

Raychem

HOT WATER TEMPERATURE MAINTENANCE PRODUCT SELECTION AND DESIGN GUIDE



THERMAL BUILDING SOLUTIONS

We provide quality solutions for winter safety, comfort and performance to building design, construction, operation and maintenance professionals. From pipe freeze protection to maintaining fluid temperatures and melting snow, detecting leaks or heating floors, you can rely on Pentair Thermal Building Solutions & services for greater safety, comfort and performance.

THE HEART OF OUR SOLUTIONS

As the inventor of self-regulating heat tracing, our Raychem brand is recognized for technical leadership in the industries we serve. Raychem cable delivers the appropriate amount of heat exactly when and where it is needed, adjusting the output produced in response to ambient and process conditions, making it ideal for heat management systems. Since inventing the technology, Pentair has sold over one billion feet of Raychem brand self-regulating cable. In addition to a self-regulating product set addressing a full range of temperature needs, we also offer other types of heating cables, control and monitoring solutions, and a full range of services related to our products.

The Raychem brand offers the industry's most complete range of dedicated heat-tracing control and monitoring systems, from simple thermostats to advanced networked systems, with easy-to-use interface technologies that put information and programming at your fingertips.

Both these technologies allow us to offer the Hot Water Temperature Maintenance (HWAT) System—the smart performance alternative to a recirculation system. HWAT maintains the hot water pipes at a uniform temperature range throughout a building--offering you energy savings, lower installed costs, while saving you material and maintenance costs.

Already installed in more than 100,000 hotels, hospitals, apartments, offices, schools, nursing homes, and correctional facilities around the world, rely on Pentair's simple and reliable alternative to recirculation.

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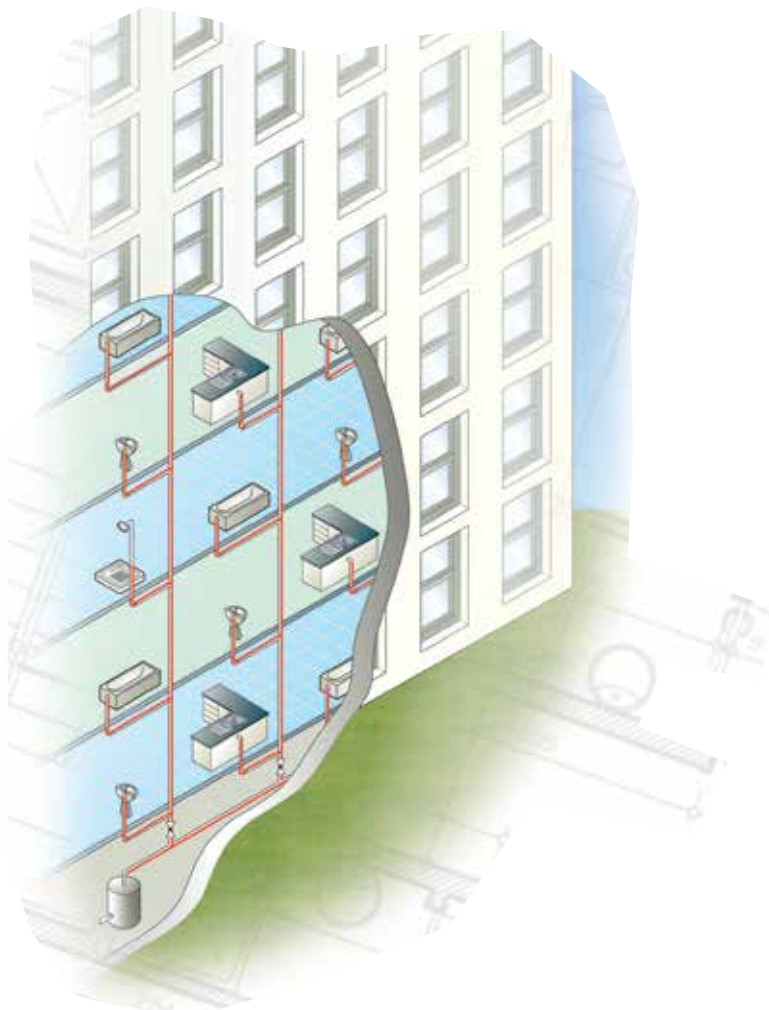
THE OPTIMAL HOT WATER TEMPERATURE MAINTENANCE SYSTEM

COMFORTABLE AND ENERGY EFFICIENT

Today's hot water system requirements focus on users' comfort as well as operational and energy savings. With this in mind, the Raychem HWAT System keeps the hot water at the right temperature everywhere in the building while saving energy at the same time.

SIMPLE, EFFECTIVE AND SMART

The HWAT system ensures an abundant supply of hot water at the same temperature throughout the building while eliminating the need for return piping. The HWAT heating cable is attached to a hot water pipe, keeping the water at the desired temperature. The cable continuously senses the temperature of the pipes, and will modify its heat output accordingly. Combined with the HWAT-ECO or ACS-30 controller, HWAT is a sophisticated temperature and energy management system. The HWAT system provides real energy savings and delivers quality hot water.



HWAT systems can be found in a variety of commercial buildings, including hospitals, office and retail buildings and schools.

Return piping, balancing valves and pumps required in a recirculation system are eliminated in an HWAT system. Branches and risers can be traced easily, as indicated in the illustration at left.

INTELLIGENT ENERGY & COST SAVING



LESS ENERGY CONSUMPTION

- The self-regulating technology manages the heat output locally.
- Heat loss is lower with only 1 pipe as opposed to a recirculation system that requires supply and return piping.
- Because a recirculation pump is not needed, energy is saved.
- Water heater efficiency is optimized, therefore, a smaller water heater can be used.
- Because the temperature of the hot water is maintained along the entire length of the supply pipe, there is no need to overheat the supply water at the water heater, as there is with a recirculation system.

The HWAT system's electronic controller calculates the amount of "on" time required to maintain the desired temperature. When water usage is low, maintain temperatures can be reduced. When water usage is high and hot water is flowing from the water heater to the point of use without delay, the heating cable can be turned off.

ECONOMICAL IN DESIGN AND INSTALLATION

A single pipe: no need for complex pressure and balance calculations or drawings which saves design time.

Simple design: the length of pipe corresponds to the length of heating cable that is required.

Easy to install: the system uses few components. The cable is attached directly onto the hot water pipe under the thermal insulation. No need for return pipe works, valves or pumps!

Fast connection: the RayClic system allows for connections to be made quickly.



The lengths of pipe correspond to the lengths of heating cable needed.

THE SECRET IS IN THE HEATING CABLE

AUTOMATIC TEMPERATURE ADJUSTMENT

The self-regulating heating cable really is the heart of the system. It senses the temperature of the pipes and modifies the heat output accordingly. The self-regulating cable can be installed on all the supply piping to ensure that instant hot water is available at every tap.

OPTIMIZED FOR EFFICIENT ENERGY USAGE

The easy-to-program Raychem HWAT-ECO or ACS-30 controllers modulate the heating cable in accordance with the specific requirements of your building. They monitor the hot water supply temperature, sound alerts on high temperature, and turn off the system to prevent scalding. This minimizes energy consumption.

Flexible temperature control: variable temperature maintenance in the range 105–140°F (40–60°C).

Building Management System (BMS) compatibility: the Raychem HWAT-ECO and ACS-30 controllers allow connection to a BMS system, enabling remote temperature maintenance and continual feedback through the alarm contacts.

Monitors the water heater temperature: activates an alarm and turns off the HWAT heating cable until temperature is below set point temperature.

Nine building specific-programs: make programming of complex buildings easier.

HWAT-ECO Master/slave function: allows one controller to network with up to eight additional controllers for fast programming.

SIMPLIFIED INSTALLATION

The Raychem RayClic connection system cuts installation time considerably. Power, splice and tee connections are made easily and reliably.

Tightening two torx head screws is all it takes.

- No need for special tools, other than the torx head driver.
- Minimal heating cable stripping.
- No “heat-shrink” components.



HWAT-R2 heating cable.



Raychem HWAT-ECO controller.



Raychem ACS-30 controller.



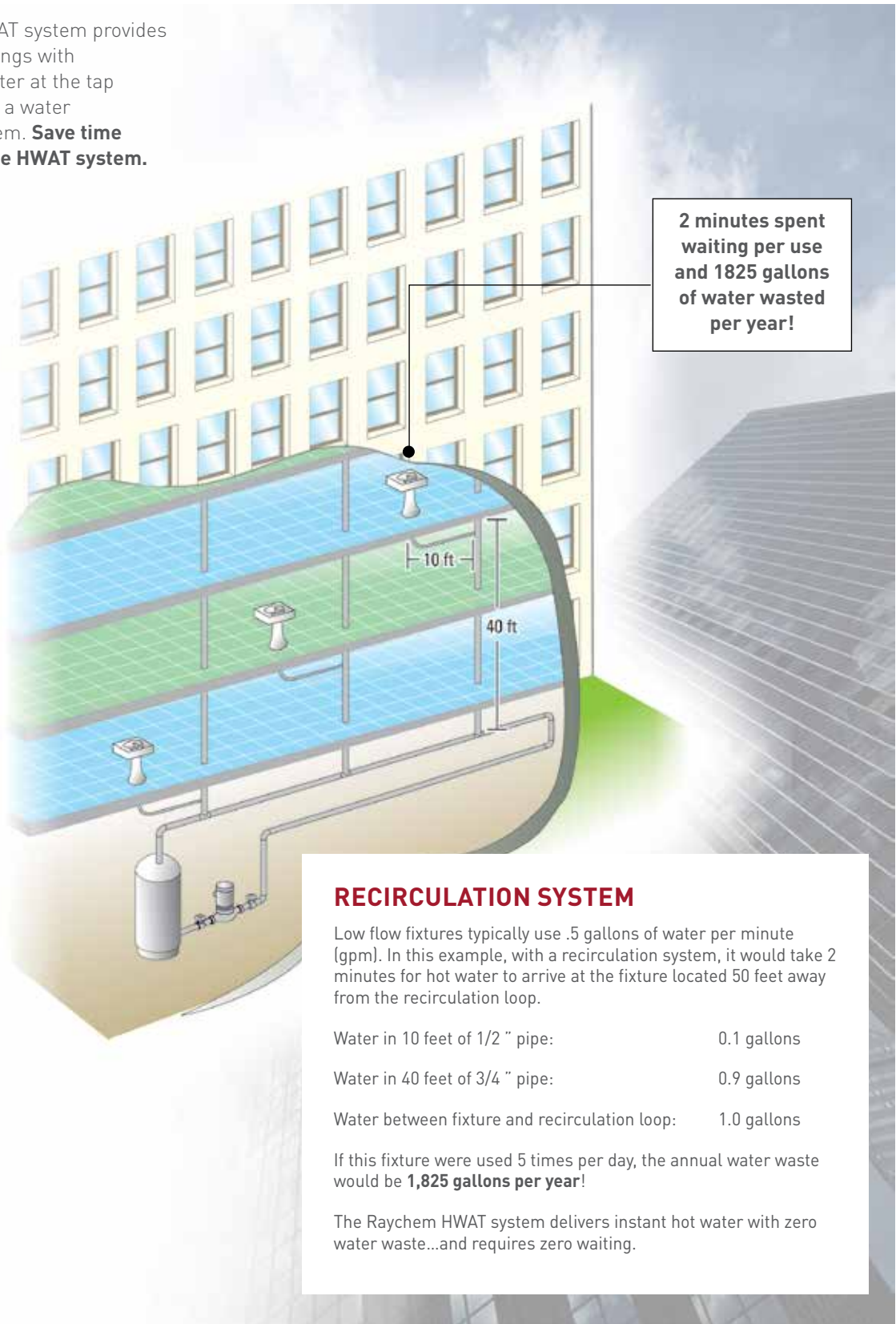
RayClic connection kit.

Raychem

TIME TO TAP

IMMEDIATE HOT WATER

The Raychem HWAT system provides commercial buildings with immediate hot water at the tap without the use of a water recirculation system. **Save time and water with the HWAT system.**





**HOT WATER TEMPERATURE
MAINTENANCE PRODUCT
SELECTION AND DESIGN GUIDE**



Raychem

The Raychem HWAT System is a hot water temperature maintenance system that provides immediate hot water without the use of a water recirculation system. This product selection and design guide provides all the information necessary to select and design an HWAT system. For information regarding other products and applications, contact Pentair at (800) 545-6258. Also, visit our web site at www.pentairthermal.com.

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Raychem HWAT DESIGN GUIDE



This step-by-step design guide provides the tools necessary to design a Raychem HWAT Hot Water Temperature Maintenance System. For additional information, contact your Pentair representative or phone Pentair at (800) 545-6258. Also, visit our web site at www.pentairthermal.com.

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INTRODUCTION

The Raychem HWAT System is a hot water temperature maintenance system that utilizes an electronic controller, self-regulating electric heating cables, and an easy-to-install set of connection kits to provide commercial buildings with immediate hot water at the tap without the use of a water recirculation system.

Recirculation systems require the water heater temperature to be at least five degrees above the maintain temperature to compensate for the heat that is lost in the recirculation loop. With HWAT systems, the water in the supply pipe is maintained at a constant temperature along the entire length of the supply pipe so heating the water above the maintain temperature is not required. Recirculation systems also require return lines, pumps, and balancing valves, all of which are all unnecessary with HWAT.

A key component of the HWAT system are the HWAT controllers. In addition to providing flexible temperature control, the controllers provide energy savings; a heat-up cycle that increases the water temperature in stagnant pipes; Building Management System (BMS) interface; alarm relay to signal power, temperature, or communication problems; a water heater sensor function; and nine predefined programs that can be customized by the user.

Typical Applications

The HWAT system is designed to be installed and operated in commercial buildings. Table 1 shows typical HWAT applications, desired maintain when HWAT-R2 heating cable is used in conjunction with the HWAT-ECO or ACS-30 controllers.

TABLE 1 TYPICAL HWAT APPLICATIONS

| Application | Desired maintain temperature |
|----------------------------------|------------------------------|
| Hospitals, nursing homes | 105°F (40°C) |
| Schools, prisons, some hospitals | 115°F (45°C) |
| Offices, hotels, apartments | 125°F (50°C) |
| Kitchens, laundries | 140°F (60°C) |

This design guide covers standard HWAT applications which must meet the following conditions:

- Installed on copper or rigid plastic pipes
- Insulated in accordance with the insulation schedule shown in Table 6
- Powered at 208 V or 240 V. Can also be powered at 277 V when using the Raychem ACS-30 controller
- Operated indoors where the ambient temperature is relatively constant and between 60°F (15°C) and 80°F (26°C)

If your application does not meet the above conditions, contact your Pentair Thermal Building Solutions representative for custom design assistance.

Approvals and Code Compliance

The HWAT system, with or without the HWAT-ECO or ACS-30 controller, is UL Listed, CSA Certified, and FM Approved in nonhazardous locations.



Pipe Heating Cable

HWAT is also in compliance with the following international and national codes:

- International Plumbing Code
- International Building Code
- International Energy Conservation Code
- National Standard Plumbing Code
- National Electrical Code
- Canadian Electrical Code

Additionally, HWAT has numerous state and local code approvals. Contact your Pentair representative for further information.

Safety Guidelines

The safety and reliability of any heat-tracing system depends on the quality of the products selected and on proper design, installation, and maintenance. Incorrect design, handling, installation, or maintenance of any of the system components can cause underheating or overheating of the pipe or damage to the heating cable system and may result in system failure, electric shock, or fire. The guidelines and instructions contained in this guide are important. Follow them carefully to minimize these risks and to ensure that the HWAT system performs reliably.

Pay special attention to safety warnings identified as  **WARNING**.

Ground-Fault Protection

To minimize the danger of fire from sustained electrical arcing if the heating cable is damaged or improperly installed, and to comply with Pentair Thermal Building Solutions requirements, agency certifications, and national electrical codes, ground-fault equipment protection must be used on each heating cable branch circuit. Arcing may not be stopped by conventional circuit breakers.

Design Requirements

To comply with warranty requirements, the design and installation of the HWAT system must be in accordance with this guide and the additional documents listed below:

- HWAT-ECO Installation and Operations Manual (H57340)
- HWAT System Installation and Operations Manual (H57548)
- RayClic Connection Kit Installation Instructions (H55388 and H55092)

Installation documents are shipped with the respective products and are also available via the Pentair Thermal Building Solutions web site at www.pentairthermal.com.

SYSTEM OVERVIEW

A complete HWAT system includes one or more HWAT-ECO or ACS-30 electronic controllers, HWAT-R2 heating cable, and RayClic connection kits. Fig. 1 illustrates a typical HWAT system. The key components of the system will be described in this section.

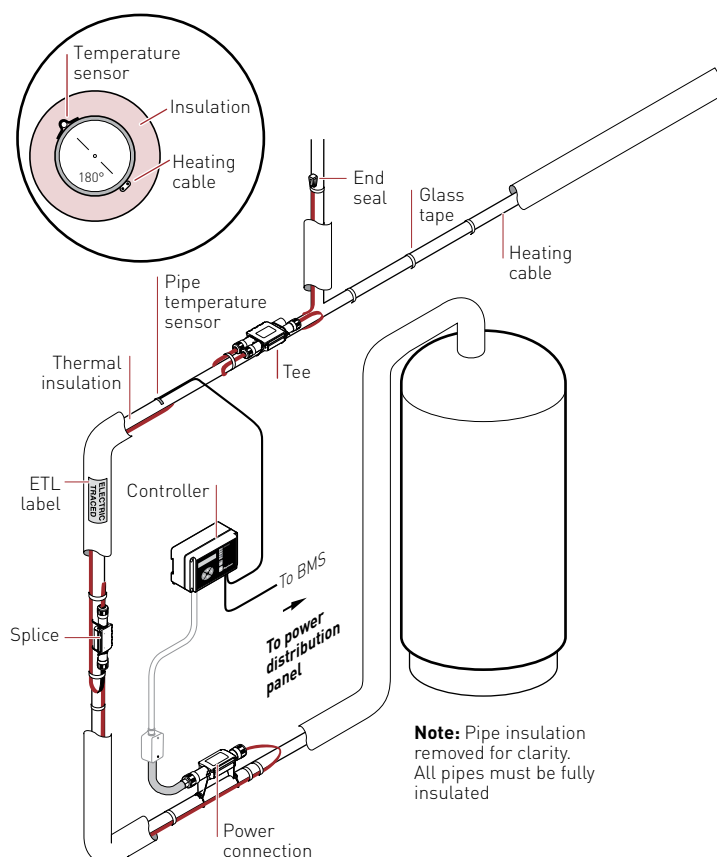


Fig. 1 Typical HWAT heating cable system

HWAT Electronic Controllers

The Raychem HWAT-ECO is an electronic controller designed for use with a single circuit of HWAT-R2 self-regulating heating cable. For large hot water systems the ACS-30 distributed controller is available, refer to the ACS-30 data sheet [H58261] for more information. The HWAT-ECO provides a variety of features and control options, listed below, for your hot water temperature maintenance system.

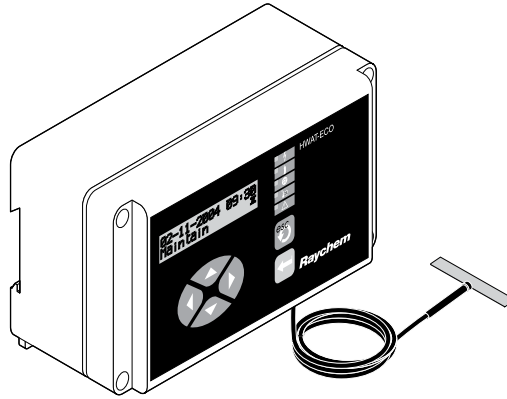


Fig. 2 HWAT-ECO controller

- **Flexible temperature control** – Selectable temperature control set points across the temperature range of the heating cable
- **Energy savings** – Lowers the maintain temperature during low water usage hours and turns off the heating cable during peak water usage hours
- **Heat-up cycle** – Increases the water temperature of a hot water system that is not in use
- **Building Management System (BMS) interface** – Receives a DC voltage to determine the desired maintain temperature
- **Alarm** – Signals power, temperature, or communication problems
- **Water heater sensor** – Monitors the supply pipe temperature, alarms on high temperature and turns off the system to prevent the possibility of scalding
- **Master/slave function** – Allows one HWAT-ECO to control up to eight additional HWAT-ECO controllers
- **Programmable settings** – Nine predefined programs that can be customized by the user

HWAT Heating Cables

HWAT-R2 self-regulating heating cables is installed on hot water supply pipes underneath standard pipe insulation. The heating cable adjusts its power output to reduce the effect of ambient temperature swings. The HWAT system provides continuous hot water temperature maintenance while eliminating the need for a recirculation system.

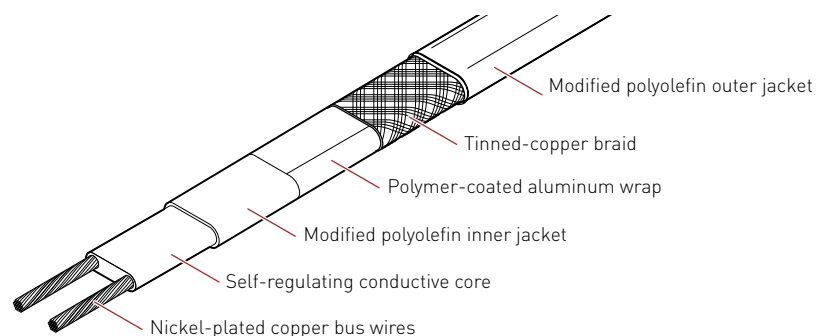


Fig. 3 HWAT-R2 heating cable

HWAT heating cables provide the following features:

- Adjust power output to reduce the variations in water temperature
- Can be cut to length, spliced, teed, and terminated in the field
- Designed for use with the HWAT-ECO or ACS-30 controller

RayClic Connection Kits

The RayClic connection system is a simple, fast, and reliable set of connection kits developed for use with HWAT self-regulating heating cables. RayClic connection kits reduce installation time, lowering the total installed cost of the HWAT system.

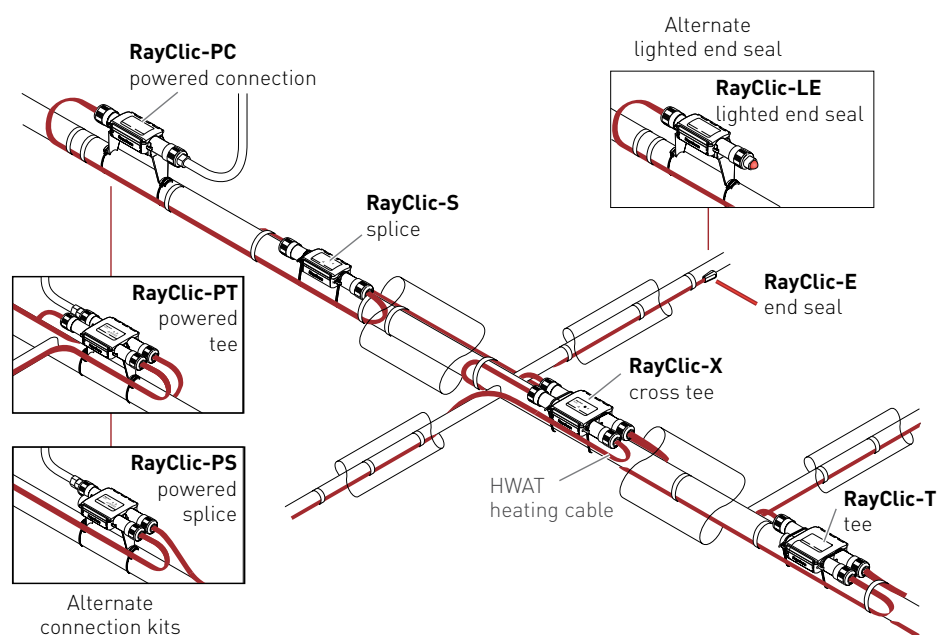


Fig. 4 RayClic connection kits

DESIGN GUIDELINES

This section describes the seven steps necessary to design an HWAT system:

- 1 Select the heating cable
- 2 Lay out the heating cable
- 3 Select connection kits and accessories
- 4 Finalize circuit length
- 5 Select control configurations
- 6 Select thermal insulation
- 7 Complete Bill of Materials

To assist you with the design, we will carry two design examples through this process. The example details are listed below each step in red.

Example 1

An elementary school where 115°F (46°C) is the desired maintain temperature and no heat-up cycle is required. Piping layout shows approximately 300 ft of pipe with two branches at the same location.

Example 2

A medium security prison where 115°F (46°C) is the desired maintain temperature and a 140°F (60°C) heat-up cycle is required. Piping layout shows approximately 700 ft of pipe with two branches at different locations.

Before You Begin

Before you begin designing your HWAT system, gather this necessary information:

- Desired maintain temperature
- Indoor ambient temperature
- Supply voltage
- Piping layout
- Total pipe length
- Pipe diameters

| HWAT System Design |
|---|
| 1. Select heating cable |
| 2. Lay out the heating cable |
| 3. Select connection kits and accessories |
| 4. Finalize circuit length |
| 5. Select control configuration |
| 6. Select insulation |
| 7. Complete Bill of Materials |

Step 1 Select heating cable

Use Table 2 to select the appropriate system temperature setting. For more information on heat-up cycles, refer to "Expanded HWAT-ECO Electronic Controller Capabilities," H58449; or ACS-30 Programming Guide (H58692). HWAT-R2 heating cable will be used regardless of the controller you choose.

Record the following information:

- Desired maintain temperature (°F/°C) _____
- Indoor ambient temperature (°F/°C) _____
- Supply voltage (V) _____
- Heat-up cycle (Yes/No) _____
- Temperature (°F/°C) _____

Example: Heating Cable Selection

| | Example 1 | Example 2 |
|------------------------------|--------------|--------------|
| Desired maintain temperature | 115°F (46°C) | 115°F (46°C) |
| Ambient temperature | 70°F (21°C) | 70°F (21°C) |
| Supply voltage | 208 V | 208 V |
| Heat-up cycle required | No | Yes |
| Heat-up cycle temperature | n/a | 140°F (60°C) |

TABLE 2 HWAT SYSTEM TEMPERATURE RANGE

| HWAT-R2 | HWAT-ECO | ACS-30 |
|------------------------------|---------------|---------------|
| Minimum maintain temperature | 105°F (40°C) | 100°F (38°C) |
| Maximum maintain temperature | 140°F (60°C) | 150°F (66°C) |
| Heat-up cycle* | >140°F (60°C) | >150°F (66°C) |

* For additional information on heat-up cycles, refer to "Expanded HWAT-ECO Electronic Controller Capabilities."

⚠ WARNING Burn Hazard
 Water temperatures above 120°F (50°C) can cause skin damage and pain. Be sure the correct insulation schedule is used and the HWAT-ECO or ACS-30 is programmed properly. Avoid exposure to water during heat-up cycles or from water systems with high maintain temperatures during normal operation.

Heating Cable Selection

Heating cable selected

Example

HWAT-R2

| HWAT System Design |
|---|
| 1. Select heating cable |
| 2. Lay out the heating cable |
| 3. Select connection kits and accessories |
| 4. Finalize circuit length |
| 5. Select control configuration |
| 6. Select insulation |
| 7. Complete Bill of Materials |

Step 2 Lay out the heating cable

The piping layout of your building may require more than one HWAT circuit. To determine the number of circuits, group your piping by maintain temperature and location for convenience, a step that may require you to consult the plumbing and/or electrical engineer. Calculate the total length of pipe in each group, allowing one foot of heating cable for each foot of pipe. The length of heating cable in each group must not exceed the circuit lengths listed in Table 3.

In Step 4, you will calculate the additional cable required to install the connection kits. This will increase the total length of heating cable and may require the need for additional circuits.

TABLE 3 MAXIMUM CIRCUIT LENGTHS

| Circuit breaker size (Amps) | Circuit Lengths |
|-----------------------------|-----------------|
| | HWAT-R2 ft (m) |
| 15 | 250 (75) |
| 20 | 330 (100) |
| 30 | 500 (150) |

Note: Assumes a minimum water temperature of 50°F (10°C) at startup

⚠ WARNING To minimize the danger of fire from sustained electrical arcing if the heating cable is damaged or improperly installed, and to comply with Pentair Thermal Building Solutions requirements, agency certifications, and national electrical codes, ground-fault equipment protection must be used on each heating cable branch circuit. Arcing may not be stopped by conventional breakers.

| Example: Lay out circuits | Example |
|-----------------------------|---------|
| HWAT heating cable selected | HWAT-R2 |
| Length of pipe | 700 ft |
| Number of circuits | 2 |
| Circuit breaker size | 30 Amp |

| HWAT System Design |
|---|
| 1. Select heating cable |
| 2. Lay out the heating cable |
| 3. Select connection kits and accessories |
| 4. Finalize circuit length |
| 5. Select control configuration |
| 6. Select insulation |
| 7. Complete Bill of Materials |

Step 3 Select connection kits and accessories

HWAT systems are approved and warranted only as a complete system. The appropriate RayClic connection kits must be used. Use Table 4 to select the connection kits and accessories necessary for your HWAT system. Refer to the RayClic Connection System data sheet (H57545) in the Technical Data section for more information on the products.

The appropriate numbers of end seals are included with each connection kit.

TABLE 4 RAYCLIC CONNECTION KITS AND ACCESSORIES

| Catalog number | Description | Quantity required | No. of end seals included |
|----------------|----------------------|--|---------------------------|
| RayClic-PC | Power connection kit | One -PC, -PS, -PT required per circuit | 1 |
| RayClic-PS | Powered splice kit | One -PC, -PS, -PT required per circuit | 2 |
| RayClic-PT | Powered tee kit | One -PC, -PS, -PT required per circuit | 3 |
| RayClic-S | Splice kit | As required* | 0 |
| RayClic-X | Cross kit | As required | 2 |
| RayClic-T | Tee kit | As required | 1 |
| RayClic-E | End seal kit | As required for spares | 1 |
| GT-66 | Glass tape | 1 roll per 50 ft of pipe | n/a |
| ETL | Electric traced tape | 1 label per 10 ft of pipe | n/a |

* To minimize cable waste, Pentair recommends that one RayClic-S be ordered for every 500 feet of cable.

Example: Select connection kits and accessories Example
 Piping layout determined that the following connection kits and accessories are required.
 2 RayClic-PC
 2 RayClic-T
 14 GT-66
 70 ETL

| HWAT System Design |
|---|
| 1. Select heating cable |
| 2. Lay out the heating cable |
| 3. Select connection kits and accessories |
| 4. Finalize circuit length |
| 5. Select control configuration |
| 6. Select insulation |
| 7. Complete Bill of Materials |

Step 4 Finalize circuit length

Additional cable is required for future access at each connection kit. Add the additional cable, as detailed in Table 5, to the estimated circuit lengths from Step 2. Confirm that the maximum lengths shown in Table 3 have not been exceeded. If your circuit lengths are greater than those shown, reconfigure your heating cable layout to allow for additional circuits.

TABLE 5 ADDITIONAL CABLE REQUIRED FOR EACH CONNECTION KIT

| Connection kit name | No. of cable connections/kit | Cable length/ connection ft (m) | Total cable length (service loop) ft (m) |
|---------------------|------------------------------|---------------------------------|--|
| RayClic-PC | 1 | 2.0 (0.6) | 2.0 (0.6) |
| RayClic-S | 2 | 1.0 (0.3) | 2.0 (0.6) |
| RayClic-T | 3 | 1.0 (0.3) | 3.0 (0.9) |
| RayClic-X | 4 | 1.0 (0.3) | 4.0 (1.2) |
| RayClic-PS | 2 | 1.5 (0.5) | 3.0 (0.9) |
| RayClic-PT | 3 | 1.3 (0.4) | 4.0 (1.2) |
| RayClic-E | 1 | n/a | n/a |

| Example: Finalize circuit length | Example | |
|---|---------------|---------------|
| | Circuit 1* | Circuit 2* |
| Length of heating cable per circuit | 350 ft | 350 ft |
| Additional cable required | | |
| RayClic-PC | 2 ft | 2 ft |
| RayClic-T | 3 ft | 3 ft |
| RayClic-X | n/a | n/a |
| Total length of heating cable required | 355 ft | 355 ft |

* In this example, the circuits were evenly divided. Equal circuit lengths are not required.

| HWAT System Design |
|---|
| 1. Select heating cable |
| 2. Lay out the heating cable |
| 3. Select connection kits and accessories |
| 4. Finalize circuit length |
| 5. Select control configuration |
| 6. Select insulation |
| 7. Complete Bill of Materials |

Step 5 Select control configuration

For single circuit applications, choose the HWAT-ECO controller. For multi-circuit applications, choose the ACS-30 controller.

| Example: Select control method | Example 1 | Example 2 |
|--------------------------------|--------------------|---------------|
| Type | Individual circuit | Multi-circuit |
| Number of circuits | 1 | up to 260 |
| Controller | HWAT-ECO | ACS-30 |

| HWAT System Design |
|---|
| 1. Select heating cable |
| 2. Lay out the heating cable |
| 3. Select connection kits and accessories |
| 4. Finalize circuit length |
| 5. Select control configuration |
| 6. Select insulation |
| 7. Complete Bill of Materials |

Step 6 Select Insulation

Select the size of thermal insulation from Table 6. You will need to know the length and diameter of each pipe used in your application.

For pipes 1 1/4 inches and smaller, use insulation that is oversized by 1/4 inch to allow room for insulating over the heating cables. Table 6 specifies IPS (Iron Pipe Size) insulation, which has a greater inner diameter than CTS (Copper Tube Size) insulation.

For pipes 3 inches and larger, the thickness of insulation can either be equal to the pipe diameter with a single heating cable or 1/3 the pipe diameter with two heating cables. For example, a 6 inch pipe with 6 inches of insulation and one run of heating cable is equivalent to a 6 inch pipe with 2 inches of insulation and two runs of heating cable.

TABLE 6 FIBERGLASS INSULATION SELECTION

| Copper pipe size (in) | IPS insulation size (in) | Insulation thickness (in) |
|-----------------------|--------------------------|---------------------------|
| 1/2 | 3/4 | 1/2 |
| 3/4 | 1 | 1 |
| 1 | 1 1/4 | 1 |
| 1 1/4 | 1 1/2 | 1 1/2 |
| 1 1/2 | 1 1/2 | 1 1/2 |
| 2 | 2 | 2 |
| 2 1/2 | 2 1/2 | 2 1/2 |
| 3 | 3 | 3 |

Note: For pipes 3 inches and larger, the thickness of insulation can be equal to the pipe diameter with one run of heating cable or 1/3 the pipe diameter with two runs of heating cable.

Example: Select Insulation

| | Copper pipe size (in) | IPS insulation size (in) | Insulation thickness (in) |
|------------------|-----------------------|--------------------------|---------------------------|
| Example 1 | 3/4 | 1 | 1 |
| | 1 | 1 1/4 | 1 |
| | 1 1/2 | 1 1/2 | 1 1/2 |
| Example 2 | 1 | 1 1/4 | 1 |
| | 2 | 2 | 2 |
| | 2 1/2 | 2 1/2 | 2 1/2 |

| HWAT System Design |
|---|
| 1. Select heating cable |
| 2. Lay out the heating cable |
| 3. Select connection kits and accessories |
| 4. Finalize circuit length |
| 5. Select control configuration |
| 6. Select insulation |
| 7. Complete Bill of Materials |

Step 7 Complete Bill of Materials

You are now ready to compile a Bill of Materials. Using the design results, detail each item as shown in Table 7 below. Fig. 5 illustrates a complete typical HWAT system.

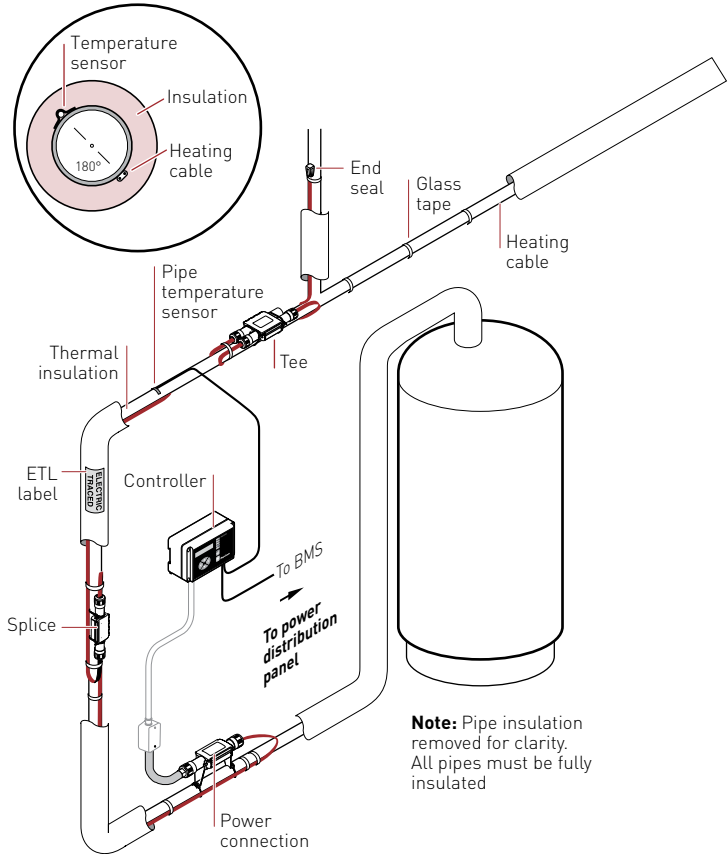


Fig. 5 Typical HWAT heating cable system

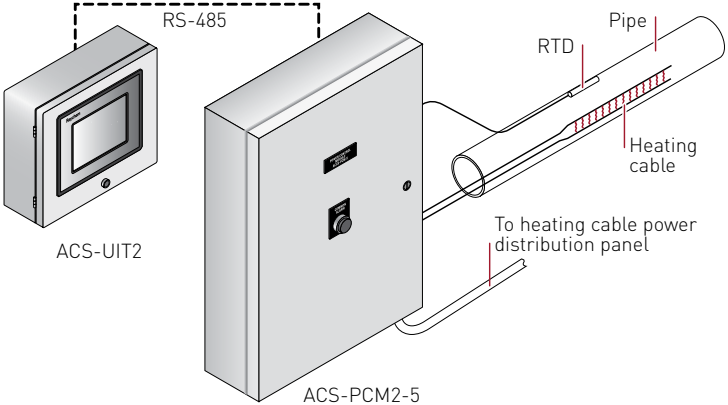


Fig. 6 Typical configuration for the Raychem ACS-30 system

TABLE 7 BILL OF MATERIALS (EXAMPLE)

| Description | Catalog number | Quantity |
|----------------------|----------------|----------|
| HWAT heating cable | HWAT-R2 | 706 ft |
| Power connection kit | RayClic-PC | 2 |
| Tee connection kit | RayClic-T | 2 |
| Controller | HWAT-ECO | 2 |
| Attachment tape | GT-66 | 12 rolls |
| Labels | ETL | 70 |



Raychem HWAT: INSULATION SCHEDULE OF NON-STATIC SUPPLY PIPING

APPLICATION DESIGN NOTE

The key to a successful Raychem HWAT hot water maintenance system is to use the correct thermal insulation on the pipes. The standard fiberglass insulation thickness schedule from the HWAT Product Selection and Design Guide (H57538) is shown in Table below. This schedule provides constant heat loss for all pipe sizes and results in uniform temperature maintenance with the HWAT system. If different thicknesses are used, pipe temperatures will vary.

TABLE 1 INSULATION SCHEDULE

| Copper pipe size (in) | IPS insulation size (in) | Insulation thickness (in) |
|-----------------------|--------------------------|---------------------------|
| 1/2 | 3/4 | 1/2 |
| 3/4 | 1 | 1 |
| 1 | 1 1/4 | 1 |
| 1 1/4 | 1 1/2 | 1 1/2 |
| 1 1/2 | 1 1/2 | 1 1/2 |
| 2 | 2 | 2 |
| 2 1/2 | 2 1/2 | 2 1/2 |
| 3 | 3 | 3 |

Note: For pipes 3 inches and larger, the thickness of insulation can be equal to the pipe diameter with one run of heating cable or 1/3 the pipe diameter with two runs of heating cable.

For supply mains greater than 2 inches in diameter, the insulation schedule in Table 1 may present some difficulty due to the space required to accommodate the insulation. If this is a problem, reduce the insulation thickness to 1/3 of that specified and install two runs of HWAT heating cable.

The reason the insulation thickness is so critical for HWAT is that the pipes are assumed to be static for long periods of time. Using the specified insulation size and thickness ensures the pipes will be at the correct and uniform temperature. However, large diameter pipes are not likely to remain static for prolonged periods of time in large installations such as hospitals and hotels. In these pipes hot water is frequently added to the pipe system replacing the cold water and reducing the effective heat loss of the pipes.

For these situations an alternative insulation schedule has been created for HWAT systems on copper pipes 2 1/2 inches or larger with constant but low flow. The mains can be insulated with only 2 inches of fiberglass thermal insulation and use a single run of HWAT heating cable if the minimum flow is maintained. Fig. 1 shows the flow rate required to have less than 1°F temperature drop for every 50 feet of supply pipe.

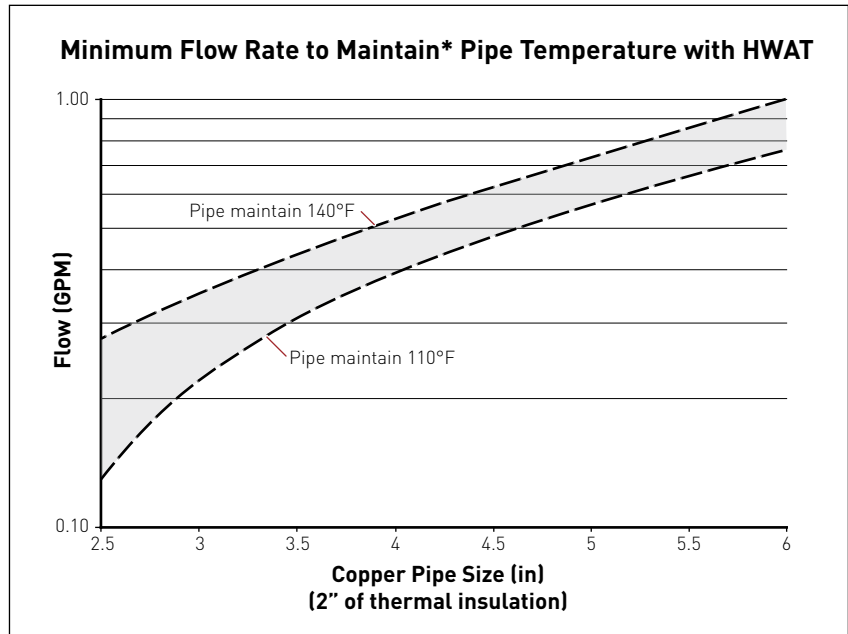


Fig. 1 Flow rate required to maintain* pipe temperature with a single run of HWAT heating cable

* Less than 1°F temperature drop for every 50 feet of supply pipe

Using this approach, HWAT systems can maintain uniform pipe temperatures throughout the system with thinner insulation on the main supply pipe and standard insulation on the branch pipes.

Install in accordance with the HWAT System Installation and Operation Manual (H57548) and the HWAT-ECO Installation and Maintenance Manual (H57340).

Approvals and performance are based on using Pentair approved connection kits and accessories, do not substitute parts.



Raychem HYBRID HWAT SYSTEM: RECIRCULATION AND HWAT DESIGN

APPLICATION DESIGN NOTE

In high rise residential construction, it is fairly common for the plumbing engineer to recirculate the hot water main but not the branch piping. This is done to minimize the wait for hot water at the point of use in the condominium. The water in the main stays hot, but because the hot water line serving the condominium is typically not recirculated, the water temperature in the branch piping goes to ambient when there is no hot water flow. These horizontal distribution lines are difficult to recirculate because of pressure and balancing in the high rise building. Furthermore, the risers don't always line up vertically because the floor plan of each unit may be different. Home owners are therefore required to run showers or sinks for long periods of time to draw new hot water into the unit, which is a significant waste of water.

The Raychem HWAT hot water maintenance system offers a solution utilizing self-regulating heating cables and the HWAT-ECO or ACS-30 electronic controller, in conjunction with the recirculation system. This combination of recirculated hot water mains and the HWAT system for the horizontal piping is the best of both worlds. The engineer can simply heat trace the horizontal hot water lines within the condominium to provide the owner with instant hot water. Different floor plans are also not a problem because the HWAT heating cable simply attaches to the hot water piping regardless of the configuration.

The drawing in Fig. 1 shows a typical hot water riser with recirculation and heat traced horizontal hot water lines feeding the condominiums. The HWAT system is installed following the design guidelines in the HWAT System Installation and Operation Manual (H57548).

Multiple horizontal runs can be controlled as long as the HWAT heating cable maximum circuit length is not exceeded, the same cable is on each run and the ambient conditions are the same for each pipe. The system shown in Figure 1 includes eight circuits of HWAT-R2 heating cable each 50 feet long, which can be wired in parallel to a junction box and controlled by a single HWAT-ECO controller.

HYBRID HWAT SYSTEM: RECIRCULATION AND HWAT DESIGN

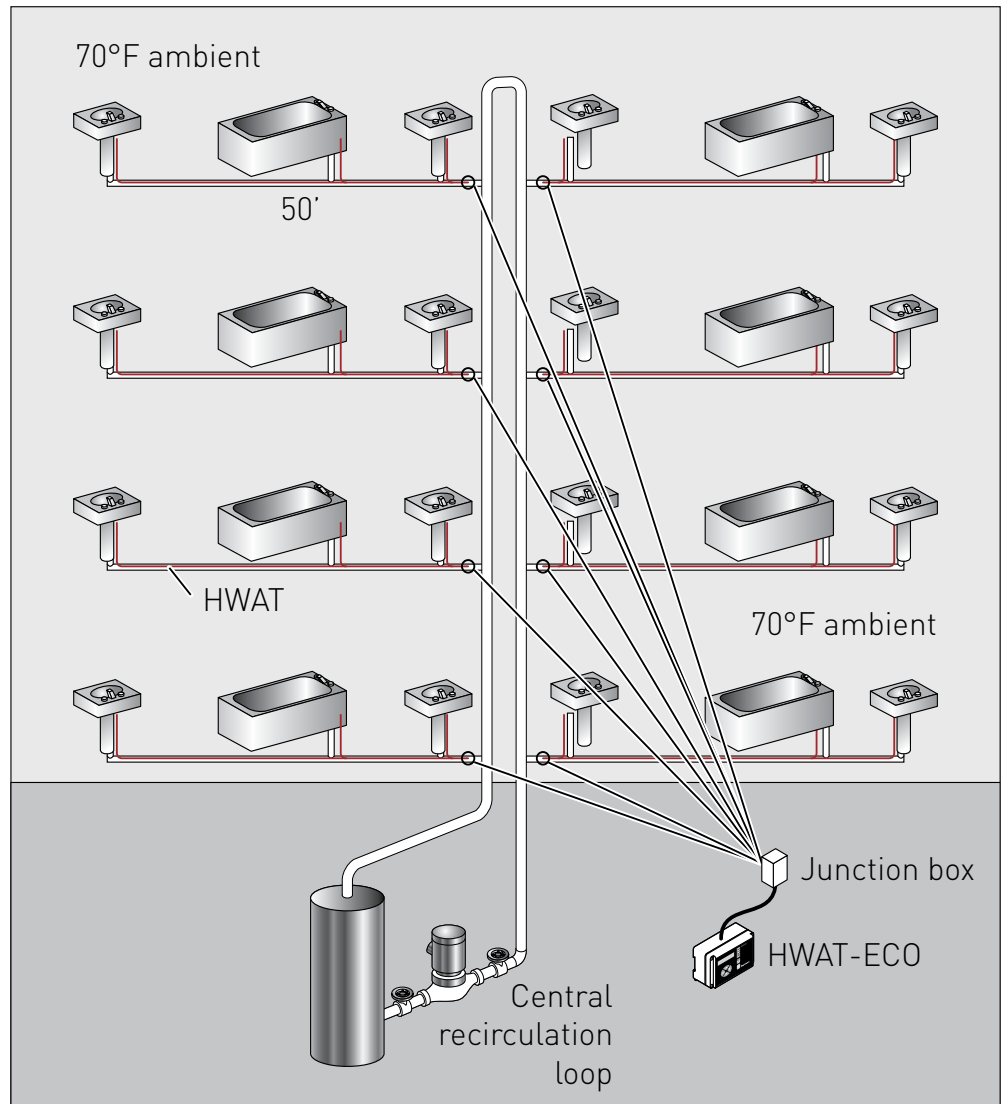


Fig. 1 Generic hybrid HWAT system

| | |
|-----------------------|---|
| Heating Cable | HWAT-R2 |
| Circuit Length | Total heating cable must be less than the maximum circuit length. |
| Insulation | Install in accordance with the Installation and Operating Manual to maintain uniform pipe temperatures. |
| Ambient | Pipes must be in uniform ambient conditions. |

Install the system in accordance with the HWAT System Installation and Operation Manual (H57548) and the HWAT-ECO Installation and Maintenance Manual (H57340).

Approvals and performance are based on using Pentair approved connection kits and accessories, do not substitute parts.



Raychem HYBRID HWAT SYSTEM ON RIGID PLASTIC PIPES

APPLICATION DESIGN NOTE

The Raychem HWAT hot water maintenance system incorporates HWAT-R2 heating cable, the Raychem HWAT-ECO or ACS-30 controller, or the Raychem ACS-30 multi-point controller. These controllers can adjust the power output of the HWAT heating cables to compensate for the poor heat transfer of plastic pipes, and maintain the correct water temperature.

Due to the increasing cost of copper, and in regions where pipe corrosion is a concern, plastic pipes are becoming more common in hot water distributions systems. Plastic pipes approved for use with HWAT heating cables include CPVC, rigid PEX and PEX tubing (fixed in place and supported no greater than every 32 inches along its length). HWAT should not be installed on un-supported PEX or nylon tubing due to the fact that frequent flexing could reduce the power output of the cable.

Use the following guidelines to install and operate HWAT heating cable on approved plastic pipe:

1. Secure the HWAT heating cables to the plastic pipe with aluminum tape continuously along its length, as shown in Fig. 1.

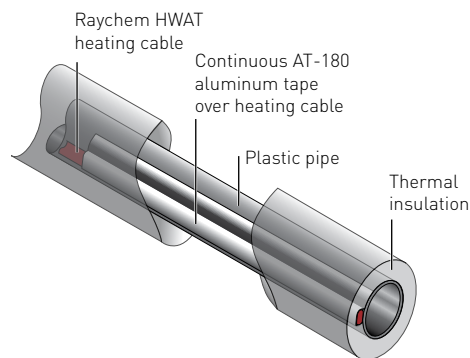


Fig. 1 HWAT heating cable installed with aluminum tape

2. To maintain desired water temperature on approved plastic pipes, adjust the temperature controllers as follows:
 - a. HWAT-ECO:
Set the "Power Correction Factor" in the HWAT-ECO menu to the values shown in Table 1.

TABLE 1 PLASTIC PIPE POWER CORRECTION FACTORS

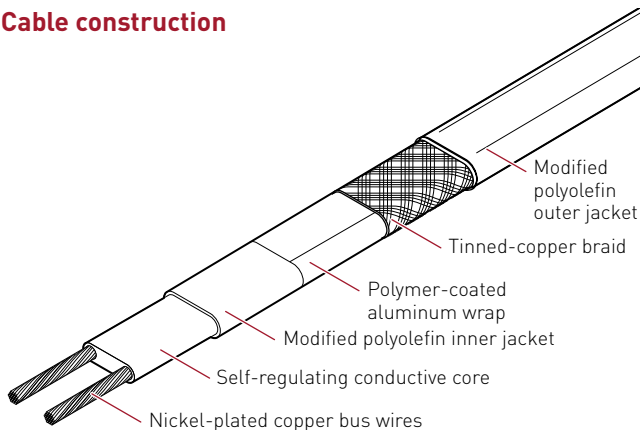
| Heating Cable | Power Correction Factor |
|----------------------|--------------------------------|
| HWAT-R2 | 1.25 |

- b. ACS-30 controller:
Select "Plastic Pipe" in the HWAT circuit set up menu. This setting automatically applies the same "Power Correction Factors" shown in Table 1.

Raychem HWAT-R2 SELF-REGULATING HEATING CABLE

For hot water temperature maintenance

Cable construction



PRODUCT OVERVIEW

Raychem HWAT self-regulating heating cables are installed on hot water supply pipes underneath standard pipe insulation. The heating cable adjusts its power output to compensate for variations in water temperature and ambient temperature. The heating cable replaces supply-pipe heat losses at the point where the heat loss occurs, thereby providing continuous, energy-efficient, hot water temperature maintenance and eliminating the need for a recirculation system.

Simplified design

Single-pipe HWAT systems eliminate the need for designing complex recirculation systems, with their pumps, piping networks, and complicated flow balancing. Special cases, such as retrofits and multiple pressure zones, are simple to design.

Low installed cost

Installation of the HWAT system is simple. The heating cable can be cut to length, spliced, tee-branched, and terminated at the job site, reducing installation costs. Fewer plumbing components are needed; recirculation piping, pumps, and balancing valves are all eliminated.

Low operating cost

The HWAT system continuously maintains hot water temperature at every point along the supply pipe. Unlike conventional recirculation systems, HWAT systems do not require the overheating of supply water to allow for cooling. The HWAT system reduces the energy requirements of typical hot water systems with reduced heat loss from supply piping, no heat loss from recirculation piping, and no pump to run.

HWAT-ECO and ACS-30 controllers

The HWAT-ECO electronic controller is designed for operation with HWAT-R2 heating cable only. The HWAT-ECO provides flexible temperature control, energy savings, heat-up cycle function, BMS interface, and nine predefined programs that can be customized by the user. The Raychem ACS-30 controller also incorporates the features of the HWAT-ECO for large systems and multiple application control. The ACS-30 only supports HWAT-R2 heating cable for hot water temperature maintenance applications.

SPECIFICATIONS

| | |
|---------------------|---|
| Jacket | Modified polyolefin |
| Braid | Tinned copper |
| Bus wires | 16 AWG nickel-plated copper |
| Supply voltage | 208-277 V (277 V only when used with the ACS-30 Control System) |
| Minimum bend radius | 0.5 in (12 mm) |

PRODUCT CHARACTERISTICS (NOMINAL)

| | |
|-----------------------------|------------------------------|
| Catalog number | HWAT-R2 |
| Jacket color | Red |
| Maintain temperature range* | 105°F (40°C) to 140°F (60°C) |
| Weight | 230 lbs/1000 ft (0.35 kg/m) |
| Dimensions | |
| Width | 0.72 in (18 mm) |
| Thickness | 0.38 in (10 mm) |

* When designed in accordance with the HWAT System Product Selection and Design Guide

DESIGN AND INSTALLATION

For proper design and installation, use the Design section of the HWAT System Product Selection and Design Guide (H57538) and the HWAT System Installation and Operations Manual (H57548).

MAXIMUM CIRCUIT LENGTH FT (M)

| | HWAT-R2 | |
|--|---------------------|---------------|
| | Breaker size | @208 V |
| | 30 A | 500(150) |
| | 20 A | 330(100) |
| | 15 A | 250 (75) |

GROUND-FAULT PROTECTION

To minimize the danger of fire from sustained electrical arcing if the heating cable is damaged or improperly installed, and to comply with Pentair requirements, agency certifications, and national electrical codes, 30-mA ground-fault equipment protection must be used on each heating cable branch circuit. Arcing may not be stopped by conventional circuit protection.

APPROVALS



Pipe Heating Cable

HWAT heating cables are UL Listed, CSA Certified, and FM Approved when used with the appropriate agency-approved Raychem components and accessories

Raychem DESIGN EXAMPLES



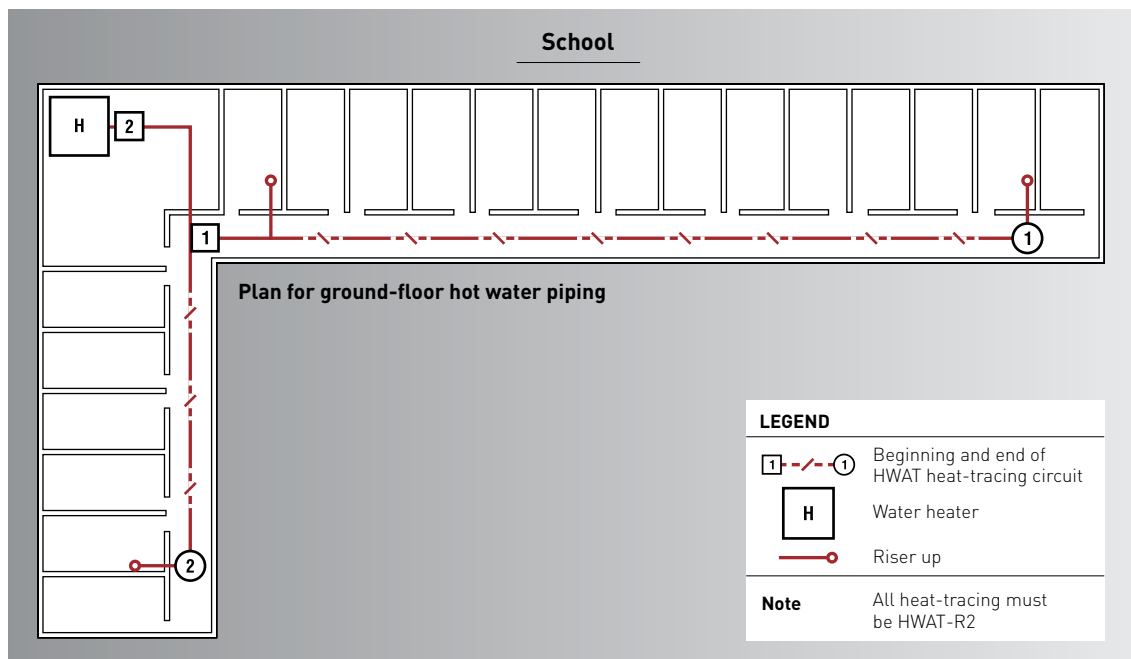
SCHOOL

The plumbing engineer was laying out the piping for the domestic hot water system for a three-story high school. The engineer did not believe it necessary to recirculate the risers and was going to run two recirculation loops, one for each wing, in the ground-floor ceiling space. However, the engineer decided that the return lines would have to take the same route as the supply lines. In this situation, the engineer knew the HWAT system would provide the more economical design. Furthermore, the client had indicated the possibility of extending either wing at some time in the future. The engineer knew that by using HWAT products, the system could be easily expanded if and when the client decided to do so.

The high school required a maintain temperature of 115°F. HWAT-R2 and two HWAT-ECO electronic controllers were chosen to maintain 115°F during normal operation and to have the ability during the weekend, when the school is unoccupied, to occasionally elevate the water temperature above 140°F or to maintain a lower temperature for energy savings.

The engineer thought it would be useful to be able to isolate either wing for maintenance, so it was decided to run two separate circuits, each to be operated independently with a HWAT-ECO. The plumbing engineer noted the pipes to be traced with HWAT heating cables on the drawings. He then inserted the standard clauses to provide, install, and test the HWAT system, and called out the correct thicknesses of fiberglass insulation, in Division 15 of the specification.

The electrical engineer noticed that in the electrical drawings, junction boxes were located near each power connection. It was decided to power both circuits from the same panel. Circuit breaker sizes and steady-state current were calculated and included on a table in the electrical drawings. The need for a ground-fault protection device in each circuit was noted on the electrical drawings.

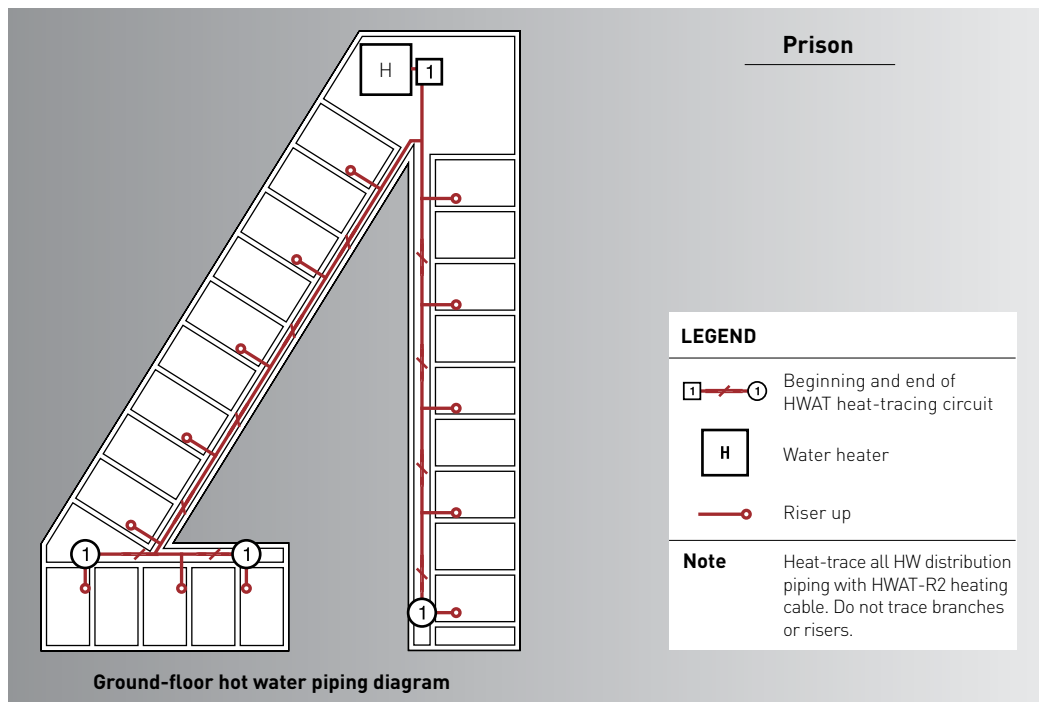


PRISON

Reviewing the architectural drawings, the plumbing engineer observed that the design consisted of about a dozen two-story "pods" arranged around an expanse of open space. For security reasons, the County had requested that mechanical equipment and piping, and the associated pipe openings, be kept to an absolute minimum. The layout of the cells in each pod did not allow any "shortcut" for return piping for a recirculation loop; it would have to follow the same corridor as the supply piping. The plumbing engineer knew from experience that in these kinds of situations, the HWAT system would be more economical than recirculation.

For the prison application, HWAT-R2 and one HWAT-ECO electronic controller were selected to maintain 105°F. Each pod would be provided with a separate water heater and it was not considered necessary to heat trace the risers. Upon measuring the length of the ground-floor piping, the plumbing engineer found it was possible to trace the entire piping in each pod with a single HWAT-R2 circuit and stay within the capacity of a 15 amp ground-fault circuit breaker. This would allow the heating cable to be conveniently powered from the electrical panel in the mechanical room. Because the mechanical rooms were located in isolated areas, the specification was written to connect the network of HWAT-ECO controllers to the building management system (BMS) using the BMS interface. Temperature set points would be programmed into the BMS with continual feedback provided by the HWAT-ECO through the alarm contacts, including loss of power and water heater monitoring. The plumbing engineer decided that the situation was sufficiently simple to ignore marking on the plumbing drawing the lines to be heat traced. Instead, the extent of the heat tracing could be called out in the notes. The plumbing engineer then inserted the standard clauses to provide, install, and test the HWAT system, and called out the correct thicknesses of fiberglass insulation, in Division 15 of the specification.

The electrical engineer confirmed that a 15 amp breaker was adequate, and calculated the steady-state current. A junction box was located adjacent to the beginning of the heating cable circuit, and its number and the number of the electrical panel in the table were noted. A draftsman copied the table onto the electrical drawings, along with a note calling out the need for a ground-fault protection device in each circuit.



APARTMENT BUILDING

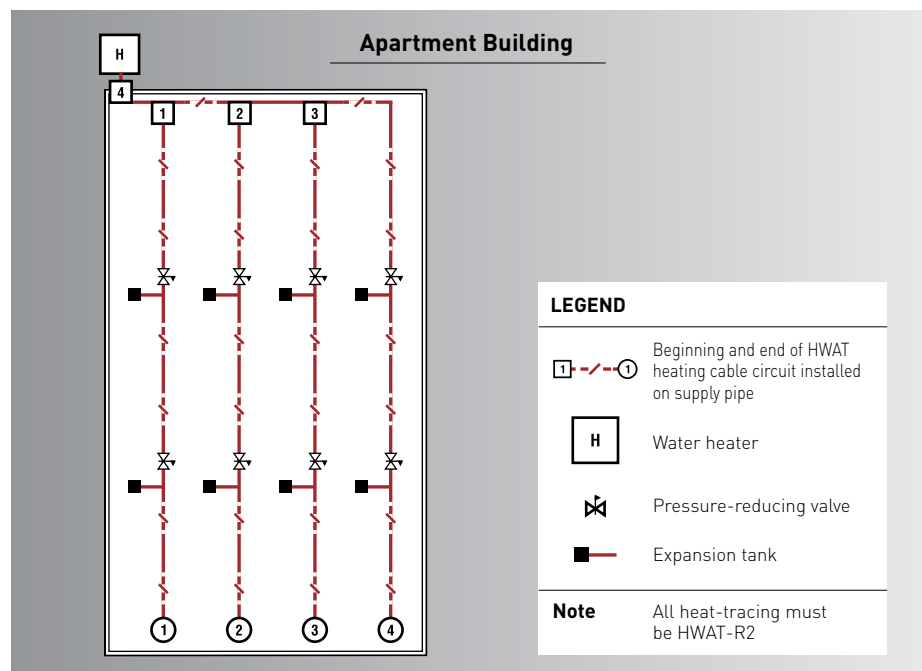
The plumbing engineer was faced with laying out the hot water piping for the 35-story state-of-the-art apartment building. The piping was relatively complex, making it especially important to balance the system adequately. As requested by the developer, the architect had squeezed in the maximum number of residential floors by working to the minimum headroom allowed by code. The plumbing engineer was required by code to divide the building into three pressure zones. However, there would be great difficulty in running the horizontal supply and return lines necessary in each zone, given the very limited space provided above the dropped ceilings. And there was not any room for the booster heaters and pumps for the recirculation system.

The plumbing engineer decided that an HWAT system would eliminate the need for horizontal piping and additional heaters or pumps. The risers could run continuously from top to bottom, broken only by pressure reducing valves at the 11th and 23rd floors. The plumbing engineer noted that the need for flow balancing was completely eliminated by using the HWAT system.

In order to interface with the Building Management System, the engineer selected the HWAT-ECO electronic controller. Having estimated that a single circuit length on a 20 amp circuit breaker could run the complete height of the building, the engineer marked an HWAT circuit on each of the four risers and sent copies of the plumbing drawing and the design sheet to the electrical engineer. HWAT-R2 was selected for a maximum circuit length of 500 feet with a 20 amp breaker and to maintain 120°F at a 70°F ambient temperature and a 208 supply voltage. HWAT-R2 was not selected because a high temperature heat-up cycle was not required.

Standard clauses to provide, install, and test the HWAT system were included in Division 15 of the specification. To provide pressure relief in the piping during system startup, an expansion tank was indicated on each riser at each pressure reducing valve.

The electrical engineer looked at the plumbing drawing and determined that it was most convenient to power all the circuits from the penthouse mechanical room. Junction boxes would be located at the beginning of each circuit and power run from a single panel. The electrical engineer calculated the breaker sizes and the steady-state currents. A finished table was included in the electrical drawings, along with a note calling for a ground-fault protection device in each circuit.



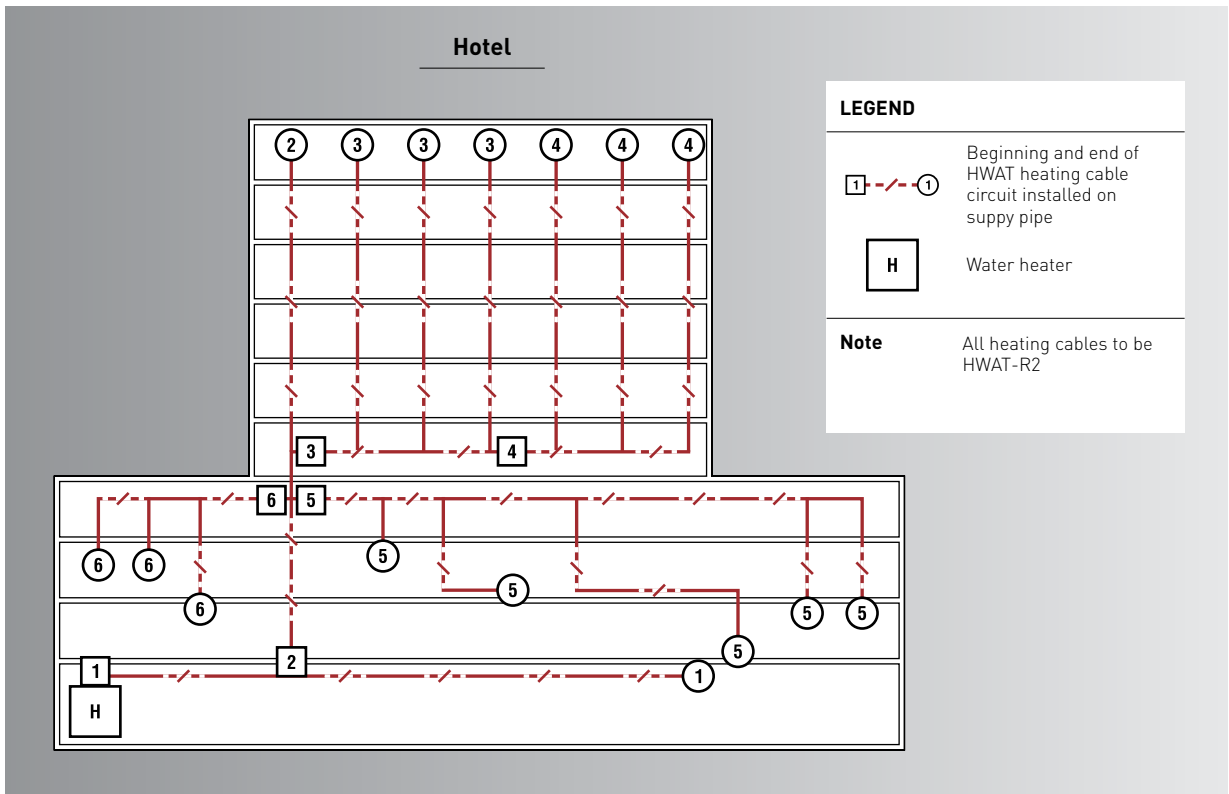
HOTEL

The plumbing engineer reviewed the architectural drawings for a new hotel. The building consisted of six floors of guest rooms over a commercial area containing a health club, restaurants, conference rooms, shops, offices, and a laundry. The plumbing engineer decided to deliver water from the boiler at 140°F directly to the kitchens and laundry, and to mix to 120°F for domestic hot water.

The HWAT system was chosen rather than recirculation because the owner insisted that there be no delay in getting hot water from any fixture, especially for the metered faucets on the first floor. Also, the HWAT system would accommodate all the architectural and construction changes that were bound to occur before the system was operating.

HWAT-R2 was selected for the 140°F line running out of the boiler to the kitchens and laundry, and HWAT-R2 for the 120°F domestic hot water system. After reviewing the circuit length table, it was determined that the entire domestic hot water piping could be traced with only two HWAT-R2 circuits by utilizing a 30 amp circuit breaker. However, the plumbing engineer decided to lay out the heating cable in smaller discrete zones to facilitate partial shutdown of the system for maintenance. Given the short circuit length for each circuit, 15 amp circuit breakers were specified and the circuits were indicated on the drawing.

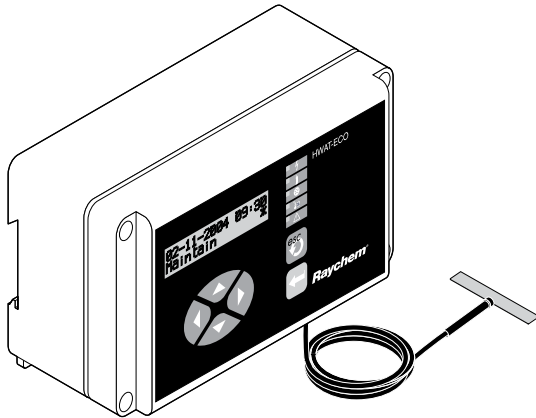
The electrical engineer looked at the layout of the circuits and assigned junction box and panel locations for each circuit according to the electrical drawings. The engineer calculated the breaker size and the steady-state current for each circuit. A completed table, with a note that the circuit breakers would incorporate 30 mA ground-fault protection, was then transferred to the electrical drawing.



Raychem HWAT-ECO-16

ELECTRONIC CONTROLLER

For hot water temperature maintenance systems




PRODUCT OVERVIEW

The Raychem HWAT-ECO-16 controller is designed for operation with the HWAT-Y2 and HWAT-R2 self-regulating heating cable.

The HWAT-ECO-16 controller provides the following features:

- Flexible temperature control of hot water temperature maintenance systems.
- Integrated function that lowers the maintain temperature during low use hours to save energy.
- Heat-up cycle function that increases the water temperature of a hot water system that is not in use.
- Building Management System (BMS) interface that receives a DC voltage to determine the desired maintain temperature.
- Alarm relay to signal power, temperature or communication problems.
- Pipe temperature monitoring with high temperature alarm and system shut down.
- Nine predefined programs that can be customized by the user.

GENERAL

| | |
|---|--|
| Area of use | Nonhazardous locations |
| Approvals |  Type 12 Energy Management Equipment <small>[for use with HWAT-Y2 & HWAT-R2 only.]</small> |
| Maintain temperature setpoint | 105°F (40°C) to 140°F (60°C) |
| Controller ambient exposure temperature | 40°F (5°C) to 105°F (40°C) |
| Ambient operating range | 60°F (15°C) to 80°F (27°C) |
| Switching capacity | 16 A @ 208/240 Vac maximum SPST |
| Operating voltage | 208/240 (±10%), 60 Hz |
| Internal power consumption | 2.5 W |
| Circuit protection | Maximum 20 A with 30-mA ground-fault protection required; not provided in HWAT-ECO-16 controller |
| Internal temperature alarm | 150°F (65°C) |
| BMS control voltage | 0 – 10 Vdc |
| Alarm contacts | Maximum 24 Vdc or 24 Vac, 1 A, SPST, voltage free, NO/NC |

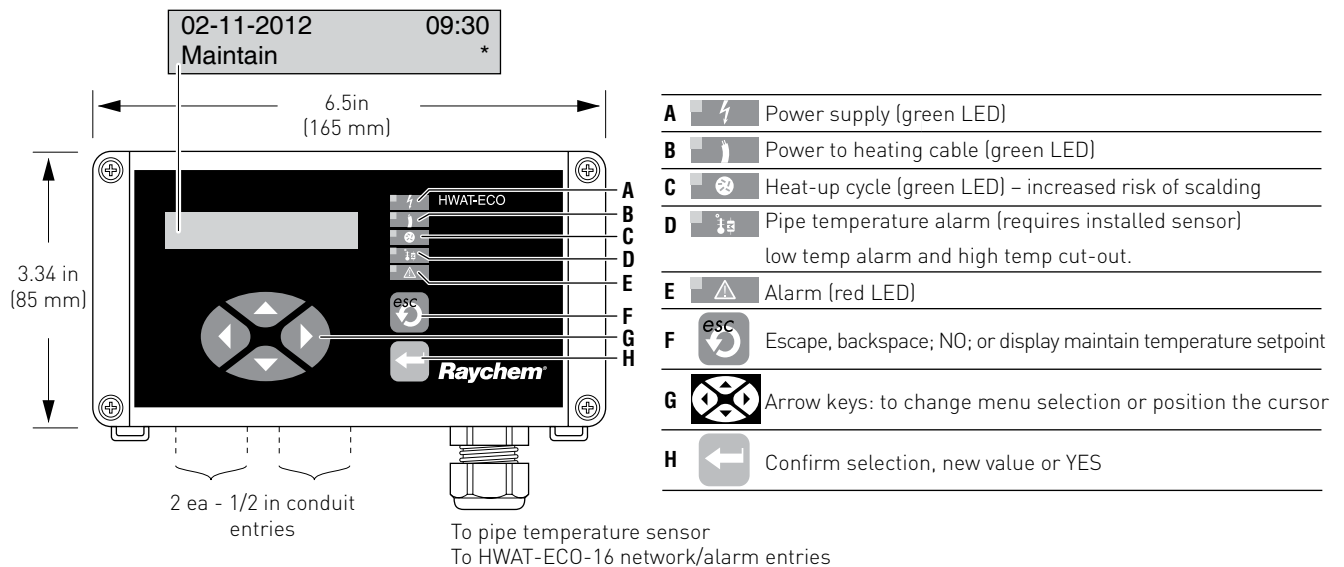
GENERAL

| | |
|-------------------------------------|---|
| Alarm events | <ul style="list-style-type: none"> • Loss of power • Controller reinitialized • Internal controller temperature too high • Water heater temperature too high (cut-out) • Water heater temperature too low • Network error |
| Power correction factor | To increase or decrease your actual pipe maintain temperature or adjust for hot water systems with rigid plastic pipes |
| Pipe temperature sensor | Thermistor with 13 ft 3 in (4 m) lead. A PT100 RTD may optionally be used. Maximum length 328 ft. (100 m) |
| Electromagnetic Compatibility (EMC) | Complies to EN 5014-1 for emission and EN 50730-1 for immunity |
| Real time clock | Leap year correction |
| Clock accuracy | ±10 minutes per year |

ENCLOSURE

| | |
|--------------------|--|
| Enclosure rating | NEMA 12 (IP54) – indoor use only |
| Enclosure material | ABS |
| Mounting | Wall mount with two screws or optional DIN rail |
| Conduit entries | Two each – 1/2 in conduit entries |
| Cable gland | 3-hole grommet Maximum cable size: <ul style="list-style-type: none"> • 2-wire: 20 AWG (0.5 mm²) • 4-wire: 24 AWG (0.2 mm²) |

TYPICAL ENCLOSURE DIMENSIONS AND MODULE LAYOUT



PROGRAMMING

| | |
|------------------|--|
| Default programs | Nine predefined programs that can be customized by the user |
| Program settings | There are 48 1/2-hour time blocks of the following program settings: Off, Economy, Maintain, and Heat-up cycle |

NETWORKING

| | |
|--------------------|---|
| Master/slave | Master is selectable in the controller, up to eight slaves can be connected |
| Master/slave cable | 2-wire, 300 V, minimum 24 AWG twisted pair (328 ft [100 m] maximum) |

MEMORY

| | |
|-----------------------------|--|
| Parameters stored in memory | All parameters are stored in nonvolatile memory, except date and time |
| Clock back-up time | Retain time and date for up to 30 days after power loss with rechargeable lithium battery. |

GROUND-FAULT PROTECTION

To minimize the danger of fire from sustained electrical arcing if the heating cable is damaged or improperly installed, and to comply with the requirements of approval agencies, Pentair and national and local electrical codes, you must use 30-mA ground-fault equipment protection on each heating cable branch circuit. Arcing may not be stopped by conventional circuit protection. The HWAT-ECO-16 does not include ground-fault protection.

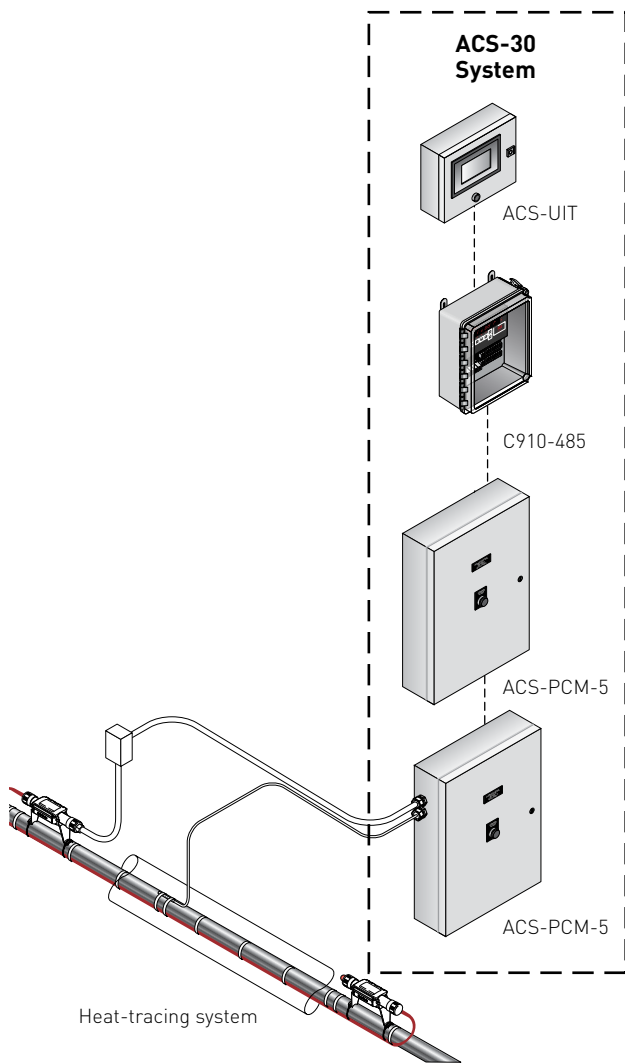
ORDERING DETAILS

| | |
|----------------|-------------|
| Catalog number | HWAT-ECO-16 |
| Part number | P000001953 |
| Weight | 2 lb (1 kg) |

Important: The Raychem HWAT-ECO-16 controller is c-UL-us Listed for use with the Raychem HWAT-Y2 and HWAT-R2 heating cables only. The warranty and system listing will be invalidated if the HWAT-ECO-16 controller is used with other heating cables.

Raychem ACS-30

MULTIPOINT COMMERCIAL HEAT-TRACING SYSTEM



PRODUCT OVERVIEW

The Raychem ACS-30 Advanced Commercial Control System is a multipoint electronic control and monitoring system for heat-tracing applications. These applications include commercial freeze protection, surface snow melting, roof and gutter de-icing, and flow and temperature maintenance.

The ACS-30 system can control up to 260 circuits with multiple networked ACS-PCM2-5 panels, or Raychem C910-485 controllers for single circuit system extension. The ACS-PCM2-5 panel can directly control up to 5 individual heat-tracing circuits using electromechanical relays rated at 30 A up to 277 V. Four Resistance Temperature Detector (RTD) sensor inputs can be assigned for each heating cable circuit providing a variety of temperature control, monitoring, and alarm options. The ACS-30 can be fitted with 16 Raychem RMM2s, providing an additional 128 temperature inputs to a maximum of 388 inputs.

Control

The ACS-30 is pre-programmed with parameters for commercial hot water temperature maintenance, pipe freeze protection, flow maintenance, freezer frost heave prevention, surface snow melting, roof and gutter de-icing prevention and floor heating applications. The pre-programmed application settings significantly simplify setting up multiple heating cable circuits. Based on the application the ACS-30 can be configured for On/Off, Ambient Sensing, Proportional Ambient Sensing (PASC), and timed duty cycle control modes for HWAT applications.

The ACS-30 measures temperatures with 3-wire, 100-ohm platinum RTDs connected directly to the unit, or through optional Remote Monitoring Modules (RMM2). Each RMM2 accepts up to eight RTDs. Multiple RMM2s are networked over a single cable to the ACS-30, significantly reducing the cost of RTD wiring.

The built-in calendar function for hot water temperature maintenance, floor heating and greasy waste applications provides flexible timed set points providing energy savings.

Monitoring

To assist with energy management the ACS-30 monitors the power consumption of each heating cable circuit for up to five years of operation. The data may be graphically displayed daily, weekly, monthly or yearly. The ACS-30 measures 12 control parameters including ground fault, temperature, and current to ensure system integrity. Configurable alarm settings provide options for local or

remote alarms. These alarms can be programmed to send notification of the alarm event by e-mail to user-selected distribution. The system can be set to periodically check for heating cable faults, alerting maintenance personnel of a pending heat tracing problem. This helps avoid costly downtime. Dry contact relays are provided for alarm annunciation back to a Building Management System (BMS).

Ground-fault protection

National electrical codes require ground-fault equipment protection on all heat-tracing circuits. The ACS-30 controller has integrated ground-fault equipment protection and therefore does not require additional ground-fault protection, simplifying installation and reducing costs.

Installation

The ACS-30 system is configured with the User Interface Terminal (ACS-UIT2) that has an LCD color display with touch-screen technology. The ACS-UIT2 provides an easy user interface for programming without keyboards or cryptic labels. The ACS-30 Program Integrator application tool is available to program, edit and download circuit parameters through the local USB port or from a remote location. The ACS-UIT2 comes in a Type 4X enclosure suitable for nonhazardous, indoor or outdoor locations and comes complete with wiring terminals and an alarm signal light.

Communications

ACS-30 units support the Modbus® protocol and are available with RS-232, RS-485 or 10/100Base-T Ethernet communication interface. Raychem ProtoNode multi-protocol gateways are available to integrate the ACS-30 into BACnet® and Metasys® N2 BMS systems.

Complete system

The ACS-30 is supplied as a complete modular system, ready for field connections to convenient power distribution panels and temperature sensor input, reducing the cost of heating cable installation.

ACS-30 SYSTEM

Multipoint temperature control with ground-fault/current/temperature monitoring when used with the ACS-UIT2

The ACS-30 is a multipoint electronic control, monitoring, and power relay system for heat-tracing cables used in commercial heat-tracing applications. The system consists of a Raychem ACS-UIT2 and up to 52 ACS-PCM2-5 power control panels. C910-485 controllers may also be connected to the system for multiple, single circuit extensions. Raychem RMM2 heat-tracing remote monitoring modules may also be used with the ACS-30 system to expand the number of temperature measurement points.

The ACS-30 provides the following alarming features per control point.

- High/low temperature
- Ground fault
- RTD failure

The ACS-30 provides ground-fault monitoring and protection for every heat-tracing circuit and fulfills the requirements of national electrical codes.

ACS-30: HEATING CABLE APPLICATION PROGRAMMING SUMMARY

Control Mode Functions

| Application | Heating cable | Control Mode | Control Settings |
|-----------------------------------|--|--|---|
| Hot Water Temperature Maintenance | HWAT | Preset power duty cycle (HWAT Design Wizard) | <ul style="list-style-type: none"> • Constant temp • Variable schedule <ul style="list-style-type: none"> – Maintain – Economy – Off – Heat Cycle (R2 only) |
| Floor Heating | RaySol MI heating cable QuickNet | Floor sensing | <ul style="list-style-type: none"> • Constant temp • Variable schedule <ul style="list-style-type: none"> – Maintain – Economy – Off • Circuit override through RTD or external device |

ACS-30: HEATING CABLE APPLICATION PROGRAMMING SUMMARY

Control Mode Functions

| Application | Heating cable | Control Mode | Control Settings |
|---|---|--|--|
| Greasy Waste Disposal and Temperature Maintenance | XL-Trace | Line sensing | <ul style="list-style-type: none"> • Constant temp • Variable schedule <ul style="list-style-type: none"> - Maintain - Economy - Off |
| Pipe Freeze Protection | XL-Trace | Ambient, PASC or line sensing | <ul style="list-style-type: none"> • Constant temp • Circuit override through external device |
| Fuel Oil Flow Maintenance | XL-Trace | Ambient, PASC or line sensing | <ul style="list-style-type: none"> • Constant temp • Circuit override through RTD or external device |
| Freezer Frost Heave Prevention | <ul style="list-style-type: none"> • RaySol • MI heating cable | Floor sensing | <ul style="list-style-type: none"> • Constant temp • Variable schedule <ul style="list-style-type: none"> - Maintain - Off |
| Surface Snow Melting | <ul style="list-style-type: none"> • ElectroMelt • MI Heating Cable | Ambient or surface temp External controller | Constant temp External snow controller |
| Roof and Gutter De-icing | <ul style="list-style-type: none"> • IceStop • MI Heating Cable | Ambient or surface temp External controller | Constant temp External snow controller |

TEMPERATURE MONITOR ONLY

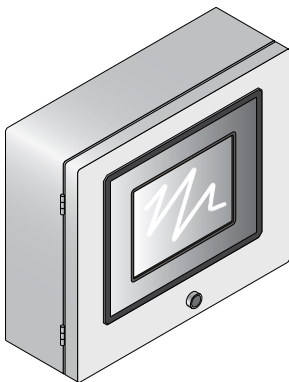
Five temperature monitor only channels
Low and high temperature alarms

VARIABLE SCHEDULE

Setpoint calendar with:

- 7 days/week calendar
- 48 - 1/2 hr time blocks/day
- Daily schedule copy function

ACS-UIT2 (USER INTERFACE TERMINAL)



The Raychem ACS-30 User Interface Terminal is a panel-mounted display for use with the ACS panel. The ACS-UIT2 has an 8.4 inch (21.7 cm) VGA color display with touch-screen technology, and provides an easy user interface for programming without keyboards or cryptic labels. It has RS-485, RS-232, or 10/100Base-T Ethernet communications ports that allow communication with external Distributed Control Systems or Building Management Systems. BACnet to Modbus protocol gateways with the Modbus registries pre-programmed are available. A USB interface is included for easy configuration and firmware upgrades.

The ACS-UIT2 is designed for use on indoor or nonhazardous location installations and is rated for NEMA 4 environments.

General

Approvals

Nonhazardous Locations



Area of use

Nonhazardous, indoors and outdoors (IP65, Type 4)

Supply voltage

100 – 240 Vac +/-10%, 50/60 Hz

Operating temperature

-25°C to 50°C [-13°F to 122°F]

Supply terminal

26–12 AWG

Storage temperature

-25°C to 80°C [-13°F to 176°F]

Dimensions

386 mm W x 336 mm H x 180 mm D, (15.21 in. W x 13.21 in. H x 7.09 in. D)

ACS-UIT2 (USER INTERFACE TERMINAL)**Alarm outputs**

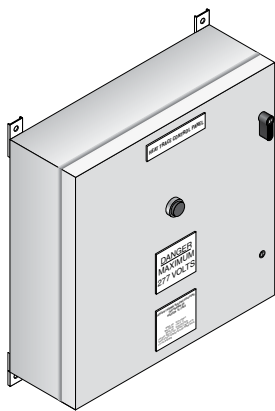
Relay outputs Three form C relays rated at 12 A @ 250 Vac. One relay used for common alarm light. Relays may be assigned for alarm outputs.

Network connection

| | |
|----------------------|---|
| Local port/remote | RS-232/RS-485 ports (RS-485, 2-wire isolated) may be used to communicate with host BMS computers using the Raychem ProtoNode-RER or ProtoNode-RER-10K. |
| Local RS-232 | A non-isolated, 9 pin D sub male |
| Remote RS-485 #2 | 10 pin terminal block, 24–12 AWG, (0.2 mm to 2.5 mm ²) wire size |
| Data rate | 9600 to 57600 baud |
| Maximum cable length | For RS-485 not to exceed 1200 m (4000 ft). Cable to be shielded twisted pair. |
| Field port | RS-485, 2-wire isolated. Used to communicate with external devices, such as ACS-PCM2-5, Raychem C910-485, and RMM2. Maximum cable length not to exceed 1200 m (4000 ft). Cable to be shielded twisted pair. |
| Field RS-485 #1 | 10 pin terminal block, 24–12 AWG, (0.2 mm to 2.5 mm ²) wire size |
| Data rate | To 9600 baud |
| LAN | 10/100 Base-T Ethernet port with Link and Activity Status LEDs |
| USB port | USB 2.0 Host port Type A receptacle (X2) |

LCD display

| | |
|--------------|---|
| Display | LCD is a 8.4 inch (21.7 cm) VGA, color TFT transfective device with integral CCFL backlight |
| Touch screen | 4-wire resistive touch screen interface for user entry |

ACS-PCM2-5 POWER CONTROL PANEL

The ACS-PCM2-5 enclosure is rated NEMA 4/12 and is approved for nonhazardous indoor or outdoor locations. The ACS-PCM2-5 provides ground fault and line current sensing, alarming, switching (electromechanical relays) and RTD inputs for five heat tracing circuits when used with the ACS-UIT2.

ACS-30 General (RPN P000001232) panels are available to satisfy special applications which require higher voltage, higher switching capacity, panel heaters, etc. Contact Pentair at 1 (800) 545-6258 for design assistance.

General

Approvals

Nonhazardous Locations



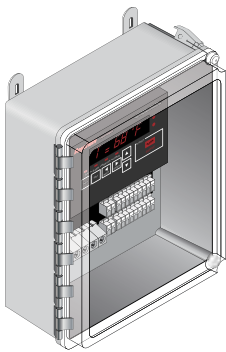
UL STD 508A
CAN/CSA C22.2 NO. 14

| | |
|-------------------------------|--|
| Ambient operating temperature | -13°F to 122°F (-25°C to 50°C) |
| Dimensions | 24" W x 24" H x 6.75" D (610 mm W x 610 mm H x 171 mm D) |
| Enclosure rating | NEMA 4/12 (indoor/outdoor locations) |
| Control supply voltage | 90 - 280 V dropped to 12 V with switching power supply |
| Weight | 70 lbs (31.75 kg) |
| Humidity | 0–90% non-condensing |
| Fuse | Bussman MDL |

ACS-PCM2-5 POWER CONTROL PANEL

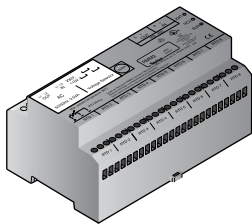
| | |
|--|--|
| Heating cable circuit contactors | |
| Rating | 3-pole – 30 A/pole 277 Vac |
| Type | Sprecher-Schuh CA7-16-10-12D |
| Quantity | 5 |
| Temperature sensors | |
| Type | 100-ohm platinum RTD, 3-wire, $\alpha = 0.00385$ ohm/ohm/°C Can be extended with a 3-conductor shielded cable of 20 ohm maximum per conductor |
| Quantity | Up to five wired directly to the ACS-CRM |
| Communication to ACS-UIT2, ACS-PCM2-5 panels, C910-485 and RMM2 | |
| Type | 2-wire RS-485 |
| Cable | One shielded twisted pair |
| Length | 4000 ft (1200 M) maximum |
| Quantity | Up to 52 ACS-PCM2-5 panels may be connected to one ACS-UIT2 |
| Line current sensors | |
| Max current | 60 A |
| Accuracy | ± 2% of reading |
| Ground-fault sensors | |
| Range | 10–200 mA |
| Accuracy | ± 2% of reading |
| Connection terminals | |
| Power supply/line/load | #22 – 8 AWG |
| RS-485 | #24 – 12 AWG |
| RTD | #24 – 12 AWG |

C910-485 ELECTRONIC CONTROLLER (OPTIONAL)



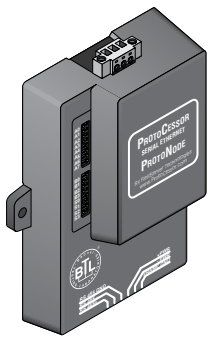
The Raychem C910-485 controller Part No. 10170-026 is a compact, full-featured, microprocessor-based, single-point commercial heating cable control system with integrated equipment ground-fault protection. The C910-485 provides control and monitoring of electric heating cable circuits for commercial heating applications. The C910-485 can be set to monitor and alarm for high and low temperature, low current, and ground-fault level. The C910-485 includes an RS-485 communication module to remotely configure, control and monitor the heating cable circuits through a building management system (BMS).

REMOTE MONITORING MODULE (OPTIONAL)



A Remote Monitoring Module (RMM2, Part No: 051778-000) is used to collect additional temperatures for control and monitoring of the heat-tracing circuit by the ACS-PCM2-5 control panel, through the ACS-UIT2 user interface terminal. The RMM2 accepts up to eight RTDs that measure pipe, vessel, or ambient temperatures. Multiple RMM2s communicate with a single ACS-UIT2 to provide centralized monitoring of temperatures. A single twisted-pair RS-485 cable connects up to 16 RMM2s for a total monitoring capability of 128 temperatures. The RMM2s are placed near desired measurement locations. The RMM2 is available for DIN rail mount or pre-installed inside a polycarbonate NEMA-4X enclosure (Part No: 523420-000).

PROTOCOL GATEWAY (OPTIONAL)



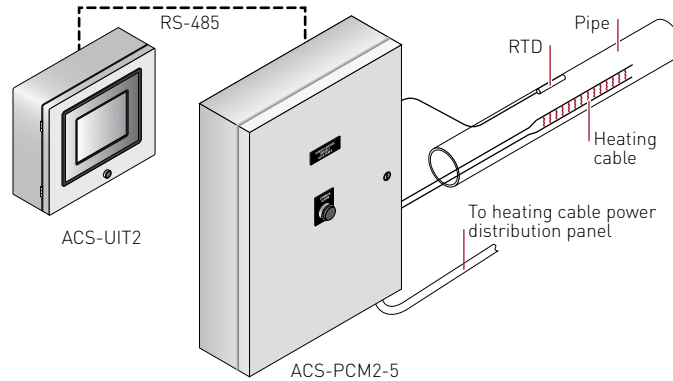
The ProtoNode is an external, high performance multi-protocol gateway for customers needing protocol translation between BACnet® or Metasys® N2 Building Management Systems (BMS) and the Raychem ACS-30 controller.

The ProtoNode-RER (Part No P000001227) is for ACS-30 systems with up to 5 PCM panels. The ProtoNode-RER-10K (Part No P00000XXXX) is for ACS-30 systems with up to 34 PCM panels.

TYPICAL CONFIGURATIONS FOR THE RAYCHEM ACS-30 SYSTEM

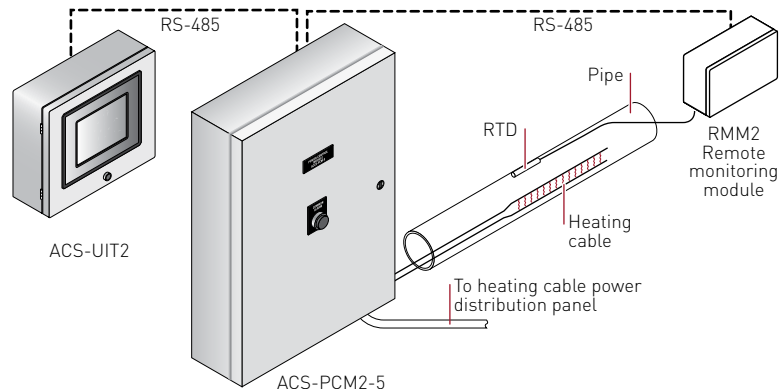
Individual controls

- Monitors ground-fault current and alarms/trip control contactor upon fault
- Monitors heater current
- Monitors pipe temperature (via RTD inputs wired back to the Raychem ACS-PCM2-5 or RMM2)



Individual controls with RMM2

- Monitors ground-fault current and alarms/trip control contactor upon fault
- Monitors heater current
- Monitors pipe temperature (via RTD inputs wired back to the Raychem ACS-PCM2-5)
- Using optional RMM2 (remote monitoring modules) mounted in the field, up to 128 RTD inputs can be added to the ACS-30 system
- The RMMs allow the RTD cables to be terminated locally and only a single RS-485 twisted wire pair brought back to the panel. This results in a significant reduction in field wiring.

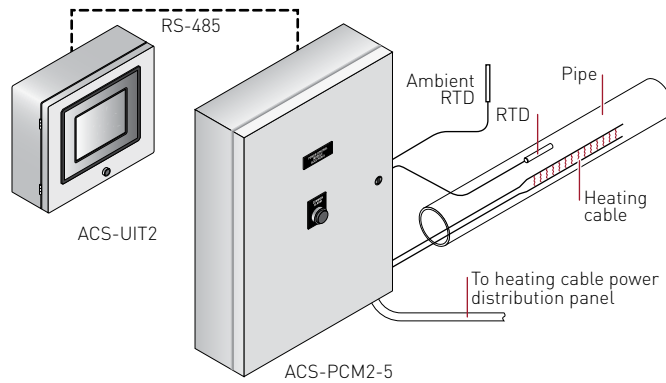


Technical Data Sheets

TYPICAL CONFIGURATIONS FOR THE RAYCHEM ACS-30 SYSTEM

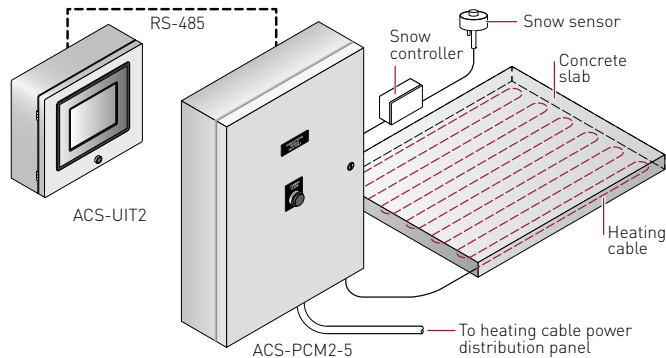
Individual ambient control

- Monitors ground-fault current and alarms/trip control contactor upon fault
- Monitors heater current
- Monitors pipe temperature (via RTD inputs wired back to the Raychem ACS-PCM2-5 or RMM2)



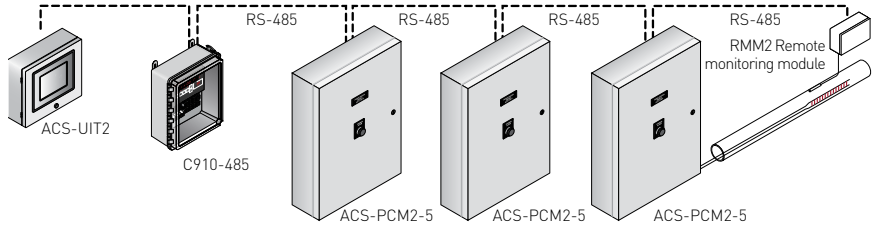
Individual external control for surface snow melting and roof & gutter application

- Monitors ground-fault current and alarms/trip control contactor upon fault
- Monitors heater current
- Monitors pipe temperature (via RTD inputs wired back to the Raychem ACS-PCM2-5 or RMM2)
- Connects to snow controllers (via RTD input) to power circuits when snow/ice melting is required



Multipanel configuration

- Multiple panels can be ganged together for control using a single Raychem User Interface Terminal
- Communications is accomplished using RS-485 protocol
- Up to 260 heat trace circuits can be supported using this architecture



Raychem RAYCLIC

CONNECTION KITS AND ACCESSORIES

For XL-Trace, IceStop and HWAT self-regulating heating cables

PRODUCT OVERVIEW

The Raychem RayClic connection system is a simple, fast and reliable set of connection kits developed for select XL-Trace, IceStop and HWAT self-regulating heating cables. There is no wire stripping needed because the insulation displacement connector makes the electrical connection.

The easy-to-install RayClic connection system reduces installation time, lowering the total installed cost of the heating cable system.

Simple

- No need for special tools
- Three-step installation

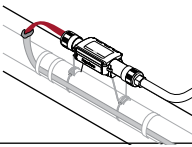
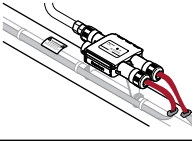
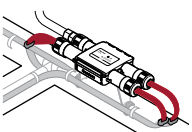
Reliable

- Intuitive installation
- Rugged, waterproof, UV-resistant enclosure

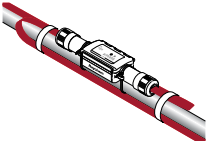
Cost-effective

- Quick installation

POWERED CONNECTION KITS

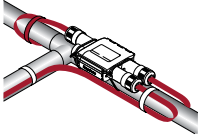
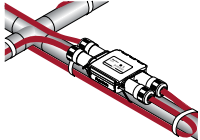
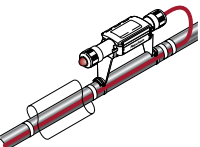
| Catalog number | Part number | Description |
|--|-------------|--|
|  RayClic-PC | 233053-000 | A RayClic-PC can supply power to one heating cable. Each kit contains one RayClic-PC power connection, one RayClic-E end seal, and one SB-04 pipe mounting bracket. The kit includes 5' power lead wires and a conduit fitting; the junction box and flexible conduit required to make a complete connection are not included. Weight: 1.8 lb (0.8 kg) |
|  RayClic-PS | 861247-000 | A RayClic-PS can be used as a power connection kit for supplying power to two heating cables. Each kit contains one RayClic-PS powered splice connection, two RayClic-E end seals, and one SB-04 pipe mounting bracket. The kit includes 5' power lead wires and a conduit fitting. The junction box and flexible conduit required to make a complete connection are not included. Weight: 2.0 lb (0.9 kg) |
|  RayClic-PT | 804231-000 | A RayClic-PT can be used as a power connection kit for supplying power to three heating cables. Each kit contains one RayClic-PT powered tee connection, three RayClic-E end seals, and one SB-04 pipe mounting bracket. The kit includes 5' power lead wires and a conduit fitting. The junction box and flexible conduit required to make a complete connection are not included. Weight: 2.0 lb (0.9 kg) |

UNPOWERED CONNECTION KITS


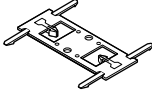
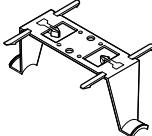
| Catalog number | Part number | Description |
|---|-------------|---|
|  RayClic-S | 559871-000 | Splice kits are installed as needed to connect two heating cables together at one point. Each kit contains one RayClic-S splice. Weight: 1.3 lb (0.6 kg) |

RAYCLIC CONNECTION KITS AND ACCESSORIES

UNPOWERED CONNECTION KITS

| Catalog number | Part number | Description |
|---|-------------|---|
| RayClic-T | 014023-000 | Tee kits are installed as needed to connect three heating cables together at one point. Each kit contains one RayClic-T tee connection and one RayClic-E end seal. Weight: 1.9 lb (0.9 kg) |
|  | | |
| RayClic-X | 546349-000 | RayClic-X kits are installed as needed to connect four heating cables together at one point. Each kit contains one RayClic-X cross and two RayClic-E end seals. Weight: 2.0 lb (0.9 kg) |
|  | | |
| RayClic-LE | P000000770 | Lighted end seal kits are installed wherever an end-of-line signal light is required. Each kit contains one RayClic-LE lighted end seal and one RayClic-SB-04 pipe mounting bracket. Weight: 1.8 lb (0.8 kg) |
|  | | |

ACCESSORIES

| Catalog number | Part number | Description |
|---|-------------|---|
| RayClic-E | 805979-000 | The RayClic-E is a replacement end seal kit. |
|  | | |
| RayClic-SB-02 | 852001-000 | The RayClic-SB-02 is a wall mounting bracket for use with any RayClic connection kit. |
|  | | |
| RayClic-SB-04 | 616809-000 | The RayClic-SB-04 is a pipe mounting bracket for use with any RayClic connection kit. One pipe mounting bracket is included with each powered connection kit and the RayClic-LE lighted end seal kit. |
|  | | |

RayClic System Specifications

| | |
|----------------------------------|--------------|
| Rated voltage | 120–277 V |
| Maximum circuit breaker size | 30 A |
| Maximum exposure temperature | 150°F (65°C) |
| Minimum installation temperature | 0°F (–18°C) |
| Enclosure rating | NEMA 4X |

Applicable Products

| | |
|----------|----------------------------------|
| XL-Trace | 5/8XL1-CR/CT and 5/8/12XL2-CR/CT |
| IceStop | GM-1XT, GM-1X, GM-2XT and GM-2X |
| HWAT | HWAT-R2, HWAT-P1 |

APPROVALS



718K Pipe Heating Cable
877Z De-Icing and Snow Melting



With XL-Trace and IceStop heating cable only
For Class I, Div. 2, Groups A,B,C,D hazardous locations- GM-1XT and GM-2XT only

DESIGN AND INSTALLATION

For proper design and installation of a RayClic connection system, use the appropriate product design guide and the installation instructions included with the connection kit.

GROUND-FAULT PROTECTION

To minimize the danger of fire from sustained electrical arcing if the heating cable is damaged or improperly installed, and to comply with the requirements of Pentair Thermal Building Solutions, agency certifications, and national electrical codes, ground-fault equipment protection must be used on each heating cable branch circuit. Arcing may not be stopped by conventional circuit protection. Many Raychem control and monitoring systems meet the ground-fault protection requirement.

RAYCLIC CONNECTION KITS AND ACCESSORIES

Raychem EXPANDED HWAT-ECO ELECTRONIC CONTROLLER CAPABILITIES



The HWAT-ECO electronic controller has multiple capabilities that help make the HWAT system a superior alternative to recirculation systems. This section expands upon some of these capabilities that were introduced in HWAT Design Guide (H57510), including the heat-up cycle and subsequent cool down, Building Management System (BMS) interface, predefined programs, and the water heater sensor function. For additional information, refer to the HWAT-ECO Installation and Operation Manual (H57340).

HEAT-UP CYCLE AND COOL DOWN

The HWAT-ECO includes a heat-up cycle function that allows the HWAT system to increase the water temperature of a hot water system that is not in use. During the heat-up cycle, the HWAT-ECO continuously powers the heating cable for the selected timeframe. Using the heat-up graphs below, program the HWAT-ECO for the amount of time required to reach the desired temperature. To allow sufficient time for the pipes to cool before hot water is used, refer to the cool-down chart to determine the amount of time required in Off mode after the heat-up cycle is complete and program the HWAT-ECO accordingly.

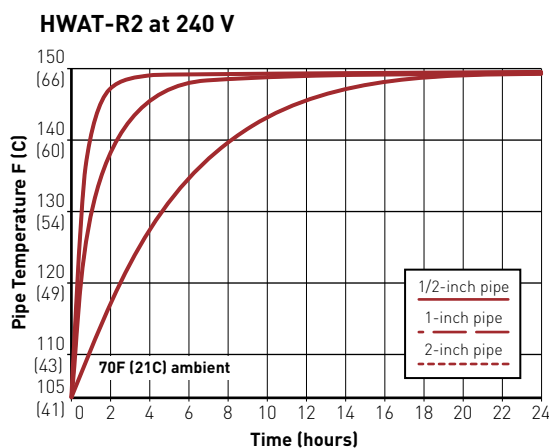
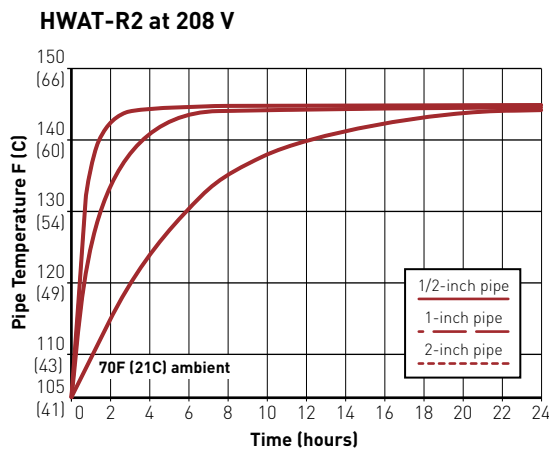


Fig. 1 Heat-up cycle graphs

Expanded Capabilities

EXPANDED HWAT-ECO ELECTRONIC CONTROLLER CAPABILITIES

⚠️ WARNING Burn Hazard

Water temperatures above 120°F (50°C) can cause skin damage and pain. Be sure the correct HWAT cable is used and the HWAT-ECO is programmed properly. Avoid exposure to water during heat-up cycles or from water systems with high maintain temperatures during normal operation.

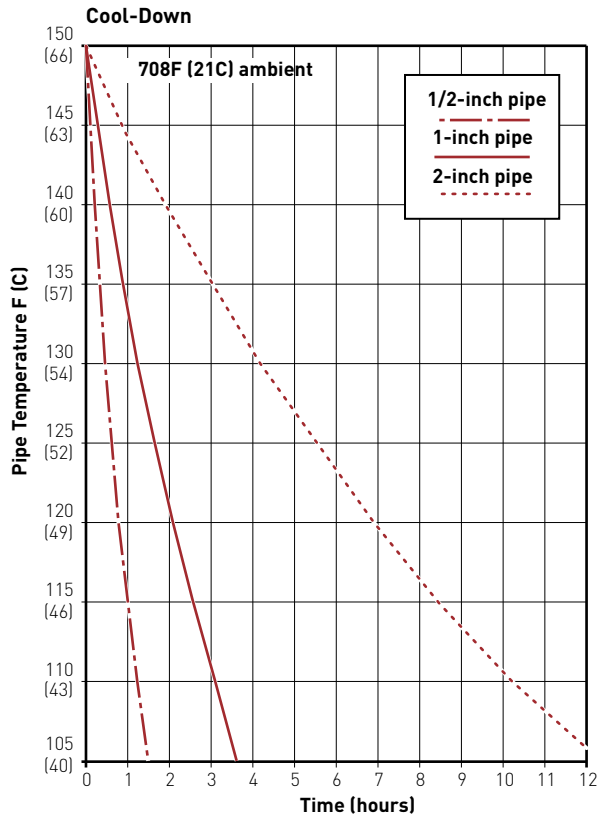


Fig. 2 HWAT cool-down graph

BMS INTERFACE

The HWAT-ECO can be programmed to have a BMS control the temperature setpoints. Under these conditions, the HWAT-ECO converts the voltage received from the BMS to maintain the desired temperature. All modes, including Heat-Up, Maintain, Economy and Off, are controlled by the BMS. Continual feedback is provided to the BMS through the HWAT-ECO alarm contacts, including loss of power, supply water temperature alarms, and communication errors.

| Temp F (C) | HWAT-R2 | U-BMS/U-gLT (VOLT) |
|------------|---------|--------------------|
| >147 (>64) | X | >6.4 |
| 147 (64) | X | 6.4 |
| 140 (60) | X | 6 |
| 131 (55) | X | 5.5 |
| 122 (50) | X | 5 |
| 113 (45) | X | 4.5 |
| 106 (41) | X | 4.1 |
| Off | X | 0 |

Fig. 3 BMS voltage input chart

PREDEFINED PROGRAMS

The HWAT-ECO has nine predefined programs that can be customized by the user. These programs include time intervals for Maintain, Economy, Heat-Up and Off modes. The economy setting is selected for low water usage periods where a lower maintain temperature is acceptable. The Off setting is selected for cool down after a heat-up cycle or for high usage periods where hot water is flowing from the water heater to the point of use with minimal delay thus not requiring energy from the HWAT system.

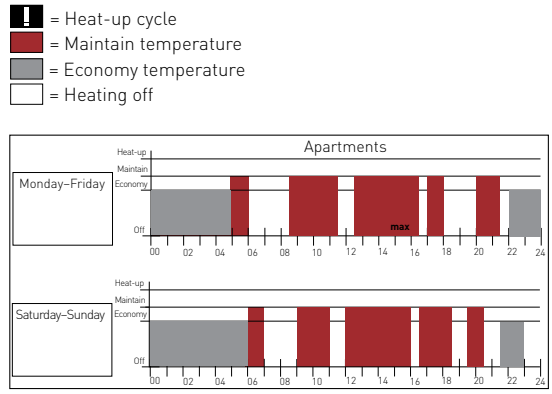


Fig. 4 Predefined program example

WATER HEATER SENSOR FUNCTION

The HWAT-ECO ensures that the maintain temperature does not exceed a user defined high temperature limit set point. When the water heater sensor option is activated, the HWAT-ECO monitors the temperature of the water being supplied to the system. As shown in Fig. 5, the water heater sensor can be installed on the outlet of the water heater or after the mixing valve, depending on the configuration of your system.

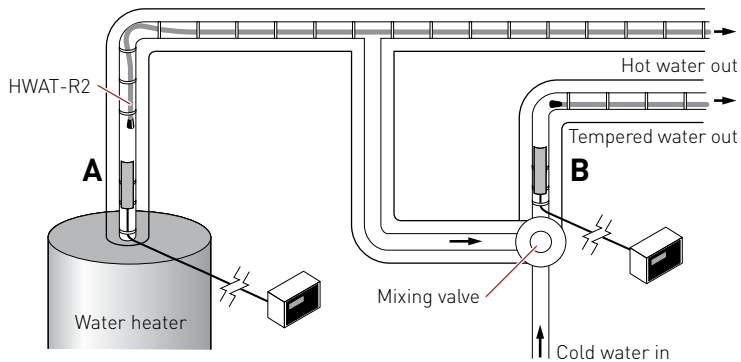
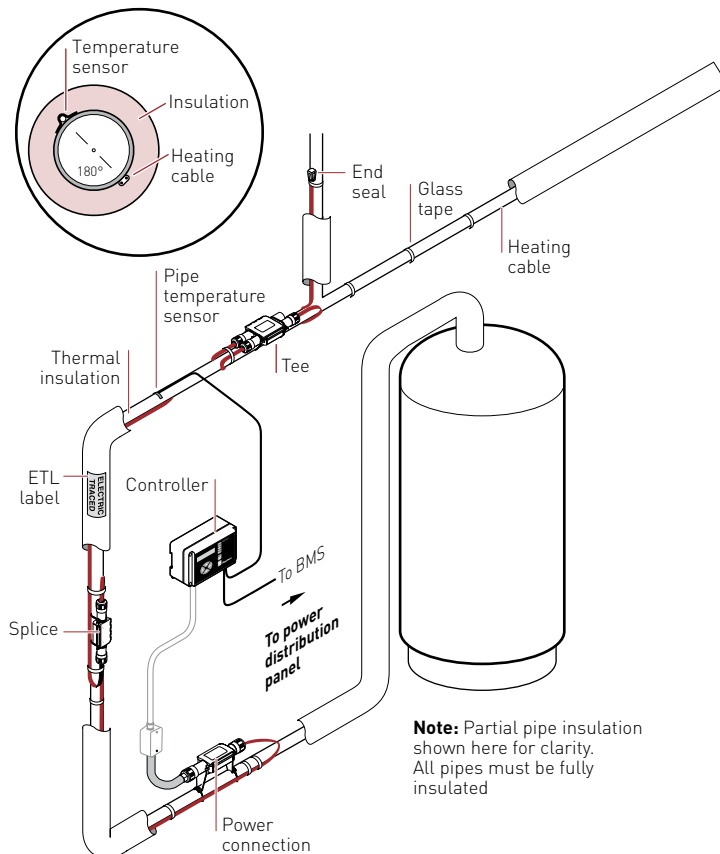


Fig. 5 Water heater sensor function example

Expanded Capabilities

EXPANDED HWAT-ECO ELECTRONIC CONTROLLER CAPABILITIES

Raychem CSI MASTER FORMAT 2012 GUIDE SPECIFICATION FOR HWAT



System for temperature maintenance of domestic hot water supply systems with energy efficient time based control and BMS communication capabilities

SCOPE

This specification describes an energy efficient system for temperature maintenance of domestic hot water supply systems without the need for recirculation designs.

This page gives a general overview of the system and the CSI formatted specification begins on page 46.

SYSTEM DESCRIPTION

The HWAT system complies with local energy codes, including California Title 24, due to a time based control methodology and an energy efficient thermal insulation schedule.

Self-Regulating Heating Cable

Raychem HWAT self-regulating heating cable (HWAT-R2) with plasticizer diffusion shield, heavy tinned copper braid and polyolefin outer jacket. The heating cable shall be part of a UL Listed, CSA Certified and FM Approved system.

System Connection Kits

Raychem RayClic connection kits for power connections, tees/splices and end seals.

Controller

Single Circuit Control

Raychem HWAT-ECO digital controller with:

- Flexible temperature control from 105 – 140°F
- Three programmable temperature set points for maximum energy efficiency:
 - Maintain
 - Economy
 - Off
- Heat cycle setting
- 24/7 time based control
- Nine pre-defined temperature setpoint programs
- BMS interface
- Pipe temperature sensor
- Master/slave function
- 24 A switching capacity rating
- NEMA 12 enclosure

Distributed Group Control

Raychem ACS-30 Multi-circuit digital control system with:

- Pre-programmed application based heattracing controller
- Touch-screen user interface (ACS-UIT2) communicates with up to 52 ACS-PCM2-5 modular control panels. The Raychem C910-485 controller may be used in the ACS-30 system for single circuit extensions
- BMS interface
- Controls up to 260 heat-tracing circuits with up to 388 temperature inputs (RTDs)
- Proportional Ambient Sensing Control (PASC).
- 30 A switching capacity rating
- Enclosure
 - ACS-UIT2: NEMA 4
 - ACS-PCM2-5: NEMA 4/12

Device Server

Raychem ProtoNode: A multi-protocol device server to interface the ACS-30 with a building management system (BMS).

Thermal Pipe Insulation

Flame retardant insulation (closed-cell or fiberglass) with waterproof covering is required following Pentair insulation schedule as detailed in the HWAT Product Selection and Design Guide.

Designer Notes

1. For proper cable selection refer to the HWAT product selection and design guide.
2. External 30-mA ground-fault circuit protection is required when using the HWAT-ECO. Ground-fault circuit protection (adjustable) is integrated in the ACS-30 controller and does not need to be provided separately.
3. No temperature sensors are required for pipe temperature control. Temperature sensors can be used to monitor the water heater or mixing valve output. With ACS-30, additional temperature sensors can be used to monitor the overall performance of the system.
4. The HWAT-ECO may be connected to the BMS using two conductor twisted pair shielded RS-485 cable (PTM Catalog Number: MONI-RS485-WIRE). The installation of the communication wiring is included in specification section 25 50 00.
5. The ACS-30 may be connected to the BMS through the ProtoNode using two conductor twisted pair shielded RS-485 cable (PTM Catalog Number: MONI-RS485-WIRE). The ProtoNode is connected to the BMS by Ethernet or RS-485. The installation of the communication wiring is included in specification section 25 50 00.
6. The HWAT-ECO is a wall mounted controller with a NEMA 12 rated enclosure for indoor installation.
7. ACS-UIT2 should be centrally located in the building connected to the remote ACS-PCM2-5 control panels using RS-485 cable. The ACS-PCM2-5 control panels may be located indoors or outdoors throughout the installation.
8. The location of the controller, power connection, tees/splices and end seals must be shown on the drawings.

Drawing Details

Installation details can be found at CADdetails.com under Hot Water Temperature Maintenance (HWAT) folder.

Section 22 05 33
Heat Tracing for Plumbing Piping

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section includes a UL Listed, CSA Certified and FM Approved heat tracing system for temperature maintenance of domestic hot water supply systems consisting of self-regulating heating cable, connection kits and energy efficient time based control.
- B. The system complies with California Title 24 energy requirements.

1.2 RELATED SECTIONS

- A. Section 22 05 33 – Heat Tracing for Plumbing Piping
- B. Section 22 07 19 – Plumbing Piping Insulation
- C. Section 25 34 00 – Integrated Automation Instrumentation and Terminal Devices for Plumbing
- D. Section 25 54 00 – Integrated Automation Control of Plumbing

1.3 SYSTEM DESCRIPTION [Select one]

- A. [Select for HWAT-ECO]** System for temperature maintenance of domestic hot water supply systems with energy efficient time based control, monitoring, and Building Management System (BMS) communication capabilities.
- B. [Select for ACS-30]** System for temperature maintenance of domestic hot water supply systems with energy efficient time based control, multi-point monitoring, integrated ground-fault circuit protection and Building Management System (BMS) communication capabilities.

1.4 SUBMITTALS

- A. Product Data
 - 1. Heating cable data sheet
 - 2. UL, CSA, FM approval certificates for hot water temperature maintenance systems
 - 3. Hot water temperature maintenance design guide
 - 4. System installation and operation manual
 - 5. System installation details
 - 6. Connection kits and accessories data sheet
 - 7. Controller data sheet
 - 8. Controller wiring diagram

1.5 QUALITY ASSURANCE

- A. Manufacturers' Qualifications
 - 1. Manufacturer to show minimum of thirty (30) years experience in manufacturing electric self-regulating heating cables.
 - 2. Manufacturer will be ISO-9001 registered.
 - 3. Manufacturer to provide products consistent with IEEE 515.1 and CSA 22.2 No 130-03 requirements.
- B. Installer Qualifications
 - 1. System installer shall have complete understanding of product and product literature from manufacturer or authorized representative

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prior to installation. Electrical connections shall be performed by a licensed electrician.

- C. Regulatory Requirements and Approvals
 - 1. The system (heating cable, connection kits, and controller) shall be UL Listed, CSA Certified and FM Approved for hot water temperature maintenance.
- D. Electrical Components, Devices, and Accessories: Listed and labelled as defined in NFPA 70, Article 100, by a Nationally Recognized Testing Laboratory (NRTL), and marked for intended use.

1.6 DELIVERY, STORAGE AND HANDLING

- A. General Requirements: Deliver, store and handle products to prevent their deterioration or damage due to moisture, temperature changes, contaminants or other causes.
- B. Delivery and Acceptance Requirements: Deliver products to site in original, unopened containers or packages with intact and legible manufacturers' labels identifying the following:
 - 1. Product and Manufacturer
 - 2. Length/Quantity
 - 3. Lot Number
 - 4. Installation and Operation Manual
 - 5. MSDS (if applicable)
- C. Storage and Handling Requirements
 - 1. Store the heating cable in a clean, dry location with a temperature range 0°F (-18°C) to 140°F (60°C).
 - 2. Protect the heating cable from mechanical damage.

1.7 WARRANTY

- A. Extended Warranty
 - 1. Manufacturer shall offer a ten (10) year warranty for all heating cables and components. Provide one (1) year warranty for all heat trace controllers.
 - 2. Contractor shall submit to owner results of installation tests required by the manufacturer.

END OF PART 1

PART 2 – PRODUCTS

2.1 MANUFACTURERS AND PRODUCTS

- A. Contract Documents are based on manufacturer and products named below to establish a standard of quality.
- B. Basis of Design
 - 1. Basis of Design Product Selections
 - a. Manufacturer
 - 1. Manufacturers shall have more than thirty (30) years' experience with manufacture & installation self-regulating heating cables.

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2. Manufacturer shall provide UL, CSA, FM approval certificates for hot water temperature maintenance system
 3. Manufacturer shall be Pentair, LLC, located at, 7433 Harwin Drive, Houston, TX 77036 Tel: (800) 545-6258, www.pentairthermal.com.
- b. Hot Water Temperature Maintenance System
1. Raychem HWAT self-regulating heating cables with plasticizer diffusion shield, heavy tinned copper braid and polyolefin outer jacket.
 2. Raychem RayClic and accessories.
 3. Raychem HWAT-ECO or Raychem ACS-30 **[Select one]** digital controller.
 4. Raychem ProtoNode multi-protocol device server.
 5. 5. The HWAT system complies with local energy codes, including California Title 24, due to a time based control methodology (HWAT-ECO or ACS-30 **[Select one]**) and an energy efficient thermal insulation schedule.

2.2 PRODUCTS, GENERAL

- A. Single Source Responsibility: Furnish heat tracing system for the temperature maintenance of domestic hot water supply systems from a single manufacturer.
- B. The system (heating cable, connection kits, and controller) shall be UL Listed, CSA Certified and FM Approved for hot water temperature maintenance. No parts of the system may be substituted or exchanged.

2.3 PRODUCTS

- A. Self-Regulating Heating Cable
 1. Heating cable shall be Raychem HWAT self-regulating heating cable manufactured by Pentair.
 - a. Model Numbers: HWAT-R2
 2. The heating cable shall consist of a continuous core of conductive polymer that is radiation crosslinked, extruded between two (2) 16 AWG nickel-plated copper bus wires that varies its power output in response to pipe temperature changes.
 3. The heating cable shall have a modified polyolefin inner jacket for dielectric integrity.
 4. The heating cable shall have a plasticizer diffusion shield.
 5. The heating cable shall have a thicker gauge (5/24) tinned copper braid for ground path and mechanical ruggedness.
 6. The heating cable shall have a color coded polyolefin outer jacket.
 7. The heating cable shall have a self-regulating factor of at least 70 percent for HWAT-R2. The self-regulating factor is defined as the percent reduction of the heating cable power output going from a 40°F pipe temperature to 150°F pipe temperature.
 8. The heating cable shall operate on line voltages of 208, 220, 240 or 277 volts without the use of transformers. **[Select one]**
 9. The heating cable shall be UL part of a UL Listed, CSA Certified and FM Approved system.

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10. The outer jacket of the heating cable shall have the following markings:
 - a. Heating cable model number
 - b. Agency listings
 - c. Meter mark
 - d. Lot/Batch ID
- B. Heating Cable Connection Kits
 1. Heating cable connection kits shall be Raychem RayClic connection kits.
 2. Manufacturer shall provide power connection, splice/tee and end seal kits compatible with selected heating cable.
 3. Installation shall not require the installing contractor to cut into the heating-cable core to expose the bus wires.
 4. 4. Connection kits shall be rated NEMA 4X to prevent water ingress and corrosion. All components shall be UV stabilized.
 5. Connection kits shall be UL Listed and CSA Certified.
- C. Heating Cable Installation Accessories
 1. High temperature, glass filament tape for attachment of heating cable to fire sprinkler piping. Cable ties are not permitted. (PTM Catalog Number: GT-66)
 2. Plastic Piping – provide an aluminium self-adhesive tape over the heating cable on all plastic piping if required. (PTM Catalog Number: AT-180)
 3. Labels – Provide warning labels every 10 feet on exterior of insulation, opposite sides of pipe. (PTM Catalog Number: ETL)
- D. Energy Efficient Time Based Control **[Select one option]**
 1. **[Option 1] Single Circuit Local Digital Controller**
 - a. Local digital controller shall be the Raychem HWAT-ECO.
 - b. Digital controller shall operate on 208 – 240 V.
 - c. Pre-programmed duty cycles based on ambient temperature ranging from 60 – 80°F.
 - d. The pre-programmed duty cycles shall be based on Raychem HWAT heating cables only. No other heating cables may be used with the HWAT-ECO controller.
 - e. Flexible temperature control from 105 – 140°F.
 - f. Three programmable temperature set points for maximum energy efficiency.
 1. Maintain
 2. Economy
 3. Off
 - g. Controller shall have heat cycle setting.
 - h. Heating cable manufacturer shall provide a local digital controller with 24/7 pre-programmed time based profiles specific to the selected heating cable application such as schools, hospitals and prisons.

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- i. Controller shall have remote temperature setting through 0 – 10 Vdc BMS interface.
- j. Controller shall have a pipe temperature sensor, low/high pipe temperatures alarms and high temperature cut-out.
 - 1. To maximize the energy efficiency of the HWAT system by verifying that the hot pipe temperature is at the correct temperature (low temperature alarm).
 - 2. To monitor and alarm if the pipe temperature is hotter than intended (high temperature alarm and cut-out)
- k. Multiple HWAT-ECO controllers can be networked together (master/slave association):
 - 1. Allows BMS to interface with a master HWAT-ECO to control cloned circuits
 - 2. Minimizes the number of HWAT-ECO controllers that must be individually programmed
- l. Controller shall have 24 A switching capacity rating.
- m. Enclosure type shall be NEMA 12 (ABS).
- n. Controller shall have NO/NC alarm contacts. Controller shall alarm on:
 - 1. Loss of power
 - 2. Controller reinitialized
 - 3. Internal controller temperature too high
 - 4. Pipe temperature too high
 - 5. Pipe temperature too low
 - 6. Master/slave error
- o. Digital controller shall have c-UL-us approvals specifically for use with the HWAT-R2 heating cable.

2. [Option 2] Multiple Circuit Distributed Digital Control System

- a. Distributed digital control system shall be Raychem ACS-30 heat-trace control system.
- b. Heating cable manufacturer shall provide a distributed digital control system with preprogrammed parameters to provide concurrent control for heating cables used for pipe freeze protection, flow maintenance, hot water temperature maintenance, surface snow melting, roof and gutter de-icing, freezer frost heave prevention and floor heating applications.
- c. All programming shall be done through the central User Interface Terminal (ACS-UIT2).
- d. The ACS-UIT2 shall be a color LCD touch-screen display with password protection to prevent unauthorized access to the system.
- e. The ACS-UIT2 shall communicate with up to fifty-two (52) ACS Power Control Panels (ACSPCM2-5) where each panel can control up to five (5) circuits and accept up to five (5) temperature inputs. C910-485 controllers may also be added to the ACS-30 system for single circuit extensions.
- f. Digital control system shall be capable of assigning up to four (4) RTD temperature inputs per heat-tracing circuit.

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- g. The ACS-UIT2 shall communicate with up to sixteen (16) Remote Monitoring Modules (RMM2), where each module can accept up to 8 temperature inputs.
- h. The ACS-UIT2 shall have a USB port to allow for quick and easy software update.
- i. The ACS-UIT2 shall have three (3) programmable alarm contacts including an alarm light on the enclosure cover.
- j. A separate offline software tool shall be made available to allow users to pre-program the digital control system and transfer program via a USB drive or Ethernet.
- k. The ACS-UIT2 enclosure shall be NEMA 4 for indoor or outdoor locations.
- l. The ACS-PCM2-5 panel shall be in a NEMA 4/12 enclosure approved for nonhazardous indoor and outdoor locations.
- m. The ACS-PCM2-5 panel shall provide ground-fault and line current sensing, alarming, switching and temperature inputs for five (5) heat tracing circuits.
- n. Each ACS-PCM2-5 panel shall have five (5) 3-pole, 30 A contactors (EMR type).
- o. The ACS-PCM2-5 panel shall be capable of operating at 120 V to 277 V.
- p. The ACS-PCM2-5 shall have an alarm contact including an alarm light on the panel cover.
- q. Digital controller shall have an integrated adjustable GFPD (10 – 200 mA).
- r. Digital control system can be configured for On/Off, ambient sensing, PASC and timed duty cycle control (HWAT only) modes based on the application. PASC control proportionally energizes the power to the heating cable to minimize energy based on ambient sensed conditions.
- s. Upon communication loss with the user interface terminal (ACS-UIT2) the ACS-PCM2-5 panels shall control with the last downloaded set point.
- t. In HWAT control mode, the ACS-30 shall have time based control algorithm with three programmable temperature setpoints for maximum energy efficiency (Maintain, Economy and Off)
- u. In HWAT control mode, the pre-programmed duty cycles shall be based on Raychem HWAT heating cables only. No other heating cables may be used in the HWAT control mode.
- v. Digital control system will have a built-in self-test feature to verify proper functionality of heating cable system.
- w. Digital control system will also be able to communicate with BMS by one of the following protocols using the Raychem ProtoNode multi-protocol gateway. **[Select one]**
 - 1. Modbus®
 - 2. LonWorks® **[Select ProtoNode-LER]**
 - 3. BACnet® **[Select ProtoNode-RER]**
 - 4. Metasys® N2 **[Select ProtoNode-RER]**

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- x. The following variables will be monitored by the digital controller and reported back to the BMS.
 - 1. Temperature
 - 2. Ground-fault
 - 3. Current draw
 - 4. Power consumption
 - 5. Associated alarms
 - y. The ACS-UIT2 shall be c-CSA-us Certified. The ACS-PCM2-5 panel shall be c-UL-us Listed.
- E. Thermal Pipe Insulation
- 1. Pipes must be thermally insulated in accordance with the HWAT Design Guide requirements.
 - 2. Thermal insulation must be a type that is flame retardant (closed-cell or fiberglass) with waterproof covering.

2.4 SYSTEM LISTING

- A. The system (heating cable, connection kits, and controller) shall be UL Listed, CSA Certified and FM Approved for hot water temperature maintenance.
- B. The temperature maintenance system shall have a design, installation and operating manual specific to domestic hot water piping.

END OF PART 2

PART 3 - EXECUTION

3.1 INSTALLERS

- A. Acceptable Installers
 - 1. Subject to compliance with requirements of Contract Documents, installer shall be familiar with installing heat-trace cable and equipment.

3.2 INSTALLATION

- A. Comply with manufacturer's recommendations in the HWAT System Installation and Operation Manual.
- B. Apply the heating cable linearly on the pipe after piping has successfully completed any pressure tests. Secure the heating cable to piping with fiberglass tape.
- C. Install electric heating cable according to the drawings and the manufacturer's instructions. The installer shall be responsible for providing a complete functional system, installed in accordance with applicable national and local requirements.
- D. Grounding of controller shall be equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- E. Connection of all electrical wiring shall be according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- F. Pipes must be thermally insulated in accordance with the HWAT design guide requirements.

3.3 FIELD QUALITY CONTROL

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- A. Initial start-up and field testing (commissioning) of the system shall be performed by factory technician or factory representative per the owner's requirements.
- B. Field Testing and Inspections
 - 1. The system shall be commissioned in accordance to the HWAT Installation and Operation manual.
 - 2. The heating cable circuit integrity shall be tested using a 2500 Vdc megohmmeter at the following intervals;
 - a. Before installing the heating cable
 - b. After heating cable has been installed onto the pipe
 - c. After installing connection kits
 - d. After the thermal insulation is installed onto the pipe
 - e. Prior to initial start-up (commissioning)
 - f. As part of the regular system maintenance
 - g. Minimum acceptable insulation resistance shall be 1000 megohms or greater
 - 3. The technician shall verify the insulation schedule is in compliance with the HWAT Installation and Operation manual.
 - 4. The technician shall verify that the HWAT-ECO **OR** ACS-30 **[Select one]** control parameters are set to the application requirements.
 - 5. The technician shall verify that the HWAT-ECO **OR** ACS-30 **[Select one]** alarm contacts are corrected connected to the BMS.
 - 6. The technician shall verify that the ACS-30 and ProtoNode-RER/-LER **[Select one]** are configured correctly with the BMS.
 - 7. All commissioning results will be recorded and presented to the owner.

3.4 MAINTENANCE

- A. Maintenance Service
 - 1. Comply with manufacturer's recommendations in HWAT System Installation and Operation Manual.

END OF SECTION



Raychem PYROTENAX TRACETEK

LIMITED PRODUCT WARRANTY

Pentair warrants all goods listed below against faulty workmanship and use of defective materials when such goods are properly installed, operated, and maintained according to product documentation. All documentation regarding proper use and installation can be found on our web site at www.pentairthermal.com.

| Brand | Type |
|-------------|---|
| Raychem | Heating cables, connection kits and accessories |
| Raychem | Thermostats, controllers, panels, contactors, sensors and accessories |
| Pyrotenax | Fire-rated and performance wiring, components and accessories |
| TraceTek | Leak detection cables, sensors, controllers and accessories |
| Capacisense | Tip clearance probes and electronics |
| Interlock | Clamp-on pipe shoes |

This warranty remains in force for a period of two (2) years from date of purchase.

This warranty is only valid for products purchased and installed within the United States, Canada, Central American, or South American countries on or after May 1, 2013. This warranty can be amended only by a written instrument signed by a duly authorized officer of Pentair. This warranty expressly excludes Pentair’s PetroTrace and TracLoc product lines.

• What Will We Do to Correct Problems?

Pentair will examine and confirm that any alleged product issue covered by this Limited Warranty actually exists and occurred in the course of proper and normal use and was not caused by accident, misuse, neglect, alteration or improper installation, operation, maintenance, repair, or testing, or such other cause outside of the responsibility of Pentair under this Limited Warranty. Pentair will repair such goods or supply replacement goods or credit Buyer’s account for goods covered by this Limited Product Warranty, whichever Pentair may elect at its sole discretion.

• How Do You Get Service?

The Buyer should promptly notify Pentair, or their Pentair Representative, either by written correspondence or by e-mail within thirty (30) days after discovery of an alleged warranty issue. Detailed warranty claim information will be requested at this time and must be supplied by the Buyer. The Buyer may then be asked to return the goods, postage paid, to the location given by Pentair.

PRODUCT NAME

- **What Does This Product Warranty Not Cover?**

Goods subjected to misuse, neglect, alteration or improper installation, operation, maintenance, repair, or testing (or such other act or omission, not attributable to Pentair) are not covered by this Limited Product Warranty. Pentair shall in no event be liable for the cost of removal or installation, for loss or damage to or loss of use of facilities or other property, loss of revenue, loss of use of revenue, loss of anticipated profits, or other damages or costs of any kind whatsoever, whether direct, indirect, incidental, or consequential, and in no event shall Pentair's liability exceed an amount equal to the sales price.

- **What Must You Do to Keep the Warranty in Effect?**

Properly install, operate and maintain your Pentair system as specified in the associated Pentair installation literature.

- **How Does State/Provincial Law Relate To This Warranty?**

THE FOREGOING WARRANTY IS IN LIEU OF ALL OTHER REPRESENTATIONS, WARRANTIES, OR CONDITIONS, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NONINFRINGEMENT, AND OF ANY OTHER OBLIGATION OR LIABILITY ON THE PART OF Pentair, WHETHER BY STATUTE, CONTRACT, STRICT LIABILITY, TORT OR OTHERWISE.

If the goods are a consumer product in Buyer's jurisdiction, Buyer may have additional legal rights under the applicable national/state/provincial legislation governing the sale of consumer goods. As a result, the above exclusions and/or limitations on the warranty may or may not apply.



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