CONNECT AND PROTECT

HWAT Large Building Design & Installation Supplement

nVent

RAYCHEM

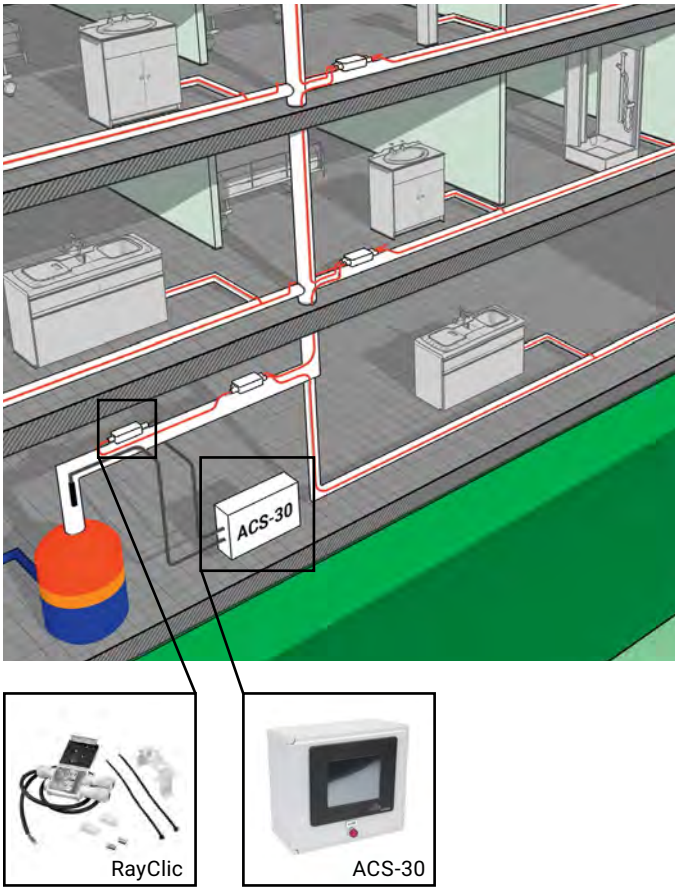
Table of Contents

SECTION 1:
HWAT LARGE BUILDING DESIGN & INSTALLATION SUPPLEMENT OVERVIEW

HWAT Large Building Design & Installation Supplement Overview

INTRODUCTION

The **nVent 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. This HWAT Large Building Design & Installation Supplement will cover large building design, installation and closeout. It has been put together to complement existing installation instructions:



RayClic

ACS-30

- HWAT System Design Guide (H57510)
- HWAT System Installation and Operations Manual (H57548)
- RayClic Powered Connection System Installation Manual (H55092)
- RayClic Connection Kits Installation Manual (H55388)
- RayClic-E End Sea Kit Installation Instructions (H55428)
- RayClic-LE Lighted End Seal Kit Installation Instructions (H58082)
- HWT-P HWAT Power Connection Kit with End Seal Installation Instructions (H59091)
- HWT-HST HWAT Splice/Tee Connection Kit Installation Instructions (H59104)
- ACS-30 Controller Installation Instructions:
    - o ACS-UIT2 Remote User Interface Terminal Installation Instructions (H58661)
    - o ACS-PCM2-5 Power Control Module Installation Instructions (H58672)
- HWAT-ECO-GF Controller Installation Manual (H60223) – for small systems

Videos
RayClic Power Connection Kit Installation Video
HWAT-ECO-GF Controller Introductory Video

DESIGN PROCESS

This supplement is intended to assist an engineer with the HWAT Design Process. The process should include a review of the general HWAT System Design Guide (H57510) for details of circuit design. This design supplement highlights those things that are specific to large building system design. The supplement also provides a blank circuit sheet and an outline of installation meetings which should be specified.

The specification should be reviewed paying particular attention to the need for third party oversight by the general contractor. Sample Specification and Meeting Outlines are provided for the required series of meetings and sign-offs that are required to activate the warranty. The engineer's presence is important at the kick off meeting. A small investment of time at the onset of the installation will minimize the number of Requests for Information later in the project and time spent dealing with issues at the end as the result of careless installation and delineation of scope between trades.

INSTALLATION PROCESS

Once the project has been awarded, a schedule should be developed and a kick off meeting held with the general contractor. A list of recommended attendees are shown in the Suggested Meeting Chart. The installing contractor will likely have to officially schedule the meeting but be sure that all parties are invited and are aware of the benefits of their attendance. If the engineer allows, include contact information in the specification will help direct the purchasing or general contractor to the nVent RAYCHEM representative. Once scheduled, the nVent RAYCHEM representative will present the HWAT system to the general contractor in electronic form and see if they will be able to implement electronic tracking of the project.

- All forms can be physically printed, but tracking of project information is far easier when collected electronically.
- Bring a Sample Circuit Sheet and review the idea and benefits of the circuit sheet with them. Note that they are to be hung at each power connection and that the installer is to record all information on these sheets.
- The general contractor can add a picture of updates to the tag at each meeting.
- Each agenda is set up to walk the participants through the applicable steps that need to be reviewed at that time.
- The intent is to have the general contractor use these sheets electronically to guide each meeting.
- Each step has a check box and a sign off sheet to be filled.
- When the meeting is completed the sheet is stored in the project file.
- Add a picture of the individual circuit sheet to the meeting forms at each step of the way and email the sheet to each of the participants as a record of the meeting.

Segment ID	1	Op temp	115	Design ft	210	#tees	0	#Cross	0
Serving	Express and Amenities								
PCM	1	Address	1	Ctrl Loc.	Elec Room 201	PC Loc.	Hall outside 205		
Panel	0	CB#	0	rating (A)	30	Voltage	208		

Meter mark						Continuity(ohms)		Cap (nf)	Insulation Resistance			Sensor#	GC	DATE
begin	end	length(m)	Length(ft)	Tees	Cross	core	braid	nf	500vdc	1000vdc	2500vdc	(if used)	Signature	
			0											
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		0	0									Final		

Installed by	A1 Electric
Local Rep Contact	Rep Kings

Figure 1: Sample Circuit Sheet

Click to open

Click to open

Click to open

Figure 2: Meeting Agenda & Record Forms

CLOSING OUT A PROJECT

At the close of a project, if each meeting agenda has been followed and the circuit tag filled out along the way, a complete view of the system should exist. During final commissioning the technician doing the final sign off can refer to these forms to compare readings and get all circuit info. At the close of start up and commissioning the technician will review the forms with the end user and explain how it defines the whole system from start to finish.

SECTION 2:
DESIGN SUPPLEMENT

Design Supplement

DESIGN GUIDELINES FOR LARGE BUILDINGS

In this supplement we will discuss the special considerations a designer should keep in mind when designing a large system. These simple details will allow for a better design, easier installation and faster start up. The following are some solutions to incorporate into the large building design.

HWAT Domestic Hot Water (DHW) Systems

The **nVent RAYCHEM HWAT system** is an excellent energy-efficient way to provide instant hot water to each point of use throughout a very large building. HWAT is not dependent on proper flow and there are no concerns of balancing or temperature drops, regardless of the size of the building. As a result, HWAT allows the DWH designer to consolidate equipment and still distribute the proper temperature to each point of use as quickly as the design requires. Consolidating equipment frees up space for billable area where return piping, pumps, and booster heaters would sit in a typical recirculating system. This is especially true for buildings with multiple pressure zones.

With codes limiting the amount of ambient temperature water that can flow from a fixture HWAT may be a designer's only choice to deliver hot water to every point of use in the short period allowed. HWAT can deliver hot water right to the point of use quickly and easily. An HWAT DHW system is easy to design, start up and operate with no need for balancing or rebalancing even if the system needs to be modified. Not only is it easy to design, but because these systems can easily be scheduled with setbacks based on usage it meets many of the new codes for scheduling and can earn LEED points for innovative design. HWAT systems can also be an effective way to maintain *Legionella* control temperatures consistent with ASHRAE 188 Guideline 12.

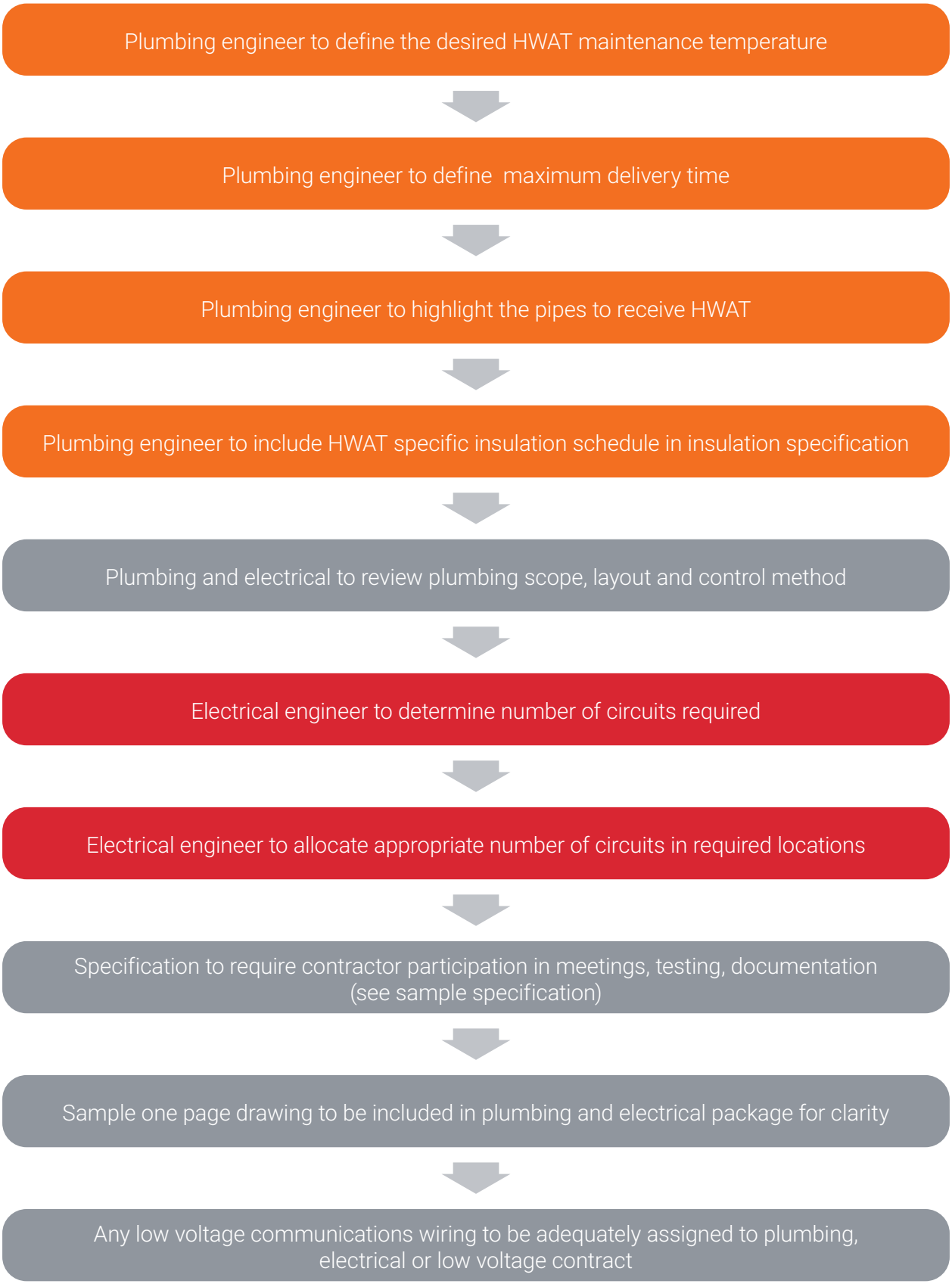
Delineation of Scope & System Ownership

Before we talk about overall design, let's first talk about delineation of scope. Since HWAT is an electrical product which is part of the plumbing system, defining scope can be difficult. With varying local conditions such as codes, contracts and contractor capabilities it is important to point out what activities are typically done by each discipline and how they can work together to achieve the best system possible at the lowest cost possible.

We typically see HWAT systems installed by electrical professionals. While it can be installed on the pipe by others, it is important that it be tested and connected by a qualified electrical professional. That said, the plumbing discipline should lead the DHW system design and should have overall responsibility for the HWAT system's ultimate performance. Providing guidance for segmenting the installation and testing requirements in the specification is a good way to identify the delineation of scope to those who will do the installation. A Sample Specification and Drawings are provided in this guide, along with Suggested Meeting Schedules and Agendas.

The HWAT system design process also crosses engineering disciplines. The plumbing and electrical engineers must work together to outline the system skeleton so that the contractors can accurately bid and install a project. It is best to enlist the help of the nVent RAYCHEM representative as early as possible to help with this process on at least the first project. The basic design process is covered in the HWAT System Design Guide (H57510) and will not be covered here. Here we will discuss those things particular to large buildings. Individual items will be listed and discussed below. The following is a project flow chart to give an overall view of the process.

HWAT DESIGN PROCESS



TEMPERATURE SPECIFICATION

The HWAT system is flexible so the design of a 105°F system would be the same as a 140°F system. The designer must, however, specify the desired operation temperature within this range so that the commissioning technician can program the controllers accordingly. Since an HWAT system does not lose temperature as the water moves through the system, the specified maintain temperature should equal the desired point of use output temperature. The mixing valve outlet temperature should also equal the maintain temperature.

Note: Some calibration may be required during the commissioning process. The settings are changed in an iterative process to get each point of use at the proper temperature. This would only be required to adjust for building variances.

PROPERLY DESIGNED MIXING VALVES

HWAT DHW systems keep systems hot by replacing heat lost through the insulation when there is no usage. Since there is no need for recirculation, there may be no flow across the mixing valve at periods of low usage. Some mixing valves need flow to work properly. The DHW designer should work with the mixing valve manufacturer to be sure that the assembly is capable of maintaining temperature in a no flow situation. Most digital mixing valves are able to deal with no flow situations.

If there is a question of whether the mixing valve will work properly in a very low, or no flow situation a "flywheel" should be created. A flywheel can be created by having a small recirculated section downstream of the mixer. Be sure to use a recirculation pump that can be tuned down to a flow of not more than 1-2gpm (similar to Taco Variable Speed #006e). It is important to ONLY return this flow to the cold water side of the mixer. It should never go back to the water heater.

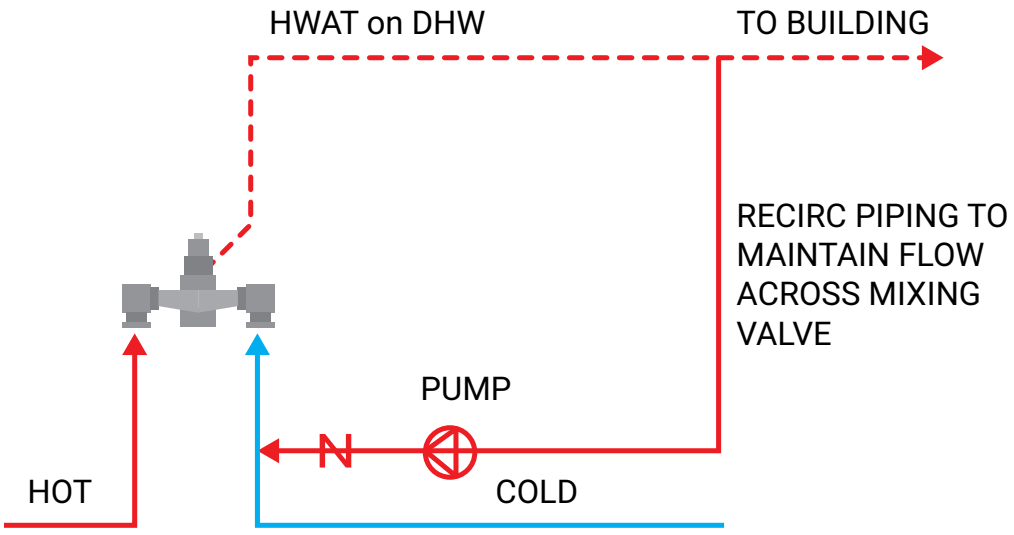


Figure 3: Flywheel Design

Click to enlarge

AMBIENT CONDITIONS AROUND DHW PIPING

The HWAT system control is based on an equal heat loss for all pipe sizes and the idea that the building interior temperature will remain constant during normal building operation. The control scheme cycles the heating cables on and off to maintain the proper water temperatures based on a fixed temperature around the DHW piping and our set insulation schedule. If the DHW piping must run through an unconditioned space, a different control scheme will be required. The sections of DHW piping in the unconditioned space will have to be isolated electrically and controlled in a temperature maintenance mode using a temperature sensor(s) on the pipe.

INSULATION THICKNESS

The performance of an HWAT system is directly proportional to the insulation used. The HWAT design guide shows this insulation schedule and the plumbing documents should spell it out clearly.

Fiberglass Insulation Selection

Copper pipe size (in)	IPS insulation size (in)	Insulation (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 1: 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.

Note 2: All insulation thickness are based on the R-value of fiberglass insulation. If insulation other than fiberglass is being used, it must be 1) fire-resistant, 2) an equivalent R-value and 3) must be compatible with the maximum exposure temperature of the heat tracing system. For further assistance, please contact your nVent representative or nVent Technical Support directly at (800) 545-6258.

Table 1: Fiberglass Insulation Selection

Changing the insulation thickness WILL impact system performance. The HWAT insulation schedule is designed to provide equal heat loss across a wide range of pipe diameters. This allows circuits, which include many pipe sizes, to maintain consistent temperatures across those pipe sizes even though they are all controlled by the same electrical circuit.

The HWAT insulation schedule can lead to some large pipe/insulation packages. To save space on larger pipes the designer can chose to double trace the pipe and reduce the insulation thickness by 2/3 (see highlighted note above). This brings a 3” pipe/insulation package from a 9” outside diameter to a 5” outside diameter. This can account for significant space savings for the building owner and core drilling charges for the installers. This change will not affect system performance. Note that we still find it good practice to control like size pipes on the same electrical circuit if possible.

Note: Do not double trace without reducing insulation thickness by 2/3rd. Double tracing will lead to higher temperatures in that area.

ELECTRICAL VS PLUMBING LAYOUT

When laying out the electrical circuits consider the building use patterns. For example, if a school has weekend functions in the main part of the building but class room wings will be unused, circuit the areas separately. This will allow the class room wings to be scheduled off while the main is left on. In mixed use buildings, schedule the office areas off while leaving residential and retail on.

The pipe sizes should be considered as well. It is recommended to keep as many like sized pipes together as possible. If main distribution piping can be on its own circuits, and individual risers grouped, it can make temperature adjustment easier and more effective. In the example below the 3" horizontal main is on one electrical circuit while the (4) 1 ½" and smaller risers are on another. The controller allows for adjustment, and the insulation schedule targets equal heat loss, but building factors can impact the actual maintained temperature. Separating sizes as much as is practical can help in the commissioning process. An electrical circuit which has 3" to ½" pipe will be harder to achieve a tight window than a circuit which serves only 1 ½" to ½" pipes.

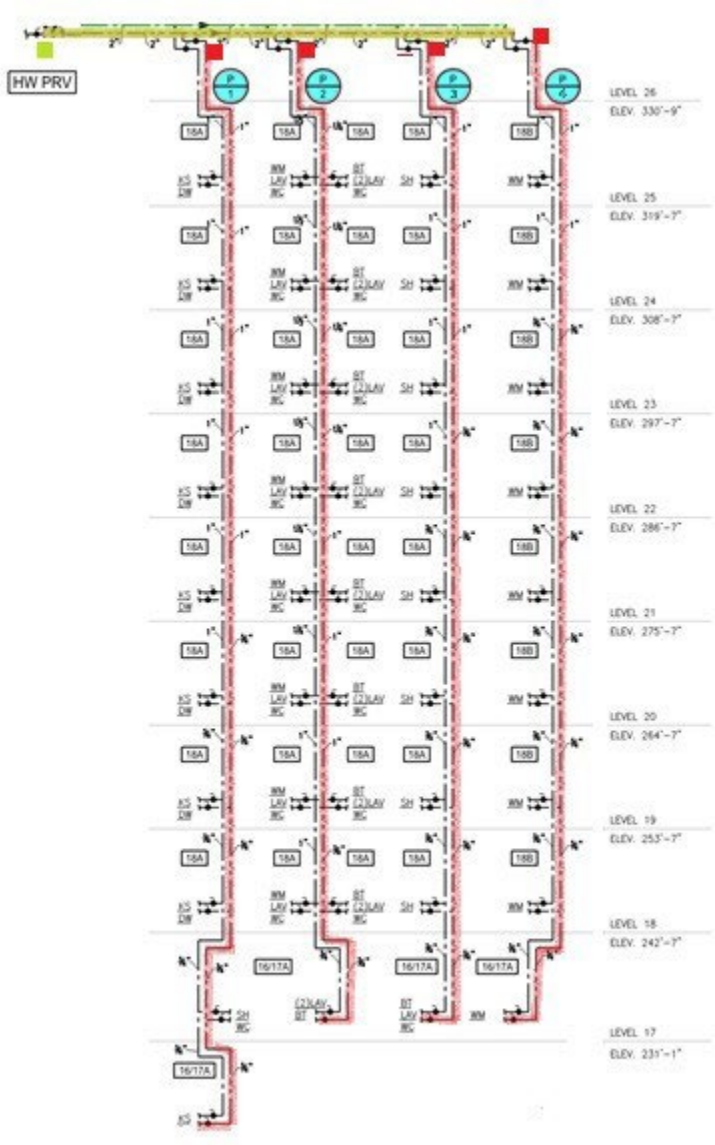


Figure 4: Plumbing & Electrical Layout

Click to enlarge

DESIGNING CIRCUITS TO MAXIMUM ALLOWABLE LENGTH

The plumbing designer and electrical designer should work together to design a system that has enough electrical circuits in the correct locations. The HWAT System Design Guide (H57510) has a list of maximum circuit lengths that must be used based on the voltage and amperage circuit breaker used. We suggest designing to only 80% of this maximum as it will allow some room for changes that happen unexpectedly in the field.

When showing power connection points, locate them in common areas where access is possible. This will allow access to the power connection (required by code) without the need to access an apartment, class room or patient room. Locating the power connection near valves will typically allow use of an access panel (12"x12" min.) which is also required for valve adjustment and service. When locating valves, place them close to distribution piping as possible to minimize small branches between main and isolation valve. This will minimize the section of pipe between the valve and the main easing heating cable design and installation.

We suggest also having access to other components if possible. While our non-powered components are rated to be buried in walls, it is always good practice to make them accessible for troubleshooting if possible. Our **nVent RAYCHEM RayClic** components offer labor savings and test points. Where no access will be available, use heat shrink components as the test points offered in the RayClic would not be available anyway.

MULTIPLE SEGMENTS PER ELECTRICAL/CONTROL CIRCUIT

In large buildings, especially high-rise buildings, a single electrical circuit might cover multiple individual HWAT segments. These individual segments can then be grouped together to fill an electrical/control circuit of like segments. In the example above we have (4) vertical risers in a pressure zone each about 100' long. Since each of the risers have similar operating conditions they can be grouped together into (1) electrical/control circuit of (4) segments 100' long. The total combined length must be less than the maximum allowable circuit length for the supplied voltage and circuit breaker size. Please note that this only works when the operating conditions for all (4) segments are the same.

This approach would also apply in a hybrid system where the main core is recirculated but drops are treated with HWAT. Individual drops can be grouped on a single electrical circuit as long as the operating conditions for each is the same and the total amount connected to the circuit does not exceed the maximum allowable.

SYSTEM CONTROL AND MONITORING

There are two basic control methods for HWAT systems:

- The **nVent RAYCHEM HWAT-ECO-GF Single Circuit Controller** is used in smaller systems where a single controller is used for each circuit. These single controllers are usually located near the circuit power connection kit. When a system gets larger than a few circuits, it starts to make more sense to switch an integrated system that is interconnected. While the ECO has an alarm contact, it cannot be tied into the larger ACS-30 system.
- The **nVent RAYCHEM ACS-30 Control System** allows each control point to be controlled and monitored and all this information is relayed back to the system User Interface Terminal ACS-UIT2 where it can easily be monitored from a single location or connected directly to a BMS.

The ACS-30 control system should be used for all large buildings. The advantages of centralized system programming and monitoring will easily offset the cost for this more advanced control option. It is a good idea to locate the User Interface Terminal (UIT) near the DHW supply and main mixing valve for easy review of the overall DHW system. The ACS-30 can be used to control and monitor all electric heat tracing applications in the building, but we will only focus on the HWAT application mode here. In HWAT mode the ACS-30 will cycle the heating cable on and off to achieve the correct temperature. An HWAT specific algorithm is used

to relate heating cable output, user defined building interior temperature and desired water temperature to apply the proper duty cycle and maintain the proper water temperature without the need for a sensor.

Using this type of control eliminates the issues of proper temperature sensor placement. Choosing the proper sensor location is dependent on ever-changing flow paths which can lead to too hot or too cold system temperatures. We do not require temperature sensors for control, but we do suggest using them for monitoring. Temperature sensors can easily be added to the ACS-30 system and they will continuously monitor for, and alarm on, high and low temperature. Using temperature sensors is a good way to monitor system performance and to warn against mixing valve issues, cross connections, or DHW supply issues. This information will be stored for the commissioning technician to use for adjustments.

We suggest locating a sensor on each side of the mixing valve to alert operations of issues with either the supply of the DHW or with the mixing valve itself. Additional sensors can easily be added at other key locations such as on express risers, horizontal mains at each pressure zone for a high-rise or at the ends of wings in a sprawling building.

Note: The ACS-30 system also provides the required equipment level ground fault protection and electrical system monitoring and alarm. If possible, get the HWAT circuits online as soon as they are completed, and pass the required testing, to activate these features. Operating the system (even in advance of having water in the pipes) will allow the ACS-30 to monitor the electrical integrity of the active circuits. The system will alarm if any active circuit is damaged during subsequent construction.

To learn about which control and monitoring option is best suited for your project, please contact an nVent Representative.

ON SITE MEETING SCHEDULES AND OUTLINES

HWAT crosses many disciplines, therefore it is important for all parties to meet at the beginning of a project to delineate scope and set expectations. It is important to note that some contractors are hesitant to devote time to meeting about HWAT installation. They may consider the installation of heating cable as trivial in comparison to their other responsibilities on a large job. Every effort must be made to get the installer(s) educated about good installation practices. The general contractor must be enlisted to provide guidance and accountability for each contractor. The general contractor should organize and run a Kick Off Meeting. Adding this to the specification is a good way to ensure that the general contractor takes appropriate interest in the HWAT system at the front end. HWAT is a multi-discipline product so it is important that the general contractor coordinate all of the parties to achieve a good installation. In large buildings it is imperative that good installation, testing and documenting practices be followed as some of the system may be buried behind walls long before the system is started up. Finding problems after walls are up is more difficult and much more costly.

The people involved in the kick off meeting will be dependent on the type and size of project. For most large HWAT projects the general contractor should schedule and officiate the meeting. The local nVent RAYCHEM representative and a representative of the design firm should be in attendance to make sure the design intent is properly conveyed to the contractors. Additional attendees should include the installing contractor (who might be one of the following), the plumbing contractor, the electrical contractor, the insulation contractor and possibly the controls contractor if the low voltage wiring is done by a different contractor.

Each contractor's scope should be clarified and reviewed for conflict with the other trades. Power connection locations should be coordinated between the electrical, plumbing and general contractor to be sure that there are the proper number of electrical feeds to the proper locations. The general contractor must be sure that access will be available to each of the power connections and coordinate with the sheetrock contractor to be sure access doors are provided if located in "hard" ceilings. Locating power connections at valves can help as access is required for pressure reducing and zone valves anyway. Locating power connections at these valves will allow one access door to serve both the valves and the power connections.

After the kick off meeting is complete a Hands-On Installation Meeting can be scheduled (this might follow the kick off meeting). The nVent RAYCHEM representative should train the installer and the general contractor on the proper use and completion of the Individual Circuit Sheet (ICS). The overall HWAT System Installation and Operations Manual (H57548) (IO), supplemental IO (this document) and individual component instructions should be reviewed and a sample component completed. Soon after the installation has started a First Segment Review should be completed to be sure that the installer truly understands, and is following, the proper installation process. The installation should be reviewed and any deviations from the IO shall be noted on the System Correction Report Form. These system reviews should continue through the life of the project as required. The Panel Installation Meeting shall cover the installation of the controls. This meeting might be combined with one of the Intermediate Review Meetings. It should include powering the units, routing and numbering of circuits and wiring of communication and sensors.

By the end of the installation the individual circuit sheet shall provide a record of the make-up of each segment and what tasks have been completed for each segment. During the Final Testing and Start Up Meeting the nVent RAYCHEM representative and general contractor will use the Blank Inspection Report and confirm that all corrective actions have been completed and that all segments test to the required levels. Once the final sign off of the installation is complete the Final Commissioning and Sign Off Meeting can be scheduled. During final commissioning the system will be checked for proper performance and adjustments made as required. The installation section will review proper temperature testing procedures which can be used to fine tune temperature settings.

Once the system is started and operational the system information should be compiled and presented to the building owner/operator. The owner/operator should be walked through the system intent, layout and operation. Use the accrued information to show how the system is laid out and where each key component is located. The system controls operation and alarm types should be reviewed. Upon completion the owner/operator should have a basic understanding of the system and how to deal with any alarms that might come up.

SAMPLE SPECIFICATION AND DRAWINGS

The following are samples of successful ways to represent an HWAT system in contract documents. The following specification outlines the product, individual contractor responsibilities, suggested coordination and training meetings, as well as testing schedule, protocol and record keeping. This specification aims to enlist the general contractor to oversee the HWAT installation. It describes the trainings and testing that will lead to a successful installation and to outline what documentation should be compiled and submitted at the successful completion of the installation.

The HWAT system will need to be represented on the plumbing and drawings in some way. The following examples are some of the ways we have seen systems documented: sample plan views, riser diagrams and control drawings. We have also included a system circuit table and individual circuit design sheets. While not every project will allow time for all of these documents we have seen them all be effective in describing the installation to the installing contractor(s). The better the system is described the better it can be bid and installed with less requests for information during the process.

Sample Specification

The following HWAT specifications include all the information about the HWAT system, controls, installation, testing and meetings:

- HWAT System Engineering Specification (H58755)

Sample Table: This is a sample table for a project with presumably (15) electrical circuits / control points. Each circuit / control point has its own line. A given electrical circuit might serve more than one control point. As an example, there could be a hot water and a warm water feed to a cafeteria wing in a school. The hot water is running at 140°F and the warm water for student hand washing at a nearby lav might be at 115°F. The total cable does not exceed the maximum allowable on an electrical circuit but the two sections run at different temperature so would need different control points. Providing a table like this on the drawings helps convey the design intent to the installers and helps make sure that the system settings match the design intent.

HWAT Project Circuit Sheet

	Circuit description (i.e. series pipes x,y,z)	Operating temp	segment 1	segment 2	segment 3	segment 4	Design length	# tees	# crosses	PCM #	Relay #	PCM Location	PC Location	Panel Name	Circuit breaker #	CB Amp Rating	Voltage
1	Express and Amenities	115	210				210			1	1	Elec Room 201	Hall outside 205			30	208
2	2nd Floor Distribution	115	475				475	2		1	2	Elec Room 201	Hall outside 218			30	208
3	Riser 46,36,16	115	150	100	130		380			1	3	Elec Room 201	Hall outside 207			30	208
4	Riser 16,37,3,33	115	125	100	130	110	465	1		1	4	Elec Room 201	Hall outside 213			30	208
5	Riser 5,30,32A,42 ZONE 2	115	95	95	105	95	390			2	1	Elec Room 201	Hall outside 213			30	208
6	22 Floor Distribution	115	160				160	3		4	1	Elec Room 2203	Hall outside 2205			30	208
7	Riser 20,40,31	115	140	170	165		475			4	2	Elec Room 2203	Hall outside 2218			30	208
8	Riser 35,21,1A	115	185	160	130		475			4	3	Elec Room 2203	Hall outside 2207			30	208
9	Riser 39,39B,39A	115	135	195	135		465			4	4	Elec Room 2203	Hall outside 2213			30	208
10	Riser 43,38,38A	115	175	160	130		465			5	1	Elec Room 2203	Hall outside 2213			30	208
	Installed by	A1 Electric															
	Local Rep Contact	Rep Kings	860-904-1234														

Figure 5: HWAT Project Circuit Sheet

Click to open

Sample Riser Diagram: In a high-rise building there are typically many DHW “risers” which serve the different fixtures within the building. These are separated into individual pressure zones and further need to be assigned electrical circuits. The following riser diagram has been marked up to indicate which risers are going to be grouped together electrically. Notice that the “express riser” and horizontal distribution piping each have their own electrical circuits.

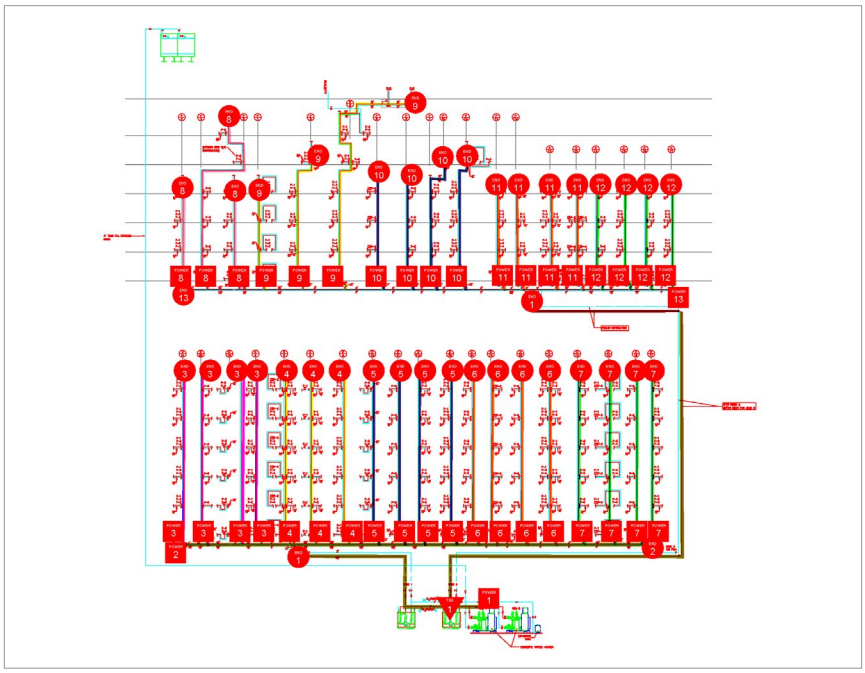


Figure 6: Sample Riser Diagram

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Sample Horizontal Main Diagram with Power Connection Locations: When looking at this same system in plan at the horizontal distribution floor one can see where the horizontal distribution comes off the express riser, through the pressure reducing valve and then feed the tops of each individual vertical riser.
The horizontal main is on its own electrical circuit and the same color risers are grouped on a single electrical circuit.

Note that the power connections are located in common areas to make access easier once the building is occupied.

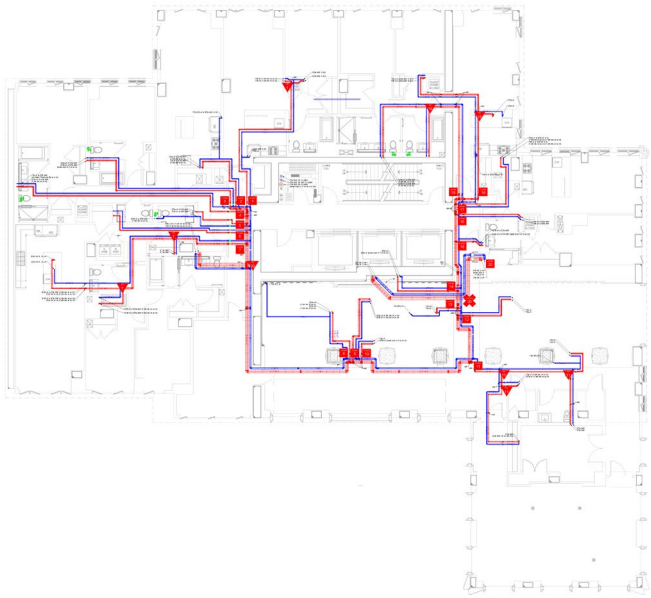

Figure 7: Sample Horizontal Main Diagram with Power Connection Locations

Click to open

Horizontal Building Piping Power Connection Location: In a building which is more spread out the same philosophy can be applied. In this application the horizontal distribution is separated out from the individual wing piping. Individual wing floors might be separated out as well if the wings are big enough.

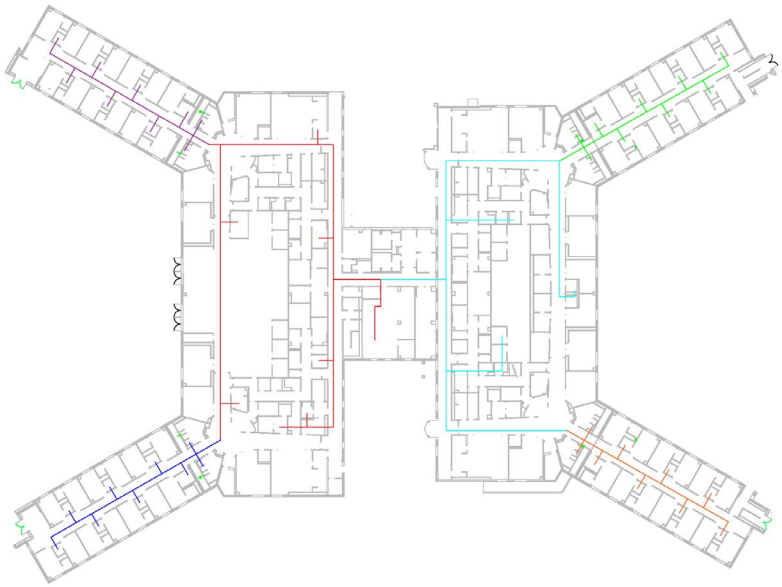

Figure 8: Horizontal Building Piping Diagram

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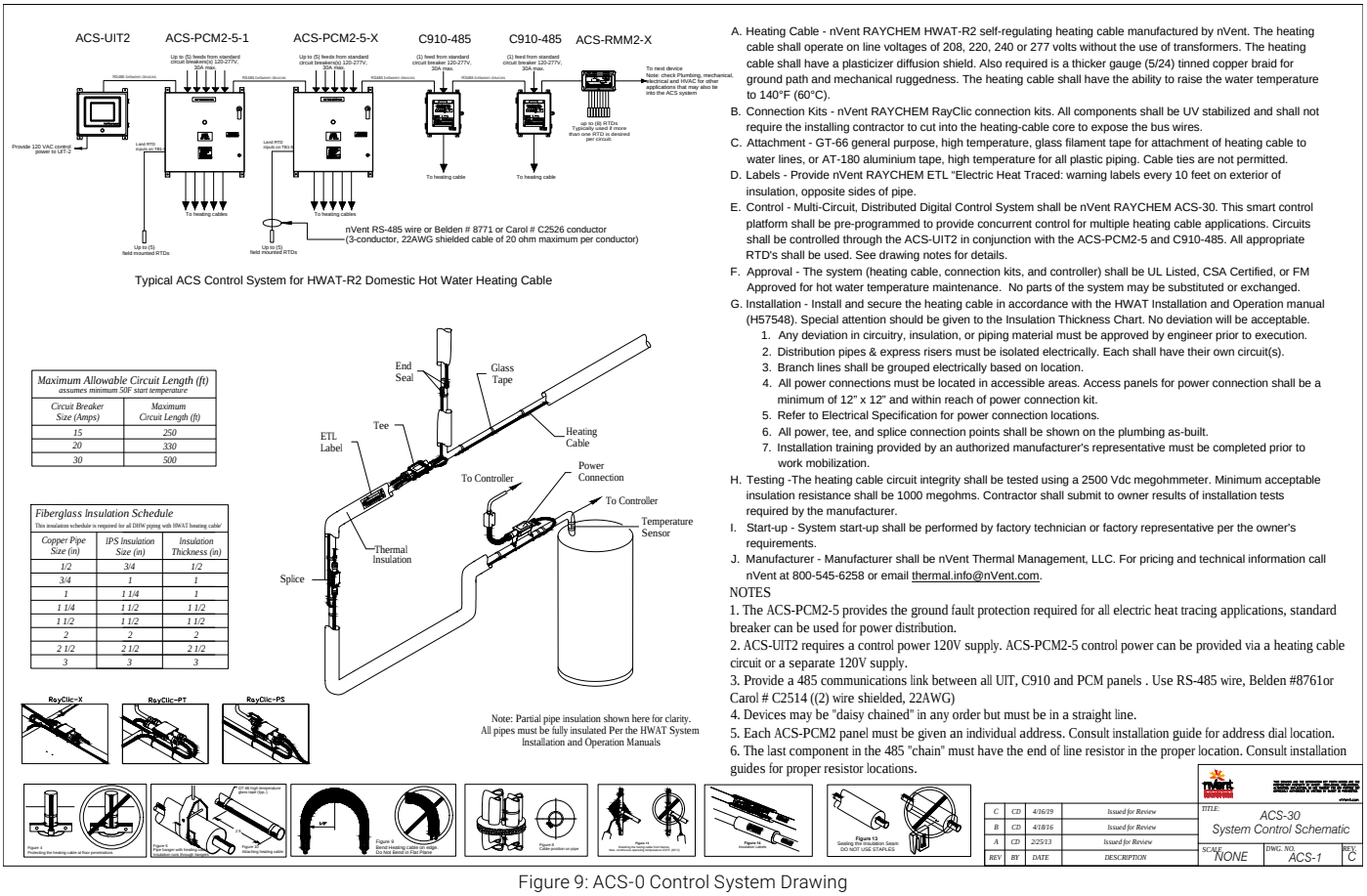
HWAT System Control:

There are two basic control methods for HWAT systems. Single circuit control is used in smaller systems where a single controller is used for each circuit. These single controllers are usually located near the circuit power connection kit. When a system gets larger than a few circuits it starts to make more sense to switch an integrated system that is interconnected. The ACS-30 Control System allows each control point to be controlled and monitored and all this information is relayed back to the system UIT where it can easily be reached. The entire system can be monitored and programmed from a single location or connected directly to a BMS.

Because the system is interconnected, low voltage inter connecting wire must be specified. The ACS-30 control system uses a standard RS-485 network to communicate between devices. Be sure that this interconnection wiring is included in the project documents. Similarly, be sure that temperature sensor locations are shown and that wire to these is included in the project documents.

The following is a basic ACS-30 Control System Drawing which covers all the requirements. There are notes to indicate the interconnections, the types of wire to be used, the possible components that will be used and a simple one line diagram of how they would interconnect.



A. Heating Cable - nVent RAYCHEM HWAT-R2 self-regulating heating cable manufactured by nVent. The heating cable shall operate on line voltages of 208, 220, 240 or 277 volts without the use of transformers. The heating cable shall have a plasticizer diffusion shield. Also required is a thicker gauge (5/24) tinned copper braid for ground path and mechanical ruggedness. The heating cable shall have the ability to raise the water temperature to 140°F (60°C).

B. Connection Kits - nVent RAYCHEM RayClic connection kits. All components shall be UV stabilized and shall not require the installing contractor to cut into the heating-cable core to expose the bus wires.

C. Attachment - GT-66 general purpose, high temperature, glass filament tape for attachment of heating cable to water lines, or AT-180 aluminium tape, high temperature for all plastic piping. Cable ties are not permitted.

D. Labels - Provide nVent RAYCHEM ETL "Electric Heat Traced: warning labels every 10 feet on exterior of insulation, opposite sides of pipe.

E. Control - Multi-Circuit, Distributed Digital Control System shall be nVent RAYCHEM ACS-30. This smart control platform shall be pre-programmed to provide concurrent control for multiple heating cable applications. Circuits shall be controlled through the ACS-UIT2 in conjunction with the ACS-PCM2-5 and C910-485. All appropriate RTD's shall be used. See drawing notes for details.

F. Approval - The system (heating cable, connection kits, and controller) shall be UL Listed, CSA Certified, or FM Approved for hot water temperature maintenance. No parts of the system may be substituted or exchanged.

G. Installation - Install and secure the heating cable in accordance with the HWAT Installation and Operation manual (H57548). Special attention should be given to the Insulation Thickness Chart. No deviation will be acceptable.

1. Any deviation in circuitry, insulation, or piping material must be approved by engineer prior to execution.
2. Distribution pipes & express risers must be isolated electrically. Each shall have their own circuit(s).
3. Branch lines shall be grouped electrically based on location.
4. All power connections must be located in accessible areas. Access panels for power connection shall be a minimum of 12" x 12" and within reach of power connection kit.
5. Refer to Electrical Specification for power connection locations.
6. All power, tee, and splice connection points shall be shown on the plumbing as-built.
7. Installation training provided by an authorized manufacturer's representative must be completed prior to work mobilization.

H. Testing -The heating cable circuit integrity shall be tested using a 2500 Vdc megohmmeter. Minimum acceptable insulation resistance shall be 1000 megohms. Contractor shall submit to owner results of installation tests required by the manufacturer.

I. Start-up - System start-up shall be performed by factory technician or factory representative per the owner's requirements.

J. Manufacturer - Manufacturer shall be nVent Thermal Management, LLC. For pricing and technical information call nVent at 800-545-6258 or email thermal.info@nVent.com.

NOTES

1. The ACS-PCM2-5 provides the ground fault protection required for all electric heat tracing applications, standard breaker can be used for power distribution.
2. ACS-UIT2 requires a control power 120V supply. ACS-PCM2-5 control power can be provided via a heating cable circuit or a separate 120V supply.
3. Provide a 485 communications link between all UIT, C910 and PCM panels . Use RS-485 wire, Belden #8761or Carol # C2514 ((2) wire shielded, 22AWG)
4. Devices may be "daisy chained" in any order but must be in a straight line.
5. Each ACS-PCM2 panel must be given an individual address. Consult installation guide for address dial location.
6. The last component in the 485 "chain" must have the end of line resistor in the proper location. Consult installation guides for proper resistor locations.

REV	BY	DATE	DESCRIPTION
C	CD	4/16/19	Issued for Review
B	CD	4/18/16	Issued for Review
A	CD	2/25/13	Issued for Review

TITLE: ACS-30 System Control Schematic
SCALE: NONE | DWG. NO. ACS-1 | REV. C

Figure 9: ACS-0 Control System Drawing

Click to open

Individual Circuit Sheet: Within these larger systems each circuit is listed on the overall circuit sheet and then all information and the history of each circuit is recorded on the individual circuit sheet.

Segment ID		1	Op temp	115	Design ft	210		#tees	0		#Cross	0	
Serving		Express and Amenities											
PCM	1		Address	1	Ctrl Loc.	Elec Room 201		PC Loc.	Hall outside 205				
Panel	0			CB# 0	rating (A)	30		Voltage	208				
Meter mark						Continuity(ohms)		Cap (nf)	Insulation Resistance			Sensor#	GC	DATE
begin	end	length(m)	Length(ft)	Tees	Cross	core	braid	nf	500vdc	1000vdc	2500vdc	(if used)	Signature	
			0											
			0											
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			0											
			0											
			0											
		0	0									Final		
Installed by		At Electric												
Local Rep Contact		Rep Kings												

Figure 10: Individual Circuit Sheet

Click to open

BlueBeam Symbols: nVent engineers use BlueBeam Review when taking off HWAT projects. We have put together a "Tool Chest" for representing the HWAT system on .PDFs drawings. This is a sample set of Bluebeam Revu tools, if it doesn't download properly (.btx file) - right click for more options.

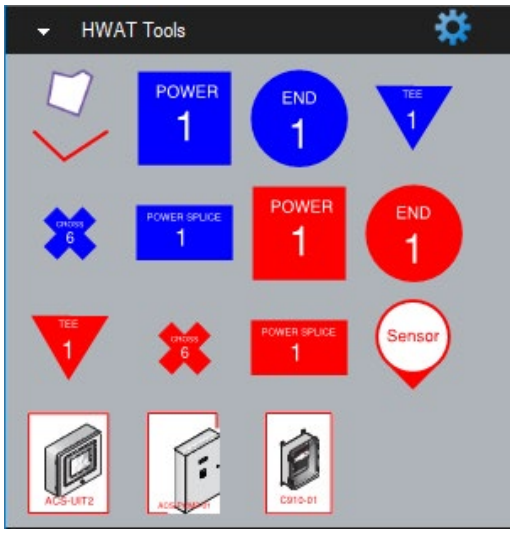


Figure 11: BlueBeam Symbols

Click to enlarge

SECTION 3:
INSTALLATION PROCESS

Installation Process

INSTALLATION PROCESS OVERVIEW

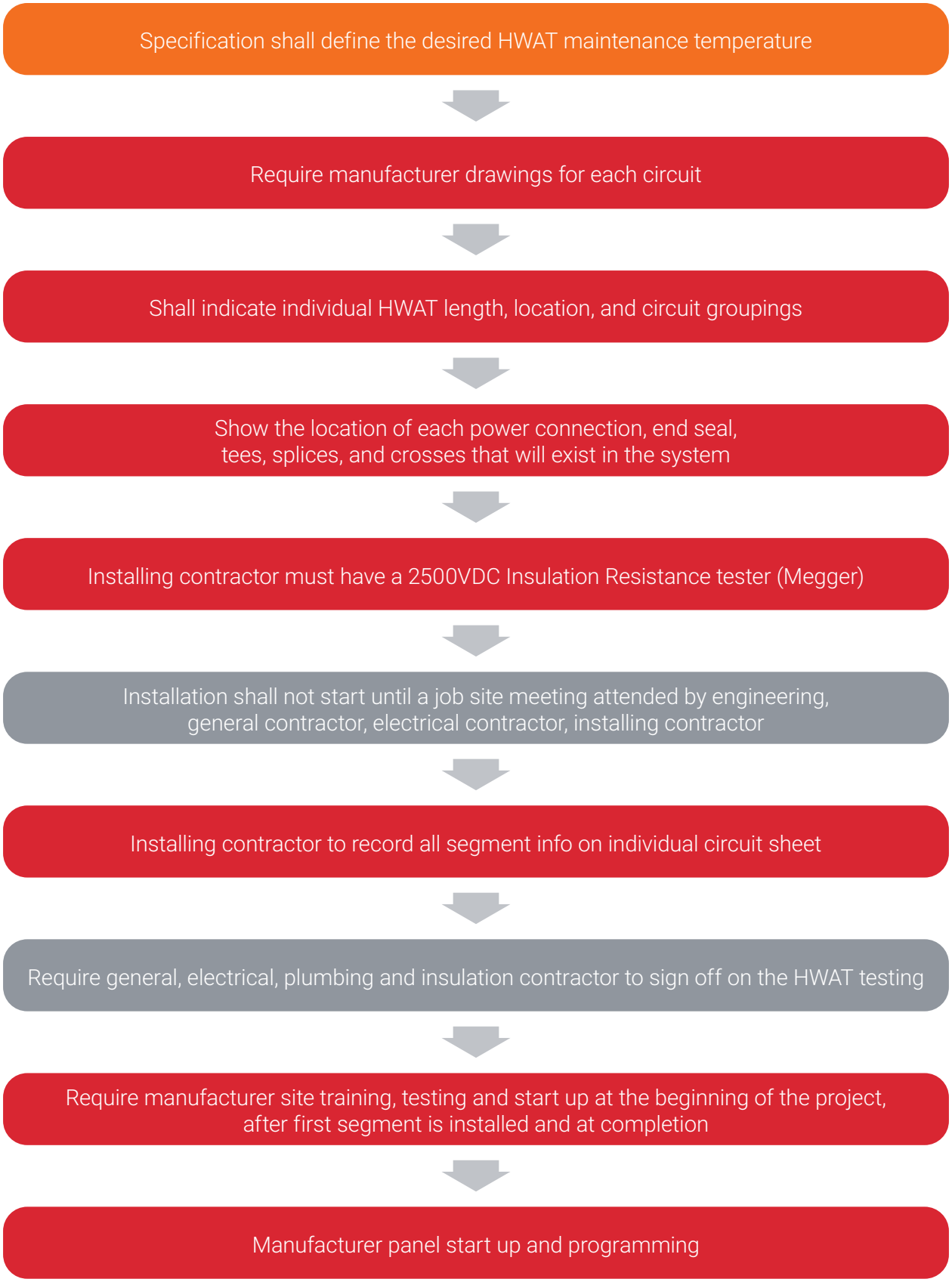
Once the project has awarded a schedule should be developed and a Kick Off Meeting with the general contractor and installing contractors held. Officially schedule the meeting but be sure that all parties are invited and are aware of the benefits of their attendance. Be sure the general contractor understands that proper testing and tracking of the installation will greatly increase the efficiency of the install. The general contractor is typically the one who will require and monitor proper testing and documentation.

Once scheduled, present the HWAT system to the general contractor in electronic form and see if they will be able to implement electronic tracking of the project. All forms can be physically printed but tracking of project information is far easier electronically. Bring a sample Individual Circuit Sheet and review the idea and benefits of the individual circuit sheets with them. A printed version of the most current individual circuit sheet should be hung at each power connection. The installing contractor is expected to record all information on these sheets.

The general contractor should take a picture of updates to the tag throughout the install. These can be reviewed with the installing contractor(s) at progress meeting(s). Suggested meetings are attached and an agenda is suggested for each. Each Agenda is set up to walk the participants through the applicable steps that need to be reviewed at a particular point in the installation process. The intent is to have the general contractor use these sheets electronically to guide each meeting. Each step has a check box and a sign off sheet to be filled. When the meeting is completed the sheet is stored in the project file. Add a picture of the individual circuit sheet to the meeting forms at each step of the way and email the sheet to each of the participants as a record of the meeting.

If all of these steps are followed, and recorded, a complete picture of the system will exist and the final testing and commissioning process should go smoothly. The commissioning technician will have sheets that indicate BOMs, power connection locations, and previous test results. Using these, the final sign off can be completed more quickly and the controller setup, programming and start up can be completed with speed and confidence.

Once started up, the system should be allowed to run for at least 24 hours. After that a systematic test of water temperatures should be completed (see page 30 of the HWAT Installation and Operation Manual (H57548)). Individual circuit temperatures may need some adjusting. Once completed, download the final programming to a flash drive and present it to the owner/operator at their training, along with all of the individual circuit sheets and meeting sign offs.


Specification shall define the desired HWAT maintenance temperature
Require manufacturer drawings for each circuit
Shall indicate individual HWAT length, location, and circuit groupings
Show the location of each power connection, end seal, tees, splices, and crosses that will exist in the system
Installing contractor must have a 2500VDC Insulation Resistance tester (Megger)
Installation shall not start until a job site meeting attended by engineering, general contractor, electrical contractor, installing contractor
Installing contractor to record all segment info on individual circuit sheet
Require general, electrical, plumbing and insulation contractor to sign off on the HWAT testing
Require manufacturer site training, testing and start up at the beginning of the project, after first segment is installed and at completion
Manufacturer panel start up and programming
Manufacturer
Installing Contractor
Requires Coordination

ON SITE MEETING SCHEDULES AND OUTLINES

The initial project kick off meeting is extremely important to set the installation direction. Because HWAT crosses many disciplines it is important for all parties to meet at the beginning of a project to set scope and expectations. We recognize that a contractor may be hesitant to devote time to meeting about HWAT installation. They may consider the installation of heating cable as trivial in comparison to their other responsibilities on a large job. Every effort must be made to educate all the involved contractors about a proper installation. Because HWAT is a multi-discipline product it is important to coordinate all of the parties to achieve a good installation. The general contractor should provide guidance and accountability for each contractor. The best way to start this process is for the general contractor to organize and run the kick off meeting.

The people involved in the kick off meeting will be dependent on the type and size of project. When organizing the kick off meeting the general contractor should be sure and include the local nVent RAYCHEM representative and a representative of the design firm(s) to attend and make sure the design intent is properly conveyed to the contractors. Additional attendees should include the installing contractor(s) (who might be one of the following), the plumbing contractor, the electrical contractor, the insulation contractor and possibly the controls contractor if the low voltage wiring is done by a different contractor.

Each contractor's scope should be clarified and reviewed for conflict with the other trades. Power connection locations should be coordinated between the electrical, plumbing and general contractor to be sure that there are the proper number of electrical feeds to the proper locations. The general contractor must be sure that access will be available to each of the power connections and coordinate with the sheetrock contractor to be sure access doors are provided if not located in drop ceilings. Locating power connections at valves can help as access is required for pressure reducing and zone valves. Locating power connections at these valves will allow one access door to serve both the valves and the power connections.

The kick off meeting should have set the roles and responsibilities. After the Kick Off Meeting is complete a Hands-On Installation Meeting can be scheduled (this might directly follow the kick off meeting). It is important to maintain a continuity of installers throughout the project. Using multiple installers typically results in a poor installation due to lack of communication or training. In the hands-on meeting the actual installation of the heating cables will be reviewed. The Individual Circuit Sheet and its importance will also be reviewed. The hands-on meeting will include a review of the overall IO, the large building installation supplement, and review all of the individual component installation instructions. After reviewing the documentation a sample power connection kit shall be assembled and tested according to the system I/O.

Soon after the hands-on meeting is held the installation should begin. Soon after the installation has started a first segment review should be completed. The first bits of the installation should be reviewed and any deviations from the IO shall be noted on the System Correction Report Form. These system reviews shall be recorded in project file and continue through the life of the project as required.

Once all of the circuits are installed properly and fully tested (or at least a zone is) a Panel Installation Meeting can be held. The meeting shall cover the installation of the controls, including powering the units, routing and numbering of circuits, and wiring of communication and sensors. All of this information should be listed in the Overall Circuit Sheet. The units should be mounted and control power run to them prior to scheduling the training. During the meeting each controller's wiring should be checked and each address should be set. With the wiring confirmed and addresses set the controllers can be started up and programmed. The program for an ACS-30 system can be completed using the ACS-30 Integrator software. All of the settings listed in the overall circuit sheet will be incorporated into the programming. It is important to note that this programming will be based on the addresses and circuits listed on the overall circuit sheet. If the segments and circuits are not properly grouped, addressed or wired the programming will not be correct and adjusting temperatures will not be possible.

By the end of the installation the individual circuit sheets, if completed and retained, will provide a record of what tasks have been completed for each segment. During the Final Testing and Startup Meeting the nVent RAYCHEM representative and general contractor will confirm that all corrective actions have been completed and that all segments were tested to the required levels. Once the final sign off of the installation is complete the final Commissioning and Sign Off Meeting can be scheduled. During final commissioning the system will be checked for proper performance and adjustment made if required. Specific points in the system will be checked for proper temperatures and circuit adjusted if required.

Sometime after the system has been commissioned the owner/operator should be trained on system operation at the Owner/Operator Training Meeting. They should be taken through a basic description of how the system works from a plumbing standpoint, how the heating cables work and generally where power connections are located. They should be walked the system design and shown how to locate and adjust a circuit. At the close of the project a collection of all of the documentation and programming should be turned over.

CONTRACTOR ROLES AND RESPONSIBILITIES

General Contractor

Guiding and keeping track of completed work can be a big help for large buildings. Because HWAT spans several trades it is important to describe a clear delineation of scope. This can be done in the kick off meeting so roles and responsibilities are clear and understood. Review construction schedule and how the HWAT System installation and testing will impact scheduling the surrounding trades.

Each power connection point will require access. If hard ceilings will be installed concealing power connections, then access doors will be required. This is a code requirement as there is an electrical junction from heating cable to feed wire. Heating cable to heating cable junctions are approved to be behind wall as long as they are made with approved connectors. Coordinate with the sheetrock contractor to be sure access doors are provided if not located in drop ceilings. Locating power connections at valves can help as access is required for pressure reducing and zone valves. Locating power connections at these valves will one access door to serve both the valves and the power connections.

Be sure that the Installing Contractor completes ALL tests BEFORE installing insulation, ceilings or walls. The list of commissioning tests required is detailed in Sections 8 and 9 of the HWAT Installation and Operational Manual (H57548). Also see circuit sheets and meeting agendas in this guide. These should be completed and retained as the job progresses and turned over to the owner/operator at the completion of the project.

General Contractor Responsibilities

- Coordinates and keeps track of completed work and scope for large buildings.
- Describes a clear delineation of scope in the kick off meeting so roles and responsibilities are understood installing contractors responsibilities.
- Confirms ALL tests are complete BEFORE installing insulation, ceilings or walls. The list of commissioning tests required is detailed in Sections 8 and 9 of the HWAT System Installation and Operation Manual (H57548).
- Reviews construction schedule and how the nVent RAYCHEM product installation and testing will impact the surrounding trades.

Notes for the general contractor: The HWAT system should only be installed in areas where the ambient temperature will be constant and between 60°F (15°C) and 80°F (26°C) when the building is occupied. Starting up controllers as soon as possible will allow them to monitor heating cable integrity automatically.

Installing Contractor Responsibilities

- Reads all applicable installation instructions, guides and contract documents.
- Requests manufacture's training prior to installation to review project details and get hands on training on components, controls and testing.
- Installs per manufacture's project specific drawings.
- Completes individual circuit sheet throughout the process.
- Has access to a 2500 VDC insulation resistance tester and testing equipment.
- Ensures that the cable passes the insulation resistance test (Test results will have to be submitted for extended warranty to apply). See section 9 of the HWAT Installation and Operational Manual (H57548).
- Completes continuity testing on each leg of the system and notes results on circuit tag.
- Guarantees that all power connection kits are installed in accessible locations. Coordinates with electrical contractor and general contractor to be sure power connections are aligned with power points and access panels if not otherwise accessible.
- Install non-powered connection kits in accessible locations if at all possible. These connections are approved for installation behind walls but should only be done so if needed.

Plumbing Contractor Responsibilities

- Completes the pipe installation and testing prior to installation of heating cable.
- Alerts project team if layout does not match project documents. (this could significantly impact HWAT circuiting).
- Ensures that pipes are thermally isolated from pipe supports.
- Indicates if any pipes will operate at or above 185°F (HWAT is not rated for this).
- Marks the pipes to receive HWAT heating cable.
- Makes sure that the main mixing valve is compatible with low/no flow systems.
- Makes provisions for expansion in isolated sections such as after a pressure reducing valve.
- Flushes domestic water system and tests for cold to hot water cross connections before HWAT system is commissioned.

Electrical Contractor Responsibilities

- Coordinates with installing contractor (if not the electrical contractor) to be sure circuit runouts match with power connection locations.
- Labels all wiring entering controllers as per overall circuit sheet for proper operation.
- Each device shall have a discrete address.
- When using the ACS-30 system standard breaker may feed the HWAT circuits.
- Provide control power as required including but not limited to the ACS-UIT and the ACS-RMM.
- Make final connections to heating cable.

Low Voltage Contractor Responsibilities

- Provides and installs communications and sensor wiring (if not the electrical contractor).
- RS-485 wire shall be Belden #8761 or Carol # C2514 (2) wire shielded, 22AWG distance shall not exceed 4000').
- Devices may be "daisy chained" in any order but must be in a straight line, no tees.
- RTD wire shall be Belden # 8771 or Carol # C2526 conductor (3-conductor, 22AWG shielded cable of 20 ohm maximum per conductor).

Insulating Contractor Responsibilities

- Insulates pipes with the correct amount of insulation to maintain desired pipe temperatures.
- The HWAT system will NOT perform correctly if the following chart is not followed:

Fiberglass Insulation Selection

Copper pipe size (in)	IPS insulation size (in)	Insulation (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 1: 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.

Note 2: All insulation thickness are based on the R-value of fiberglass insulation. If insulation other than fiberglass is being used, it must be 1) fire-resistant, 2) an equivalent R-value and 3) must be compatible with the maximum exposure temperature of the heat tracing system. For further assistance, please contact your nVent representative or nVent Technical Support directly at (800) 545-6258.

Table 1: Fiberglass Insulation Selection

Note: Adjustments can be made to this schedule if it is accounted for in the design of the electrical circuiting. DO NOT change insulation thickness or type without informing the design team and the local nVent RAYCHEM representative. Enlist the help of Technical Support for any deviations from this insulation schedule.

Suggested Meetings

Meeting	Attendees	Required Documents
Kick Off	nVent RAYCHEM representative, engineer, general contractor, plumbing contractor, insulating contractor, controls contractor	DWGs, Specification, HWAT IO, HWAT Large Building Design & Installation Supplement (this document) for large buildings, and Sign Off Sheet
Hands-On Installation	nVent RAYCHEM representative, general contractor, plumbing contractor, installing contractor (this might be the plumber, electrical or some independent contractor such as the controls contractor)	Bring and mount the Individual Circuit Sheet for that segment, Installer must bring 2500Vdc Megger, DWGs, Specification, HWAT IO, HWAT IO Supplement (this document) for large buildings, and Sign Off Sheet
First Segment Review	nVent RAYCHEM representative, installing contractor, general contractor	Fill in the appropriate line on the Individual Circuit Sheet, Installer must bring 2500Vdc Megger and Multimeter capable of reading Ohms and Capacitance, System Correction Report Form, and Sign Off Sheet
Intermediate Review (There could be several of these throughout a large project.)	nVent RAYCHEM representative, installing contractor, general contractor	Fill in the appropriate line on the Individual Circuit Sheet, Installer must bring 2500Vdc Megger and Multimeter capable of reading Ohms and Capacitance, System Correction Report Form, and Sign Off Sheet
Panel Installation	nVent RAYCHEM representative, electrical contractor, installing contractor, general contractor	Boxes mounted in proper location with power and sensor wires run to the panel(s),Controls Schematic, Overall Project Circuit Sheet, Multimeter, and Sign Off Sheet
Final Commissioning & Sign Off	nVent RAYCHEM representative, general contractor, electrical contractor, controls contractor	Fill in the appropriate line on the Individual Circuit Sheet, Installer must bring 2500Vdc Megger and Multimeter capable of reading Ohms and Capacitance, and Sign Off Sheet
Temperature Testing	nVent RAYCHEM representative, engineering contractor, general contractor, electrical contractor, controls contractor	Do not run water in the system 10 hours before the temperature test. Be sure the DHW system can provide the proper temperature water, be sure the mixing valve has been fully tested and adjusted. Follow the temperature testing procedure outlined in the HWAT IO and fill in the Hot Water Temperature Survey
Owner/Operator Training	nVent RAYCHEM representative, engineer, general contractor, plumbing contractor, installing contractor, owner/operator	HWAT Large Building Design & Installation Supplement (this document), HWAT System IO and completed project documents.

See HWAT Installation and Operational Manual (H57548), Sample Tables and Drawings, Sample Agendas.

ONSITE MEETING SCHEDULE AND OUTLINES

Onsite Meetings Schedules

Large building installations are complex and require cross-disciplinary collaboration. As such, a successful HWAT installation is the result of a series of onsite project meetings every step of the way.

1. Kick off Meeting

2. Hands-On Installation Meeting

3. First Segment Review Meeting

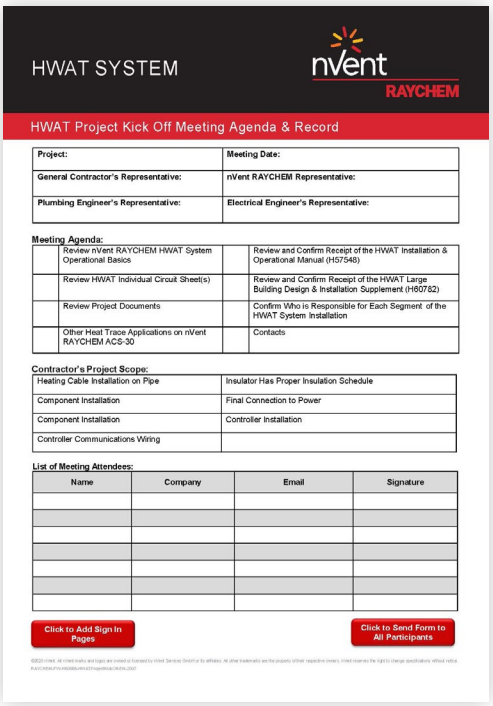
4. Intermediate Review Meeting

5. Panel Installation Meeting

6. Final Commissioning & Sign Off Meeting

7. Temperature Testing

8. Owner/Operator Training



HWAT SYSTEM

nVent RAYCHEM

HWAT Project Kick Off Meeting Agenda & Record

Project:	Meeting Date:
General Contractor's Representative:	nVent RAYCHEM Representative:
Plumbing Engineer's Representative:	Electrical Engineer's Representative:

Meeting Agenda:

	Review nVent RAYCHEM HWAT System Operational Basics		Review and Confirm Receipt of the HWAT Installation & Operational Manual (H57546)
	Review HWAT Individual Circuit Sheet(s)		Review and Confirm Receipt of the HWAT Large Building Design & Installation Supplement (H60782)
	Review Project Documents		Confirm Who is Responsible for Each Segment of the HWAT System Installation
	Other Heat Trace Applications on nVent RAYCHEM ACS-30		Contacts

Contractor's Project Scope:

Heating Cable Installation on Pipe	Insulator Has Proper Insulation Schedule
Component Installation	Final Connection to Power
Component Installation	Controller Installation
Controller Communications Wiring	

List of Meeting Attendees:

Name	Company	Email	Signature

Click to Add Sign In Pages

Click to Send Form to All Participants

Click to open

Meeting Outlines

Kick Off Meeting

For most large HWAT projects the general contractor should schedule and officiate the kick off meeting. The local nVent RAYCHEM representative and a representative of the design firm should be in attendance to make sure the design intent is properly conveyed to the contractors. Additional attendees should include the installing contractor (who might be one of the following), the plumbing contractor, the electrical contractor, the insulation contractor and possibly the controls contractor if the low voltage wiring is done by a different contractor.

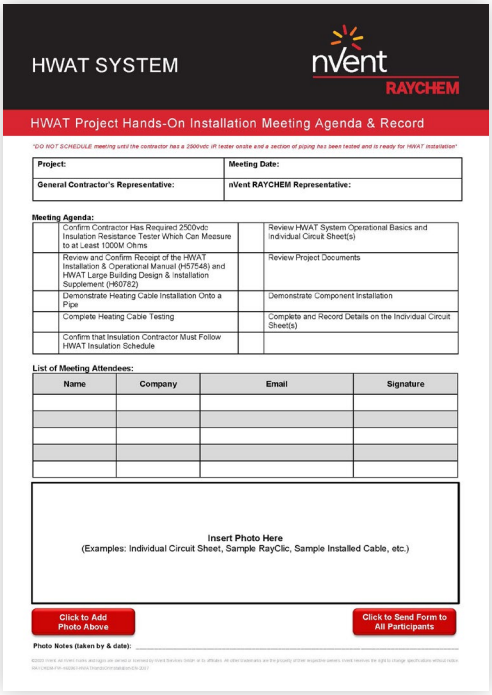
Each contractor's scope should be clarified and reviewed for conflict with the other trades. Power connection locations should be coordinated between the electrical, plumbing and general contractor to be sure that there are the proper number of electrical feeds to the proper locations. The general contractor must be sure that access will be available to each of the power connections and coordinate with the sheetrock contractor to be sure access doors are provided if not located in drop ceilings. Locating power connections at valves can help as access is required for pressure reducing and zone valves. Locating power connections at these valves will one access door to serve both the valves and the power connections.

The people involved in the kick off meeting will be dependent on the type and size of project. When organizing the kick off meeting the general contractor should be sure and contact the local nVent RAYCHEM representative and a representative of the design firm(s) to attend and make sure the design intent is properly conveyed to the contractors. Additional attendees should include the installing contractor (who might be one of the following), the plumbing contractor, the electrical contractor, the insulation contractor and possibly the controls contractor if the low voltage wiring is done by a different contractor.

Each contractor's scope should be clarified and reviewed for conflict with the other trades. Power connection locations should be coordinated between the electrical, plumbing and general contractor to be sure that there are the proper number of electrical feeds to the proper locations. The general contractor must be sure that access will be available to each of the power connections and coordinate with the sheetrock contractor to be sure access doors are provided if not located in drop ceilings. Locating power connections at valves can help as access is required for pressure reducing and zone valves.

Hands-On Installation Meeting

Contractor must have a 2500 vdc insulation resistance tester capable of reading to at least 1000m ohms. IR testing is analogous to pressure testing a pipe. An IR tester is the only way to confirm there is no damage to a heating cable. After confirming the contractor has everything required for an installation schedule a training date. The plumbing contractor must mark which pipes are to be traced prior to the meeting. It makes sense to do the training on an actual section of pipe if timing allows.



HWAT SYSTEM

nVent RAYCHEM

HWAT Project Hands-On Installation Meeting Agenda & Record

"DO NOT SCHEDULE meeting until the contractor has a 2500vdc IR tester onsite and a section of piping has been tested and is ready for HWAT installation"

Project:	Meeting Date:
General Contractor's Representative:	nVent RAYCHEM Representative:

Meeting Agenda:

	Confirm Contractor Has Required 2500vdc Insulation Resistance Tester Which Can Measure to at Least 1000M Ohms		Review HWAT System Operational Basics and individual Circuit Sheet(s)
	Review and Confirm Receipt of the HWAT Installation & Operational Manual (H57548) and HWAT Large Building Design & Installation Supplement (H60782)		Review Project Documents
	Demonstrate Heating Cable Installation Onto a Pipe		Demonstrate Component Installation
	Complete Heating Cable Testing		Complete and Record Details on the Individual Circuit Sheet(s)
	Confirm that Insulation Contractor Must Follow HWAT Insulation Schedule		

List of Meeting Attendees:

Name	Company	Email	Signature

Insert Photo Here
(Examples: Individual Circuit Sheet, Sample RayClic, Sample Installed Cable, etc.)

Click to Add Photo Above

Click to Send Form to All Participants

Photo Notes (taken by & date): _____

Click to open

The training should start with a review of the Project documents, the individual circuit sheet, the HWAT Installation and Operation manual and the HWAT Installation supplement for Large Buildings. After reviewing the documentation take out the individual circuit sheet for the circuit/segment to be installed. Show the individual sections that make up that particular segment. If this segment will be grouped with others discuss the importance of not exceeding the maximum circuit length with the combined total footage of all the connected segments. This is a good time to discuss what the planned pace of the project is and how they plan to proceed. Point out that it is best to have the same people install the whole system. The people being trained should be the ones to complete the whole install. If personnel.

Walk the run and review things like floor and wall penetrations, tees and Hangers. Discuss where the reel should be located and how the cable will be pulled and if the entire circuit/segment can be installed. If, due to construction constraints, the whole run cannot be installed discuss where the cable segments will start and stop and how the ends will be protected until the installation is complete.

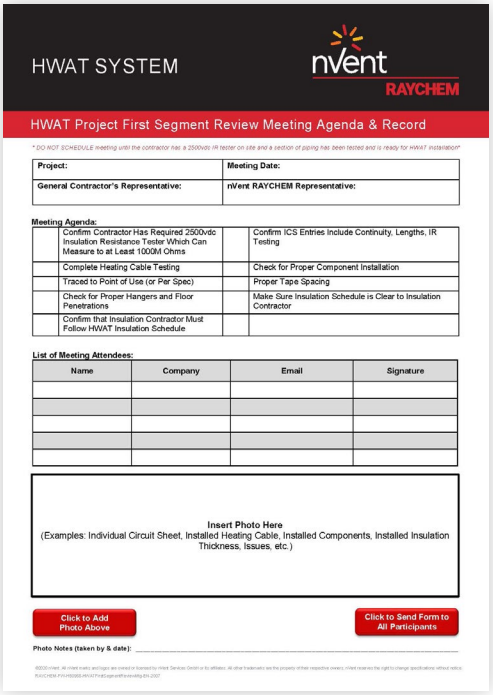
Demonstrate the installation of the heating cable onto the pipe and install a power connection and splice/tee as required.

After completing the heating cable install review cable testing. Be sure to point out the importance of continuity testing in confirming that the components are properly installed. Review completing and recording the individual circuit sheet in playbook. Be sure to add the readings and footage for each section. Discuss how the individual circuit sheet will be used in future and fasten it to the pipe at the power connection.

First Segment Review

In the first segment review meeting the nVent RAYCHEM representative or field sales support person will be reviewing the work done since the hands-on meeting. Each step of the IO should be checked in the field for compliance. This visit will set the direction for the future so the reviewer should be extra critical during this visit. The circuit should be tested for IR, continuity and capacitance. The whole heating cable run should be visually inspected looking to be sure it is properly secured, hangers and penetrations are proper and to be sure that the run extends to the point of use or as directed in the contract documents. Each component should be inspected and checked for access. Each non-compliant detail should be noted in the System Correction Report Form.

Confirm that the related trades have all the required information. Make sure the insulation contractor knows the insulation schedule. Confirm the electrician knows where the power connections are located and has coordinated with the general contractor to supply access panels as required. Preview the upcoming work to be sure the installer has a clear plan for the next circuits and where they will be located and run.



HWAT SYSTEM

nVent RAYCHEM

HWAT Project First Segment Review Meeting Agenda & Record

Project:	Meeting Date:
General Contractor's Representative:	nVent RAYCHEM Representative:

Meeting Agenda:

	Confirm Contractor Has Required 2500vdc Insulation Resistance Tester Which Can Measure to at Least 1000M Ohms		Confirm ICS Entries Include Continuity, Lengths, IR Testing
	Complete Heating Cable Testing		Check for Proper Component Installation
	Traced to Point of Use (or Per Spec)		Proper Tape Spacing
	Check for Proper Hangers and Floor Penetrations		Make Sure Insulation Schedule is Clear to Insulation Contractor
	Confirm that Insulation Contractor Must Follow HWAT Insulation Schedule		

List of Meeting Attendees:

Name	Company	Email	Signature

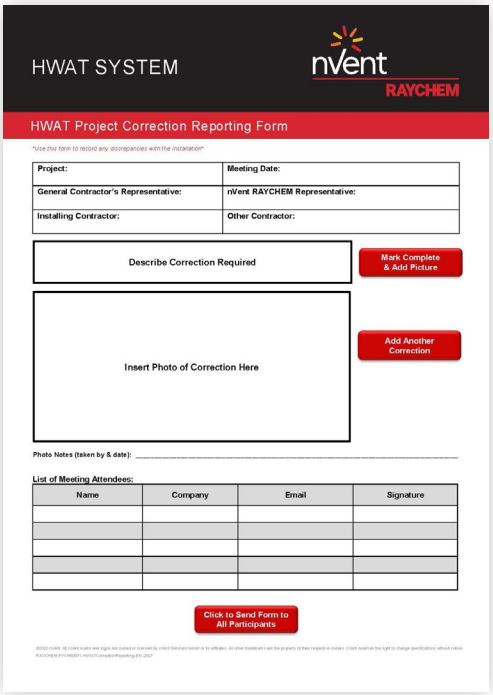
Insert Photo Here
(Examples: Individual Circuit Sheet, Installed Heating Cable, Installed Components, Installed Insulation Thickness, Issues, etc.)

Click to Add Photo Above

Click to Send Form to All Participants

Photo Notes (taken by & date): _____

Click to open



HWAT SYSTEM

nVent RAYCHEM

HWAT Project Correction Reporting Form

Project:	Meeting Date:
General Contractor's Representative:	nVent RAYCHEM Representative:
Installing Contractor:	Other Contractor:

Describe Correction Required

Mark Complete & Add Picture

Insert Photo of Correction Here

Add Another Correction

Photo Notes (taken by & date): _____

List of Meeting Attendees:

Name	Company	Email	Signature

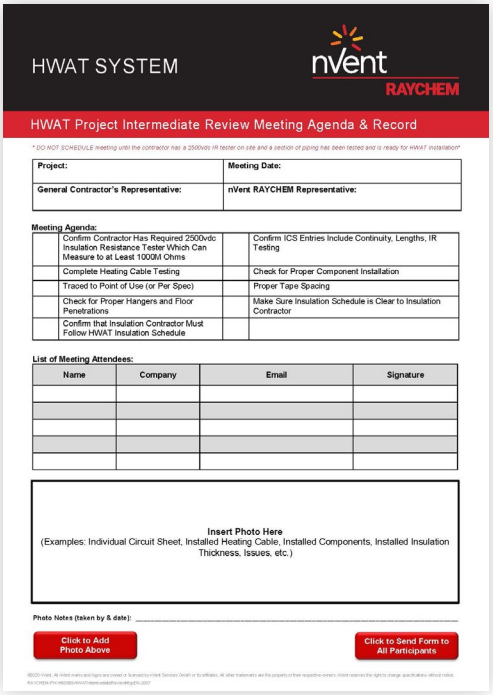
Click to Send Form to All Participants

Click to open

Intermediate Review

The intermediate reviews are what keep the project on track. More frequent reviews will help keep the project on track. The nVent RAYCHEM representative, the installer and general contractor should review the installation via phone at least weekly to be sure that the project stays on track and if more intermediate visits are required. For the intermediate review, nVent RAYCHEM representative or field sales support should conduct the review with the installer and general contractor. Note that each step of the IO should be checked in the field for compliance. Each circuit should be tested for IR, continuity and capacitance. Each heating cable run should be visually inspected looking to be sure it is properly secured, hangers and penetrations are proper and to be sure that the run extends to the point of use or as directed in the contract documents. Each component should be inspected and checked for access. Each non-compliant detail should be noted in the System Correction Report Form.

Confirm that the related trades have all the required information. Insulation contractor knows the insulation schedule. The electrician knows where the power connection is, the general contractor will supply access panels as required. Preview the upcoming work to be sure the installer has a clear plan for the next circuits and where they will be located and run.



HWAT SYSTEM

nVent RAYCHEM

HWAT Project Intermediate Review Meeting Agenda & Record

Project:	Meeting Date:
General Contractor's Representative:	nVent RAYCHEM Representative:

Meeting Agenda:

	Confirm Contractor Has Required 2500vdc Insulation Resistance Tester Which Can Measure to at Least 1000M Ohms		Confirm ICS Entries Include Continuity, Lengths, IR Testing
	Complete Heating Cable Testing		Check for Proper Component Installation
	Traced to Point of Use (or Per Spec)		Proper Tape Spacing
	Check for Proper Hangers and Floor Penetrations		Make Sure Insulation Schedule is Clear to Insulation Contractor
	Confirm that Insulation Contractor Must Follow HWAT Insulation Schedule		

List of Meeting Attendees:

Name	Company	Email	Signature

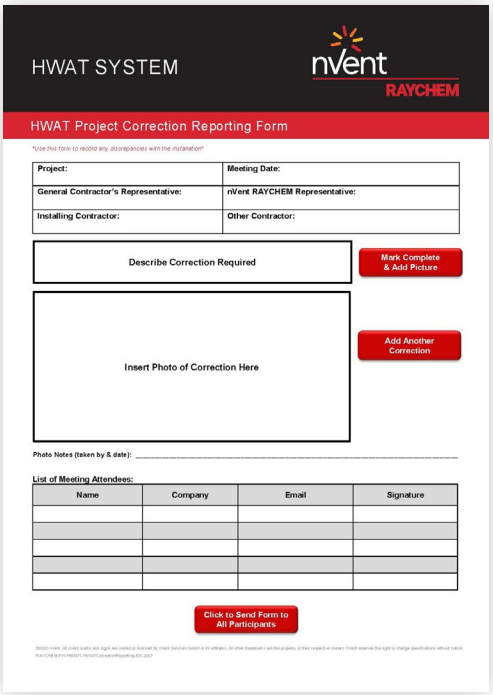
Insert Photo Here
(Examples: Individual Circuit Sheet, Installed Heating Cable, Installed Components, Installed Insulation Thickness, Issues, etc.)

Photo Notes (taken by & date): _____

Click to Add Photo Above

Click to Send Form to All Participants

Click to open



HWAT SYSTEM

nVent RAYCHEM

HWAT Project Correction Reporting Form

Project:	Meeting Date:
General Contractor's Representative:	nVent RAYCHEM Representative:
Installing Contractor:	Other Contractor:

Describe Correction Required

Mark Complete & Add Picture

Insert Photo of Correction Here

Add Another Correction

Photo Notes (taken by & date): _____

List of Meeting Attendees:

Name	Company	Email	Signature

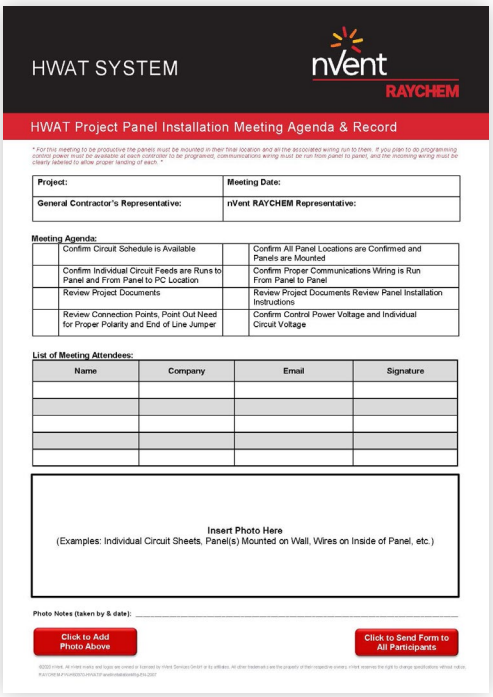
Click to Send Form to All Participants

Click to open

Panel Installation

The panel installation meeting is intended to go over where to land the wiring and how to program controllers. For this meeting to be productive the panels must be mounted in their final location and all the associated wiring run to them. If there will be programming, control power must be available at each controller to be programed, communications wiring must be run from panel to panel, and the incoming wiring must be clearly labeled to allow proper landing of each.

The circuit spreadsheet must be available and each panel must be ready for wires to be landed. When the circuits have passed final testing the wire can be landed per the project HWAT drawings. Once landed, the controllers can be started. Heating cables that have not been/passed testing can be left off and the controller started if desired. These circuits must be repaired prior to landing in panel. Leaving out untested/damaged circuits can allow testing of communications and initial programming if desired. If all circuits are not ready and the controllers cannot be fully started and programmed.



HWAT SYSTEM

nVent RAYCHEM

HWAT Project Panel Installation Meeting Agenda & Record

Project:	Meeting Date:
General Contractor's Representative:	nVent RAYCHEM Representative:

Meeting Agenda:

	Confirm Circuit Schedule is Available		Confirm All Panel Locations are Confirmed and Panels are Mounted
	Confirm Individual Circuit Feeds are Runs to Panel and From Panel to PC Location		Confirm Proper Communications Wiring is Run From Panel to Panel
	Review Project Documents		Review Project Documents Review Panel Installation Instructions
	Review Connection Points, Point Out Need for Proper Polarity and End of Line Jumper		Confirm Control Power Voltage and Individual Circuit Voltage

List of Meeting Attendees:

Name	Company	Email	Signature

Insert Photo Here
(Examples: Individual Circuit Sheets, Panel(s) Mounted on Wall, Wires on Inside of Panel, etc.)

Photo Notes (taken by & date): _____

Click to Add Photo Above

Click to Send Form to All Participants

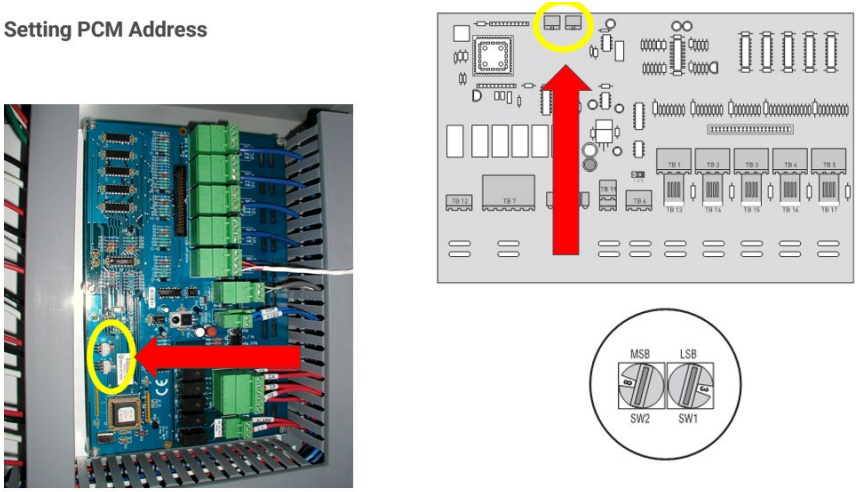
Click to open

Note: Any circuits which are not adequately marked, missing or extra. Also note any communications issues. These must all be resolved before the panels can be fully programmed and commissioned.

As a supplement to the HWAT Installation and Operational Manual (H57548), the following are some typical controls issue that are seen:

Setting Component Addresses

- In a Modbus based system each component must have a unique address. The following shows how to set the address of an ACS-PCM. Please consult the C910-485 Installation, Operation, and Maintenance Manual (H58415), ACS-30 Programing Guide (H58692) and ACS-PCM2-5 Power Control Module Installation Instructions (H58672) to set their addresses.



Each ACS-PCM2-5 must be powered up and given a specific address which matches the address assigned during the integrator setup.

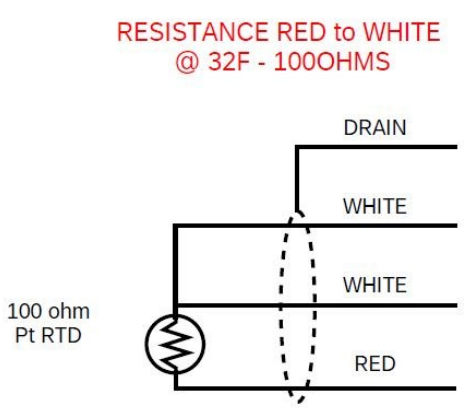
Click to enlarge

Troubleshooting an RTD

Controllers read resistance of an RTD to interpret temperature. Resistance is read across a ball of solder. This solder changes resistance with temperature. The resistance is known and is described by the table. A three wire RTD uses a third wire to adjust for lead length. Two wires are attached on one side of the ball of solder and are used for subtracting out lead resistance. This allows for long lead lengths without the need for calibration.

Readings taken from white to white should only show the lead length (1-3 ohms). The reading between each white (sense) and the red (common or source) should be the resistance in the table for the RTD temperature plus that of the lead resistance.

Note: Some manufacturers may use red, red white or other color combinations for the same type of device.



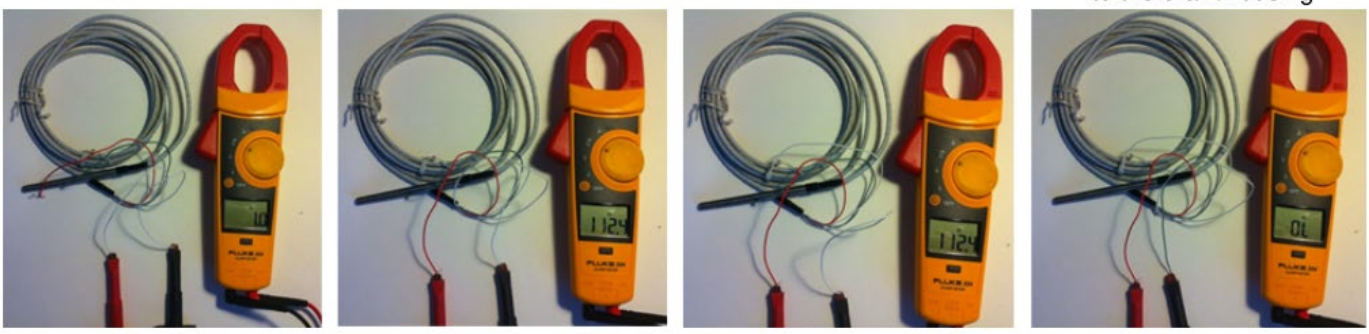
Ohms	°F	°C
100	32	0
101.95	41	5
103.9	50	10
105.85	59	15
107.79	68	20
109.73	77	25
111.67	86	30
113.61	95	35
115.54	104	40
117.47	113	45
119.4	122	50
121.32	131	55
123.24	140	60
125.16	149	65
127.07	158	70

Click to enlarge

White to White
low resistance equal to ohms.ft of lead wires

Each White to Red
reading should match omhs on chart at the expected temperature of the RTD being measured. This example 112 ohms equals 90F

All to Drain
Each wire to the drain should read open. Any ohms read indicate a short to the drain/housing



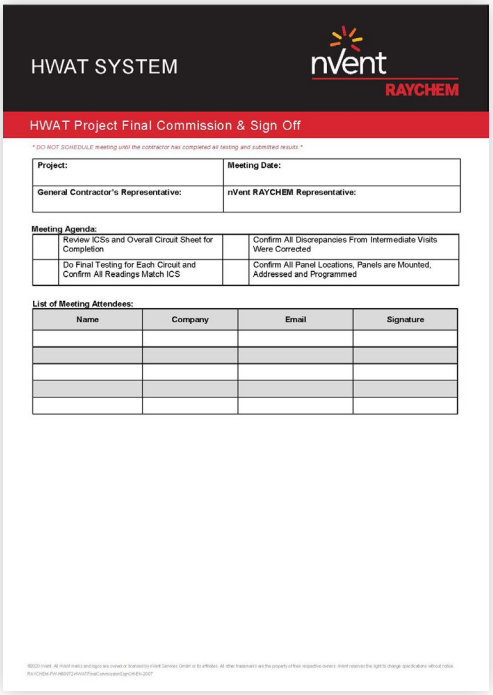
Click to enlarge

Final Commissioning & Sign Off Meeting

The final sign off should be a formality to confirm that all readings listed on the Individual Circuit Sheets are correct and still valid. The controllers should be checked for proper operation and complete programming. At this point the programming should be completed and all equipment in place and operational. The final commissioning is intended to confirm that the system has indeed been installed as designed and as described on the Overall Circuit Sheet.

This is a time for third party confirmation of final insulation resistance readings which can then be submitted for an extended warranty. Once all circuits are completed, tested and signed off the system should be operational.

Once the final commissioning is complete a temperature test should be done at strategic locations to confirm proper temperatures are being maintained. If the building is occupied and water is being used for cleaning the testing should be done early in the morning prior to use so that only water that is maintained by the HWAT system will be seen. See the temperature testing procedure and the temperature log sheet for recording data.



HWAT SYSTEM

nVent RAYCHEM

HWAT Project Final Commission & Sign Off

DO NOT SCHEDULE meeting until the contractor has completed all testing and submitted results.

Project:	Meeting Date:
General Contractor's Representative:	nVent RAYCHEM Representative:

Meeting Agenda:

	Review ICSs and Overall Circuit Sheet for Completion		Confirm All Discrepancies From Intermediate Visits Were Corrected
	Do Final Testing for Each Circuit and Confirm All Readings Match ICS		Confirm All Panel Locations, Panels are Mounted, Addressed and Programmed

List of Meeting Attendees:

Name	Company	Email	Signature

Click to open

Heat Trace Commissioning Table Project Name: _____ Date: _____ Weather Conditions: _____

Descr-iption	Cable Part #	Serial or Batch #	Length (ft or m)	Breaker	Breaker Size	Panel #	Circuit #	Continu-ity (Ω)	Capacit-ance (nF)	Insulation Resistance (GΩ)			Load (A)	Notes
										500V	1000V	2500V		

Click to open

Temperature Testing

Temperature testing is described in the HWAT IO. When testing an HWAT System for temperatures it is important to test in an appropriate sequence. It is also important to test BEFORE any water is used for the day. Be sure to measure water that was maintained overnight by the HWAT system not water that may have just been drawn off of the water heater or perhaps through an inadvertent cross over. Be sure that the building temperature input into the program matches the actual building temperature during testing.

Before testing confirm the water temperature at the water heater and at the main mixing valve and record these temperatures. Check the ACS-30 temperature monitoring to see if any alarms have been registered. If there are temperature alarms these should be addressed, and the water allowed to normalize overnight, before doing testing.

Testing should start at the point of use closest to the water heater and progress out. Testing should be done after a minimum of 4 hours of no water usage. It is a good idea to turn off all cold water valves to eliminate the possibility of introducing cold water to the hot side via a cross connection. The following example illustrates a typical temperature test sequence for an HWAT System. Water should be measured with a direct contact thermometer right in the water flow. Try to test at fixtures that have two handles so that handle settings, or valve cross over, will not be a factor.

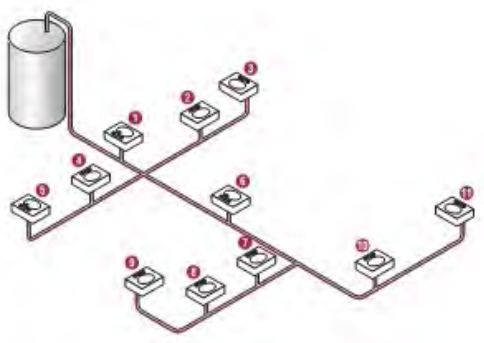


Figure 12: Typical Temperature Test Sequence

Water temperature survey

Project _____ Date _____
Location _____ Start Time _____
Site Contact _____ End Time _____

Room	GPM	start	15 sec	30 sec	45sec	1min	1.5min	2min	3min	3min	4min	4min	5min	notes

Click to open

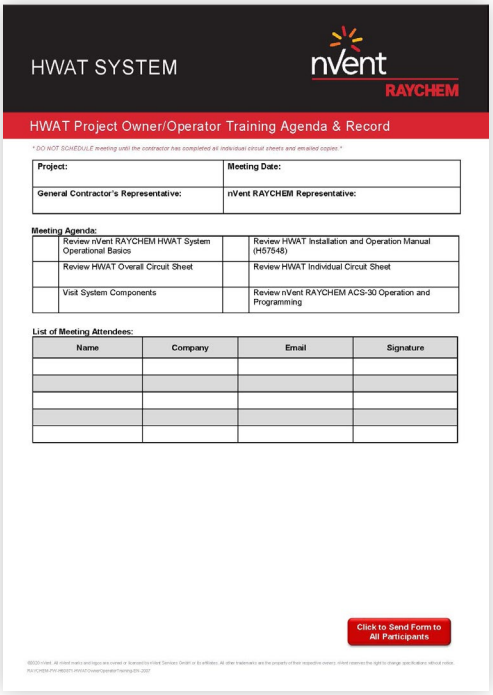
Owner/Operator Training

Review HWAT System Operational Basics

The HWAT system consists of a heating cable ran parallel to the hot water pipe and insulated with a specific thickness of fiberglass insulation. This heating cable is cycled on and off to maintain a specific temperature in the line at a given ambient temperature. HWAT is not intended to heat the water, it is only intended to keep the water at temperature in the piping system.

The HWAT Installation and Operation manual reviews installation but also reviews testing and troubleshooting. Review this manual and the testing to the information on the completed Individual Circuit Sheets. Review the overall circuit sheet to convey the overall system extent and design. Visit each component and describe each system part and show the related literature.

Review the ACS-30 System at the ACS-UIT-2. This is where operation and programming are reviewed. Show how the saved program can be loaded and saved and how it can be manually changed at the UIT. Step through each screen to show where setting are located and how they can be changed.



HWAT SYSTEM

nVent RAYCHEM

HWAT Project Owner/Operator Training Agenda & Record

* DO NOT SCHEDULE meeting until the contractor has completed all individual circuit sheets and emailed copies *

Project:	Meeting Date:
General Contractor's Representative:	nVent RAYCHEM Representative:

Meeting Agenda:

	Review nVent RAYCHEM HWAT System Operational Basics		Review HWAT Installation and Operation Manual (H57548)
	Review HWAT Overall Circuit Sheet		Review HWAT Individual Circuit Sheet
	Visit System Components		Review nVent RAYCHEM ACS-30 Operation and Programming

List of Meeting Attendees:

Name	Company	Email	Signature

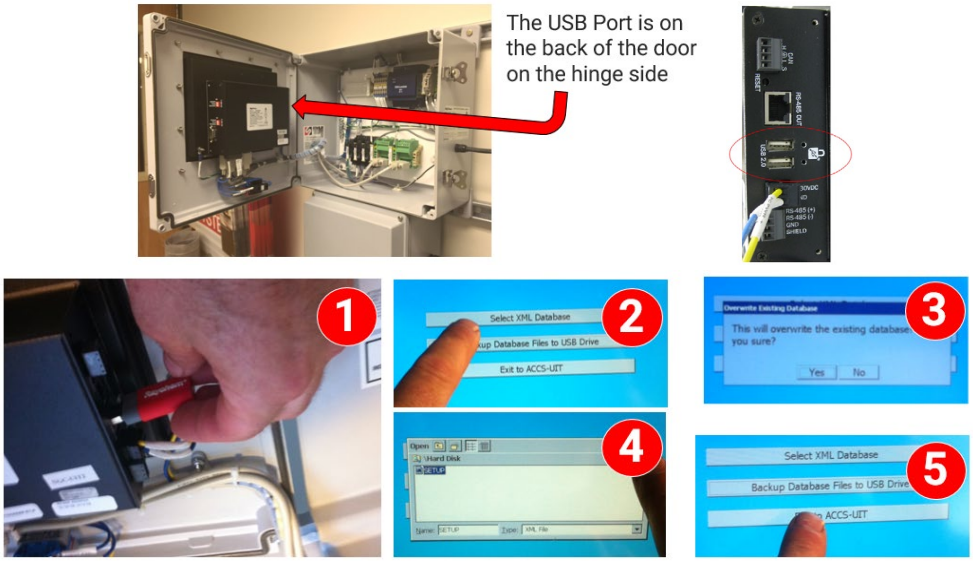
Click to Send Form to All Participants

Click to open

It is important to point out that the proper temperature water must be fed into the piping system or the output temperature will not be correct. Locate the mixing valve and water heaters. Also note that cross connection will impact water temperatures. It is sometimes possible to find issues by analyzing water temperatures over time. If you know the water flow rate and measure the time it takes to get hot water you can calculate how far away the issue is. From flow rate and time you can calculate the volume of water run out. If you know the pipe size(s) you can use this volume to calculate how far away from the fixture the “problem is”.

FINAL PROGRAMMING SETTINGS

Download final ACS setting onto a jump drive and distribute to contractor and owner. See complete instructions in the ACS-30 Program Integrator Guide (H58325).



Click to enlarge

TROUBLESHOOTING

Building Manager steps to troubleshoot HWAT DHW system.

Note that the HWAT system is only meant to replace the heat lost through the insulation. The will maintain the water in the pipe at temperature. The water heater is what brings the water to temperature originally. Only the first volume of water out of the pipe is maintained by the HWAT. Once water is run hot water from the DHW heater enters the system.

When troubleshooting it is important to understand the flow of water through the system. If there is an issue with the HWAT system the water first out of the tap will be cold. Cold water from a improperly set/operating main mixing valve, and/or water heater, will not be seen until the whole volume of the piping system is emptied. Evaluating the water temperature over time will give an indication of what part of the DHW system may be at issue.

Problem Seen	Possible Issue and step(s) to take
The water starts hot then goes cold	HWAT system (or at least the part closest to the fixture) is working. Check Water heater and main mixing valve.
You only get lukewarm water or it fluctuates	The local or main mixing valve may be malfunctioning, or a cross connection to cold may exist. Check to see water going into system is at the right temperature. If correct look for a cross connection
Note: A cross connection can sometimes be seen by turning off the hot water to a section and seeing if pressure remains on the hot side of the faucet. If other fixtures served by the same pipe are ok then it may be the individual fixture showing the problem. Turn of cold supply to fixture and see if the problem goes away.	
You get water after a short time	The last section of DHW piping not traced or tee for last section not properly connected. Refer to drawings
It takes a long time to get hot water	An entire HWAT circuit may be off. Check for power at controller.
Water never gets hot	Main mixing valve is not properly adjusted or water heater is not sending hot water and the HWAT System is not on

SECTION 4:
TOOLS & PROJECT FORMS

Tools

Online Design Tool

The Trace-Calc Pro for Buildings tool lets you create a design project that can contain multiple applications, multiple circuits, and multiple pipe segments with different design parameters on a single circuit.

- Generate summary and BOM quickly
- Save your projects for future use
- Access the online tool from our website

Specifications/CAD Drawings

Downloaded latest nVent RAYCHEM specifications and detail drawings on our partner portals:

- CADdetails
- MasterSpec

Bim Design & Modeling Tools

Trace-It Add-In

The new nVent RAYCHEM Trace-It 2.0 add-in enables designers working in Autodesk Revit to design, calculate and specify reliable, high quality heat tracing solutions directly and quickly within their BIM models.

- Calculate and specify heat tracing designs within BIM models
- Download Trace-It on Autodesk App store

BIM Families

- nVent RAYCHEM provides a suite of BIM families to help designers incorporate heat tracing systems into their BIM designs.
- Download our latest heat tracing families for AutoDesk Revit
- Learn more about BIM on our website

Project Forms

The following forms are embedded in the pages that follow for reference, but can also be downloaded by clicking the links or actual images:

1. Overall Project and Individual Circuit Sheets
2. Kick Off Meeting Agenda & Record
3. Hands-On Installation Meeting Agenda & Record
4. First Segment Review Meeting Agenda & Record
5. Intermediate Review Meeting Agenda & Record
6. System Correction Report Form
7. Panel Installation Meeting Agenda & Record
8. Final Testing & Start Up
9. Final Commissioning & Sign Off Meeting Form
10. Owner/Operator Training Agenda & Record

OVERALL PROJECT AND INDIVIDUAL CIRCUIT SHEETS

HWAT Project Circuit Sheet

	Circuit description (i.e. serves pipes x,y,z)	Operating temp	segment 1	segment 2	segment 3	segment 4	Design length	# tees	# crosses	PCM #	Relay #	PCM Location	PC Location	Panel Name	Circuit breaker #	CB Amp Rating	Voltage
1	Express and Amenities	115	210				210			1	1	Elec Room 201	Hall outside 205			30	208
2	2nd Floor Distribution	115	475				475	2		1	2	Elec Room 201	Hall outside 218			30	208
3	Riser 46,35,16	115	150	100	130		380			1	3	Elec Room 201	Hall outside 207			30	208
4	Riser 16,37,3,33	115	125	100	130	110	465	1		1	4	Elec Room 201	Hall outside 213			30	208
5	Riser 5,30,32A,42	115	95	95	105	95	390			2	1	Elec Room 201	Hall outside 213			30	208
	ZONE 2																
6	22 Floor Distribution	115	160				160	3		4	1	Elec Room 2203	Hall outside 2205			30	208
7	Riser 20,40,31	115	140	170	165		475			4	2	Elec Room 2203	Hall outside 2218			30	208
8	Riser 35,21,1A	115	185	160	130		475			4	3	Elec Room 2203	Hall outside 2207			30	208
9	Riser 39,39B,39A	115	135	195	135		465			4	4	Elec Room 2203	Hall outside 2213			30	208
10	Riser 43,38,38A	115	175	160	130		465			5	1	Elec Room 2203	Hall outside 2213			30	208
	Installed by	A1 Electric															
	Local Rep Contact	Rep Kings	860-904-1234														

Click to open

Segment ID	1	Op temp	115	Design ft	210		#tees	0	#Cross	0			
Serving	Express and Amenities												
PCM	1	Address	1	Ctrl Loc.	Elec Room 201		PC Loc.	Hall outside 205					
Panel	0		CB# 0	rating (A)	30		Voltage	208					

Meter mark						Continuity(ohms)		Cap (nf)	Insulation Resistance			Sensor#	GC	DATE
begin	end	length(m)	Length(ft)	Tees	Cross	core	braid	nf	500vdc	1000vdc	2500vdc	(if used)	Signature	
			0											
			0											
			0											
			0											
			0											
			0											
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			0											
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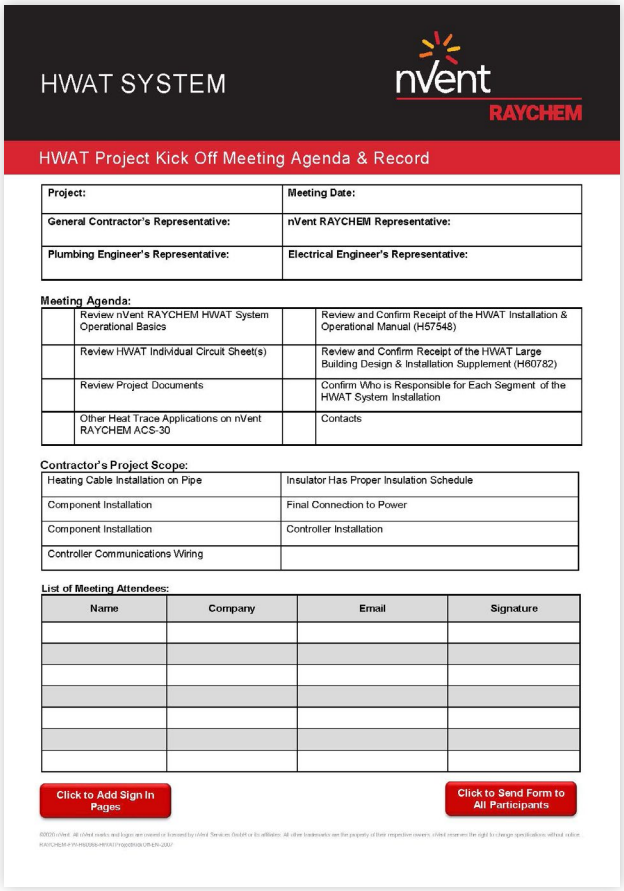
		0	0									Final		
Installed by		A1 Electric												
Local Rep Contact		Rep Kings												

Click to open

MEETING AGENDA AND RECORD FORMS



HWAT SYSTEM

nVent RAYCHEM

HWAT Project Kick Off Meeting Agenda & Record

Project:	Meeting Date:
General Contractor's Representative:	nVent RAYCHEM Representative:
Plumbing Engineer's Representative:	Electrical Engineer's Representative:

Meeting Agenda:

	Review nVent RAYCHEM HWAT System Operational Basics		Review and Confirm Receipt of the HWAT Installation & Operational Manual (H57548)
	Review HWAT Individual Circuit Sheet(s)		Review and Confirm Receipt of the HWAT Large Building Design & Installation Supplement (H60782)
	Review Project Documents		Confirm Who is Responsible for Each Segment of the HWAT System Installation
	Other Heat Trace Applications on nVent RAYCHEM ACS-30		Contacts

Contractor's Project Scope:

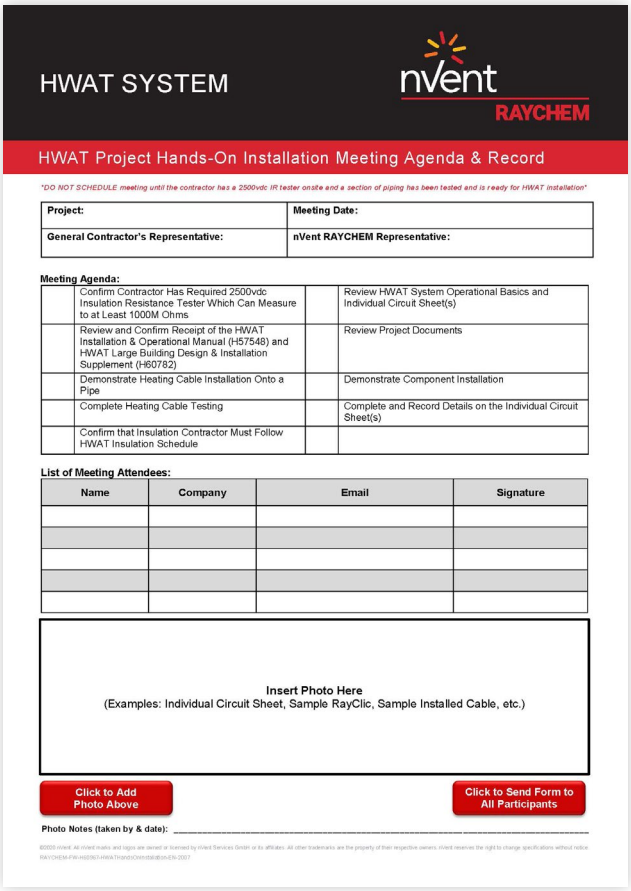
Heating Cable Installation on Pipe	Insulator Has Proper Insulation Schedule
Component Installation	Final Connection to Power
Component Installation	Controller Installation
Controller Communications Wiring	

List of Meeting Attendees:

Name	Company	Email	Signature

Click to Add Sign In Pages

Click to Send Form to All Participants



HWAT SYSTEM

nVent RAYCHEM

HWAT Project Hands-On Installation Meeting Agenda & Record

"DO NOT SCHEDULE meeting until the contractor has a 2500vdc IR tester onsite and a section of piping has been tested and is ready for HWAT installation"

Project:	Meeting Date:
General Contractor's Representative:	nVent RAYCHEM Representative:

Meeting Agenda:

	Confirm Contractor Has Required 2500vdc Insulation Resistance Tester Which Can Measure to at Least 1000M Ohms		Review HWAT System Operational Basics and Individual Circuit Sheet(s)
	Review and Confirm Receipt of the HWAT Installation & Operational Manual (H57548) and HWAT Large Building Design & Installation Supplement (H60782)		Review Project Documents
	Demonstrate Heating Cable Installation Onto a Pipe		Demonstrate Component Installation
	Complete Heating Cable Testing		Complete and Record Details on the Individual Circuit Sheet(s)
	Confirm that Insulation Contractor Must Follow HWAT Insulation Schedule		

List of Meeting Attendees:

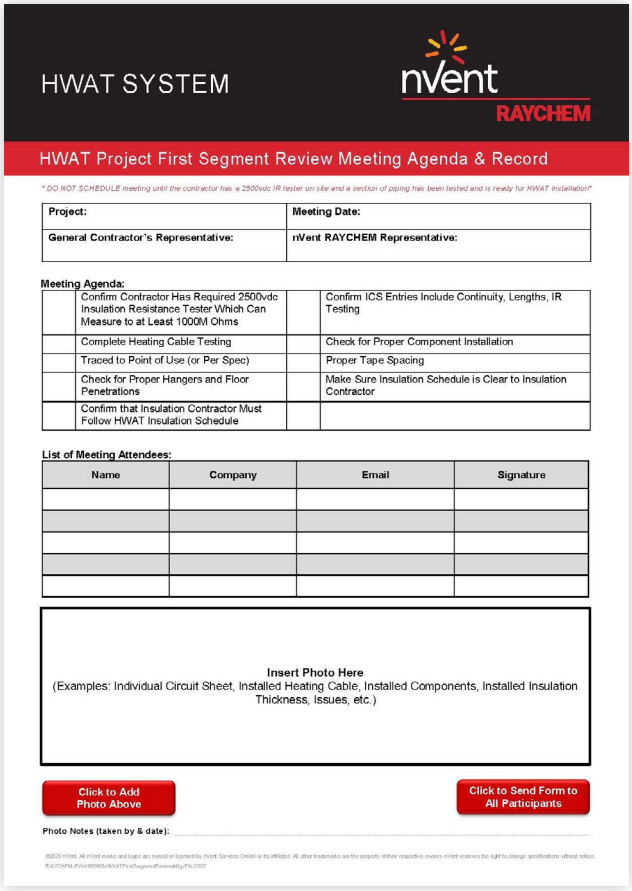
Name	Company	Email	Signature

Insert Photo Here
(Examples: Individual Circuit Sheet, Sample RayClic, Sample Installed Cable, etc.)

Click to Add Photo Above

Click to Send Form to All Participants

Photo Notes (taken by & date): _____



HWAT SYSTEM

nVent RAYCHEM

HWAT Project First Segment Review Meeting Agenda & Record

" DO NOT SCHEDULE meeting until the contractor has a 2500vdc IR tester on site and a section of piping has been tested and is ready for HWAT installation"

Project:	Meeting Date:
General Contractor's Representative:	nVent RAYCHEM Representative:

Meeting Agenda:

	Confirm Contractor Has Required 2500vdc Insulation Resistance Tester Which Can Measure to at Least 1000M Ohms		Confirm ICS Entries Include Continuity, Lengths, IR Testing
	Complete Heating Cable Testing		Check for Proper Component Installation
	Traced to Point of Use (or Per Spec)		Proper Tape Spacing
	Check for Proper Hangers and Floor Penetrations		Make Sure Insulation Schedule is Clear to Insulation Contractor
	Confirm that Insulation Contractor Must Follow HWAT Insulation Schedule		

List of Meeting Attendees:

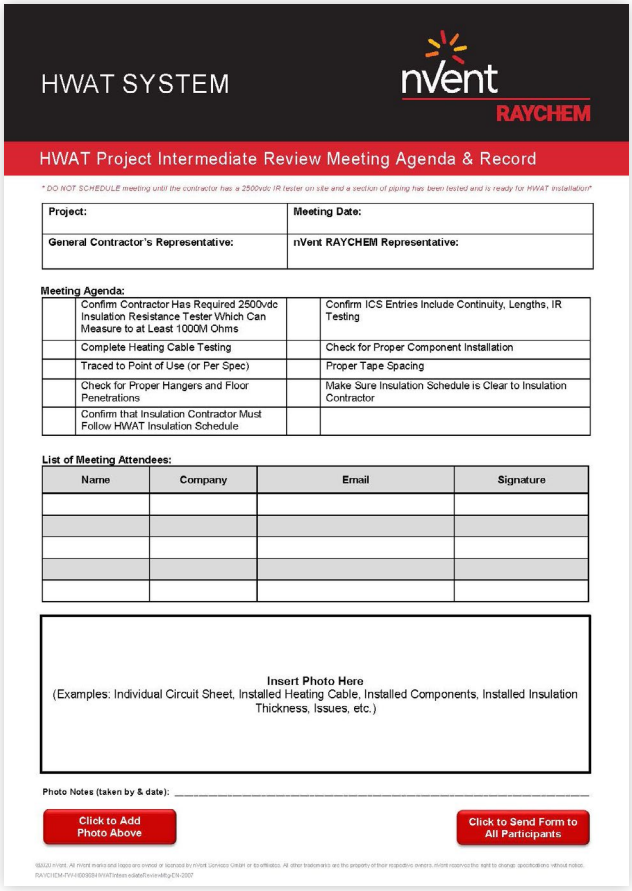
Name	Company	Email	Signature

Insert Photo Here
(Examples: Individual Circuit Sheet, Installed Heating Cable, Installed Components, Installed Insulation Thickness, Issues, etc.)

Click to Add Photo Above

Click to Send Form to All Participants

Photo Notes (taken by & date): _____



HWAT SYSTEM

nVent RAYCHEM

HWAT Project Intermediate Review Meeting Agenda & Record

" DO NOT SCHEDULE meeting until the contractor has a 2500vdc IR tester on site and a section of piping has been tested and is ready for HWAT installation"

Project:	Meeting Date:
General Contractor's Representative:	nVent RAYCHEM Representative:

Meeting Agenda:

	Confirm Contractor Has Required 2500vdc Insulation Resistance Tester Which Can Measure to at Least 1000M Ohms		Confirm ICS Entries Include Continuity, Lengths, IR Testing
	Complete Heating Cable Testing		Check for Proper Component Installation
	Traced to Point of Use (or Per Spec)		Proper Tape Spacing
	Check for Proper Hangers and Floor Penetrations		Make Sure Insulation Schedule is Clear to Insulation Contractor
	Confirm that Insulation Contractor Must Follow HWAT Insulation Schedule		

List of Meeting Attendees:

Name	Company	Email	Signature

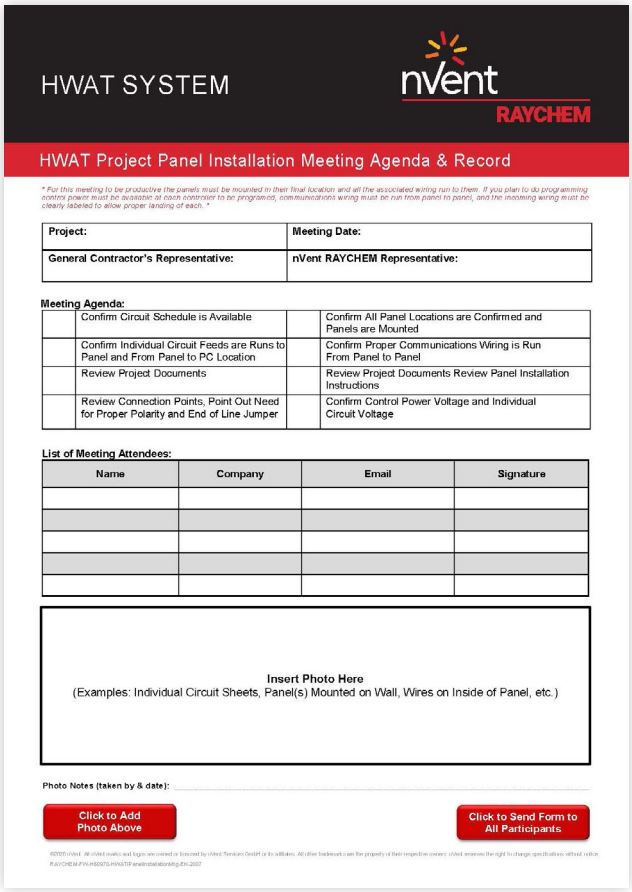
Insert Photo Here
(Examples: Individual Circuit Sheet, Installed Heating Cable, Installed Components, Installed Insulation Thickness, Issues, etc.)

Photo Notes (taken by & date): _____

Click to Add Photo Above

Click to Send Form to All Participants

Click to open



HWAT SYSTEM

nVent RAYCHEM

HWAT Project Panel Installation Meeting Agenda & Record

* For this meeting to be productive the panels must be mounted in their final location and all the associated wiring run to them. If you plan to do programming, control power must be available at each controller to be programed, communications wiring must be run from panel to panel, and the incoming wiring must be clearly labeled to allow proper landing of each. *

Project:	Meeting Date:
General Contractor's Representative:	nVent RAYCHEM Representative:

Meeting Agenda:

	Confirm Circuit Schedule is Available		Confirm All Panel Locations are Confirmed and Panels are Mounted
	Confirm Individual Circuit Feeds are Runs to Panel and From Panel to PC Location		Confirm Proper Communications Wiring is Run From Panel to Panel
	Review Project Documents		Review Project Documents Review Panel Installation Instructions
	Review Connection Points, Point Out Need for Proper Polarity and End of Line Jumper		Confirm Control Power Voltage and Individual Circuit Voltage

List of Meeting Attendees:

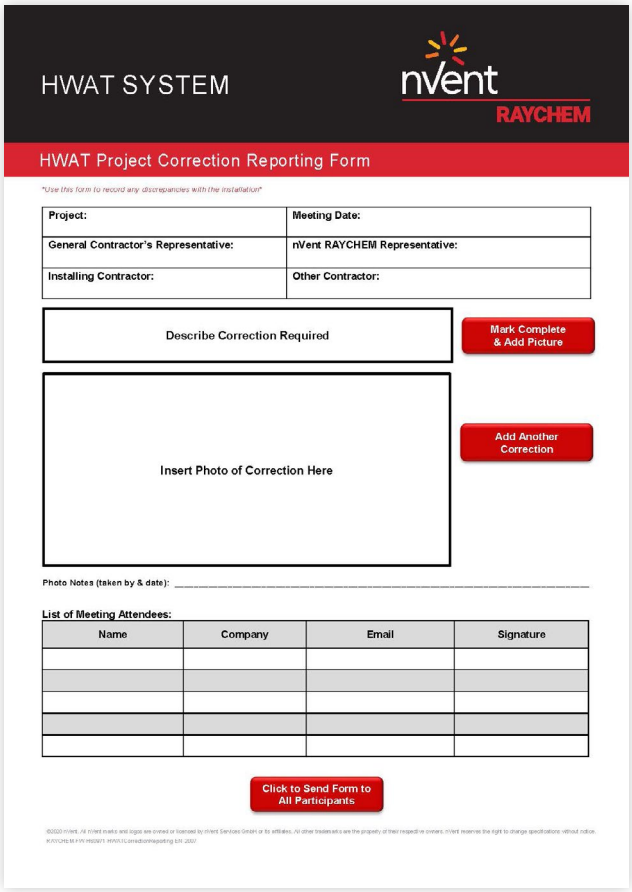
Name	Company	Email	Signature

Insert Photo Here
(Examples: Individual Circuit Sheets, Panel(s) Mounted on Wall, Wires on Inside of Panel, etc.)

Photo Notes (taken by & date): _____

Click to Add Photo Above

Click to Send Form to All Participants



HWAT SYSTEM

nVent RAYCHEM

HWAT Project Correction Reporting Form

Use this form to record any discrepancies with the installation

Project:	Meeting Date:
General Contractor's Representative:	nVent RAYCHEM Representative:
Installing Contractor:	Other Contractor:

Describe Correction Required

Mark Complete & Add Picture

Insert Photo of Correction Here

Add Another Correction

Photo Notes (taken by & date): _____

List of Meeting Attendees:

Name	Company	Email	Signature

Click to Send Form to All Participants

Click to open

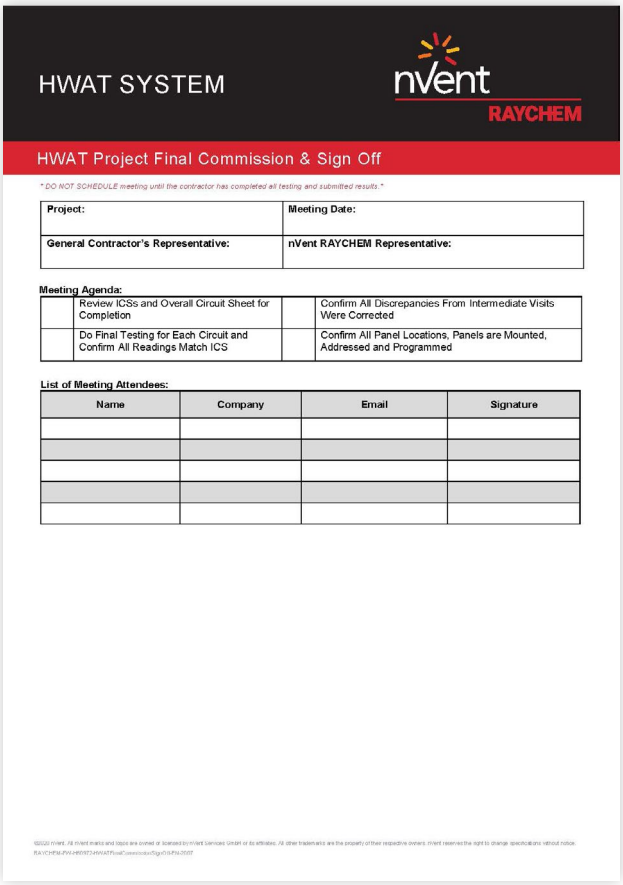
FINAL TESTING AND START UP

Heat Trace Commissioning Table Project Name: _____ Date: _____ Weather Conditions: _____

Descr-iption	Cable Part #	Serial or Batch #	Length (ft or m)	Breaker	Breaker Size	Panel #	Circuit #	Continu-ity (Ω)	Capacit-ance (nF)	Insulation Resistance (GΩ) 500V	1000V	2500V	Load (A)	Notes

Click to open

FINAL COMMISSIONING AND SIGN OFF MEETING FORM



HWAT SYSTEM

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HWAT Project Final Commission & Sign Off

** DO NOT SCHEDULE meeting until the contractor has completed all testing and submitted results.**

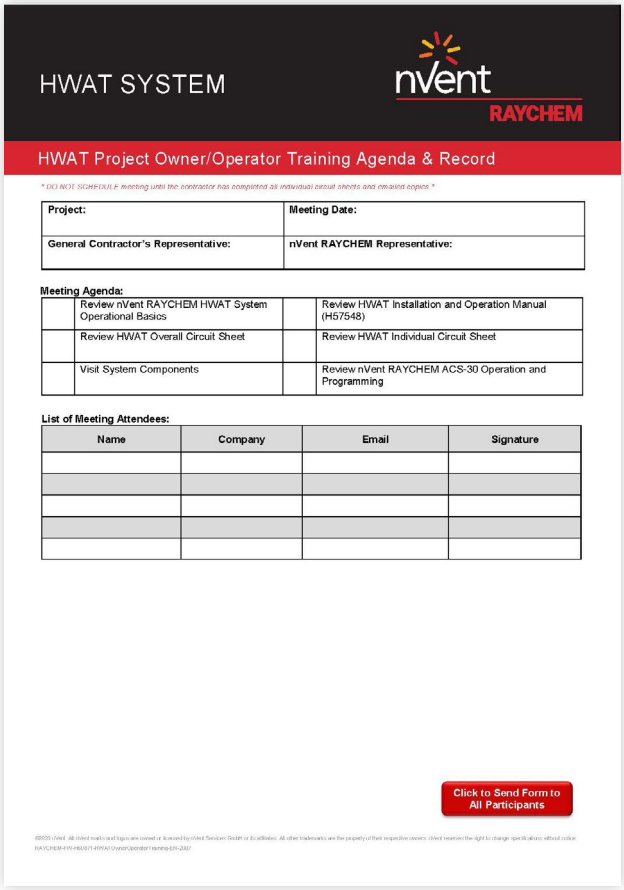
Project:	Meeting Date:
General Contractor's Representative:	nVent RAYCHEM Representative:

Meeting Agenda:

	Review ICSs and Overall Circuit Sheet for Completion		Confirm All Discrepancies From Intermediate Visits Were Corrected
	Do Final Testing for Each Circuit and Confirm All Readings Match ICS		Confirm All Panel Locations, Panels are Mounted, Addressed and Programmed

List of Meeting Attendees:

Name	Company	Email	Signature



HWAT SYSTEM

nVent RAYCHEM

HWAT Project Owner/Operator Training Agenda & Record

** DO NOT SCHEDULE meeting until the contractor has completed all individual circuit sheets and emailed copies **

Project:	Meeting Date:
General Contractor's Representative:	nVent RAYCHEM Representative:

Meeting Agenda:

	Review nVent RAYCHEM HWAT System Operational Basics		Review HWAT Installation and Operation Manual (H57548)
	Review HWAT Overall Circuit Sheet		Review HWAT Individual Circuit Sheet
	Visit System Components		Review nVent RAYCHEM ACS-30 Operation and Programming

List of Meeting Attendees:

Name	Company	Email	Signature

Click to Send Form to All Participants

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