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Electric Heat Cable for Farm and Home Use

Kenneth L. McFate
Department of Agricultural Engineering

In many situations around farm and home, a small amount of heat applied at the right time and place will prevent equipment damage, accidents and livestock losses.

Electric heating cable, properly selected and applied, can be a real convenience and labor saver during cold winter months.

If lead-covered cable is used, it should be thoroughly coated with a glyptal paint or hot pitch to prevent the alkali in the cement from attacking the lead sheath during the curing process.

While some applications require a particular type of heating cable, six general precautions must be followed for satisfactory performance of any heat cable or heat tape:

- Do not cut cable — a change in length will change wattage and may cause overheating.
- Do not cross or lap one cable directly over another. Excessive heating may occur and the cable will burn out.
- Place cable carefully to avoid damage to either the insulation or the internal heating wire. If laying or wrapping cable in cold weather, energize long enough for it to become warm, plyable and easy to work with.
- Follow the manufacturer's installation and operating instructions carefully.
- Make all "plug in" and other connections moisture-proof.
- Follow your local and National Electric Code Wiring specifications.

Protecting water pipes

Water pipes, hydrants and drains in unheated buildings or completely exposed areas can be protected from freezing with either heating cable or heating tape.

The wattage necessary to prevent freezing depends on the size of pipe, the minimum surrounding temperature, the desired water temperature (35 degrees Fahrenheit to prevent freezing), and whether the pipe is insulated.

You can get more watts per linear foot by spiraling the cable around the pipe. This, of course, requires a greater total length of cable.

Table 1 shows the approximate wattage needed to prevent freezing when pipe and cable are insulated with 1-inch-thick insulation and also when pipe and cable are not insulated. These data illustrate the importance of a well insulated pipe protection system.

Table 1
Approximate wattage required to prevent freezing of steel water pipes at +20 degree F and -10 degree F temperatures

Pipe diameter	Minimum expected temperature	Heat required per linear foot of pipe	
		Pipe, bare	Pipe, insulated 1 inch
1/2 inch	-10 F	10.0 watts per foot	2.3 watts per foot
1/2 inch	+20 F	3.3 watts per foot	0.7 watts per foot
3/4 inch	-10 F	12.3 watts per foot	3.7 watts per foot
3/4 inch	+20 F	4.1 watts per foot	1.0 watts per foot
1 inch	-10 F	15.1 watts per foot	4.5 watts per foot
1 inch	+20 F	5.0 watts per foot	1.2 watts per foot
1-1/4 inch	-10 F	18.6 watts per foot	5.6 watts per foot
1-1/4 inch	+20 F	6.2 watts per foot	1.8 watts per foot
1-1/2 inch	-10 F	21.2 watts per foot	6.4 watts per foot
1-1/2 inch	+20 F	7.0 watts per foot	2.2 watts per foot

[1]Insulated jacket assumes a 1-inch thickness of mineral wool or equivalent, protected from moisture and with water temperature in pipe at 35 to 40 degrees Fahrenheit.

If we assume a 45 degree F temperature differential (pipe temperature = 35 degrees Fahrenheit and outdoor temperature = -10 degrees Fahrenheit) we would need to wrap a bare 3/4-inch pipe with about 12.3 watts of heating cable for each linear foot of exposed pipe. If the same pipe is wrapped with a 1-inch thick insulation jacket, only 3.7 watts per foot of pipe length are needed. The insulated pipe-lower wattage cable installation will operate much more economically than the exposed pipe installation.

A somewhat higher wattage (say 5 to 7 watts per foot) would, of course, be satisfactory for the insulated pipe system and would cost little more to operate if the cable is thermostatically controlled.

Either adjustable or factory pre-set thermostats should be operated at a temperature of from 35 to 40 degrees Fahrenheit.

When the pipe is insulated, place the thermostat-sensitive bulb next to the pipe. Be sure to protect pipe insulation from moisture so that it will maintain its effectiveness. The plastic foam type is, however, water resistant and its characteristics are not adversely affected by water. If lead covered cable is used, do not strap it too tightly to the pipe. If these installations are not thermostatically controlled, they should be switch controlled or easily disconnected during periods of warm weather.

For maximum economy, plan to insulate all water pipe. Then select the right length and type of heating tape or cable by first measuring the pipe diameter and pipe length. As many folks will use only the insulation that is included with some heat cable kits, you should again refer to the particular manufacturer's instructions and select the length of cable on this basis, with the coldest wintertime temperature as your guide. Insulation in many kits will be much less than 1 inch thick when wrapped in place.

Poultry watering troughs

For warming water in long poultry watering troughs, either heat tape or cable can be placed in the bottom. To maintain ice-free conditions with low house temperatures (15 to 20 degrees Fahrenheit), use about 7 to 10 watts per linear foot of trough. Protect the cable from poultry with a coat of asphalt emulsion, encase it in a heavy spring or place under a wire mesh.

Special cable applications

For special applications like heating molasses and other viscous liquids, you will generally need much more heat than we've discussed here. For more information on these, consult your local electrical contractor or power supplier.

Heating concrete slabs

Electric heating cable placed in concrete slabs warms brooding areas in the farrowing house, work areas in milk parlors and maintenance areas in the farm shop. When placed in concrete sidewalks, steps, ramps and driveways, it provides protection, comfort and convenience for livestock and humans.

Many cable manufacturers make up complete heating mats and heating kits for these applications. Most kits have a 10-foot section of "cold" lead wire vulcanized to the "hot" resistance wires, with an attachment plug on the other end. Individual cables can also be used if the correct type, wattage and length of cable is selected to meet specific needs. Table 2 shows the relationships between heating cable wattage, watt density in watts per square feet of surface area and different cable spacings.

Table 2
Relationships between heating cable wattage, watt density in watts per square feet of surface area and different cable spacings

	Cable spacing to obtain density indicated

Type cable (watts per feet)	Density (watts per square feet)					
	25	30	35	40	45	50
	To obtain above density, allow following space between cables, in inches					
2.5	1.20	1.00	Use higher wattage cable	Use higher wattage cable	Use higher wattage cable	Use higher wattage cable
2.75	1.32	1.10	Use higher wattage cable	Use higher wattage cable	Use higher wattage cable	Use higher wattage cable
3.0	1.44	1.20	1.03	Use higher wattage cable	Use higher wattage cable	Use higher wattage cable
3.5	1.68	1.40	1.20	1.05	Use higher wattage cable	Use higher wattage cable
5.0	2.40	2.00	1.71	1.50	1.33	1.20
6.7	3.22	2.68	2.30	2.02	1.79	1.61
7.0	3.36	2.80	2.40	2.10	1.87	1.68
7.5	3.60	3.00	2.57	2.25	2.00	1.80
10.0	4.80	4.00	3.42	3.00	2.66	2.40

Because "cable-in-concrete" applications are permanent, special precautions should be used when installing:

- Place cable between 1 inch and 1-1/2 inches below concrete surface and be sure cables are at least 1 inch apart at all times.
- Ground the heating mats or cable systems for maximum safety.
- Check electrical continuity before and during installation.
- Run nonheating leads in conduit for mechanical protection but **never** run the heating leads inside of conduit.
- Be sure nonheating and heating lead connections are moisture-proofed.
- If thermostat is used, run capillary tube through a second conduit for mechanical protection and place sensitive bulb slightly above and between two heat cables.

Except for the size of the area to be heated and the amount of heat to be provided, installation techniques are quite similar for most concrete installations. Where high temperatures are required for prolonged periods of time, as in farrowing houses and milk parlors, place a 2-inch plastic insulation material such as foam plastic board or a 4-inch slab of insulating concrete under the cable.

As a general guide, design for a density of 40 watts per square foot when providing heat for specific areas used for brooding pigs, for warming milk parlor floors, for de-icing concrete steps, ramps, walks, driveways, and livestock watering pads. In most cases, width of such spaces need only be 18 or 24 inches.

Protecting roofs and gutters

Properly installed heating cable will keep gutters and downspouts open when alternate freezing and thawing occurs. By keeping such channels open, water is prevented from backing up under the roof and causing damage inside of the home.

Electric heating cable kits for gutter and roof protection are available in a wide range of lengths and usually include the necessary roof attachment clamps. A lead core is often molded into the cable to keep the small loops in place.

For a typical installation, allow about 2 feet of 5- to 7-watt per foot cable for each linear foot of roof to be protected. Be sure to ground all metal gutters and downspouts to an 8 foot driven ground rod.

Control the heat cable with a conveniently located switch equipped with an indicating pilot light. If the switch is located outside, be sure it is of weatherproof construction. Turn the switch on when snow starts and off when snow is gone or whenever air temperatures reach 45 degrees Fahrenheit. There is little need to operate the cable when outdoor temperatures are considerably below freezing, as no reasonable amount of heat will free the frozen ice packs, nor will leaks occur under such conditions.

Soil heating for plant growth

Electric heat cable is one of the most economical ways of heating hotbeds. A hotbed can be constructed at little cost. Either plastic-covered or lead-covered cable can be used to start and grow plants with good results. With thermostatic control, you can warm an 18 square foot bed for as little as 5 cents per day.

Heat cable controls

For water pipe and drain protection, an inexpensive thermostat, similar to that used in commercial heating tapes, functions quite well. These are often preset to turn cable on when temperature reaches 40 degrees Fahrenheit. A more expensive, more precise control will slightly reduce seasonal operating costs. In either case, it is important to fasten the sensitive bulb directly to the water pipe at the coldest point, but insulate the bulb to the same degree you insulate the pipe. This will prevent the possibility of overheating.

For warming electrically heated concrete slabs in milk parlors for the operator's comfort, either a thermostat can be used or a properly selected time clock can turn heat on a few hours before and then off again shortly after each milking operation. This latter automatic switch is convenient and economical if you don't want the slab heated at all times. It will not "forget" to shut off the heat when it isn't needed.

For de-icing and snow melting systems, you need only a toggle switch with a pilot light to indicate, at a glance, when the heating circuit is energized.

When heat cable is used for hotbeds or for brooding pigs, uniform floor and concrete surface temperatures, respectively, are much more critical. In such applications, the thermostat should have a range of about 30 to 100 degrees Fahrenheit with a differential of no more than 5 degrees Fahrenheit, but preferably 3 degrees Fahrenheit.

When selecting any control, be sure it is built with enough capacity to handle the electrical load.

What voltage?

Since heat tape and heat cable used on the farm will usually warm relatively small areas, it will often be more convenient to use the readily available 120-volt units. Where large amounts of cable are used, line loss to the cable can be reduced with a 240-volt cable-thermostat system.

An important point to remember is: always provide the proper voltage — that voltage for which the cable was designed. Here's why: If a 120-volt heating unit is connected to 240 volts, the cable insulation will melt and the entire heating unit will need to be replaced. On the other hand, if a cable rated at 240 volts is connected to 120-volt service, it will produce only one-fourth of its rated wattage or heat output.

Costs

The retail cost of typical heating tapes will vary from 20 to 40 cents per foot depending upon length. If equipped with a built-in thermostat, the cost per tape is increased by about $4.

Single wire heating cable rated at 5 watts per foot may vary in cost from 10 to 15 cents per foot, without thermostat, depending upon length of cable purchased.

The cost of pre-assembled heat cable mats with a 40 watt per square foot density, but without accessories or installation, may vary from 15 to 22 cents per square foot of heated floor area.

The seasonal operating cost of any heat tape or heat cable will, of course, depend upon local weather conditions, the amount of insulation used and the degree and type of control used on the cable. In any case, it will be quite nominal when compared with the benefits received.

For more details on other application or on the wiring of suggested applications, consult your local electric power supplier or MU Extension center.

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Related MU Extension publications

- G1409, Is Your Wiring System Safe and Energy Efficient?
  http://extension.missouri.edu/publications/DisplayPub.aspx?P=G1409
- MWPS28, Wiring Handbook for Rural Facilities
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