

Frost Heave Prevention Design Guide

Description

- Cold storage areas and freezers are continuously maintained at temperatures at or below freezing.
- As a result, the concrete floor and substrate will also experience temperatures below freezing.
- Ice formation can occur in unheated substrates causing soil expansion and damage to the floor.
- To prevent frost heave conditions, electrical heating cables are installed in the sub-structure to maintain soil temperatures above freezing and prevent ice lens formation.

Application

- To prevent frost heave conditions, electrical heating cables are installed in the sub-structure to maintain soil temperatures above freezing and prevent ice lens formation.
- Electrical heating cables are installed in conduit located in the sub-structure below the floor insulation barrier.
- The sub-structure can be any suitable construction material, such as, concrete, compacted sand or in some cases, compacted soil.
- Conduit spacing is typically 0.6 m-1.2 m (2 ft-4 ft) on centers.

Design

- The heating load for a typical frost heave application is mostly dependent on the thermal insulation barrier between the concrete floor and the sub-structure.
- Standard applications that are below grade do not require any additional considerations.
- For applications that are above grade level, thermal insulation must be installed around the perimeter of the refrigerated area.
- Heater cable selection is a function of the minimum freezer design temperature, thermal resistance (R-Value) of the insulation barrier, and the conduit spacing.
- The R-Value can be calculated by dividing the insulation thickness (in inches) by the insulation thermal conductivity (K Factor).

Control

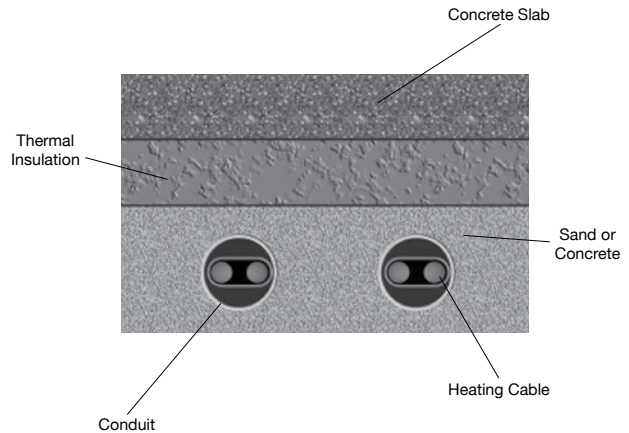
- Temperature control is recommended for this application to reduce the freezer loading and energy consumption during operation. Temperature sensors should be located in conduit midway between cable runs. An evaluation of energy savings of a control system Vs system cost and maintenance cost should be done for each installation.

Circuit Protection

- It is recommended that ground fault circuit protection for equipment be provided for cables installed in electrically heated foundations.

Monitoring

- Ground leakage monitoring is recommended for cables installed in electrically heated foundations to detect dielectric integrity.
- Current monitoring is recommended for cables installed in electrically heated foundations to detect changes in the heater power outputs.

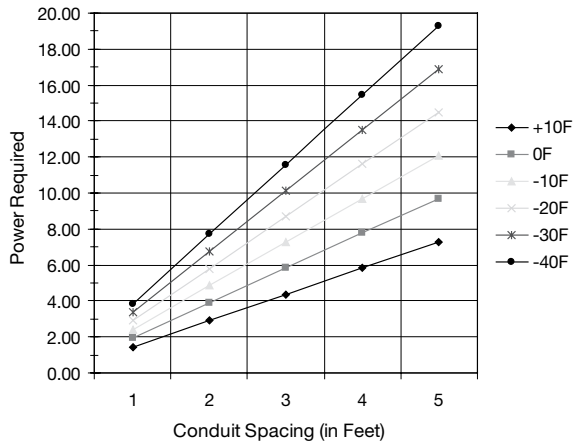


Typical Frost Heave Prevention Sub-Structure

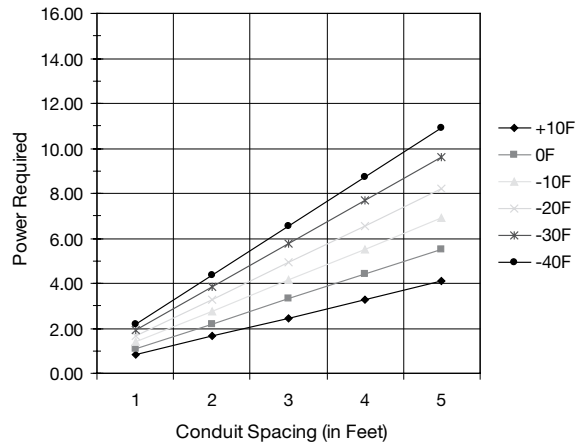
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Determine your conduit spacing and cable wattage requirement from the charts below. Select the appropriate chart based on your specified insulation resistance factor and the minimum freezer temperature.

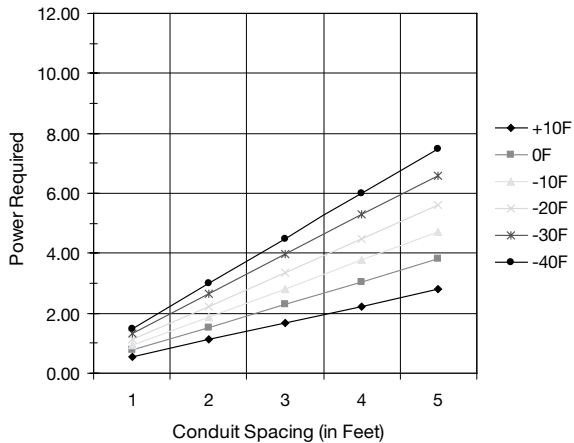
**Frost Heave Prevention Data
R-10 Insulation**



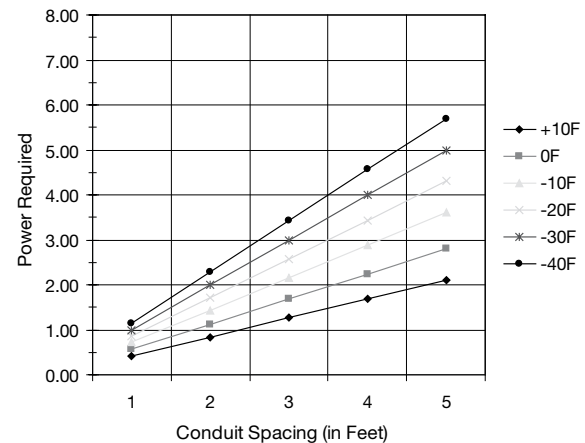
**Frost Heave Prevention Data
R-20 Insulation**



**Frost Heave Prevention Data
R-30 Insulation**



**Frost Heave Prevention Data
R-40 Insulation**



Note: Power required is expressed in watts per linear foot of heating cable. Charts are based on a 50% safety factor per recommendations in IEEE Std 515.1, Frost heave prevention in foundations.

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Cable Selection

To provide ease of repair or retrofit of the installed heating cables, the cable is typically installed in conduit. Each cable type must be evaluated for its design and installation requirements.

Self-Regulating Heating Cables

- For below grade applications, polymer overjacketed constructions are recommended.
- When installed in conduit, self-regulating cables require adjustments to power output to compensate for the installation method.

| Cable Type | Adjustment Factor |
|------------|-------------------|
| LT Series | 0.60 |
| CLT Series | 0.65 |
| QLT Series | 0.90 |
| HLT Series | 0.90 |

- Verify that the thermal output and resulting sheath temperatures are compatible with the conduit or piping materials.
- Terminate heating cables with components approved for use with the specific cable.

Parallel Constant-Wattage Heating Cables

- For below grade applications, polymer overjacketed constructions are recommended.
- Installed cable lengths must be adjusted to account for heating zone spacing and cold lead length.
- Verify that the thermal output and resulting sheath temperatures are compatible with the conduit or piping materials.
- Tight bending radius and hairpin layouts must be avoided when possible.
- Terminate heating cables with components approved for use with the specific cable.

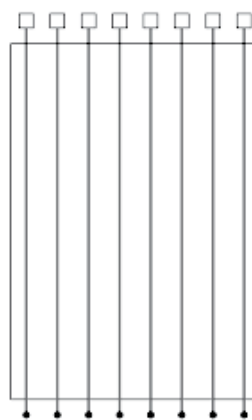
Mineral Insulated Heating Cables

- Design for straight runs with minimal bending requirements only.
- Installed cable lengths must be adjusted to account for cold lead length.
- Verify that the thermal output and resulting sheath temperatures are compatible with the conduit or piping materials.

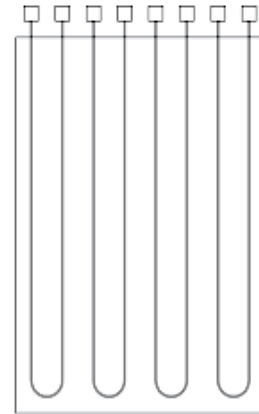
Typical Conduit Layout

Layout conduit system based on power required and selected conduit spacing.

- Space conduit runs equally to cover area to be heated.
- Do not locate conduit closer than 4" from the edge of the subfloor or penetrations.
- Design for only one heater per conduit run.
- Do not cross expansion or control joints.
- The maximum degree of conduit turn is 180 degrees.
- The heating cable must not extend outside of the room in which it originates.
- The heating cable must not be installed in walls or ceilings.
- Do not exceed maximum segment length of selected heater per conduit run.



Straight Run Layout



Hairpin Layout