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Heating Cables

Self-Regulating, Constant Watt, and Mineral Insulated Cable

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Our Agency

- Established in 1987, Liberty Electric Sales is celebrating its 33rd year of serving Upstate NY with industry leading products, designs and technical expertise in the Electrical, HVAC, and Industrial industries.

- Our agency started with a focus on electric heat applications and has grown through both sales volume and strategic timing. In the past 5 years, we've bought and integrated 3 other representative agencies - we total around 50 lines.

- Our main offices are located in Syracuse, N.Y., and we're staffed with 5 outside salespeople, and 8 inside sales & support staff.

- We call on a diverse audience, including architects/engineers, electrical/mechanical wholesalers, contractors, industrials, and institutional accounts.

Our Heat Cable Team

- **Rob Zerrillo** has been in the industrial/commercial heating business for over 14 years. First working with a Cleaver Brooks distributor and then for the last 10 years with LEP focused on electric heating applications. Rob has worked on and developed solutions over 500 different heat trace applications in UNY. His primary responsibility is being in the field at job sites, working with engineers/architects on new designs and helping contractors with installations.

- **Tricia Neuburger** has been with Liberty Electric for over 18 years and is currently our Operations Manager overseeing the inside technical and support staff who ensure that customers get quick responses on quotes, orders and other issues. Her primary responsibility is to be the stationary point of contact for all customers to get them the best solutions of all of our products and manufacturers.

- **Ed Jordan** has been with Liberty for 5 years and is our resident heat cable resource expert. Ed's background is mechanical engineering, and worked previously as an HVAC design engineer, and is also a commercial /private jet pilot. Ed is responsible for heat trace designs, quotes, and technical information.

Presentation Outline

- Types of Heating Cable
  - Self Regulating
  - Constant Watt
  - Mineral Insulated
- Applications
  - Roof & Gutter De-Icing
  - Slab Snow Melting
  - Pipe Tracing Protection
  - Fire Sprinkler Protection
  - Grease Flow Protection
- Low Voltage Systems
- Common Cable Controls
- Specs and Installation

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Types of Heated Cable

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3 Types of Heat Cable

1. **Self Regulating**
   Variable heat/wattage output, resilient, and versatile, can be cut & connected in the field. We find self-regulating is the most commonly used heat cable for roof & gutter and pipe trace applications.

2. **Constant Watt**
   Constant watt cable is also resilient and versatile, some types can also be field cut and terminated. Constant wattage cable gives out consistent heat and does not vary in output, making it predictable. Mostly seen in floor heating, snow melting, and frost heave applications.

3. **Mineral Insulated**
   Available in copper and stainless sheath, this cable is highly robust, has a constant wattage output, capable of high watt density, and has a very long-life expectancy. This is NOT a field workable cable but is pre-terminated with welded end seals. Typically seen in snow melting, and roof & gutter de-icing applications (slate & copper roofs).

Self-Regulating Cable

Self-regulating cable is very versatile, relatively easy to work with, and doesn't harm what its installed on-making it the most commonly used heat cable for most commercial/ industrial applications.

SR cable works through expansion and contraction between the buss wires to vary or "self-regulate" its wattage output based on the temperature it is up against.

- **Industry Standard:** Output is rated at 50°F. 5, 8, 12 watts/ft is what the rated output is at 50°F.
- Output wattage/heat is determined by irradiated carbon content mixture during production and surface temp after installed.
- **Cable can crossover/touch itself without burning through.**
- **Most energy efficient cable choice.**
- Low temp SR cable good to 150°F/180°F max, SR cables can go to up to 540°F max.

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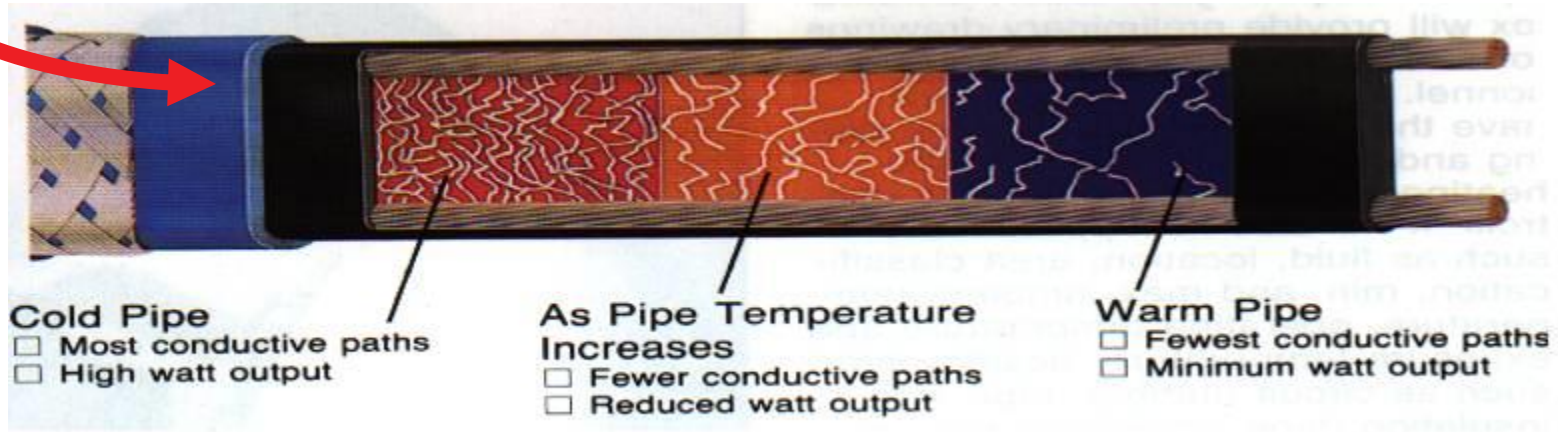
SR Cable Construction

- Buss wire
- Irradiated Carbon matrix (Carbon Black)
- Primary over-jacket
- Tinned copper over-braid
- UV or chemical resistant over-jacket

SR Cable's Magic

- Carbon Black suspended in polymer matrix is used to conduct current between parallel buss wires.
- Expansion and contraction of polymer matrix versus temperature causes output variation.
- Output wattage and temperature controlled by mix of polymer and carbon black.
- The reason an SR cable cannot reduce much beyond its 50F industry-rated temp, is because the inner jacket prevents the carbon mastic from expanding more.



SR Circuit Length Max.

Recommended Circuit Lengths NOT TO EXCEED per V for 5w/ft cable (12 w/ft. max draw)

30A Breaker:

120V – 275ft.

208V – 400ft.

240V – 450ft.

277V – 525ft.

- Typically this cable has a limited life expectancy; wattage output diminishes over time and conditions (10-15 yrs. on avg. with controls).
- **Higher voltages can accelerate this wearing, but cable also produces a higher heat output overall.**
- **Not designed for voltages over 277. Single phase only.**
- End seal terminations are not designed for sustained immersion periods under water.

Constant Watt Cable

- 12 AWG buss wires.
- 4, 8, and 12-watt output most common.
- 37 Ga. Ni-Chrome resistance wire.
- 120 – 480V range.
- Can perform up to 320F / 390F max. exposure.
- Class 1, Div. 2, groups A, B, C, D.

- Constant Watt cable is versatile, and shines in many applications, including floor heating, pipe tracing, frost-heave prevention, and in low watt outputs residential roof & gutter melting.
- Constant Watt cable delivers a **predictable, consistent wattage output.** Sizing circuits is easy.
- Pipe Trace CW cables can be cut and terminated in the field, but typically flooring cables can only be repaired by nature of how they are manufactured.

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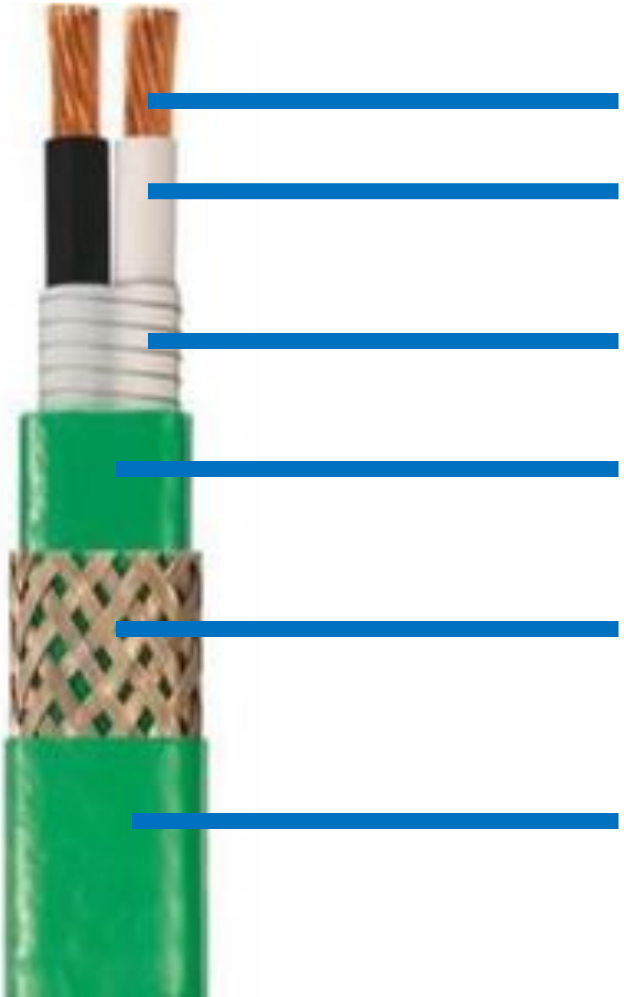
Constant Watt Cable



Buss Wire(s)

Primary Buss Over-jacket

Resistance Wire

Primary Over-jacket

Tinned Copper Over-braid

UV or Chemical Resistant Over-jacket

Constant Watt Cable

Advantages:

- Operate Standard Voltages; 120V to 480V
- Lower start up in-rush current
- Pipe Trace; cut-to-length and flexible - easy to install
- CID2, Zone 1 & 2 Certifications

Disadvantages:

- CANNOT TOUCH AGAINST ITSELF
- Application limitations; runs too hot for some applications.
- PVC vinyl inner jacketed cables can corrode from inside out.
- Floor warming cables are generally not cut to length in field.

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Mineral Insulated Cable

MI cable is a rigid metal and insulation sheathed heater element that can be designed and manufactured in custom lengths. These cables are capable of carrying higher voltages and higher watt/heat output. Made with SS or Cu jacketing, they have welded end seals and are capable of being submerged.

MI can be constructed as a single or 2-conductor cable. Single conductor cables must start and end in the same termination location to power.

MI is typically used for pavement snow melting, roof & gutter de-icing, sump-pit freeze protection, and pipe tracing.

- Constant wattage output.
- CANNOT TOUCH AGAINST ITSELF.
- Copper and Stainless-Steel sheath types- bare metal or HDPE jacketed. Stiff cable memory.
- Robust, durable, and long-life expectancy, typically 30+ yrs.
- 120 – 600V range
- Max. temp 1100F working/ 1400F max. exposure (stainless).
- Class 1, Div. 2, groups A, B, C, D

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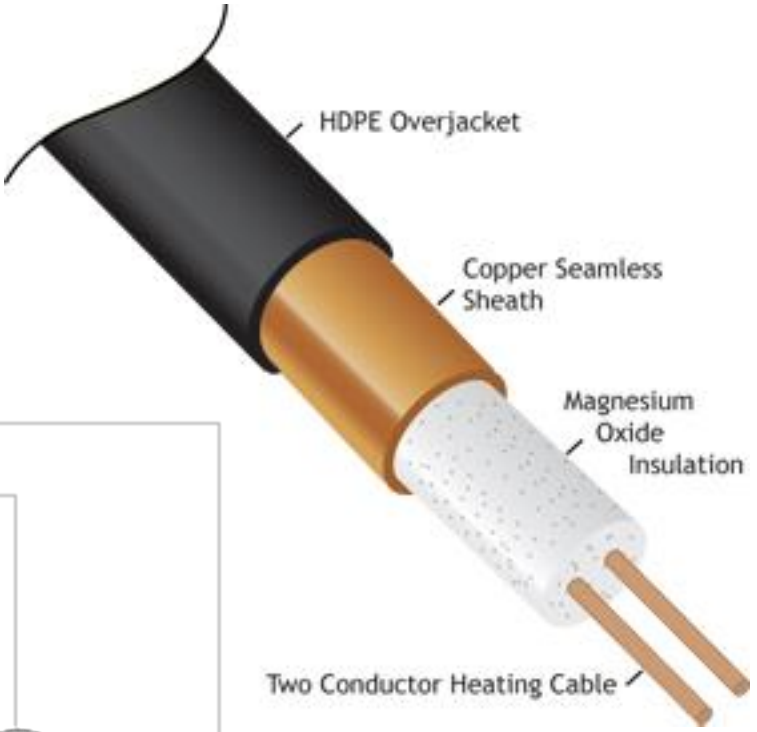
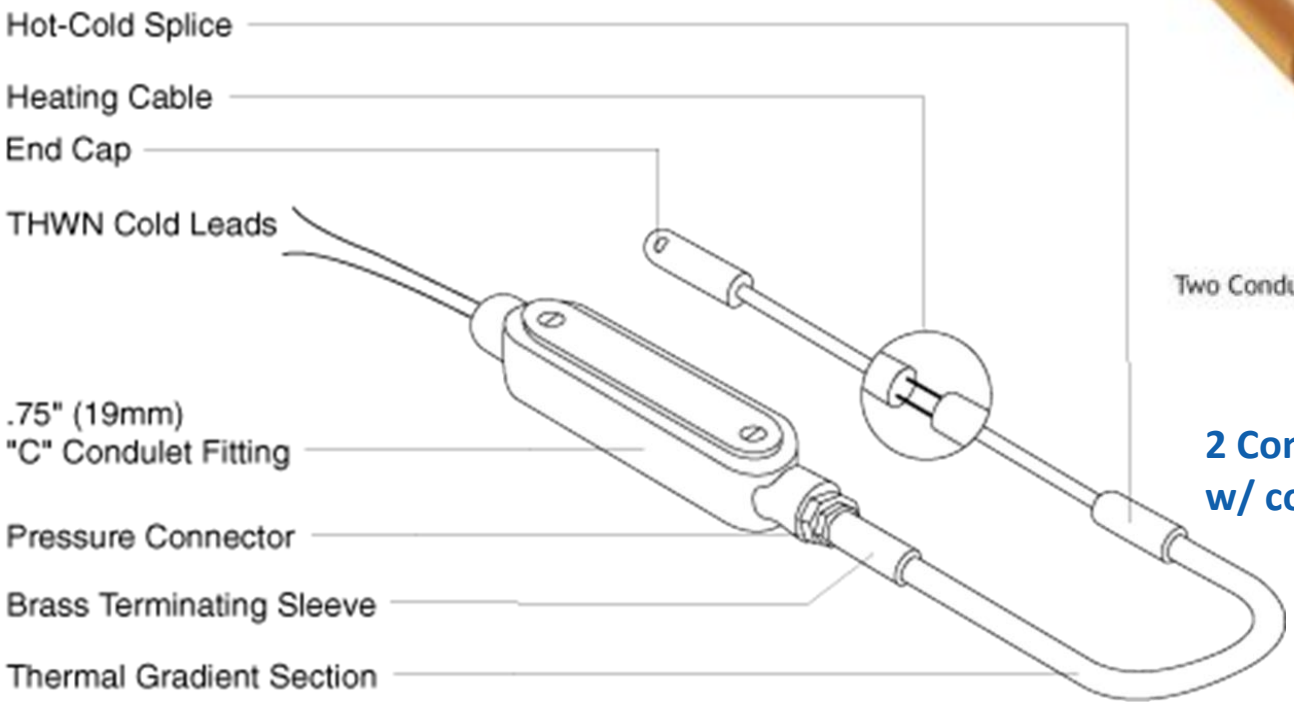
M.I. Cable Construction

Single Conductor Assembly





2 Conductor Assembly w/ condulet.

M.I. Cable

Advantages:

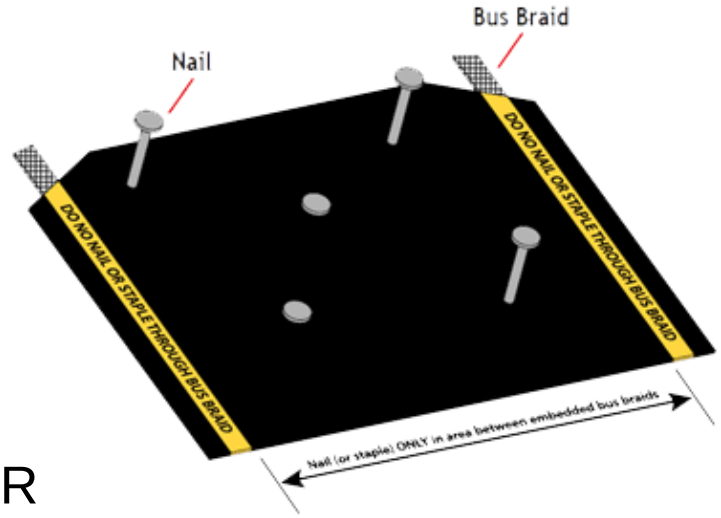
- Robust, durable, and long-lasting.
- Customizable/engineered solution.
- Length, wattage/heat output, 1 or 2 conductor, copper or stainless, jacketed, pulling eye.
- Welded end seals, and capable of full submersion in non-corrosive fluids.
- CID1/CID2 and Zone 1/ Zone 2 Certifications.

Limitations:

- It’s a customizable/engineered solution; must have exact info.
- CANNOT overlap/touch itself
- Lengths are typically limited to under 500’- weight, and difficult to manage spool. Stiff memory.
- Difficult to splice or repair correctly in field.
- Relatively inflexible – more difficult to install.

Flat Polymer Heaters

- Flat Polymer Heaters are 3” – 12” sheets of homogenous, semi-conductive polymer strips of **self-regulating material** (PTC Nano-Technology) used with low-voltage snow melt systems.



- They function exactly the same as SR cables and work through expansion and contraction, based on the surface temp. of what its physically touching.

- This material can be nailed and stapled through bent around corners and cut without damaging the performance.

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Heat Cable Applications

Roof & Gutter De-Icing

- SR is a common choice for this application, because it can touch against itself, and is safe on any roofing material.
- The heat cable functions to allow a pathway to get water off the roof, into the gutter, and into the downspout. Most cable heat is lost to the ambient.
- SR cable creates a melt path approx. 2” per side of the cable (new) but depending on cable quality can shrink with age/wattage decrease.
- Commonly used in conjunction with moisture/temp sensors to automatically turn the system on and off when temp falls below 35F and moisture is detected on the sensor.

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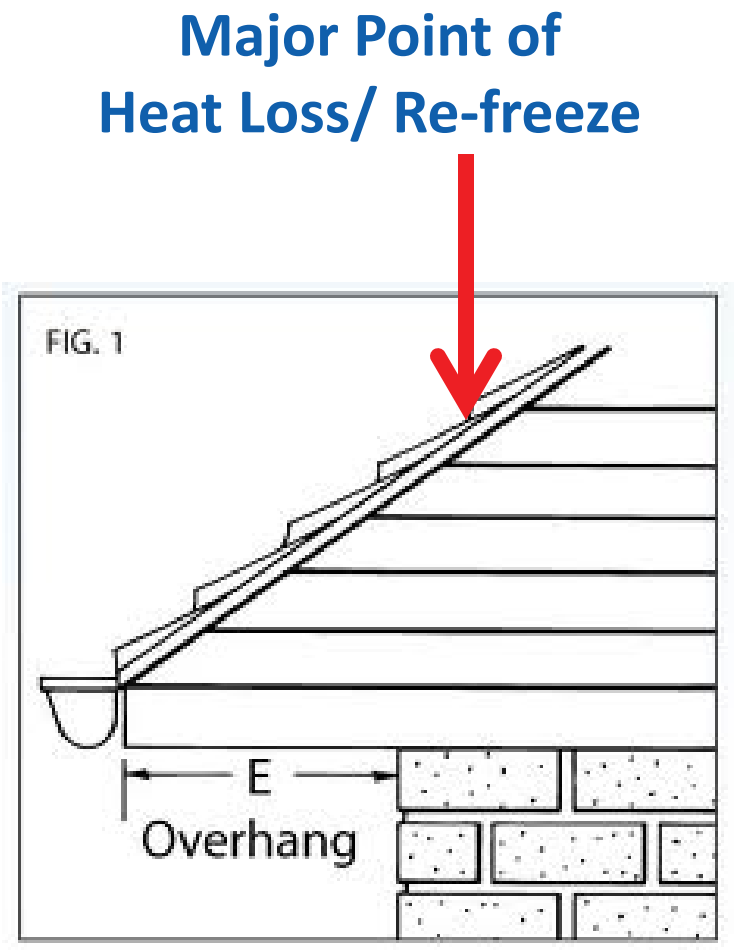
Roof & Gutter De-Icing

- The greatest point of heat loss comes where the outer wall and overhang meet.
- We typically recommend extending (sawtoothing) cable at least 1 foot past this point to keep ice dams from forming. Sawtooth width is 2’
- Metal Roofs, run sawtooth between ribs.
- In most cases, continuing the circuit down & up the downspout is less expensive than splicing. Adhere roof clips with epoxy cement to avoid roof penetrations.



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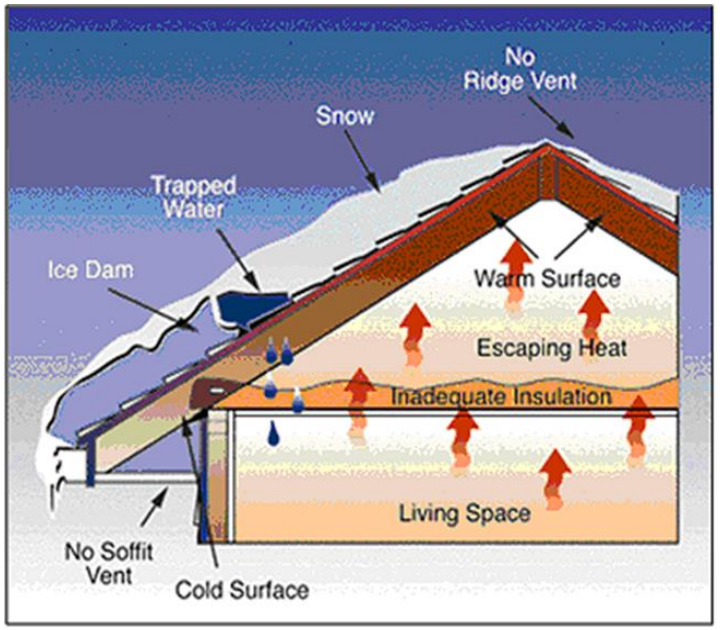
Roof & Gutter De-Icing

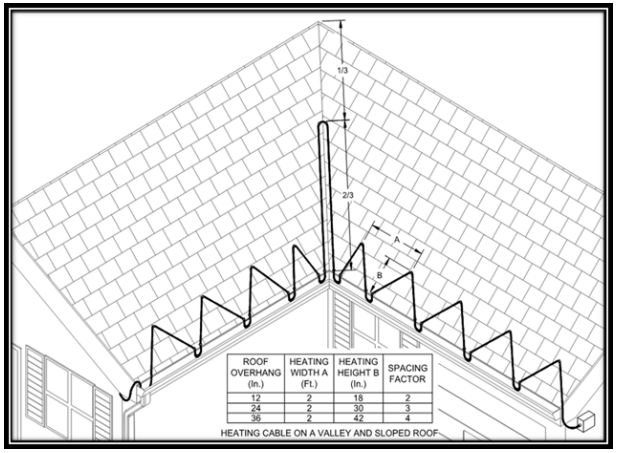
Typical Ice Dam Reasons:

- Poorly insulated attics
- Lack of sunlight hours/radiant solar gain.
- Inadequate ventilation
- No or clogged soffit vents
- Air leaks into building
- Vent stacks
- Entryways
- Building orientation
- Poor roof design



Items to Consider:

- Voltages available
- Roofing material
- How many downspouts, and how do they drain?
- Lengths: linear, valleys, and DS's.
- Overhang? How far?



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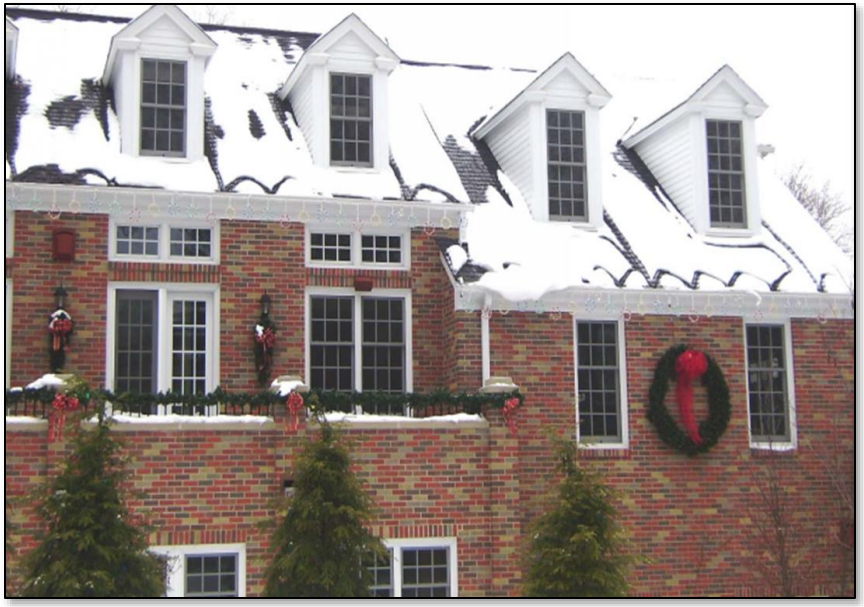
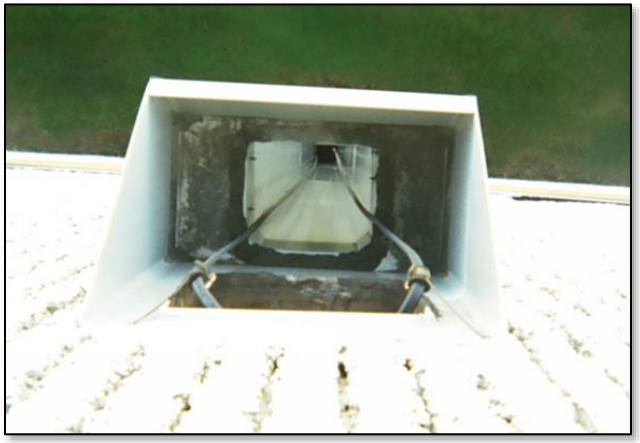
Roof & Gutter De-Icing





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Pavement Snow Melting

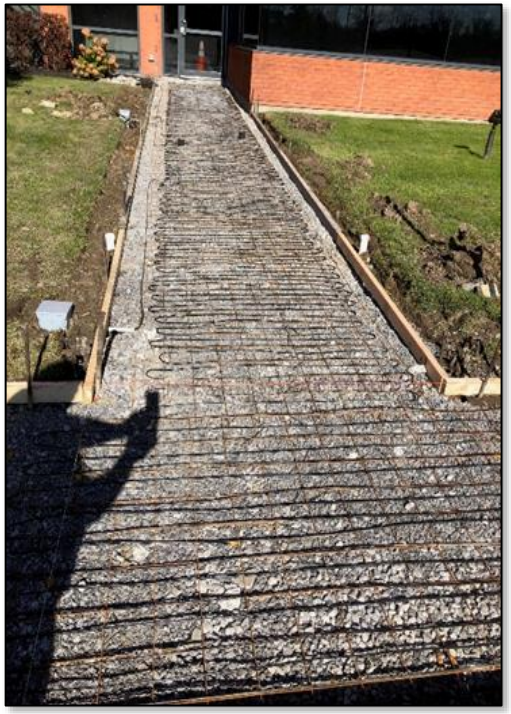
- Automatic Snow Melting Systems for walkways and pavement is a great way to save medium to long-range costs, preserve concrete & pavers longer, prevent slip hazards, keep salt and corrosives from being tracked into the building, and creating further damage.

- The 2 most popular systems are Hydronic and Electric. Despite the bad reputation electric systems have historically been tagged with, they operate more efficiently, with less maintenance at a competitive, if not less expensive initial cost of materials & install.

Slab Snow Melting

- When using constant watt snow melt mats, or MI cable, we recommend heat output around 45-50 watts/ sq ft. to melt snow at 2” per hour falling in Upstate NY. Both products are able to reduce wattage output; MI cable is customizable for heat output per ft. and turn on a 6” radius. Mats are also available in 36-38w output.

- Per NEC code, MI cable or mats must be at least 2” below the surface of the concrete. The system is then controlled by a combination moisture/ temp sensor embedded in the concrete- or can be used with surface/aerial mounted sensors. Do not cross expansion joints; decorative scores are OK.



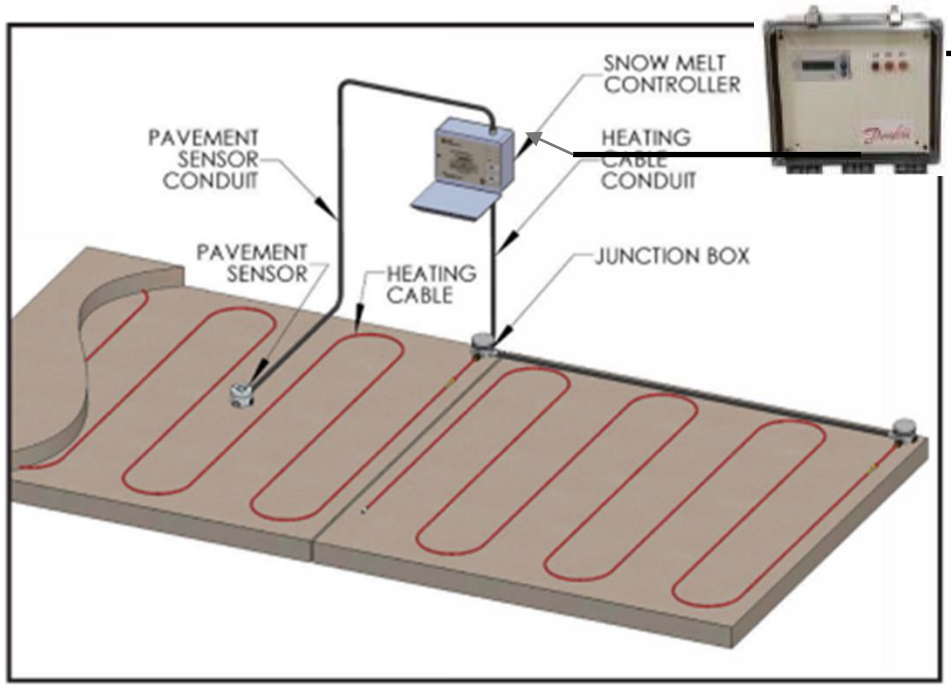
Controller with Arial Sensor

Pavement Sensor

Basic System Components

GFCI contactor/ relay panel

Service Panel 30A
2-pole circuits



This is a basic system layout:

Electrical panel feeds a contactor/relay panel. A snow melt controller is wired to the contactor/relay. There are 2 sensors that detect temp. and moisture. When activated, they signal the controller, which sends signal to contactors and closes them to allow power to pass.

Electric snow melt systems are more consistent than hydronic provided power stays consistent. Under exact same circumstances the electric system can melt faster, more consistently, and runs for less hours of operation vs. a hydronic system.

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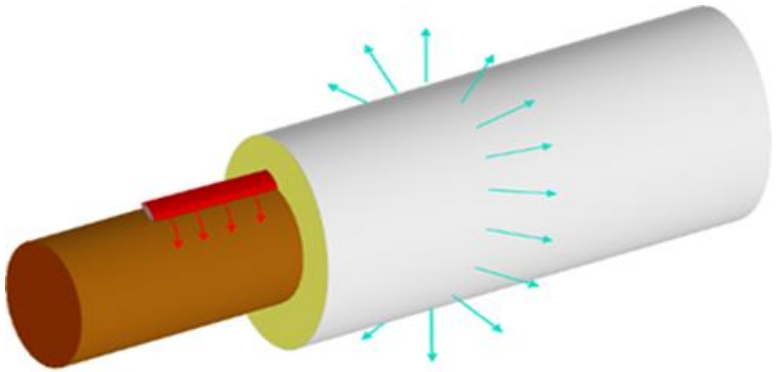
Electric Vs. Hydronic?

- It all comes down to application. What/how much are you trying to keep warm or melt? **In an apples to apples comparison, here's how they stack up:**
  - **Material Cost -** Pretty close on the actual melting equipment, but hydronic systems often need more equipment for the job and will be higher if they cannot tap into an existing loop.
  - **Labor Costs - *Electric*.** Hands down.
  - **Operational Costs -** 1996 ASHRAE study in Chicago winter found electric was less expensive to operate. System was operating around 87% less than hydronic to keep glycol circulating. Electric can also pre-calculate running costs per hour accurately vs. hydronic.
  - **System Maintenance - *Electric***. Almost none; just clean sensor faces.
  - **System Performance -** no BTU loss off glycol, ***Electric*** melts evenly on roofs or sidewalks. Low-voltage systems are also available.

Pipe Tracing & Temp Maintenance

- Pipe Tracing/Preventing heat loss off piping is a very common application for heat cable. SR cable is the most popular for this application because overall it's the easiest and most versatile to use.
- Heat cable doesn't add heat to the fluid inside the pipe. It simply offsets the heat losses based on pipe diameter, desired temp, and level/thickness of insulation.
- Insulation **MUST** be used in conjunction with heat cable to properly offset heat losses. Typical commercial/industrial application use a minimum 1" thickness on the entire piping system.



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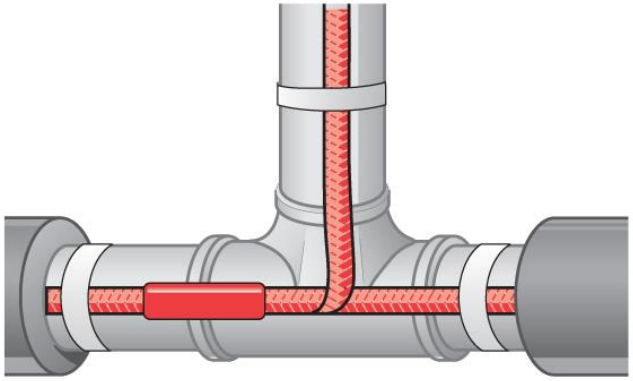
Pipe Tracing

- When considering the right wattage cable product to use for pipe tracing, a simple watt loss calculation needs to be done.
- The higher the thickness of insulation, the less heat losses you have off the skin of the pipe/vessel.
- Typically, applying the heat cable to the lower portion of the pipe is optimal placement.
- Linear runs use far less cable than spiral wrapping the pipe. Larger diameter pipes require more linear runs to ensure proper heat dissipation and flow in the pipe.



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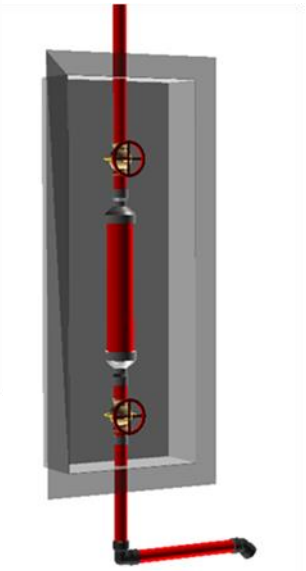
Fire Sprinkler Heat Tracing

- **8.16.4.1.4**
  - Listed heat-tracing systems shall be permitted in accordance with 8.16.4.1.4.1 & 8.16.4.1.4.2

- **8.16.4.1.4.1**
  - Where used to protect branch lines, the heat tracing system shall be specifically listed for use on branch lines.



Heat tracing for sprinkler systems follows the same protocols as freeze protection cables.

Grease Waste Heat Tracing

Outdoor Grease Trap:

- Large Capacity
- 1,500 To 6,000 Gallons
- One Or Multiple Traps In Series
- Outside Of Building
- Piping Needs To Be Kept Warm
- GREASE CONGEALS @ < 100°F

SR cable with redundant runs is a great way to ensure long lasting system performance.

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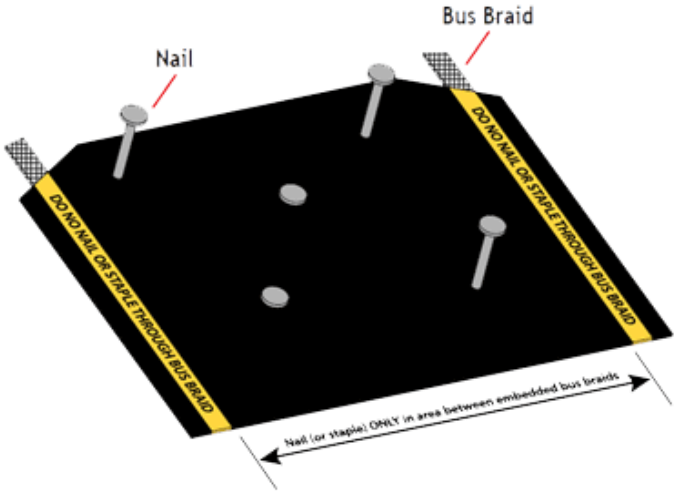
Low Voltage Systems



Low Voltage Systems

- Low-voltage systems are powered by a 24V AC or DC voltage power supply. They can be direct wired (DC voltage) from a solar system without going through an inverter.
- The elements vary in width from typically 3” to 12” wide, a homogenous semi-conductive polymer that is only 3/64” thick.
- Low-voltage systems typically use 30-60% less energy than a MI or Constant Wattage system.
- The power supply transformers can also be field adjusted to provide faster melt rates, or lower wattage consumption and a slower melt rate.

Low-Voltage Systems

- Heating elements are also very forgiving to install, and can be stapled, screwed, and custom cut. This helps eliminate potential installation issues with the heaters but wiring and connections must be checked & tested thoroughly before concrete is poured.
- **In snow melting applications, burial depth can vary from 2” to 8.”** The system is controlled by an ambient sensing thermostat/single point of control.
- **For Roof & Gutter De-Icing**, the heating elements are installed with the roof, just under the shingles. The beauty of this product is it can also be folded over the drip edge.

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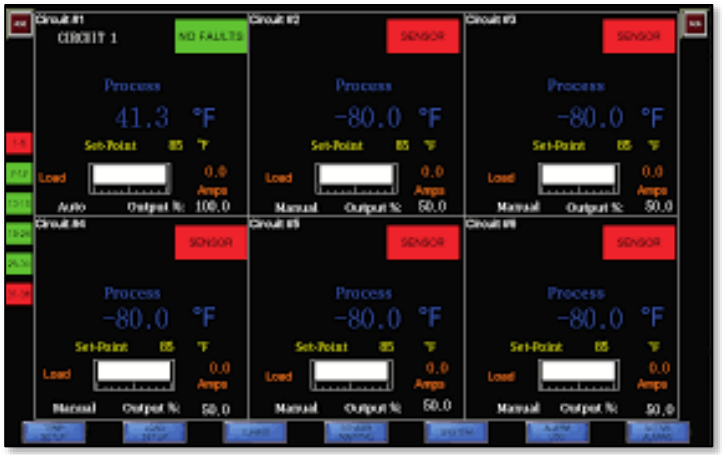
Heat Cable Controls



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Heat Cable Controls

- Heat cable controls range from simple, single-circuit basic controls to full-range GFI circuit breaker integrated PLC/HMI panels capable of controlling 100+ circuits.
- All heat cables need to be properly terminated using the recommended manufacturer approved equipment or similar. “**Quick Connect**” power connection kits are more expensive but do install very quickly by comparison and minimize chances for installation error.
- Thermostats can serve as both the source of power connection and beginning of heat cable run.
- Per NEC code requirement, there must be some means of GFI on a heat trace circuit- some single and multi-circuit controllers can provide at a higher cost.

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Single Circuit Controls

- Single-circuit controls range from $100 bi-metal bulb & capillary thermostats to $1,500 mini-PLC/HMI panels.
- PLC panels provide all the critical info and **can be linked to BMS systems via standard comm protocols.** This level of control also usually includes GFI protection.
- Digital /RTD input thermostats are also very popular and bridge the gap between the inaccuracy of a bi-metal stat and the sophistication of the PLC controller. These controllers may also include GFI protection, and dry alarm contacts.
- Roof & gutter and sidewalk de-icing controls can also detect moisture and temperature. These controls are pre-set to 35°F and must be in contact with snow/water to automatically turn system on. Placement is key!

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Multi Circuit Controls

Multi-circuit panels can handle from 2 to 100+ circuits. They are more costly up front, but have huge value including:

- Detailed temp and power info.
- GFI breaker-integrated, and a huge labor savings. Just bring in 1 feed.
- BMS integration, pick your com protocol.
- Multiple sensor inputs.

Multi-circuit controllers also include **GFI protected contactor-relay panels.** Simple designs with 30, 40, or 50A contactors that pair with the manufacturer's snow melt or pipe trace controller. **Contactor-relay panels are very popular because they are simple, effective, and a lot less costly than the PLC panels.** However, each circuit used in a contactor relay has to be brought over from a service panel.

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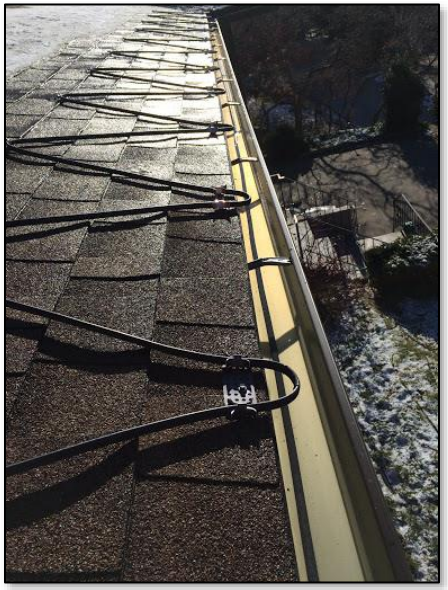
Installation & Specs



Installation & Startup

When designing and specifying heat cable systems, try to give as much information as possible, such as (for example):

- **For Roof & Gutter De-icing:**
  - Gutter and downspout lengths and widths and diameters needed.
  - If metal, how far is rib spacing?
  - How far up valleys to be melted?
  - How do downspouts drain? To ground or catch basin?

- **For Snow Melting:**
  - Where are the expansion joints located?
  - Where (location) is feed power coming from?
  - Exact measurements of slabs to be heated.

* Try not to leave details to the discretion of the installer! Most will take the path of least resistance, time, and cost.

Installation & Startup

- Installers should be reviewing the plans for installation the week prior to the work (at least) and ensure all materials are on ready to go, or on site.
- It is a very good idea to specify that heat cable systems **MUST have meg-ohm and resistance readings recorded and submitted to GC or customer after installation** - this ensures the products were not damaged at the time of install.
- Factory, or rep start-ups are also a good idea to ensure the checklist is being followed and the job is ‘blessed’ by the product manufacturer.
- We all run parallel roads. Engineers, reps, contractors all working together to do the job right, and keep the customer happy!

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Thank You

Questions/ Comments?

Check out our website at www.libertyelectricproducts.com.

For more information email sales@libertyelectricproducts.com.