



**Environmental Technology, Inc.
Online Information Network!**

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"Providing Our Customers and Prospects With Timely Information" Snow Melting Systems

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This article is the second in a series dealing with the theory and practice of snow melting utilizing hydronic heat transfer. As always, we invite your comments.

Heat Required to Melt Snow:

Previously, it was shown that about 63,000 BTU was required to remove a 1" snowfall from 100 sq. ft. of exposed surface. Thus, for a snowfall of 1" per hour (a considerable rate!), 630 BTU/Hr would be required to clear the snow as fast as it fell. This heat rate is generally, considered excessive; design rates of 200 to 250 BTU/Hr per sq. ft. are planned for areas that need to be cleared quickly, and up to about 150 BTU/Hr per sq. ft. for areas that can tolerate some accumulation during a snowfall.

Design Details of the Snow-melt Slab:

General Considerations/ Operations:

Three issues are important for the finished slab in operation: first, that the structural integrity is not compromised by the presence of the snow melting piping or heat cable; second, that the

Recommended Reading

"Residential Water Heaters for Radiant Heating (or, 'How to Create Your Own Cruise Missile')" by Lawrence V. Drake, Executive Director of the Radiant Panel Association; *Air Conditioning Heating & Refrigeration News*-- (December 16, 1996)

Although whimsically titled, Larry's article offers practical, cautionary information to those contemplating the application of domestic hot water heaters in either open or closed loop hydronic heating.

New On The Horizon

As this issue reaches you, a new Model GIT™-3 Roof/Gutter/Downspout deicing product will be submitted for examination

pipng or cable does not produce thermal shock that over stresses the slab material in local areas; and third, that the entire surface temperature of the slab is warm enough to melt the snow without alternating strips of clear and snow covered areas. This following discussion of the two general methods of heating an outdoor slab addresses these issues.

by Underwrites Laboratories. Configured as a stand-alone sensor/controller - like the GIT™-2, the new product will provide 24 Amp heater switching capability and incorporates fault protection to disconnect upon detecting unsafe operating conditions.

Piping in Concrete or Asphalt

Mechanical Issues:

Embedded pipe presents a laminar discontinuity to the structure of the slab. To minimize the risk of cracking, there should be not less than 2" of concrete between the face of the slab and the circumference of the pipe. Thus, the minimum thickness of a concrete slab for a sidewalk would be the outside diameter of the pipe plus 2"(top clearance) plus 2" (bottom clearance). This requirement favors minimum size pipe (or tubing) be utilized to reduce the required pavement volume. Piping in asphalt can be somewhat closer to the finished surface because asphalt is more flexible than concrete.
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Glycols -

Which One?

Both ethylene glycol-based and propylene glycol-based heat transfer fluids are available for snow melting and other low-temperature services. (Because certain additives are not intended for long-term use, objective authorities caution against the use of automotive cooling system antifreezes for these applications.) Of the two alternatives, ethylene glycol is preferred for the following reasons:

- Greater freeze-point depression
- Higher heat transfer capability
- Lower viscosity (ie less system friction loss)

The only "defect" in ethylene glycol relates to its toxicity, however, in the concentrations required for freeze protection, propylene glycol is also "toxic".

Coincidentally, both fluids will completely (100%) degrade to carbon dioxide and water, but ethylene glycol

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For slabs carrying vehicular loads (requiring greater thickness to start with), the slab design must recognize that the pipe is present, But the pipe is probably less important than in the case of a sidewalk.

Piping in Concrete Or Asphalt

Thermal Issues:

The slab will crack if it is heated locally (i.e., in the vicinity of the pipe) such that the rate of temperature rise in the immediate area develops thermal stresses greater than the ability of the material to accept these stresses. This fact favors small diameter pipe (or tubing), low conductivity pipe material, and moderate temperature heating fluid. It also suggest the advisability of starting the snow melting system fluid pump without preheating the fluid so that the entire combination (circulating fluid and slab) warm up together.

The need to approach uniform surface temperature is achieved by spacing the pipes form 6" to 12" on center, a spacing which helps to meet the need to minimize thermal stresses in the slab. Circulating fluid temperature should be limited to about 120° F, and that temperature should be reached, gradually, only after a warmup time of at least an hour.

Electric Heat Cables in Concrete or Asphalt-Mechanical Issues:

Electric resistance cables can be installed in concrete or asphalt paving. The heat cable should be about 2" below the top surface of the pavement to assure physical integrity of the slab and approximate uniform surface temperature. The diameter of the heating cable is, essentially, insignificant insofar as it affects the ability of the slab to carry loads, so the slab does not have to be increased in thickness as is the case of hydronic pipe/tubing.

Electric Heat Cables in Concrete or Asphalt-Thermal Issues:

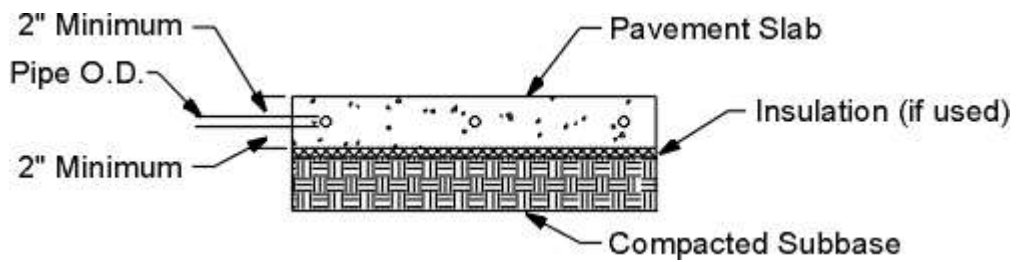
To assure approximately uniform surface temperature, electric heating cables are typically installed on relatively close centers (as determined by the required heat output) and, as mentioned above, at 2" below the surface of the slab. Relative to hydronic pipe/tubing, electric heating cables have a comparatively small diameter, corresponding to a smaller region of heat transfer to the slab material. However, as some constant wattage type resistance cables (may) quickly achieve surface temperatures in excess of 300° F - and the metal sheath of mineral-insulated (MI) constant wattage cables maybe exhibit even higher surface temperatures, both the temperature rate-of-rise and the

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does it quicker (20 days in soil, less than 10 days in water) and with one-half the oxygen requirement of propylene glycol.

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General Construction Considerations Fig. 1



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localized maximum slab temperature should be controlled to minimize thermal stresses that may contribute to concrete cracking.

General Considerations- Construction:

Figure 1 shows a typical pavement slab containing piping (or tubing). The slab is shown placed on insulating board, which is desirable to limit the amount of heat lost to the earth below. Placing concrete (or asphalt) is a difficult, heavy, labor-intensive activity. To accomplish this activity with pipe or electric heating elements embedded in the finished product requires careful planning and considerable cooperation between the workers on the project to ensure the heating items end up in their intended locations.

For concrete, If the heating is to be delivered by pipe, the pipe must be securely attached to the rebar or wire mesh and , as the concrete is poured, it must be pulled up into the slab so that it is at the desired level in the slab. This method is feasible on sidewalks or residential driveways where the area is limited and there are relatively few workers. On larger areas, the piping mechanics are likely to be overwhelmed by the necessarily rapid pace of the concrete placement. In such cases, the pipe has to be tied to rebar that is set on "chairs" at the desired final depth before the pour even begins, and the initial concrete must be placed carefully so as not to disturb the pipe coils. It is also necessary to be sure to not leave any voids in the segment of the pour that is under the pipe.

For Asphalt, the pipe is installed atop the base course, preparatory to placement of the finished wear coat. If plastic pipe or tubing has been utilized, it is necessary to circulate cold water in the pipe until the asphalt mass cools to a safe temperature (about 200° F).

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The installation instructions required by Underwriters Laboratories for U-L Listed snow/ice

melting cable or mats intended for burial in concrete may specifically require the slab to be placed in two pours. If such a limitation is not mentioned, either a single or double pour may be used.

For either pipe or electric cables, the building wall-to-pavement joint, expansion or control joints, or other breaks in the continuity of the finished slab must be dealt with. Steel pipe can withstand the physical forces associated with such breaks in the slab, but the pipe will be attacked by water and chemicals that will work down into the opening at such joints or breaks. Plastic pipe can withstand the water/chemical attack, but it cannot withstand the shear and tensile forces that would be present at such locations. Electrical elements can tolerate neither the chemical attack nor the mechanical forces. Therefore, each independent slab "panel" must contain its own snow melting coil with its supply circumventing all intervening discontinuities.

To Cross such joints, the following techniques (or equivalent) must be employed:

1. Steel pipe should be wrapped or completely coated with tar or similar bitumastic material for several inches each way from the joint. Steel pipe must not be allowed to extend into the ground below the slab. The pipe must be within the concrete throughout the installation.

2. Plastic piping should drop below the slab, crossing the plane of the joint before rising back into the slab. This "U" bend will provide the flexibility needed for the slight movements that may occur, and the pipe will not be harmed by typical soil chemicals.

3. The factory-assembled cold leads of electric heaters must exit the bottom (or edge) of the slab,

terminating in a waterproof junction box adjacent to the pavement "panel." This accessible junction presents a convenient point at which to connect (or extend) the respective branch circuit conductors.