

What we will cover

- Why are we there
- Basic heat tracing systems
 - Freeze Protection
 - Water Grease
 - Fire Protection
- HWAT Domestic Hot Water Maintenance
- Snowmelt Systems
 - Slabs
 - Gutters



1

Why do we do Site Visits?

- **Training**

Teach installers about design, components, controllers

- **Commissioning**

Check to be sure that the system was installed per GAF designs and that cables and components are installed per mnf. requirements

- **Startup**

First confirm the proper, fully tested equipment is in place to startup. Setup controllers for that particular application while confirming that the proper sensors are in the proper locations.

- **Troubleshooting**

Be prepared to troubleshoot by knowing the equipment to be checked and having the spare parts that might be required for a fix.



2

What do we need to record?

- Proposed new report form
- Check installation vs submittal. Record any deviations
- Check cable matches design application, scope. Record any deviations
- Test per new sequence, Record on new sheet
- Check control type, voltage, sensors (type and location), then set up per design

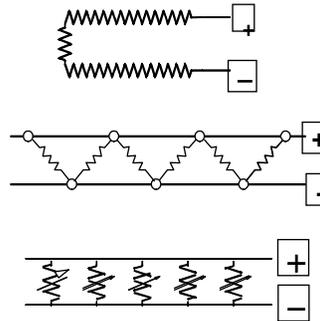
The screenshot shows a software interface for a report form. At the top, it says 'Technician 1: [Name]' and 'Technician 2: [Name]'. Below that is a 'Location' section with fields for Equipment, Job #, Job Name, Customer, Street Address, Sales Person, City, State, and Zip. The 'Equipment' section includes Manufacturer, System Type, Model, Voltage, Cable, Control, and # of Sensors/Control. The 'Purpose of Visit' section has a dropdown menu with 'Test installed heating cables' selected. At the bottom, there is a 'Work Completed' section with a large empty text area.



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Heat-Tracing Technologies

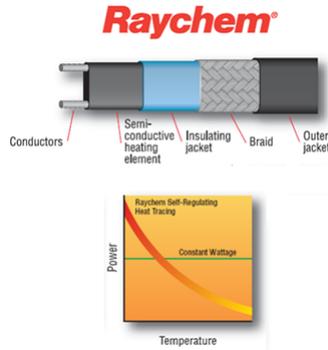
- Constant Wattage
- Zone Constant Wattage
- Self-Regulating



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Self-Regulating Technology

Self-regulating technology utilizes a semi-conductive heating element in contact with two parallel bus wires, self-regulating cables adjust their heat output based on their ambient temperature, providing a convenient solution for many applications.



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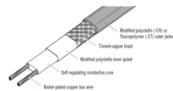
The Systems



5,8,12XL1,2-CR/CT XLTrace heating cables

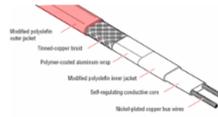
XLTrace System: Freeze Protection Applications

- Used Comes in 5,8, and 12 w/ft to keep a pipe from freezing.
- Available with a -CR (orange) for water or -CT (black) for grease
- Run linearly along the pipe as required.
- Maximum Circuit Length for a given amperage/voltage/startup
- Sized to specified insulation type and thickness.



IceStop System: Roof Snowmelting Applications

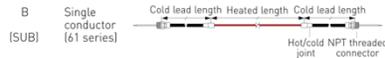
- Run in gutters and down spouts to provide a drain path



HWAT-P1 and HWAT-R2 heating cables

HWAT System: Domestic hot water Applications

- Used to keep domestic hot water (which is not flowing) at temperature between the water heater and the point of use.
- Run linearly along the pipe to a specific distance from faucet
- Requires a specific insulation schedule see I/O or Design Guide.
- Uses a special HWAT-ECO controller or ACCS-30 controller.



Mineral Insulated System: Slab Snowmelting Applications

- Serpentined in a slab to prevent snow build up
- Comes preterminated from the factory. IT CAN NOT BE CUT TO LENGTH



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RayClic Connections

The image displays the RayClic connection system, which includes various components and their applications. On the left, a diagram shows a pipe with several RayClic connections labeled: RayClic-PC, RayClic-S, RayClic-PT, RayClic-E, RayClic-X, RayClic-T, and RayClic-PB. Below this diagram is the text "RayClic connection system". To the right, there are three sets of components, each consisting of a white plastic connector, a black cable, and a yellow label with the word "SPICE" on it. At the bottom, there are five icons: a pipe with a snowflake, a trap, a bathtub, a snowflake with a shovel, and a red and black circular logo.

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Typical pipe freeze protection applications

The image shows typical pipe freeze protection applications. On the left, there is a photograph of industrial piping. To the right of the photo are three icons: a snowflake and thermometer, a flame, and a blue square with a white 'P'. Below these icons are three columns of text:

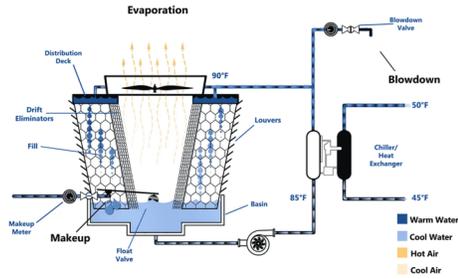
<p>Cooling Tower Piping</p> <ul style="list-style-type: none"> • Chill Water Supply • Chill Water Return • Equalizer line • Make-up Water Line • Drains 	<p>Parking garage</p> <ul style="list-style-type: none"> • Trap Primer • Sanitary • General Water Piping 	<p>Special Applications</p> <ul style="list-style-type: none"> • Condensate Lines • Fire Lines
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8



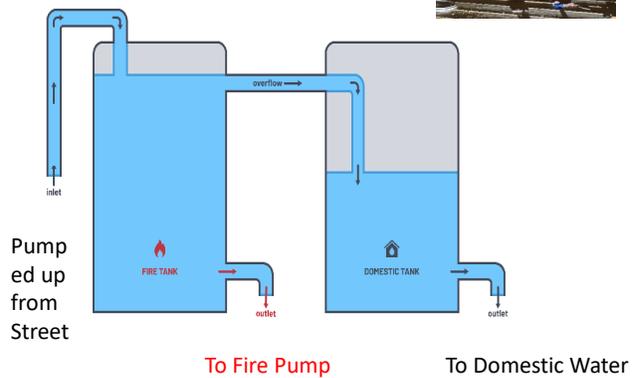
8

How a Cooling Tower Works

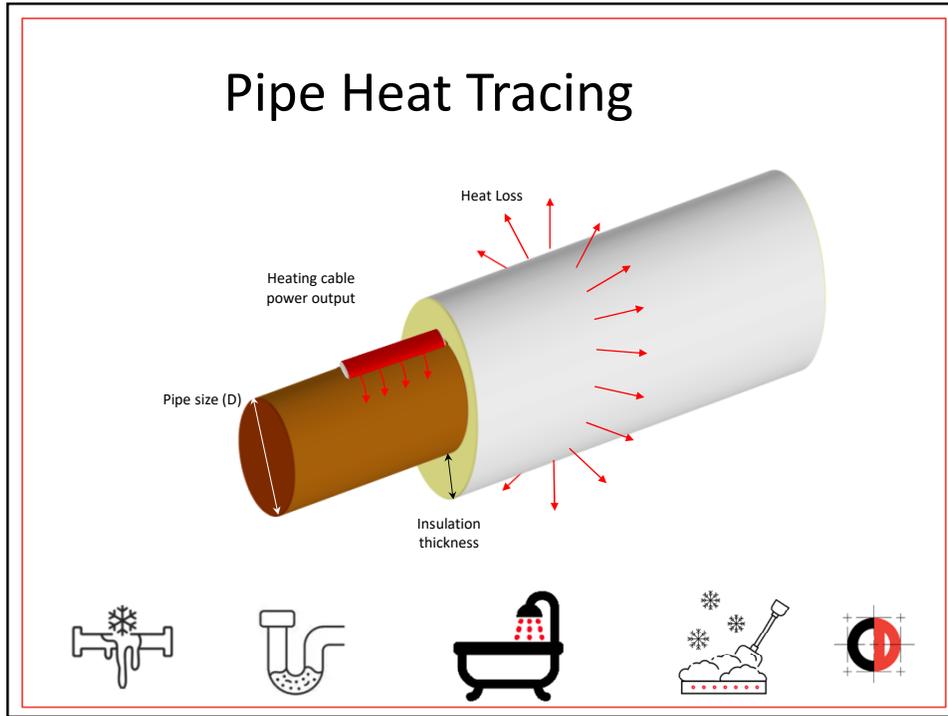


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Domestic Water Tank



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DESIGN GUIDE

- Online [Design Guide](#) Defines Heater Selection

Pipe Freeze Protection and Flow Maintenance — XL-Trace Edge System

Raychem

This step-by-step design guide provides the tools necessary to design a Raychem XL-Trace Edge pipe freeze protection or flow maintenance system for pipe applications. For design assistance, contact your Raychem representative or call 888.545.4528. Also, visit our website at chonetec.com.

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- This design guide provides Raychem's recommendation for designing an XL-Trace Edge pipe freeze protection and flow maintenance system for the following applications:
 - Prevent protection of general water piping (above ground and buried)
 - Flow maintenance of waste lines (above ground and buried)
 - Flow maintenance of fuel lines (above ground)

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Table 2 Pipe Heat Loss (Q) for Outdoor or Buried Pipe (W/Ft) for 1/2 to 3 1/2 inches

Insulation Thickness (in)	Q (W/Ft)		Pipe diameter (D) in inches								
	1/2	3/4	1	1 1/4	1 1/2	1 3/4	2	2 1/2	3	3 1/2	
0.5	20	11	10	12	14	16	18	22	25	30	34
1.0	20	28	25	29	35	41	46	55	65	77	86
1.5	100	56	52	61	72	86	100	115	135	160	180
2.0	83	61	65	72	84	100	119	140	165	200	231
2.5	20	11	0.6	0.7	0.8	1.0	1.1	1.3	1.5	1.7	1.9
3.0	20	28	1.6	1.9	2.2	2.5	2.8	3.2	3.8	4.4	4.9
3.5	100	56	3.4	3.9	4.5	5.2	5.8	6.8	7.8	9.1	10.2
4.0	150	83	5.3	6.1	7.0	8.2	9.0	10.6	12.2	14.2	15.9
4.5	20	11	0.5	0.6	0.7	0.8	0.8	1.0	1.1	1.3	1.4
5.0	20	28	1.3	1.5	1.7	1.9	2.1	2.4	2.8	3.2	3.6
5.5	100	56	2.8	3.1	3.5	4.0	4.4	5.1	5.8	6.7	7.4
6.0	150	83	4.3	4.8	5.5	6.3	6.9	8.0	9.1	10.5	11.6

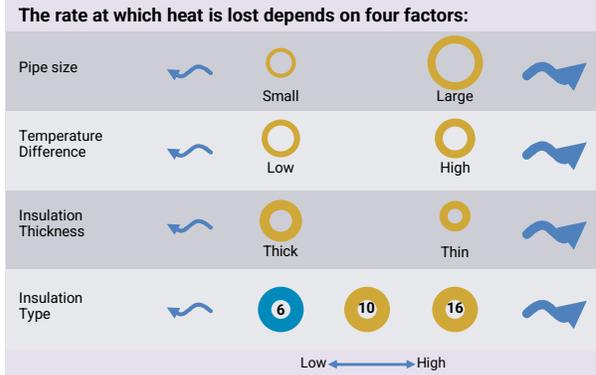
Table 3 Maximum Circuit Length in Feet

Circuit Amps (A)	477 V (100% Demand)					
	10	15	20	25	30	35
10	154	96	62	48	38	32
15	229	150	100	78	62	52
20	304	200	134	106	84	70
25	379	250	168	134	106	88
30	454	300	202	162	128	106
35	529	350	236	190	150	124
40	604	400	270	218	170	142
45	679	450	304	246	194	162
50	754	500	338	274	218	182
55	829	550	372	302	246	202
60	904	600	406	330	274	230
65	979	650	440	358	302	258
70	1054	700	474	386	330	286
75	1129	750	508	414	358	314
80	1204	800	542	442	386	342
85	1279	850	576	470	414	370
90	1354	900	610	498	442	400
95	1429	950	644	526	470	430
100	1504	1000	678	554	498	460
105	1579	1050	712	582	526	490
110	1654	1100	746	610	554	520
115	1729	1150	780	638	582	550
120	1804	1200	814	666	610	580
125	1879	1250	848	694	638	610
130	1954	1300	882	722	666	640
135	2029	1350	916	750	694	670
140	2104	1400	950	778	722	700
145	2179	1450	984	806	750	730
150	2254	1500	1018	834	778	760
155	2329	1550	1052	862	806	790
160	2404	1600	1086	890	834	820
165	2479	1650	1120	918	862	850
170	2554	1700	1154	946	890	880
175	2629	1750	1188	974	918	910
180	2704	1800	1222	1002	946	940
185	2779	1850	1256	1030	974	970
190	2854	1900	1290	1058	1002	1000
195	2929	1950	1324	1086	1030	1030
200	3004	2000	1358	1114	1058	1060
205	3079	2050	1392	1142	1086	1090
210	3154	2100	1426	1170	1114	1120
215	3229	2150	1460	1198	1142	1150
220	3304	2200	1494	1226	1170	1180
225	3379	2250	1528	1254	1198	1210
230	3454	2300	1562	1282	1226	1240
235	3529	2350	1596	1310	1254	1270
240	3604	2400	1630	1338	1282	1300
245	3679	2450	1664	1366	1310	1330
250	3754	2500	1698	1394	1338	1360
255	3829	2550	1732	1422	1366	1390
260	3904	2600	1766	1450	1394	1420
265	3979	2650	1800	1478	1422	1450
270	4054	2700	1834	1506	1450	1480
275	4129	2750	1868	1534	1478	1510
280	4204	2800	1902	1562	1506	1540
285	4279	2850	1936	1590	1534	1570
290	4354	2900	1970	1618	1562	1600
295	4429	2950	2004	1646	1590	1630
300	4504	3000	2038	1674	1618	1660
305	4579	3050	2072	1702	1646	1690
310	4654	3100	2106	1730	1674	1720
315	4729	3150	2140	1758	1702	1750
320	4804	3200	2174	1786	1730	1780
325	4879	3250	2208	1814	1758	1810
330	4954	3300	2242	1842	1786	1840
335	5029	3350	2276	1870	1814	1870
340	5104	3400	2310	1898	1842	1900
345	5179	3450	2344	1926	1870	1930
350	5254	3500	2378	1954	1898	1960
355	5329	3550	2412	1982	1926	1990
360	5404	3600	2446	2010	1954	2020
365	5479	3650	2480	2038	1982	2050
370	5554	3700	2514	2066	2010	2080
375	5629	3750	2548	2094	2038	2110
380	5704	3800	2582	2122	2066	2140
385	5779	3850	2616	2150	2094	2170
390	5854	3900	2650	2178	2122	2200
395	5929	3950	2684	2206	2150	2230
400	6004	4000	2718	2234	2178	2260
405	6079	4050	2752	2262	2206	2290
410	6154	4100	2786	2290	2234	2320
415	6229	4150	2820	2318	2262	2350
420	6304	4200	2854	2346	2290	2380
425	6379	4250	2888	2374	2318	2410
430	6454	4300	2922	2402	2346	2440
435	6529	4350	2956	2430	2374	2470
440	6604	4400	2990	2458	2402	2500
445	6679	4450	3024	2486	2430	2530
450	6754	4500	3058	2514	2458	2560
455	6829	4550	3092	2542	2486	2590
460	6904	4600	3126	2570	2514	2620
465	6979	4650	3160	2598	2542	2650
470	7054	4700	3194	2626	2570	2680
475	7129	4750	3228	2654	2598	2710
480	7204	4800	3262	2682	2626	2740
485	7279	4850	3296	2710	2654	2770
490	7354	4900	3330	2738	2682	2800
495	7429	4950	3364	2766	2710	2830
500	7504	5000	3398	2794	2738	2860
505	7579	5050	3432	2822	2766	2890
510	7654	5100	3466	2850	2794	2920
515	7729	5150	3500	2878	2822	2950
520	7804	5200	3534	2906	2850	2980
525	7879	5250	3568	2934	2878	3010
530	7954	5300	3602	2962	2906	3040
535	8029	5350	3636	2990	2934	3070
540	8104	5400	3670	3018	2962	3100
545	8179	5450	3704	3046	2990	3130
550	8254	5500	3738	3074	3018	3160
555	8329	5550	3772	3102	3046	3190
560	8404	5600	3806	3130	3074	3220
565	8479	5650	3840	3158	3102	3250
570	8554	5700	3874	3186	3130	3280
575	8629	5750	3908	3214	3158	3310
580	8704	5800	3942	3242	3186	3340
585	8779	5850	3976	3270	3214	3370
590	8854	5900	4010	3298	3242	3400
595	8929	5950	4044	3326	3270	3430
600	9004	6000	4078	3354	3298	3460
605	9079	6050	4112	3382	3326	3490
610	9154	6100	4146	3410	3354	3520
615	9229	6150	4180	3438	3382	3550
620	9304	6200	4214	3466	3410	3580
625	9379	6250	4248	3494	3438	3610
630	9454	6300	4282	3522	3466	3640
635	9529	6350	4316	3550	3494	3670
640	9604	6400	4350	3578	3522	3700
645	9679	6450	4384	3606	3550	3730
650	9754	6500	4418	3634	3578	3760

Variables that affect – Heat loss



Heating cable maintains the temperature of stagnant fluid by replacing the heat lost through the thermal insulation.



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DESIGN GUIDE



- Online [Design Guide](#) Defines Heater Selection

Table 7 Additional Heating Cable for Valves

Pipe diameter (IPS) (inches)	Heating cable (feet (meters))
1/2	0.8 (0.24)
3/4	1.3 (0.4)
1	2.0 (0.6)
1-1/4	3.3 (1.1)
1-1/2	4.3 (1.3)
2	4.3 (1.3)
3	4.3 (1.3)
4	4.3 (1.3)
6	5.0 (1.5)
8	5.0 (1.5)
10	5.6 (1.7)
12	5.9 (1.9)
14	7.3 (2.2)
18	9.4 (2.9)
20	10.5 (3.2)

Table 8 Additional Heating Cable for Pipe Supports and Flanges

Support	Additional cable
Pipe hangers (insulated)	No additional heating cable
Pipe hangers noninsulated and U-bolt supports	Add 2x pipe diameter
Welded support shoes	Add 3x the length of the shoe
Flanges	Add 2x pipe diameter

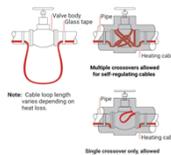


Figure 10: Valve

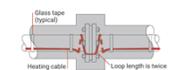


Figure 11: Flange

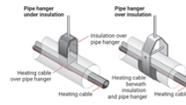


Figure 4: Pipe hanger with heating cable

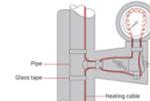


Figure 12: Pressure gauge

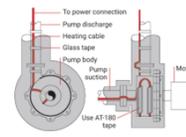


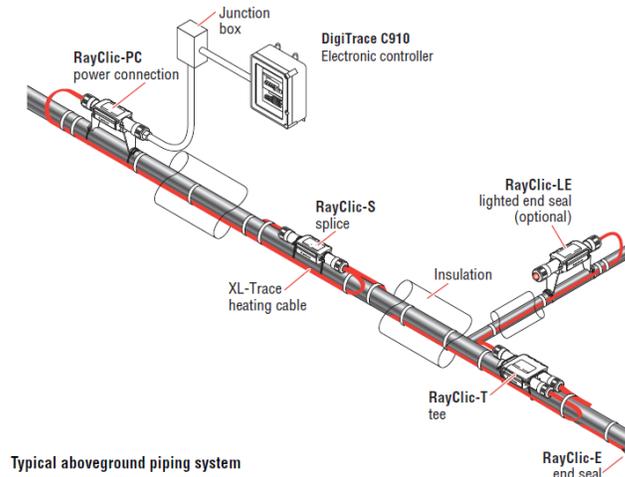
Figure 13: Split case centrifugal pump

- Online [Installation Guide](#) Defines Heater Selection



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Typical Above Ground XLTrace System

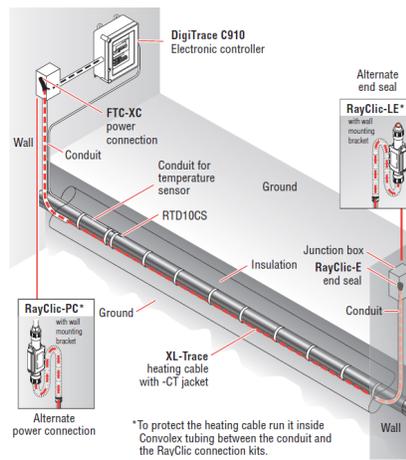


Typical aboveground piping system



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Typical Below Ground XLTrace System



Typical buried piping system

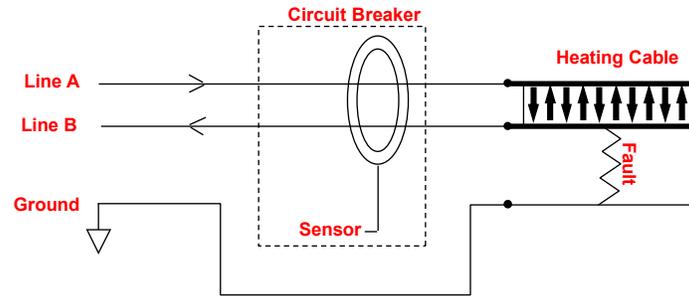


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Ground-fault circuit breaker operation



- If currents in Line A and Line B are not equal, some current is going to ground through a fault. The ground fault circuit detects this imbalance and trips the circuit breaker.



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DigiTrace C910



- Line, ambient or Proportional Ambient Sensing Control (PASC)
- 30A two pole EMR, 100-277V
- Integrated 30mA ground-fault protection.
- Monitor and alarm for high and low temperature, high and low current, ground-fault level, and voltage.
- RS-485 module available for remote control and configuration.

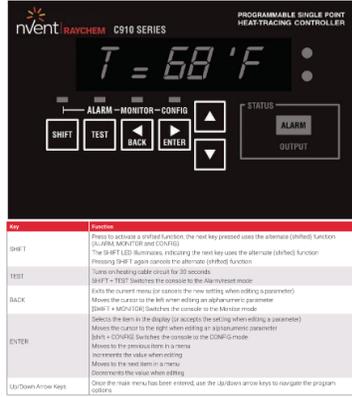


See the C910 Installation Manual:
<https://cdn.chemelx.com/Product%20Documents/Installation%20Manuals/Raychem-IM-H58415-C910series-EN.pdf>



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C910 Programming



Config
This mode allows you to access the console menu to examine or alter the settings. The LED above the CONFIG key is illuminated while in this mode. To access the operational menu:

Programming the C910-485 Heat Trace Controller

C910 Two RTDs on TS1 Ambient Freeze Protection

Fire (Requires 2 RTDs)
Press "SHIFT" (see "CONSOLE/STATUS")

Menu	Default	Change mode
Set	253.0°F	TS1
Alarm	Delayed	
Alarm Control Mode	ON OFF	
Control Tempset	OFF	
Controlset	OFF	
RTD Sensor	RTS	
RTD 1 L	RTS	
RTD 1 H	RTS	
RTD 2 L	RTS	
RTD 2 H	RTS	
RTD 3 L	RTS	
RTD 3 H	RTS	
RTD 4 L	RTS	
RTD 4 H	RTS	
RTD 5 L	RTS	
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RTD 98 H	RTS	
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Find the Raychem C910 Installation and Operation Manual here:
<https://info.raychem.com/ProductDocuments/Installation/20Ma%20nVent-Raychem-IM-HS8415-C910Series-EN.pdf>



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460 Controller



RAYCHEM 460 is a **UL listed** controller that provides heat tracing control and monitoring with built in GFPD for applications including pipe freeze protection, flow maintenance and heat loss replacement.

- Line, ambient or Proportional Ambient Sensing Control (PASC)
- 30A two pole EMR, 100-277V
- Integrated 30mA ground-fault protection.
- Up to two 2 KOhm / 77°F (25°C), 2-wire Thermistors
- Monitor and alarm for high and low temperature
- Alarm relay



20

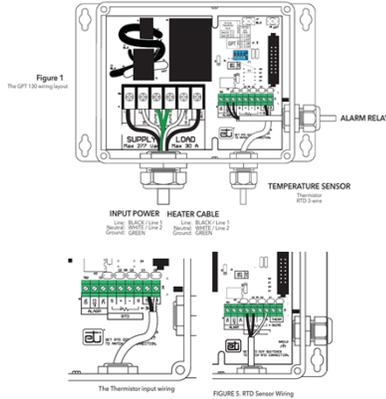
ETI TRACON GPT 130



The GPT 130 Heat Trace Temperature Controller is ideal for use in any electric heat application requiring a control system to maintain a steady temperature. With 2% accuracy span, built in 30 amp relay with a 30mA GFEP your application will be safely and reliably controlled. Any 100k ohms 3-wire RTD or Thermistor sensor can be used for temperature sensing.



See GPT 130 manual here:
<https://www.networketi.com/wp-content/uploads/2025/10/Tracon-Model-GPT-130-Manual-REV-E-10.26.25.pdf>



The GPT-130 can use a thermistor or 100Ω RTD



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GREASE WASTE SYSTEMS



Design Considerations Of The Piping System

- Fats, Oils, And Grease (FOG) Can Build Up In Upstream Piping Systems, Creating Blockages.
- Poorly Maintained Interceptors And Downstream Blockages Can Both Lead To Upstream Blockages.



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GREASE WASTE FLOW MAINTENANCE SYSTEM COMPONENTS

- Power Distribution
 - Circuit Breaker
 - Conduit & Wire
- Controller & Temperature Sensor
- Power Connection Kit
- Heating Cable
 - Attachments
- In-Line Splice Kits
 - Splice Connections
 - Tee Connections
- End Seal

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GREASE WASTE SYSTEM BELOW GRADE

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Fire Sprinkler systems



- Application Requirements The system complies with Raychem requirements for above ground general water piping when:
- The heating cable is permanently secured to insulated metal pipes with GT-66 glass tape or to plastic pipes using AT-180 aluminum tape.
- 465, C910-485, or ACS-30 controllers with integrated ground fault protection and alarm contacts are used and are connected to a fire control panel.
- The heating cable is installed per manufacturer's instructions with approved Raychem connection kits. See Table 11 on page 26 and the XL Trace Edge System Installation and Operation Manual (H58033)
- Control on ambient sensor, alarm on pipe temperature
- Report to fire supervisory system



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RAYCHEM 465 Controller

Designed Specifically for Fire Protection Pipe Tracing



- Built-in GF tested per UL 1053
- RAYCHEM XL-Trace system is a c-UL-us Listed for Fire Sprinkler Systems per UL 515A (VGNJ/VGNJ7) with the RAYCHEM 465 controller.
- Line, ambient or Proportional Ambient Sensing Control (PASC)
- 30A two pole EMR, 100-277V
- Integrated 30mA ground-fault protection.
- Two 2 KOhm / 77°F (25°C), 2-wire Thermistors
- Monitor and alarm for high and low temperature
- Alarm relay



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C910 and 465 Fire Protection Sheets



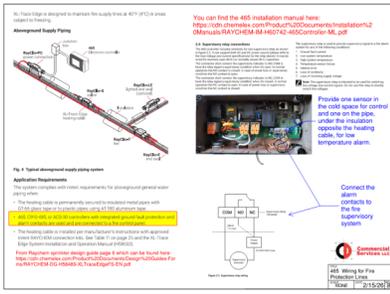


Fig. 1 Ambient temperature based sensing system

Application Requirements

The system complies with current requirements for all enclosed general water piping when:

- The piping is in a room or area where the ambient temperature is 40°F (4°C) or higher.
- The piping is in a room or area where the ambient temperature is 40°F (4°C) or higher.

Notes:

- The piping must be in a room or area where the ambient temperature is 40°F (4°C) or higher.
- The piping must be in a room or area where the ambient temperature is 40°F (4°C) or higher.

From the C910 installation and operation manual:
<https://pm.chemex.com/ProductDocuments/InstallationManuals/Manuals/465-465Controller-ML.pdf>

From the 465 installation manual here:
<https://pm.chemex.com/ProductDocuments/InstallationManuals/Manuals/465-465Controller-ML.pdf>

Provide one sensor in the coil space for control and one on the pipe, under the insulation opposite the heating cable, for temperature alarm.

Connect the alarm to the fire supervisory system.

465 Wiring for Fire Protection Line
 150V 215-200

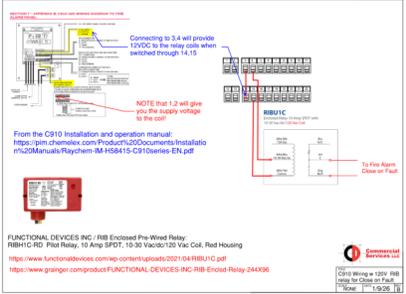


Fig. 2 Enclosed fire sensing system

Connecting to 3.4 will provide 12VDC to the relay coils when sensed through 1.4. 1.5

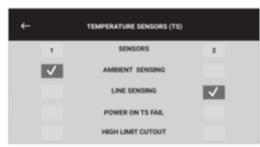
NOTE that 1.2 will give you the supply voltage to the coil.

From the C910 Installation and operation manual:
<https://pm.chemex.com/ProductDocuments/InstallationManuals/Manuals/Raychem-IM-465415-C910series-EN.pdf>

FUNCTIONAL DEVICES INC. / RB Enclosed Fire-Wired Relay
 RBHC RD - Fire Relay, 15 Amp SPDT, 15-30 Vac/30 Vac C&I, Red Housing
<https://www.functionaldevices.com/wp-content/uploads/2021/04/RBHC1.pdf>
<https://www.granger.com/product/FUNCTIONAL-DEVICES-INC-RB-Encsd-Relay-244X36>

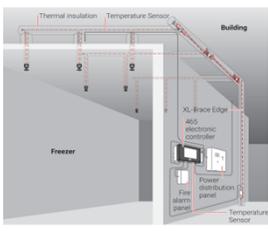
C910 Wiring - 120V RB
 Long for Open on Fail
 150V 215-200

- Control on air temperature
- Alarm on pipe temperature



TEMPERATURE SENSORS (TS)

1	SENSORS	2
<input checked="" type="checkbox"/>	AMBIENT SENSING	
<input type="checkbox"/>	LINE SENSING	<input checked="" type="checkbox"/>
<input type="checkbox"/>	POWER ON TS FAIL	
<input type="checkbox"/>	HIGH LIMIT CUTOFF	



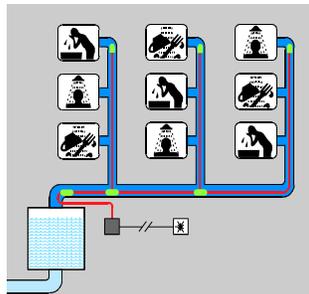
Thermal insulation, Temperature Sensor, Building, Freezer, XL-Trace Edge, 465 electronic controller, Fire alarm panel, Temperature Sensor



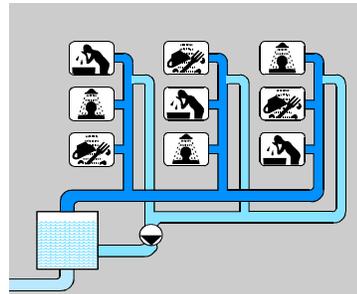
27

Domestic Hot Water What is HWAT and/or Recirculation?





HWAT



Recirculation



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HWAT Replaces Heat Lost As Needed

70° F Ambient Heat Loss 120° F DHW

Insulation HWAT Cable

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HWAT vs XLTrace

Raychem

Freeze Protection & Flow Maintenance

Raychem

Domestic Hot Water Maintenance

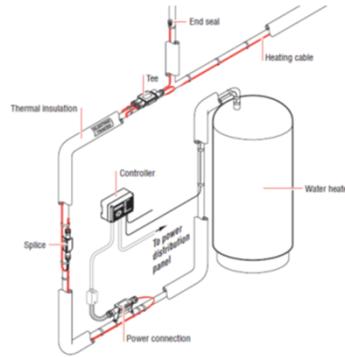
- Different Polymer Heater designed to maintain higher temperatures
- Aluminized Mylar barrier to prevent off-gassing from some insulations
- Thicker gauge wires used in ground braid for additional mechanical protection
- Thicker polyolefin outer jacket for additional mechanical protection

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Typical HWAT System



- HWAT is installed indoors (including behind walls).
- There is a specific insulation schedule so that the heat loss is the same across the system. The insulation thickness is matched to the pipe size so all pipe sizes have equal heat loss.
- Since the inside temperature doesn't change and all pipes have the same heat loss the desired water temperature can be achieved using a duty cycle rather than a sensor. One sensor is provided just to monitor low/high temperature.
- NOTE that the boiler sensor will turn off the HWAT system if it sees a low temperature.



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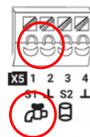
HWAT-ECO-GF SINGLE HWAT CIRCUIT CONTROLLER



- Built-In Ground Fault Protection
- 120, 208, 240 & 277 V Capability
- Check for proper voltage

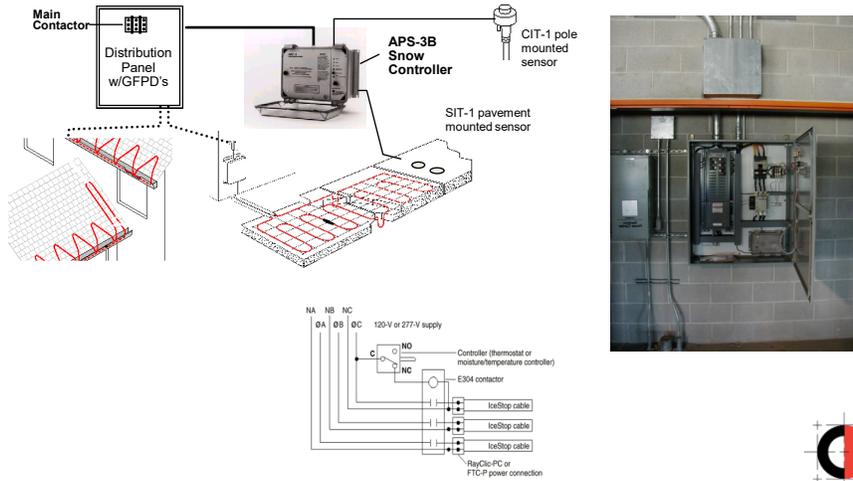
Red cable gets 208-277, purple cable gets 120

- Temperature sensor NOT required.
- If only one sensor be sure it is on PIPE
- Use Constant program
- Ask plumber for temperature setting, note setting in report
- Take a picture of the home screen, the status screen and the serial number when done



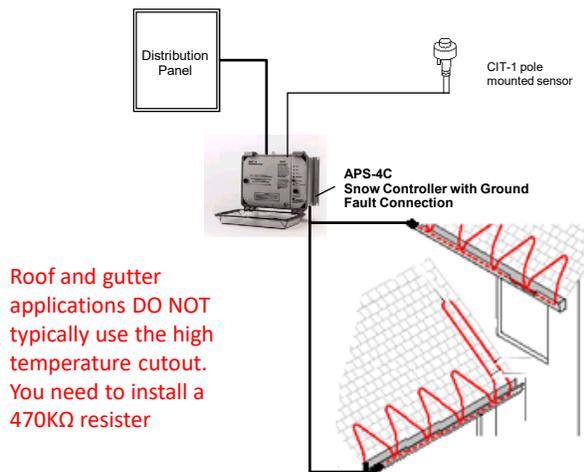
32

Dual Sensing Snow Melting Group Control



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Dual Sensing Snow Melting Control



Roof and gutter applications DO NOT typically use the high temperature cutout. You need to install a 470KΩ resistor



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Sensors for Snow Melting



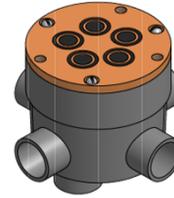
- Sensors detect both moisture and ambient temperature
- Operates from 24VAC
- Used in Pro & APS Series and EUR-5A (in SMPG) controllers



GIT-1
Gutter Sensor



CIT-1
Aerial Sensor



SIT-6E
Pavement Sensor



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CD Commercial Services

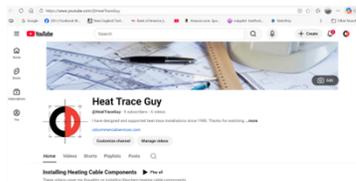


<https://cdcommercialservices.com/>

Electric Heat Trace Design, Inspection, and Constructability

Put our 30 years of experience to work for you

CONTACT



<https://www.youtube.com/@HeatTraceGuy>



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