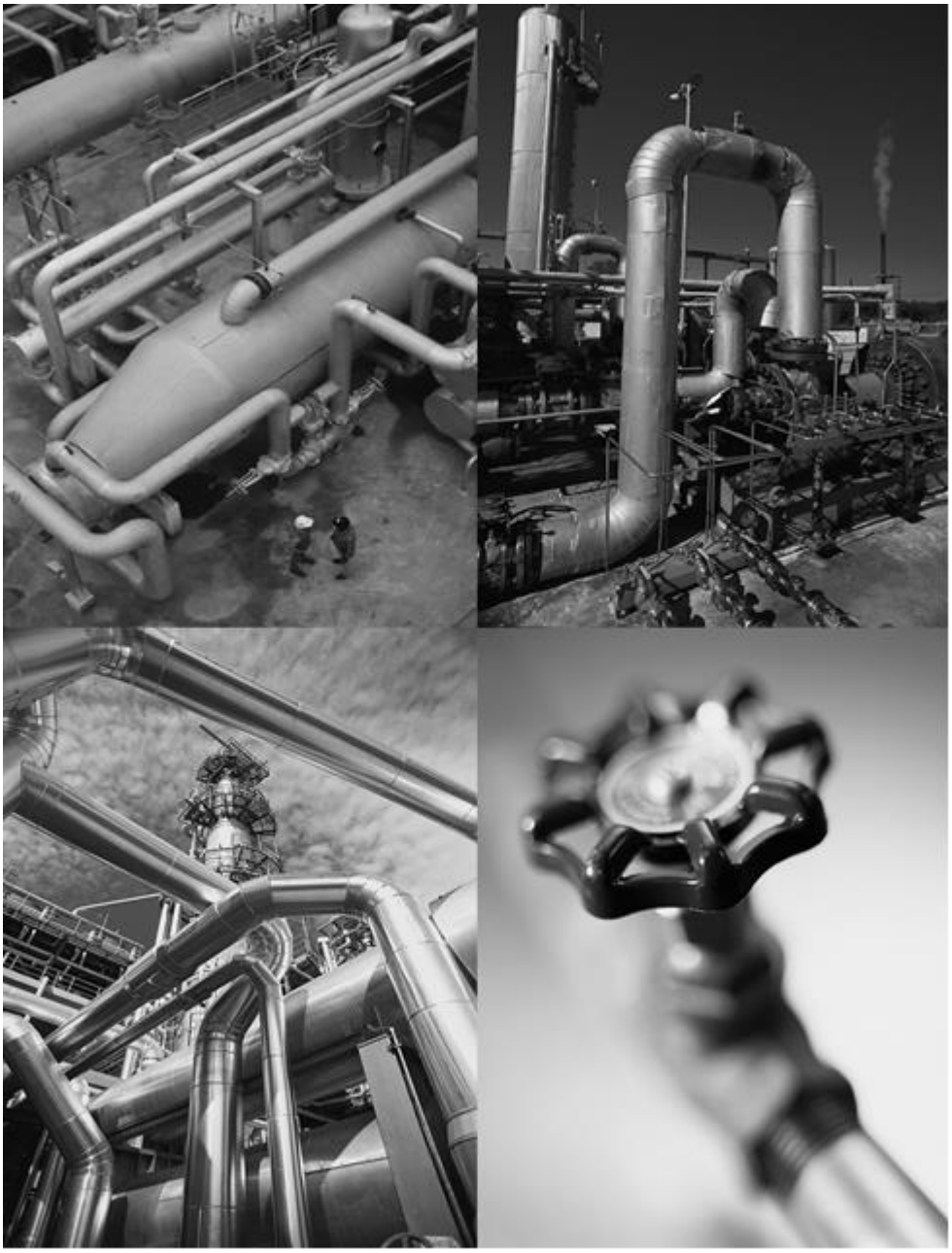
Pipe Freeze Protection Design/Install Guide



Pipe Freeze Protection Design / Install Guide

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INTRODUCTION

Drexan HeatTracer products are designed to serve the most demanding environments including hazardous and non-hazardous areas, as well as areas where corrosive exposure may be of concern.

PipeGuard® is certified to; CSA/UL (CUS) standards for use throughout North America, ATEX for Europe, and is suitable for both metal and non-metal pipes, tanks and vessels (see p. 10).

The integrity of a heat tracing system depends upon on how accurately the cable is selected and how well it is installed. An improperly designed and installed heat tracing system could result in cable failure and possible physical injury.

The following instructions will provide you with a step-by-step procedure for determining the best solution for your freeze protection applications.

Please visit us at www.Drexan.com

STEP 1 – INFORMATION REQUIRED

- **Pipe diameter**
- **Pipe length**
- **Minimum ambient temperature**
  This is the minimum temperature expected (worst case) throughout the winter months.
- **Maintain temperature**
  For freeze protection a typical maintain temperature of 5˚C (40˚F) is sufficient.

  For process temperatures ensure the temperature rating of the cable is suitable.

  Cable ratings: Refer to the respective cable data sheets available at: www.drexanheattracer.com.
- **Start-up temperature**
  This temperature will have a direct effect on the maximum circuit length and the breaker size required. You should select the temperature at which the cable will normally become energized, not necessarily the coldest temperature.
- **Metal or non-metallic Pipe**
  Some materials have superior heat transfer compared to others. Metal for example will conduct heat better than a polymeric material. For this reason we recommend the use of aluminum foil tape (part # TAPE-AL) on polymeric pipes applied over the pipe under the cable.
- **Pipe hardware (valves, shoes, flanges etc.)**
  When measuring the total length of the pipe to be heat-traced remember to allow extra cable for the pipe hardware.
- **Thermal Insulation type & thickness**
  All pipes, equipment and pipe hardware must be thermally insulated.

Measurement: Metric? Imperial? **Temperature:** Celsius? Fahrenheit?

Voltage: (include if 3 phase) _____

Applications

Pipe Tracing: Metal? Other? (specify) _____

Pipe Length: _____ **Diameter:** _____ **Insulation Type:** _____

Insulation Thickness: _____ **Not Yet Determined:** _____

Low Ambient Temp: _____ **Max. Pipe Temp.:** _____ **Maintain Temp.:** _____

Area Classification: Class _____ **Div.** _____ **Group** _____

Number of Supports _____ **Valves** _____ **Hangers** _____

STEP 2 – DESIGN CONSIDERATIONS

- When a pipe enters a building it is important that the cable extends into the building approximately 12" to ensure the pipe temperature is maintained above freezing.
- When a pipe enters the ground to below the frost line it is important to run the cable well below the frost line to ensure the pipe temperature is maintained above freezing.
- When a main pipe has a short branch line connected to it, the branch line may be double traced (down & back) to eliminate the need for a Tee Splice Kit.
- Heating cable should not pass through the air. When crossing from one pipe to another, the cable should run through a Flexible Extension (part # FLEX-E)
- Select the cable wattage output to suit the application. A conservative design will allow a slightly higher wattage output, per foot of cable, than required.
- Insulate all heat sinks in the heat tracing system. Allow sufficient cable to trace additional heat sinks. **See Table 2**
- DO NOT expose heating cables to temperatures higher than their temperature ratings.
- For valves, install the heating cable so that the valves can be conveniently removed for servicing.
- The type and thickness of thermal insulation will have a direct effect on the amount of heat required. Longer circuit lengths may be achieved by increasing the insulating thermal value to lower the cable wattage output required. **See Table 1**
- Multiple runs of cable may be required on larger pipes with high heat loss.
- When using a spray-on insulation it is recommended that a layer of aluminum foil tape be placed over the cable to prevent embedding of the cable in the thermal insulation, thereby resulting in poor heat transfer from the cable to the pipe.
- If lines are steam cleaned, pay particular attention to the maximum exposure temperature, even if the heating application is freeze protection. Standard freeze protection cables will fail if exposed to low pressure steam. Specify either PipeGuard Hot or PipeGuard CMH cables in these applications.

STEP 3 – ELECTRICAL REQUIREMENTS

Design the heat tracing system using the most commonly expected start-up temperature.

Be practical. If you choose the most extreme (coldest possible) start-up temperature, for example -40 degrees, you may unnecessarily shorten the circuit lengths, or require larger breaker sizes or additional panels and power cable.

However, keep in mind that if the heating system starts up at a lower temperature than it was designed for, you may experience breaker tripping.

To determine maximum circuit length and breaker size required, refer to tables found on the cable data sheets available at www.drexanheattracer.com.

For voltages other than 120/240V refer to cable data sheets at www.drexanheattracer.com.

All heating cable systems require ground fault protection (27- or 30-mA trip level) as per National / Canadian Electrical Codes.

STEP 4 – SELECTING CABLE

When determining the minimum ambient temperature for your location, always consider the worst case or lowest temperature. Selecting a low ambient design temperature will provide an increased safety factor.

From the following tables you can determine the amount of heat (watts/ft. pipe) required to maintain your pipe @ 40°F / 5°C - See **Table 1**

For example: An ambient temperature of minus 20°F (-29°C) and a 2” pipe with 1” of Glass Fiber thermal insulation will require 3.8 Watts per foot of pipe.

Note: The charts used in this guide are based on Glass Fiber Thermal Insulation. These charts may also be used with polyisocyanurate and Mineral Wool insulations of the same thickness.

When installing cable on pipe with high process temperatures or on pipes that will be steamed out during maintenance, consideration must be given to the cable exposure temperature.

For example: If the cable will be exposed to temperatures in excess of 65°C/150°F then you must select a cable with a higher temperature rating such as Drexan HeatTracer PipeGuard Hot (PGH) or PipeGuard CMH. Refer to the cable data sheets located on the Drexan HeatTracer website: www.drexanheattracer.com

Table 1

WATTS PER FT. PIPE REQUIRED									
Pipe Dia.	Ambient Temp.		Insulation Thickness						
Inch	°F	°C	½"	1"	1 ½"	2"	2 ½"	3"	4"
½	0	-18	2.0	1.3	1.0	1.0	1.0	0.8	0.7
	-10	-23	2.5	1.6	1.3	1.2	1.0	1.0	0.8
	-20	-29	2.9	2.0	1.6	1.4	1.2	1.0	1.0
	-40	-40	3.9	2.5	2.0	1.8	1.6	1.5	1.3
¾	0	-18	2.3	1.5	1.2	1.0	1.0	0.8	0.7
	-10	-23	2.9	1.9	1.5	1.3	1.0	1.0	0.9
	-20	-29	3.5	2.2	1.8	1.5	1.4	1.3	1.0
	-40	-40	4.5	2.9	2.3	2.0	1.8	1.6	1.4
1	0	-18	2.8	1.7	1.4	1.2	1.0	1.0	0.8
	-10	-23	3.4	2.1	1.7	1.4	1.3	1.2	1.0
	-20	-29	4.1	2.5	2.0	1.7	1.5	1.4	1.2
	-40	-40	5.3	3.3	2.6	2.2	2.0	1.8	1.6
1 ¼	0	-18	3.3	2.0	1.6	1.3	1.0	1.1	0.9
	-10	-23	4.1	2.5	2.0	1.6	1.4	1.3	1.1
	-20	-29	4.9	3.0	2.3	1.9	1.7	1.6	1.3
	-40	-40	6.4	3.9	3.0	2.5	2.2	2.0	1.8
1 ½	0	-18	3.7	2.2	1.7	1.4	1.3	1.1	1.0
	-10	-23	4.5	2.7	2.1	1.8	1.5	1.4	1.2
	-20	-29	5.4	3.3	2.5	2.0	1.8	1.7	1.4
	-40	-40	7.1	4.3	3.3	2.7	2.4	2.2	1.9
2	0	-18	4.4	2.6	2.0	1.6	1.4	1.3	1.1
	-10	-23	5.5	3.2	2.4	2.0	1.8	1.6	1.4
	-20	-29	6.5	3.8	2.9	2.4	2.1	1.9	1.6
	-40	-40	8.6	5.0	3.8	3.1	2.7	2.5	2.1
2 ½	0	-18	5.2	3.0	2.3	1.8	1.6	1.4	1.2
	-10	-23	6.4	3.7	2.8	2.3	2.0	1.8	1.5
	-20	-29	7.6	4.4	3.3	2.7	2.4	2.1	1.8
	-40	-40	10.0	5.8	4.3	3.6	3.0	2.8	2.3
3	0	-18	6.1	3.5	2.6	2.1	1.8	1.6	1.4
	-10	-23	7.6	4.3	3.2	2.6	2.3	2.0	1.7
	-20	-29	9.0	5.2	3.8	3.0	2.7	2.4	2.0
	-40	-40	11.9	6.8	5.0	4.0	3.5	3.1	2.6
4	0	-18	7.6	4.3	3.1	2.5	2.2	1.9	1.6
	-10	-23	9.5	5.3	3.9	3.1	2.7	2.3	1.9
	-20	-29	11.3	6.3	4.6	3.7	3.2	2.8	2.3
	-40	-40	14.9	8.3	6.0	4.9	4.1	3.7	3.0

Table 1 cont.

WATTS PER FT. PIPE REQUIRED									
Pipe Dia.	Ambient Temp.		Insulation Thickness						
Inch	°F	°C	½"	1"	1 ½"	2"	2 ½"	3"	4"
6	0	-18	11.0	6.0	4.6	3.4	2.8	2.5	2.0
	-10	-23	13.5	7.4	5.3	4.2	3.5	3.1	2.5
	-20	-29	16.0	8.8	6.3	5.0	4.2	3.7	3.0
	-40	-40	21.1	11.6	8.2	6.5	5.5	4.8	3.9
8	0	-18	14.0	7.5	5.3	4.2	3.5	3.0	2.4
	-10	-23	17.2	9.3	6.6	5.2	4.3	3.8	3.0
	-20	-29	20.5	11.0	7.8	6.2	5.2	4.5	3.6
	-40	-40	27.0	14.6	10.3	8.1	6.8	5.9	4.7
10	0	-18	17.0	9.2	6.4	5.0	4.2	4.0	3.0
	-10	-23	21.0	11.4	8.0	6.2	5.2	5.0	4.0
	-20	-29	26.0	13.6	10.0	7.4	6.2	5.3	4.2
	-40	-40	34.0	18.0	13.0	10.0	8.1	7.0	6.0
12	0	-18	20.0	11.0	8.0	6.0	5.0	4.2	3.3
	-10	-23	25.0	13.3	9.3	7.2	6.0	5.1	4.1
	-20	-29	30.0	16.0	11.0	9.0	7.0	6.1	5.0
	-40	-40	39.0	21.0	15.0	11.3	9.3	8.0	6.4
14	0	-18	22.0	12.0	8.0	6.3	5.2	5.0	4.0
	-10	-23	27.2	15.0	10.0	8.0	7.0	6.0	4.4
	-20	-29	33.0	17.3	12.0	9.3	8.0	7.0	5.2
	-40	-40	43.0	23.0	16.0	12.2	10.1	9.0	7.0
16	0	-18	25.0	13.2	9.2	7.1	6.0	5.0	4.0
	-10	-23	31.0	17.0	11.4	9.0	7.3	6.2	5.0
	-20	-29	37.0	20.0	14.0	11.0	9.0	7.4	6.0
	-40	-40	48.5	26.0	18.0	14.0	11.3	10.0	8.0
18	0	-18	28.0	15.0	10.2	8.0	7.0	6.0	4.3
	-10	-23	35.0	19.0	13.0	10.0	8.0	7.0	5.4
	-20	-29	42.0	22.0	15.0	12.0	10.0	8.2	6.4
	-40	-40	54.3	290	20.0	15.3	13.0	11.0	8.4
20	0	-18	31.0	17.0	11.3	9.0	7.0	6.1	5.0
	-10	-23	38.0	21.0	14.0	11.0	9.0	8.0	6.0
	-20	-29	46.0	24.0	17.0	13.0	11.0	9.0	7.0
	-40	-40	60.2	32.0	22.0	17.0	14.0	12.0	9.2
24	0	-18	37.0	20.0	14.0	11.0	9.0	7.1	6.0
	-10	-23	46.0	24.0	17.0	13.0	11.0	9.0	7.0
	-20	-29	55.0	29.0	20.0	15.0	13.0	11.0	8.0
	-40	-40	72.0	38.0	26.0	20.0.	16.3	14.0	11.0

The following **Table 2** shows the amount of extra cable required to heat trace pipe hardware such as valves and supports.

Allow an extra 4 feet of cable per cable circuit run for the power and end seal terminations. Example: 3 feet for the power termination and 1 foot for the end termination.

Table 2

HEAT LOSS ADDERS (CABLE PER FOOT) Pipe Hardware Types					
Pipe Size Inches	**Flange Per Pair**	**Vent Drain**	**Pipe Support**	**Globe, Ball & Butterfly**	**Gate Valve**
½	0.3	1	1	1	1
¾	0.3	1	1.5	1	1.5
1	0.3	1	1.5	1	2
1 ¼	0.3	1	2	1.5	2.5
1 ½	0.3	1	2	1.5	2.5
2	0.3	1	2	2	2.5
2 ½	0.3	1	2	2.5	3
3	0.3	1	2	2.5	3
4	0.5	1	2.5	3	4
6	0.8	1	2.5	3.5	5
8	0.8	1	2.5	4	7
10	0.8	1	3	4.5	8
12	0.8	1	3	5	9
14	1	1	3	5.5	10
16	1	1	3.5	6	11
18	1	1	3.5	7	12
20	1	1	3.5	7.5	13
24	1	1	4	8	15

STEP 5 – CABLE COMPONENTS

A typical heat tracing system will include cable, cable components and controls as required.

*AMIGA-1 Power Connect Kit

AMIGA-3 Power/Tee/Splice Kit

AMIGA-E End Seal Kit

AMIGA is an advanced connection system designed for use with the Drexan HeatTracer family of Self-Regulating PipeGuard cables. **AMIGA-1** provides Power Connection to one heater. **AMIGA-3** can connect up to three heaters to power or be used as an inline splice (no power) or inline tee (no power).

AMIGA consists of a pipe-mounted stanchion and an enclosure (junction box) with terminal blocks mounted on DIN rail. The AMIGA stanchion provides ample room in which installers can manipulate heating cables, has excellent mechanical protection for cables installed on a pipe, and permits application of up to 4 inches (102 mm) of thermal insulation.

AMIGA is CSA/UL (CUS) certified for both non-hazardous and hazardous locations up to Class I Division 2 (Zone 2).

Low Profile Metallic Components

***LP-PC-1 AL**
Power Connection – Single Cable

***LP-PC-2 AL**
Power Connection – Two Cables

***†LP-E AL**
End Seal

***LP-S AL**
Splice Kit

***†LP-T AL**
Tee Kit

***LP-PCT-2 AL**
Tee Power Connection – Two Cables

High Profile Components

***HP-PC-1 AL**
Power Connection – Single Cable

HP-LE-1R/HP-LE-2R
Lighted End Seal 120V/277V

HeatShrink® Components

***†HS-PC**
Power Connection
(Junction box not included)

***†HS-TSPLICE**
Splice Kit

***†HS-ESK**
End Seal Kit

HS-JB
Junction Box

APPROVALS

231572
E484945*/E480818†

Class I, Div. 2, Groups A, B, C, D
Class II, Div. 2, Groups E, F, G
Class III
G-General Use
Ordinary Locations

STEP 6 – MONITORING AND CONTROL

Select the thermostat or control device that best suits your application. The method of control can range from simple mechanically switched thermostats, electronic control and monitoring systems or ambient air sensing control.

Mechanical

STAT-LS-40F

The STAT-LS-40F thermostat is ideal for applications where freeze protection or lower-range temperature control is critical. In cold climates the thermostat switches heating devices that prevent pipes, valves, tanks and fittings from freezing. This thermostat can be used in ambient-sensing applications by placing the sensor in the air or as a line-sensing thermostat by securing the bulb to the pipe or tank. It can be used as a single circuit control or as a pilot control for several circuits by switching a contactor. Set point at factory is 40°F / 5°C.

STAT-LS-ADJ

The STAT-LS-ADJ thermostat is ideal for applications where freeze protection or lower-range temperature control is critical. In cold climates this thermostat switches heating devices that prevent pipes, valves, tanks and fittings from freezing. This thermostat can be used in ambient-sensing applications by placing the sensor in the air or as a line-sensing thermostat by securing the bulb to the pipe or tank. It can be used as a single circuit control or as a pilot control for several circuits by switching a contactor.

STAT-TXR-ADJ

The STAT-TXR-ADJ thermostat is ideal for applications where freeze protection or temperature control in **hazardous locations** is critical. This thermostat can be used in ambient-sensing applications by placing the sensor in the air or as a line-sensing thermostat by securing the bulb to the pipe or tank.

The STAT-TXR-ADJ can be used as a single circuit control or as a pilot control for several circuits by switching a contactor.

Electronic

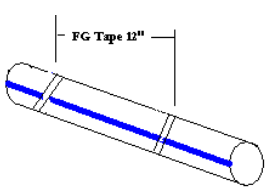
TRACEMATE™ and TRACEMATE II CTR

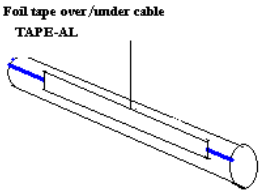
The TraceMate family of electronic controls is designed for indoor or outdoor use in general purpose non-hazardous and hazardous Class I Division 2 / Zone 2 areas.

TraceMate comes complete with a built in Ground Fault Protection Device (GFPD) eliminating the need for a separate ground fault breaker.

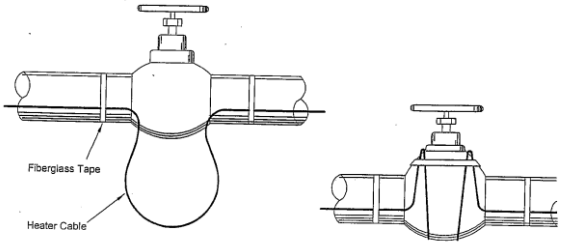
INSTALLING SELF REGULATING CABLE

- Install heating cable on the bottom half of the pipe between 4 & 8 o'clock. Install cable straight along the pipe. In some instances, it may be necessary to install more than one run or spiral the cable around the pipe. Example: pipe heat loss requires 12 W/ft, cable output is 8 W/ft. therefore apply 1.5 feet cable per foot of pipe.
- For typical installations the heating cable should be fastened with fiber glass tape.
  Note: Do not use metal strapping or tie wire to fasten cable to pipe.





- Aluminum foil tape (TAPE-AL) is typically used when installing heating cable on plastic pipes. By applying a layer of foil tape on the pipe under the cable provides more efficient heat transfer. An additional layer of foil tape fastening the cable to the pipe also assists in the heat transfer as well as can prevent the cable from being embedded in the insulation.
- Do not cut the cable until it is fastened to the pipe. This ensures you will have a sufficient amount of cable for terminations and heat sinks such as valves, flanges, pipe supports and any other piping equipment.
- Install the heating cable in such a way as to allow for easy removal of valves and other equipment.



- Heating cable ends must be kept dry at all times. Until the cable is terminated all end should be sealed from the environment with a moisture proof tape.
- When pipe is buried ensure the power and end of circuit terminations are above grade.
- After insulation has been applied to the pipe, over the cable, visually inspect to ensure there are no gaps in the seams or damage to the insulation.
  Note: An improperly insulated pipe will result in a cold pipe.

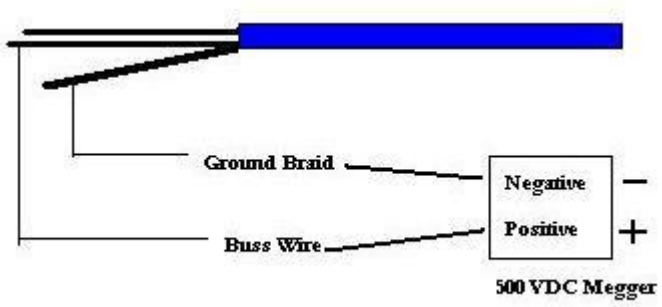
TESTING SELF-REGULATING CABLE

A test should be performed when the heating cable is received, prior to installation and after installation using a 500 VDC megger.

Note: Do not use a megger in excess of 2500 VCD.

Detecting cable damage prior to the application of insulation can prevent additional labor costs.

Minimum readings of 20 Megohms for each circuit is an acceptable level to test for.



A record should be kept of the reading after the cable has been installed. This reading can be used as a reference point when taking future readings during regular maintenance.

A history of resistance readings can be useful in spotting moisture ingression into the cable from either junction boxes or physical damage to the cable.

See the following page for a “Test Report” template.

HEATING CABLE TESTING REPORT

Customer_____ Contractor_____

Phone No._____ Phone No. _____

Site Location_____ Project Ref. _____

Readings Prior to Installation:

Cable Reference No_____ Heater Length

Insulation Resistance (M Ohms) _____

Tested By _____ Date_____

Witnessed By _____ Date_____

Readings after Installation:

Insulation Resistance (M Ohms)_____

Tested By _____ Date_____

Witnessed By _____ Date _____

Final Readings:

Insulation Resistance (M Ohms)_____

Panel No. _____ Breaker No._____

Ambient Temp_____Volts _____ Amps _____

Tested By _____ Date _____

Witnessed By_____Date _____

TROUBLESHOOTING SELF-REGULATING HEATING CABLE

Symptom	Probable Cause	Remedy
Circuit Breaker Trips	Breaker undersized for the length of the cable on that circuit	Revisit the current loads and resize breakers or shorten the cable run lengths Note: Check Feeder wire size to confirm a larger breaker may be used
	Start-up temperature too low	Start cables up at a higher temperature by adding a thermostat
	Physical damage to cable causing a short	Locate and repair
	Buss wires touching at the end seal	Locate and repair
	Heating cable connections or feeder wire may be shorting out either by contaminations, moisture, or contact between wires in the connection	Locate and repair
Zero power output	Low or no input voltage	Repair electrical supply
	Connections not properly made	Repair connections
	Pipe is at elevated temperature	Check pipe temperature and recalculate the output wattage
	Heating cable has been exposed to excessive temperature	Replace the heating cable with appropriate temperature rated cable
Power output is correct but pipe temperature is below design values	Insulation is wet or open exposing the pipe to the ambient air.	Remove and replace with dry insulation
	Insufficient cable was installed on pipe shoes, valves or other heat sinks	Splice in additional cable BUT do not exceed the maximum cct length for the breaker size
	Thermostat setting is incorrect	Adjust thermostat to correct setting.
	Incorrectly designed.	Revisit the design conditions and criteria

FOR HEATTRACER TECHNICAL ASSISTANCE CALL 1-800-663-6873 (NORTH AMERICA ONLY) OR +1.780.413.1774