check all splices and tees. Check at end seals for continuity as indicated in "Test Methods" on page 23.
	Improper connection causes a high-resistance connection.	Check and fix splices or tees.
	The control thermostat is wired incorrectly.	Check and rewire controller.

TROUBLESHOOTING

Symptom	Probable Causes	Correction
C. Heating cable fails insulations resistance test.	Connections or splices may be shorting out. Physical damage to the heating cable.	To confirm that heating cable is damaged or accessories are shorting, test the insulation resistance according to the procedure described in "Test Methods" on page 23. Locate and repair incorrect connections or splices. Locate and remove damaged sections of heating cable. To locate shorting problems, follow these steps: 1. Visually inspect the power connection, splices, and end seals for proper installation. 2. Check for visual indications of damage to the cable, especially in any area where there may have been maintenance work. 3. Look for damage at entrances to downspouts, around eaves, and at transitions from roof to gutter. 4. If at this point you have not located the problem, you will need to begin isolating sections of the heating cable to find the general area of damage. (For example, cut the circuit in half and, using a megohmmeter, test both halves to find the damaged section.) Then remove the damaged section of heating cable.
	Excessive moisture in connection boxes or splices.	Dry out and reseal connections and splices. Test with a megohmmeter per installation instructions.
	Nick or cut in heating cable or power feed wire with moisture present.	Locate and replace damaged heating cable or power feed wire.
D. Snow is not melting around the heating cable.	Circuit breaker tripped. Controller not on or not working. Ambient temperature too cold.	See Symptom A, "Circuit breaker trips." Check controller.
E. Downspouts are blocked by ice.	Circuit breaker tripped. Controller not on or not working. Ambient temperature too cold.	See Symptom A, "Circuit breaker trips." Check controller.
F. The circuit does not draw sufficient power of approximately 8 W/ft at 32°F (0°C) in snow or ice (5 W/ft at 32°F (0°C) in air).	Circuit breaker tripped. Controller not on or not working. All sections not connected.	See Symptom A, "Circuit breaker trips." Check controller. Repeat continuity test, as detailed on page 24.

APPENDIX A. WINTERGARD WET HEATING CABLES DATA SHEET



Catalog number	H612050 H612100 H612250 H612500 H6121000	H622050 H622100 H622250 H622500 H6221000
Nominal service voltage	120 V	208 V – 240 V
Power output in ice or snow at 32°F	8	8
Weight per 100 ft (lb)	6	6
Nominal cable width (in)	0.42	0.42
Nominal cable thickness (in)	0.22	0.22
Bus wire	16 AWG nickel-coated copper	16 AWG nickel-coated copper
Braid/outer jacket	Tinned-copper braid with modified polyolefin outer jacket	
Maximum exposure temperature (°F)	150	150
Environment	Use only in ordinary (nonhazardous) areas. Do not expose to any chemicals	
Minimum bend radius	5/8 in (16 mm)	5/8 in (16 mm)

Maximum circuit length in feet

Heating cable type	Circuit breaker rating (Amps)	Maximum heater length (ft) per circuit for minimum start-up temperature 0°F	32°F
WinterGard Wet H612 120 Vac	15	100	125
	20	125	165
	30	150	200
WinterGard Wet H622 208 V – 240 V	15	200	250
	20	250	320
	30	305	400

Accessories

WinterGard Wet heating cables must be terminated using only approved Raychem accessories. Refer to the Design and Installation Guidelines of this document

Agency approbals

877Z De-icing and Snow-Melting Equipment

-WS

The WinterGard Wet heating cables are UL Listed and CSA Certified only when used with the appropriate agency-approved Raychem accessories.

Ground-fault protection

To minimize the danger of fire from sustained electrical arcing if the heating cable is damaged or improperly installed, and to comply with the requirements of Pentair Thermal Management, agency certifications, and national electrical codes, ground-fault equipment protection must be used on each heating cable branch circuit. Arcing may not be stopped by conventional circuit protection.

APPENDIX B. WINTERGARD WET SYSTEM LIMITED WARRANTY

Pentair Thermal Management warrants all goods listed below against faulty workmanship and use of defective materials when such goods are properly installed, operated, and maintained according to product documentation. All documentation regarding proper use and installation can be found on our web site at www.thermal.pentair.com.

This warranty remains in force for a period of two (2) years from date of purchase.

This warranty is only valid for products purchased and installed within the United States, Canada, Central American, or South American countries on or after May 1, 2013. This warranty can be amended only by a written instrument signed by a duly authorized officer of Pentair Thermal Management.

Brand	Type
Raychem	Heating cables, connection kits and accessories

• What Will We Do to Correct Problems?

Pentair Thermal Management will examine and confirm that any alleged product issue covered by this Limited Warranty actually exists and occurred in the course of proper and normal use and was not caused by accident, misuse, neglect, alteration or improper installation, operation, maintenance, repair, or testing, or such other cause outside of the responsibility of Pentair Thermal Management under this Limited Warranty. Pentair Thermal Management will repair such goods or supply replacement goods or credit Buyer's account for goods covered by this Limited Product Warranty, whichever Pentair Thermal Management may elect at its sole discretion.

• How Do You Get Service?

The Buyer should promptly notify Pentair Thermal Management, or their Pentair Thermal Management Representative, either by written correspondence or by e-mail within thirty (30) days after discovery of an alleged warranty issue. Detailed warranty claim information will be requested at this time and must be supplied by the Buyer. The Buyer may then be asked to return the goods, postage paid, to the location given by Pentair Thermal Management.

• What Does This Product Warranty Not Cover?

Goods subjected to misuse, neglect, alteration or improper installation, operation, maintenance, repair, or testing (or such other act or omission, not attributable to Pentair Thermal Management) are not covered by this Limited Product Warranty. Pentair Thermal Management shall in no event be liable for the cost of removal or installation, for loss or damage to or loss of use of facilities or other property, loss of revenue, loss of use of revenue, loss of anticipated profits, or other damages or costs of any kind whatsoever, whether direct, indirect, incidental, or consequential, and in no event shall Pentair Thermal Management's liability exceed an amount equal to the sales price.

• What Must You Do to Keep the Warranty in Effect?

Properly install, operate and maintain your Pentair Thermal Management system as specified in the associated Pentair Thermal Management installation literature.

• How Does State/Provincial Law Relate To This Warranty?

THE FOREGOING WARRANTY IS IN LIEU OF ALL OTHER REPRESENTATIONS, WARRANTIES, OR CONDITIONS, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS FOR A PAR- TICULAR PURPOSE OR NONINFRINGEMENT, AND OF ANY OTHER OBLIGATION OR LIABILITY ON THE PART OF PENTAIR THERMAL MANAGEMENT, WHETHER BY STATUTE, CONTRACT, STRICT LIABILITY, TORT OR OTHERWISE.

If the goods are a consumer product in Buyer's jurisdiction, Buyer may have additional legal rights under the applicable national/state/provincial legislation governing the sale of consumer goods. As a result, the above exclusions and/or limitations on the warranty may or may not apply.

DESIGN WORKSHEET

This design worksheet is meant to provide a quick way to estimate the products needed for a roof and gutter de-icing application on standard roofs. You only need to use the sections necessary for your roof application. Refer to the body of this guide for complete information.

1. **Determine heating cable design and amount of heating cable required for your roof application**

A. Sloped roof—shingle roof (page 4)			x	Feet of heating cable per foot of roof edge	x	Feet of roof edge	=	Feet of heating cable for roof
B. Sloped roof—standing seam–metal (page 5)				Feet of heating cable per foot of roof edge	x	Feet of roof edge	=	Feet of heating cable for roof
C. Roof extensions—gutter connections and drip loops (page 7)				Feet of roof edge	x	0.5	=	Feet of heating cable for roof extensions
D. Valleys (page 8)				Height of valley	x	1.33	=	Feet of heating cable for valley
E. Roof/wall intersections (page 8)				Height of intersection	x	1.33	=	Feet of heating cable for intersection
F. Flat roof (page 6)	Feet of roof perimeter	+	Footage of drains	+	Footage to drains		=	Feet of heating cable for flat roof
G. Gutters—nonstanding seam roof (page 9)					Length of gutters		=	Feet of heating cable for gutters
H. Wide gutters (page 9)				Length of gutters	x	2	=	Feet of heating cable for wide gutters
I. Downspouts (page 10)	(Height of downspouts + 1 ft)	x	# of downspouts	x	Runs of heating cable per downspout		=	Feet of heating cable for downspout

Add together amount of heating cable needed

2. **Select heating cable**

Voltage ❑ 120 V (H612) ❑ 208 V–240 V (H622)

3. **Determine number of circuits**

27 or 30-mA ground-fault circuit breaker size available (check one): ❑ 15 A ❑ 20 A ❑ 30 A

Using Table 8 on page 20, determine the maximum circuit length allowed: _____ Feet max.

Total heating cable length divided by maximum circuit length allowed equals minimum number of circuits required

_____	÷	_____	=	_____
Heating cable length		Max. circuit length		# of circuits required

4. **Select accessories.** Determine quantity of accessories and heating cable allowance (from Table 7 on page 18).

A. Power connection

		_____	=	_____
		# of circuits		# of power connection kits
_____	x	1 ft	=	_____
# of power connection kits				Heating cable accessory allowance

B. Tee connection

		_____	=	_____
		# of tees		# of tee kits
_____	x	2 ft	=	_____
# of tee kits				Heating cable component allowance

C. End seal (included in power connection kits and tee kits)

_____	x	0.5 ft	=	_____
# of end seals				Heating cable component allowance

5. **Determine total heating cable required.**

A. Heating cable length (from Worksheet Step 1) = _____

B. Accessory heating cable allowances (Worksheet Step 4) = _____

C. Amount of extra heating heating cable needed = _____

D. Add A + B + C to get total amount of heating cable needed. Recheck number of circuits (Worksheet Step 3) = _____

6. **Select attachment accessories.** Select the attachment method from Table 3 on page 11. Determine the minimum quantity of attachment accessories required.

   A. Sloped shake or shingle roof

   _____ (Roof length in feet) ÷ 7 = _____ (# of packages of H913 clips)

   _____ (Roof length in feet) ÷ 35 = _____ (# # of boxes of H914 clips)

   B. Other sloped nonstanding-seam roof

   _____ (# of seams traced) x 4 = _____ (# of H913 or H914 clips or other clips)

   C. Standing-seam metal roof

   _____ (Roof length in feet) ÷ _____ (Seam spacing in feet) x 2 = _____ (# of H913 or H914 clips)

   D. Flat roof

   _____ (Heating cable length) ÷ 5 = _____ (Belt loops)

   E. Downspouts

   _____ (# of downspouts) x _____ (# of runs of heating cable per downspout) = _____ (# of H915 downspout hangers)

7. **Select control method.** Select the method of control from "Step 3. Control" on page 16.

   A. Manual control

   B. Ambient thermostat ❑ AMC-F5

   C. Automatic controller ❑ RM-3 ❑ RM-4

8. **Fill in Bill of Materials.** See Table 7 on page 18 for a complete description of accessories.

Quantity	Units	Description	Catalog numbers
	feet	Heating cable	H612 or H622
	each	Ground-fault protection devices	H921 (w/H900 only)
	each	Power connection kits	H900, H908
	each	Splice kits	H910
	each	Tee kits	H910
	each	Roof clips	H913 or H914
	each	Downspout hangers	H915
	each	Cable ties, UV-resistant	N/A

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