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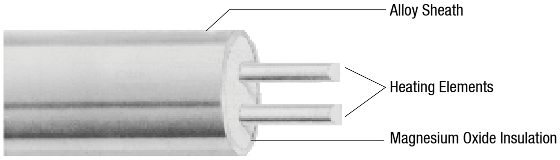
Application

- Electric heating of paved surfaces such as sidewalks, driveways and parking ramps is an efficient, economical method of preventing snow and ice accumulation.
- Electrical snow melting systems replace older, less efficient means of snow removal such as heated water or oil circulating systems, plowing or shoveling, and offer an effective alternative to the application of salts and other chemicals which result in pavement damage and environmental pollution.

Features

- Mineral insulated cable is a high performance, industrial quality, series resistance heating cable which uses a high temperature metallic conductor as the heating element.
- The conductor is insulated with an inorganic dielectric,
- Magnesium Oxide (Mg0).
- The cable has a corrosion resistant Alloy 825 outer sheath which provides mechanical protection and a ground path.
- Because of the superior performance of MI cable, snow melting designs can use these advantages to reduce the overall cost and improve the reliability of the snow melting system.
- Constant Wattage
  - MI cable provides a series resistance heating system so that the power output is uniform over the entire length of the cable.
  - Parallel, self-regulating heaters develop significant voltage drop over their circuit length which results in reduced power output at the end of the circuit.
- No Inrush
  - MI cable eliminates oversizing of circuit breakers because of cold temperature inrush.
  - Most MI cable does not exhibit cold temperature inrush, and circuit breakers are sized for steady state load.
  - Circuit breakers for parallel, self-regulating heaters must be oversized to compensate for inrush.
- Rugged Sheath
  - MI cables have a rugged, Alloy 825 outer sheath which resists mechanical damage during installation.
  - Parallel, self-regulating heaters have plastic sheaths which are easily damaged during installation.
- High Voltage
  - MI cables can be operated up to 600 volts while parallel, self-regulating heaters are limited to 277 volts.
  - Increased voltage results in longer circuit lengths and fewer circuits.
  - In addition, increased voltage correspondingly reduces amperage for an overall reduction of power distribution costs. And, at higher voltages, the need for step down transformers can be eliminated.
- High Power
  - MI cable can be operated up to 70 watts per foot.
  - Because of the superior performance capabilities of MI cable, power outputs can be increased, which reduces the amount of cable necessary for the required watt density.
  - Parallel, self-regulating cables are limited to 30-35 watts per foot at start-up, which results in narrower spacing and increased heater quantities.
- High Temperature Exposure
  - MI cables can withstand high temperatures, a requirement for installation in asphalt.
  - Parallel, self-regulating heaters are damaged by these temperatures.



- Conduit Installation
  - MI cables can be installed inside conduit without deration of the heater.
  - No additional cable is required if the cable is installed in conduit.
  - Parallel, self-regulating heater power output must be de-rated as much as 40% if installed in conduit, which increases the amount of cable required.
- Design Options
  - MI cables are available in a wide variety of resistances and with either one or two conductors.
  - More design choices allow the designer to provide the most economical heating solution, taking many design variable into consideration such as circuit length, voltage, and power distribution requirements.
  - Parallel, self-regulating heaters are limited to only one or two cable choices, with few options for design efficiency.

Options

- HC4X50: Contactor, 50 amp, NEMA 4X enclosure
- HC750: Contactor, 50 amp, NEMA 7 enclosure
- JBA: Cast Aluminum junction box, NEMA 4
- SS05: Stainless tie wire
- HCS-3: Clip strip, 3”, 6” or 9” spacing
- HCS-4: Clip strip, 4”, 8” or 12” spacing
- TA4X140: Ambient Thermostat, 15-140°F, NEMA 4X
- SMMC-3: Control Panel
- SMAS: Aerial Sensor
- SMGS: Gutter Sensor
- SMPS: In- ground Sensor
- SS-1: Automatic Snow/Ice Melting Controller

Certifications and Compliances

- UL Listed: E33597
- CSA Standard: C22.2 No. 130-16
- CSA Certified: LR42104
- Other Standard: IEEE 515.1-2012

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MI Cable Design Procedure
For the most economical MI snow melting system, you will want to consider the following design guidelines:

Design Guideline	Benefit
Maximize heater power output	Reduced heater quantity
Maximize heater spacing	Reduced heater quantity
Maximize voltage	Longer circuits, fewer circuits
Minimize amperage	Lower power distribution costs

The following design procedure is based on providing the most economical snow melting system, using the advantages of MI cable. With this approach, cable power output and spacing are maximized.

Term	Units	Description
W	Watts/m² (Watts/ft²)	Desired Watt Density
V	Volts	Cable Voltage
A	M² (Ft²)	Surface Area for One Circuit
a	Amps	Total Circuit Amps
P	Watts/m (Watts/ft)	Cable Power Output
R	Ohms/M (Ohms/Ft)	Cable Resistance
L	Meters (Feet)	Cable Circuit Length
S	Millimeters (Inches)	Cable Spacing

Step 1: Select Desired Watt Density (W)
The ASHRAE "Systems Handbook" classifies snow melting systems as to the urgency for melting.

- Class I (Minimum): Residential walks or driveways and interplant areaways.
- Class II (Moderate): Commercial (stores and offices) sidewalks and driveways, and steps of hospitals.
- Class III (Maximum): Toll plazas of highways and bridges, and aprons and loading areas of airports.

These classifications are based on the allowable rate of snow melting. Actual watt densities required depend on environmental conditions including air temperature, wind speed, snow fall rate, and snow coverage. The data in Figure-1 is taken from the recommendations and calculation methods provided in the ASHRAE handbook, and is intended to allow the designer to exercise some judgment based on risk factors.

Step 2: Select Voltage (V)
Increased voltage reduces amperage and increases circuit length which reduces the overall cost of the snow melting system.

Step 3: Determine Area for Each Heat Tracing Circuit (A)
For large projects, the area corresponding to each heat tracing circuit can be based on maximum circuit amps which are limited by circuit breaker size. The Canadian and National Electrical Codes require the steady state circuit breaker load to be derated to 80% of the nominal circuit breaker rating. For example, the steady state load for a 40 amp breaker would be 80% of 40 or 32 amps. Alternately, a larger area can be divided into smaller zones based on conduit and panel locations or expansion joint bound cries. A typical zone size is 200 square feet.

$$A = \frac{a \times V}{W} \quad \text{EQ-1}$$

$$a = \frac{P \times L}{V} \quad \text{EQ-2}$$

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Figure 1: Electric Snow Melting System Design Data

	Common Watt Densities Actually Installed Watts/m^2 (Watts/ft^2)		
Location	**Class I**	**Class II**	**Class III**
Calgary, AB	485 (45)	592 (55)	700 (65)
Edmonton, AB	538 (50)	646 (60)	754 (70)
Little Rock, AR	215 (20)	323 (30)	538 (50)
Denver, CO	452 (42)	538 (50)	646 (60)
Wilmington, DE	323 (30)	431 (40)	538 (50)
District of Columbia	323- 431 (30-40)	431-592 (40-55)	592-646 (55-60)
Mt. Home, ID	226 (21)	398 (37)	614 (57)
Chicago, IL	431 (40)	538 (50)	646 (60)
Indianapolis, IN	431 (40)	431 (40)	431-646 (40-60)
Dubuque, IA	431 (40)	431-646 (40-60)	646 (60)
Kansas City, KS	431 (40)	538 (50)	646 (60)
Ashland, KY	323 (30)	452 (42)	646 (50)
Bangor, ME	431 (40)	431 (40)	646 (60)
Baltimore, MD	323-485 (30-45)	538-646 (50-60)	646-807 (60-75)
Boston, MA	431-538 (40-50)	538-646 (50-60)	646-807 (60-75)
Detroit, MI	431-646 (40-60)	646 (60)	646 (60)
Minneapolis, MN	452 (42)	646-807 (60-75)	754-807 (70-75)
St. Louis, MO	431 (40)	431-646 (40-60)	646 (60)
Winnipeg, MB	431 (40)	538 (50)	646 (60)
Moncton, NB	377 (35)	485 (45)	592 (55)
Omaha, NE	431-485 (40-45)	646 (60)	646 (60)
Concord, NH	538 (50)	538 (50)	6.97 (75)
Atlantic City, NJ	323 (30)	431 (40)	646 (60)
New York, NY	377-431 (35-40)	431-538 (40-50)	538-646 (50-60)
Syracuse, NY	431-646 (40-60)	646 (60)	646 (60)
Charlotte, NC	452 (42)	323-452 (30-42)	452 (42)
Cincinnati, OH	431 (40)	538 (50)	646 (60)
Cleveland, OH	431 (40)	485 (45)	485-592 (45-55)
Ottawa, ON	485 (45)	592 (55)	700 (65)
Toronto, ON	377 (35)	485 (45)	592 (55)
Tulsa, OK	215 (20)	323 (30)	431 (40)
Montreal, PQ	485 (45)	646 (60)	646 (60)
Regina, SK	485 (45)	646 (60)	646 (60)

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Step 4: Determine Maximum Cable Power Output (P)
Normally, you will want to maximize cable power output to minimize the amount of cable required. MI power outputs are limited by the pavement type and installation methods.

Pavement Type	Maximum Cable Output (P) Watts/m (Watts/ft)
Asphalt	50 (15)
Concrete Heater 50 mm (2 in) deep	130 (40)
Concrete Heater 150 mm (3 in) deep	165 (50)
Concrete Heater 200 mm (4 in) deep	200 (60)
Concrete Heater 250 mm (5 in) deep	230 (70)

Step 5: Determine Cable Circuit Length (L)
Cable circuit length in feet is given by the equation:

$$L = \frac{A \times W}{P} \qquad \text{EQ-3}$$

Step 6: Determine Cable Spacing (S)
Cable spacing in inches (S) is given by the equation:

$$S = \frac{A}{L} \times 12 \qquad \text{EQ-4}$$

Step 7: Determine Cable Resistance (R)
Cable resistance in ohms/foot (R) is given by the equation:

$$R = \frac{V^2}{L^2 \times P} \qquad \text{EQ-5}$$

Step 8: Select Cable
Use Figure-2 to select the correct cable based on cable resistance and the desired number of conductors. When there is no corresponding cable with the exact resistance calculated in Step 7, select the cable with the resistance nearest to the calculated number. Selecting a cable with a higher resistance will decrease power output with the same circuit length while selecting a cable with a lower resistance will increase power output with the same circuit length.

Figure 2: MI Custom Cable Resistance Characteristics - Cable Installed In Concrete

2–Conductor Cable 0.3125" Diameter Alloy, 600 Volts		
	Cable Resistance ohms/m (ohms/ft)	
Cable Number	Heating Design @ 3°C (38°F) Operating	Breaker Design @ –18°C (0°F) Operating
588B	0.0218 (0.0066)	0.0198 (0.0060)
614B	0.0457 (0.0139)	0.0416 (0.0127)
627B	0.0867 (0.0264)	0.0842 (0.0257)
640B	0.1301 (0.0397)	0.1288 (0.0392)
670B	0.2118 (0.0646)	0.2100 (0.0640)
710B	0.3390 (0.1033)	0.3361 (0.1024)
715B	0.5299 (0.1615)	0.5279 (0.1609)
720B	0.6706 (0.2044)	0.6680 (0.2036)
732B	1.0631 (0.3240)	1.0591 (0.3228)
750B	1.6375 (0.4991)	1.6337 (0.4979)
774B	2.4071 (0.7337)	2.4015 (0.7319)
810B	5.3055 (1.6170)	5.2932 (1.6133)
819B	6.1242 (1.8666)	6.1100 (1.8622)
830B	9.7267 (2.9646)	9.7041 (2.9577)
840B	14.0825 (4.2921)	14.0497 (4.2821)
859B	19.2897 (5.8792)	19.2449 (5.8655)

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Figure 2: MI Custom Cable Resistance Characteristics - Cable Installed In Concrete

	2–Conductor Cable 0.1875" Diameter Alloy, 300 Volts	
	Cable Resistance ohms/m (ohms/ft)	
Cable Number	Heating Design @ 3°C (38°F) Operating	Breaker Design @ –18°C (0°F) Operating
556K	0.1319 (0.0402)	0.1202 (0.0366)
658K	0.1782 (0.0543)	0.1624 (0.0495)
674K	0.2275 (0.0693)	0.2073 (0.0632)
693K	0.2839 (0.0865)	0.2588 (0.0789)
712K	0.3588 (0.1093)	0.3269 (0.0996)
715K	0.4507 (0.1374)	0.4108 (0.1252)
721K	0.6934 (0.2113)	0.6860 (0.2091)
722K	0.6433 (0.1961)	0.5725 (0.1745)
732K	1.0397 (0.3169)	1.0308 (0.3142)
742K	1.3558 (0.4132)	1.3443 (0.4097)
752K	1.6948 (0.5165)	1.6804 (0.5122)
766K	2.1510 (0.6556)	2.1328 (0.6500)
774K	2.4207 (0.7378)	2.4114 (0.7350)
783K	2.7151 (0.8275)	2.7047 (0.8244)
810K	3.2712 (0.9970)	3.2587 (0.9932)
813K	4.2525 (1.2961)	4.2363 (1.2912)
818K	5.8881 (1.7946)	5.8657 (1.7878)
824K	7.6545 (2.3330)	7.6254 (2.3241)
830K	9.6940 (2.9546)	9.6714 (2.9477)
838K	12.1175 (3.6932)	12.0893 (3.6846)
846K	15.4580 (4.7114)	15.4220 (4.7004)
860K	18.3399 (5.5897)	18.2973 (5.5768)
866K	21.6149 (6.5879)	21.5647 (6.5726)
894K	29.4749 (8.9835)	29.4064 (8.9626)
919K	58.9498 (17.9670)	58.8128 (17.9253)

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Figure 2: MI Custom Cable Resistance Characteristics - Cable Installed In Concrete

2–Conductor Cable 0.1875" Diameter Alloy, 600 Volts		
	Cable Resistance ohms/m (ohms/ft)	
Cable Number	Heating Design @ 3°C (38°F) Operating	Breaker Design @ –18°C (0°F) Operating
145K	0.0141 (0.0043)	0.0129 (0.0039)
189K	0.0276 (0.0084)	0.0251 (0.0077)
216K	0.0530 (0.0161)	0.0515 (0.0157)
239K	0.1271 (0.0387)	0.1260 (0.0384)
250K	0.1630 (0.0497)	0.1616 (0.0492)
279K	0.2575 (0.0785)	0.2553 (0.0778)
310K	0.3108 (0.0947)	0.3096 (0.0944)
316K	0.5136 (0.1565)	0.5116 (0.1559)
326K	0.8505 (0.2592)	0.8473 (0.2582)
333K	1.0795 (0.3290)	1.0754 (0.3278)
346K	1.4949 (0.4556)	1.4892 (0.4539)
372K	2.3907 (0.7287)	2.3852 (0.7270)
412K	3.8317 (1.1679)	3.8228 (1.1651)
415K	4.8470 (1.4773)	4.8357 (1.4739)
423K	7.7290 (2.3557)	7.7110 (2.3502)
430K	9.1700 (2.7949)	9.1487 (2.7884)
447K	14.7375 (4.4918)	14.7032 (4.4813)

Step 9: Finalize Design (continued)
Actual heater length in feet is given by Equation-6, where R is the actual resistance of the selected cable from Figure 2. The same equation can be used to fine-tune both the power output of the cable and circuit length:

$$L = \frac{V}{\sqrt{P \times R}} \qquad \text{EQ-6}$$

Total circuit breaker load (a) in amps can be calculated from Equation-2 using the cable resistance given for circuit breaker sizing in Figure-2 as noted. Heater spacing is determined from Equation-4. Cable sheath temperature is determined from Figure-3.

Step 10: Specify Heater
MI cable is specified as per Catalog Ordering System.

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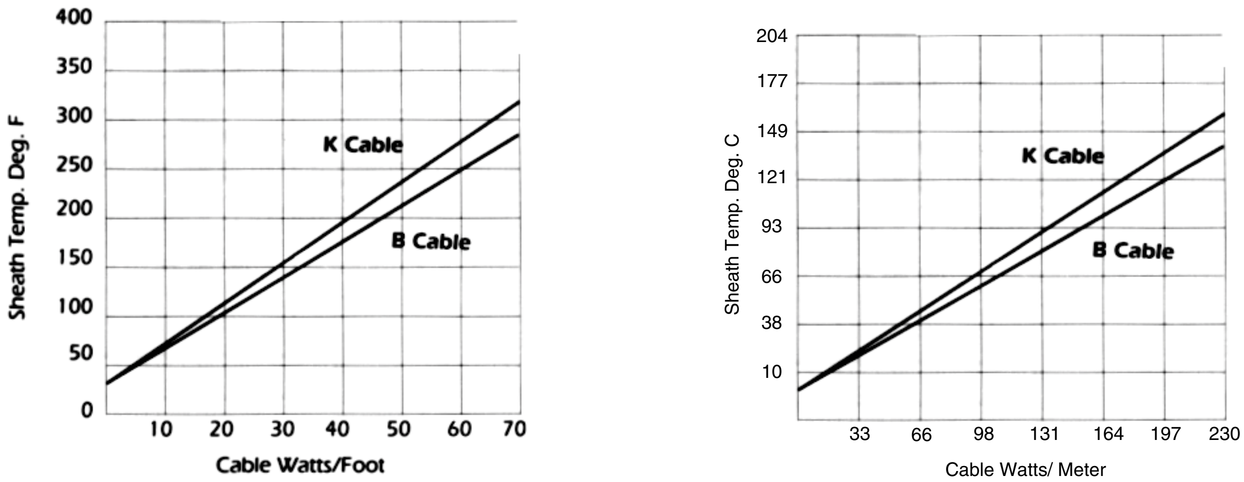
Figure 3: MI Cable Sheath Temperature In Concrete



Note: Based on ambient temp of -1° C (30° F). Upper surface temperature of concrete will be approximately 0.56°C (1.0°F) above ambient temperature for each cable W/m (W/ft).

Catalog Numbering Guide

(*) A 670 150 07 (*)

- (*) — Optional Construction Prefix
  - P - Pulling Eye for A Form only
  - X - Oversize cold sections or special feature requirement
- A — Form: A or E from table
- 670 — Conductor selection from table
- 150 — Hot section length in Meters (Feet)
- 07 — Cold section Length(s) order in Meters (Feet)
- (*) — Optional Construction Suffix
  - UM - UL Snow Melting Listing tag ①

① *Requires volts, amps and watts with each cable order.*