

Hot water temperature maintenance

Providing the comfort of instant hot water is the key requirement of any modern hot water system. The Raychem single-pipe system keeps water at the right temperature in a building's water distribution pipe work. The intelligent system first keeps the investment cost low and then it operates economically and efficiently.

A hygienic system

Less water volume and less heat loss in the pipe work assure for less bacteriological problems.

A flexible and space-saving system

The space requirement for pipes has been reduced because there are no return pipes. Risers, shafts and openings can be minimised freeing space for other services.

Low investment costs

The heating cable is simply fixed on the supply pipe. There is no need for return pipe work, valves or pumps, nor for complex design and balancing work associated with return systems.

Lower power consumption

The heat loss in the system is lower as only the heat loss from the feed pipe (and not

from the return pipe) is to be compensated for. There is also no power requirement for circulation pumps.

The single-pipe system can be used with a smaller boiler and as there is no cold return water coming in the boiler, the heat-up of the water is more efficient.

The intelligent HWAT-ECO control unit saves power e.g. it can lower the temperature or switch off the during water consumption peaks.

No maintenance costs

The system has no mechanical parts such as a recirculation pump or control valves. There are no parts to wear out.

Gel-filled end seal
(RayClic-E-02)

Heating cable
(HWAT-L, M or R)

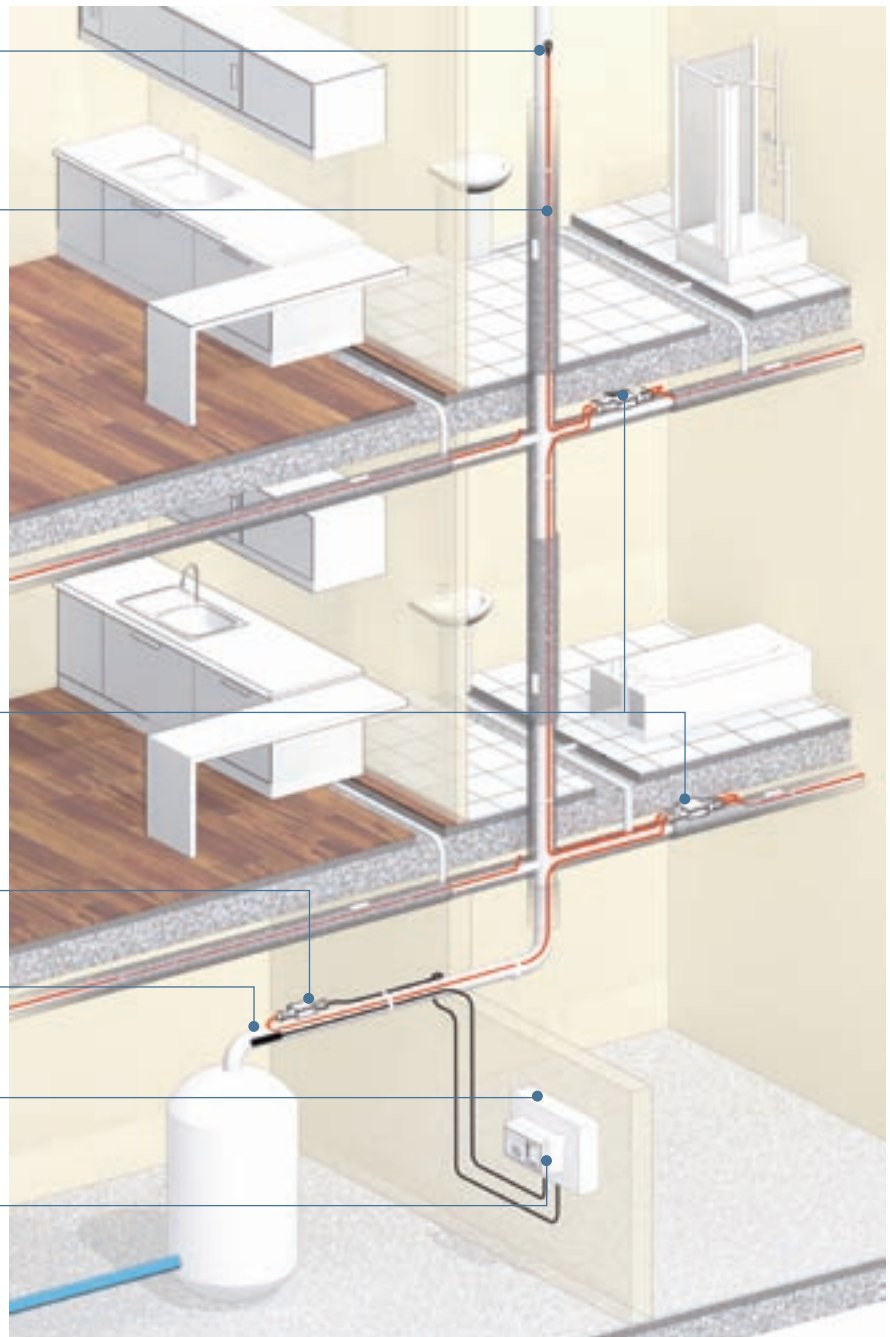
4-way connection
(RayClic-X-02)

Power connection
(RayClic-CE-02)

Sensor HWAT-ECO (incl.)

Residual current device (rcd) (30 mA)
Circuit-breaker (C type)

Temperature control unit
(HWAT-ECO)



Design guide, control units and accessories

1. Heating cable selection

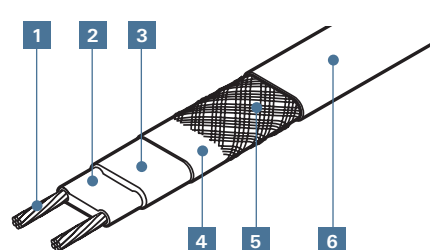
Optimum water temperature maintenance for single family houses, flats, offices, hotels, hospitals, convalescent homes, sports centres, ...

Heating cable type	HWAT-L	HWAT-M	HWAT-R
Power output	7W/m at 45°C	9 W/m at 55°C	12 W/m at 70°C
Max. exposure temperature	65°C	65°C	80°C
Outer jacket colour	yellow	orange	red
Control unit HWAT-ECO	–	recommended for enhanced energy - efficiency	essential

Legionella prevention

Possibility of thermal legionella prevention up to the draw-off points

2. Composition of the HWAT-L/M/R heating cable



- 1 Copper conductor (1.2 mm²)
- 2 Self-regulating heating element
- 3 Modified polyolefin insulation
- 4 Aluminium foil wrap
- 5 Protective tinned copper braid
- 6 Modified polyolefin protective outer jacket.

Technical data: see page 53

3. Heating cable length

- The heating cable is installed in a straight line on the pipework
- The heating cable can be traced right up to the draw-off points

Total length of pipe to be traced
 + approx. 0.3 m per connection
 + approx. 1.0 m per T-connection
 + approx. 1.2 m per 4-way connection

= required heating cable length

4. Insulation thicknesses

Pipe size (mm)	15	22	28	35	42	54
Insulation thickness (mm)	20	20	25	30	40	50

Ambient temperature: 18°C
 Thermal conductivity $\lambda = 0.035 \text{ W}/(\text{m}\cdot\text{K})$
 For other thermal conductivity insulation materials, contact your Tyco Thermal Controls representative.

5. Electrical protection

- The total length of heating cable determines the number and size of the circuit breakers
- Residual current device (rcd): 30 mA required
- Power cabling for the heating cables according to local regulations
- The power connection must be carried out by an approved electrical installer

Circuit-breaker to BSEN 60898 (type C): the maximum length of the heating circuit is based on a minimum start-up temperature of +12°C, 230 VAC.

	HWAT-L	HWAT-M	HWAT-R
10 A	80 m	50 m	50 m
13 A	110 m	65 m	65 m
16 A	140 m	80 m	80 m
20 A	180 m	100 m	100 m

Hot water temperature maintenance

6. Checklist for planning the installation

The system design should take into account:

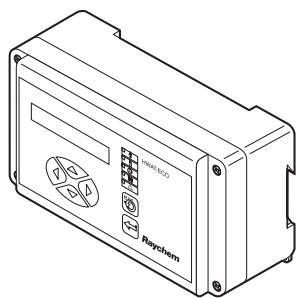
- Pipe diameter and material
- Insulation type and thickness
- Ambient temperature
- Circuits should divide the plumbing into logical segments
- Don't exceed the maximum circuit length
- Show connection locations on the drawings
- Locate power connections near the electrical panel
- Locate T-connections in accessible areas

7. Testing of the installation

See page 50

8. Control units

HWAT-ECO



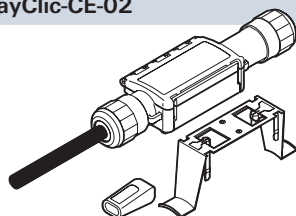
Electronic temperature control unit with integrated clock

- Building-specific program
- Boiler temperature monitoring
- Economy programs
- Password protection
- Simple user interface
- Compatible with HWAT-L/M/R heating cables
- BMS interface
- Alarm outputs

Technical data: see page 11

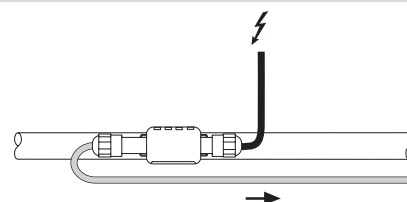
9. Accessories

RayClic-CE-02

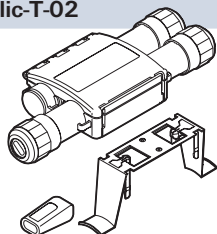


Power connection

- With 1.5 m power cable
- End seal and support bracket
- IP 68 moisture ingress protection
- External dimension: L = 240 mm
W = 64 mm
H = 47 mm

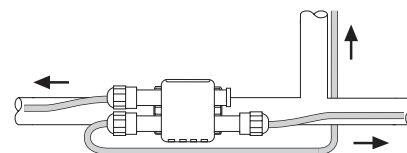


RayClic-T-02

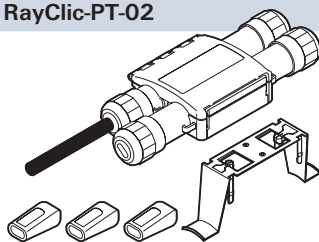


T-connection

- Connection for 3 cables
- End seal and support bracket
- IP 68 moisture ingress protection
- External dimension: L = 270 mm
W = 105 mm
H = 42 mm

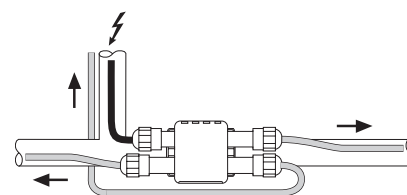


RayClic-PT-02

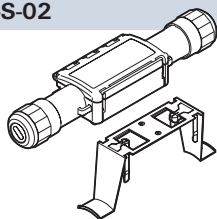


Power T-connection

- 3 connections with integral 1.5 m power cable
- 3 end seals and 1 support bracket
- IP 68 moisture ingress protection
- External dimension: L = 270 mm
W = 105 mm
H = 42 mm

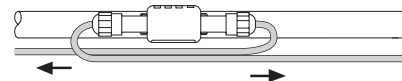


RayClic-S-02

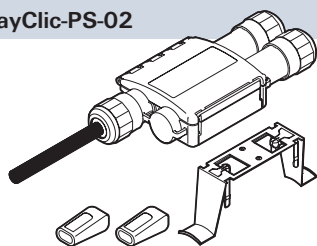


Splice for joining 2 lengths of heating cable

- Connection for 2 cables with 1 support bracket
- IP 68 moisture ingress protection
- External dimension: L = 240 mm
W = 64 mm
H = 47 mm

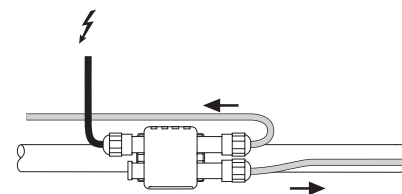


RayClic-PS-02

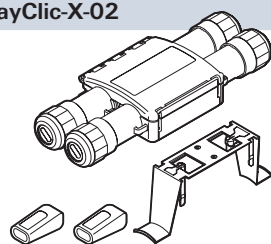


Powered splice

- Connection for 2 cables with integral 1.5 m power cable
- 2 end seals and 1 support bracket
- IP 68 moisture ingress protection
- External dimension: L = 270 mm
W = 105 mm
H = 42 m

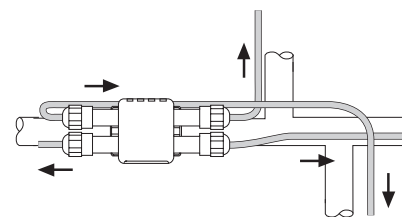


RayClic-X-02

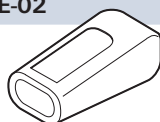


4-way connection

- Connection for 4 cables
- 2 end seals and 1 support bracket
- IP 68 moisture ingress protection
- External dimension: L = 270 mm
W = 105 mm
H = 42 m



RayClic-E-02

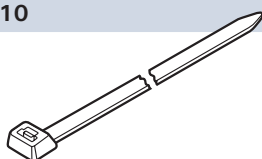


Gel-filled end seal

- For system extensions (to be ordered separately)
- IP 68 moisture ingress protection



KBL-10

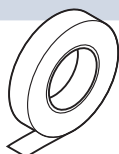


Cable ties

- One pack of 100 required for approx. 30 m of pipework
- Length: 370 mm
- Temperature and UV resistant

Use ATE-180 on plastic pipes

GT-66



Heat-resistant glass cloth tape

- For steel pipes or for any installation below 4.4°C
- 20 m roll for approx. 20 m of pipework

Use ATE-180 on plastic pipes

GS-54

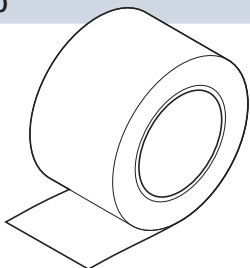


Glass cloth tape for attaching heating cable to pipe

- For stainless-steel pipes or for any installation below 4.4°C
- 16 m per roll, 12 mm width

Hot water temperature maintenance

ATE-180

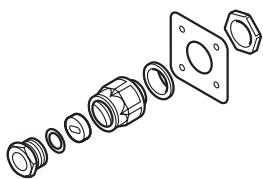


Aluminium adhesive tape

- Heat resistant up to 150°C
- 55 m roll for approx. 50 m of pipework

On plastic pipes: the heating cable must be covered with aluminium adhesive tape along its entire length

IEK-20-M (for HWAT-L, -M) /IEK-25-04 (for HWAT-R)



Insulation entry kit

- Insertion of heating cable in metal cladding
- Consists of: metal fasteners, metric gland and joint seal

LAB-I-01



Electric traced label

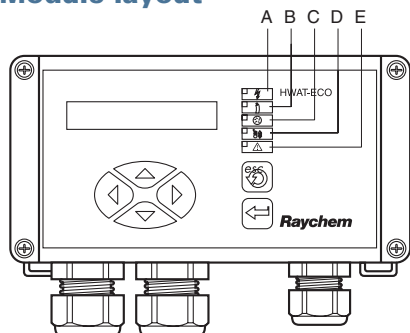
- To be placed at 5 m intervals on insulation surface

10. General installation instruction

See page 14

HWAT-ECO Temperature control unit

Module layout



- A** Power supply on (green LED)
- B** Power to heater on (green LED)
- C** Legionella prevention (green LED) - heating cable 100% powered - increased risk of scalding
- D** Maintain temperature lowered following boiler temperature decrease (green LED) - boiler temperature is lower than expected.
- E** Error (red LED)



Change menu selection or position cursor

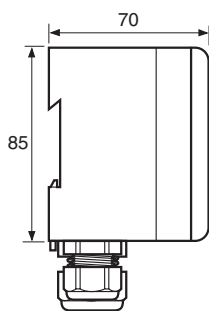
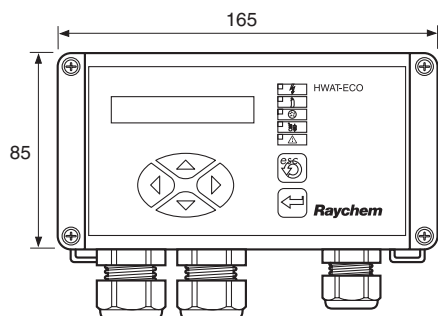


Escape, backspace or NO



Confirm selection, new value or YES

Technical data



(Dimensions in mm)

Product description	HWAT-ECO
Use	Only for HWAT-L/M/R heating cables
Selectable maintain temperature	37 °C to 65 °C in max. 48 timer blocs per day
Operating voltage	230 VAC (+10%, -10%), 50 Hz
Switching capacity	20 A / AC 230V
Internal power consumption	2,5 W
Circuit breaker	Max. 20 A, C-Characteristic
Power cable section entry	1.5 - 4 mm ² for fixed wiring only
Auxiliary cable section entry	Up to 16 AWG (1.3 mm ²)
Weight	880 g
Mounting options	Wall mount with 2 screws or DIN rail
Cable glands (entries)	2 x M20 and 1 x PG13.5 with 3 inputs for external wires of 3-5 mm
Protection level	IP 54
Ambient temperature	0 °C to 40 °C
Housing material	ABS
Internal temperature alarm	85 °C
Master/slave cable	2-wire twisted pair shielded, max. 1.3 mm ² core and insulation of 500 V
Master/Slave	Master is selectable in the unit, up to 8 slaves can be connected
BMS interface	0 - 10 VDC
Alarm relay contacts	Max. 24VDC or 24 VAC, 1 A, SPDT voltage free
Boiler temperature sensor	PTC KTY 81-2 10 or PT 100
Power correction factor	60% to 140% (fine tuning of maintained temperature)
Clock back-up time	Min. 1 year with lithium battery CR2025 (3V)
Clock accuracy	±10 minutes per year
Real time clock	Automatic summer/winter time and leap year correction
Parameters stored in non-volatile	All parameters, except date and time memory
Approval	VDE according to EN 60730
EMC	According to EN 50081-1/2 for emission and EN 50082-1/2 for immunity

Raychem requires the use of a 30 mA residual current device and a C-Characteristic circuit breaker to provide maximum safety and protection from fire.

The unit complies with IEC1000-3-3 (flicker) if installed according to part 3 of VDE 0838. To avoid flicker install the unit in such a way that at the current value of the systems start-up temperature (max. 20 A per heating circuit) the voltage drop does not exceed 1% at the power supply of the lightning apparatus (normally subpanel).

Hot water temperature maintenance

Program

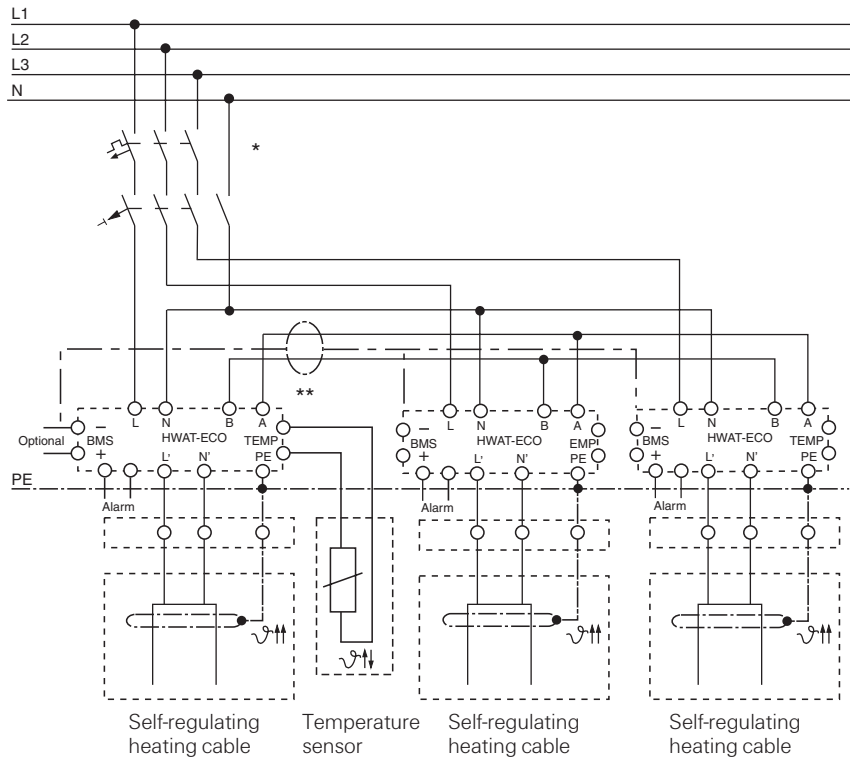
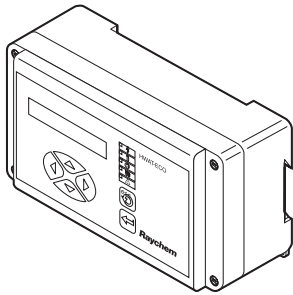
The HWAT-ECO has 7 different building specific time/temperature programs. These programs are based on our long experience for optimum comfort and energy saving. For user specific changes in the programming, the Edit timer program can be used.

Program name	Building type
Program 0	Constant temperature ($\pm 55^{\circ}\text{C}$)
Program 1	Apartment block
Program 2	Prison / Barracks
Program 3	Hospital
Program 4	Hotel
Program 5	Sports centre / Swimming pool
Program 6	Office

In addition, user specific programs can be created

Temperature can be varied in 1/2 h blocks to any desired temperature between: OFF, economy t° , maintain t° and legionella prevention (100% powered, increased risk of scalding)

Wiring diagram for HWAT-L / HWAT-M / HWAT-R with HWAT-ECO temperature control unit

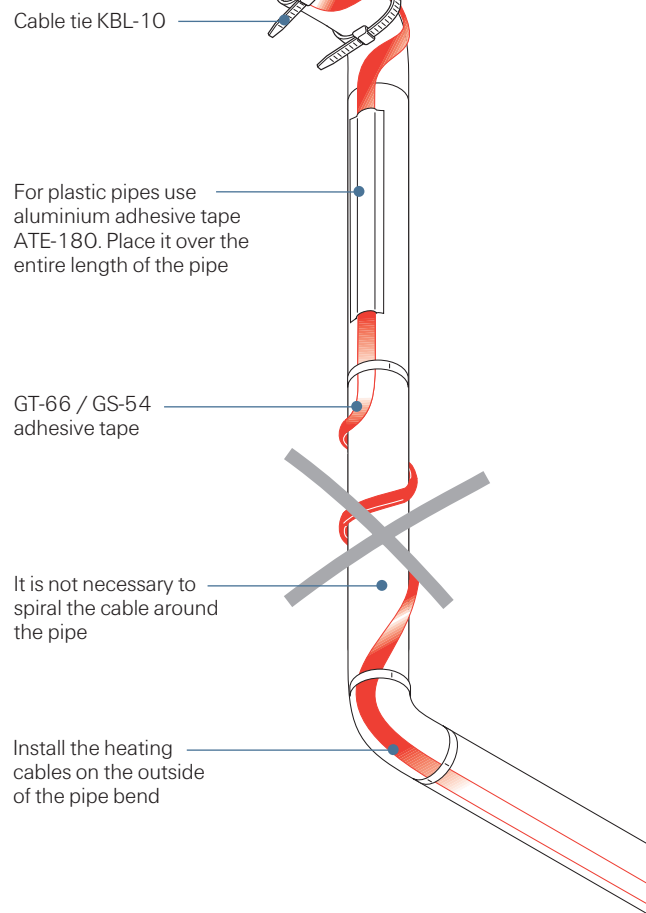
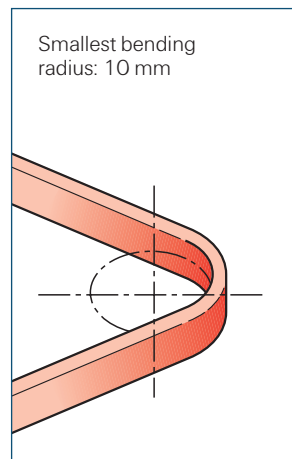
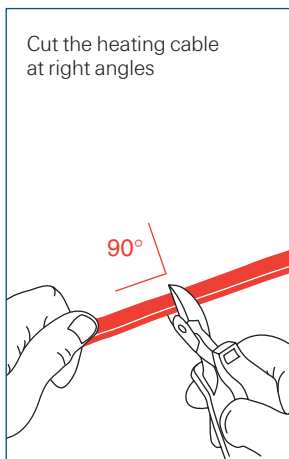
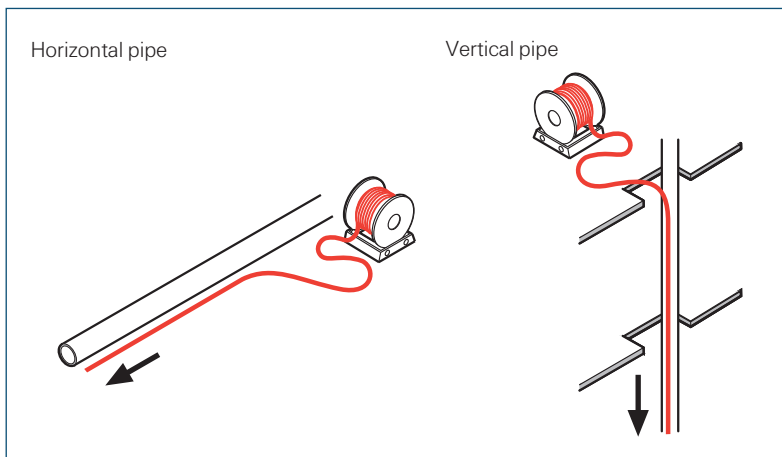
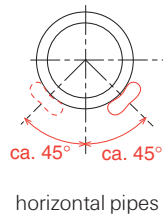


- * Two- or four-pole electrical protection by circuit breaker may be needed for local circumstances, standards and regulations
- ** The earth wire of shielded RS-485 cable needs to be connected to the BMS (-) terminal of each HWAT-ECO in the Master / Slave network.

Hot water temperature maintenance

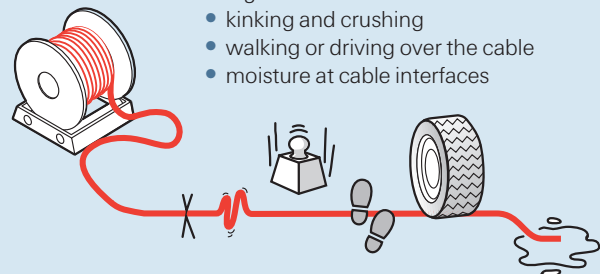
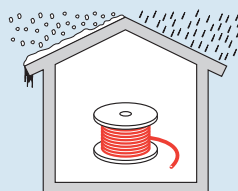
11. Installation instructions for HWAT-L/M/R cables

- The heating cable should be installed in a straight line on the pipework.
- Install on dry surfaces
- Minimum installation temperature: -10°C



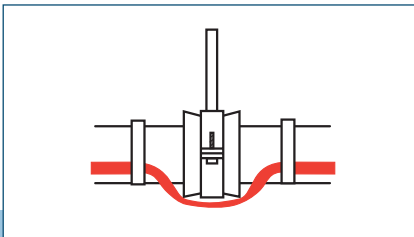
Installation of self-regulating heating cables

- Store in a dry and clean place.
- Temperature range: -40°C to $+60^{\circ}\text{C}$.
- Protect any cable ends with an end seal.

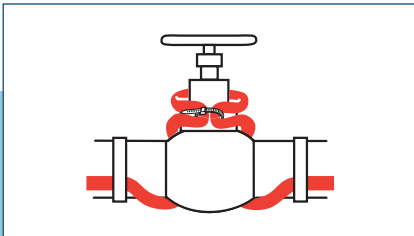
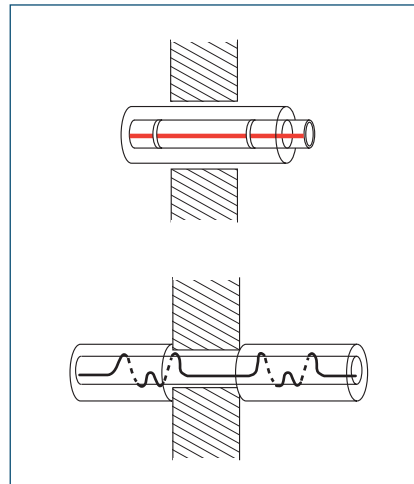
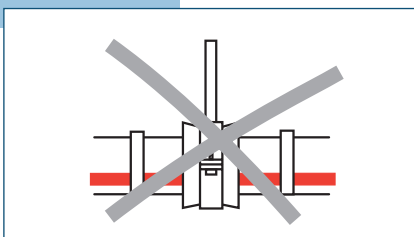


Avoid:

- sharp edges
- high tractive force
- kinking and crushing
- walking or driving over the cable
- moisture at cable interfaces

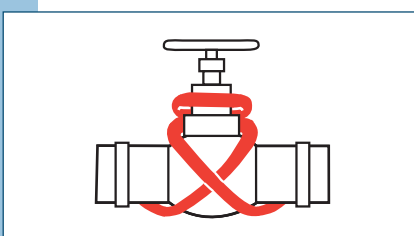


- Run the cable over pipe suspensions
- Do not clamp the cable

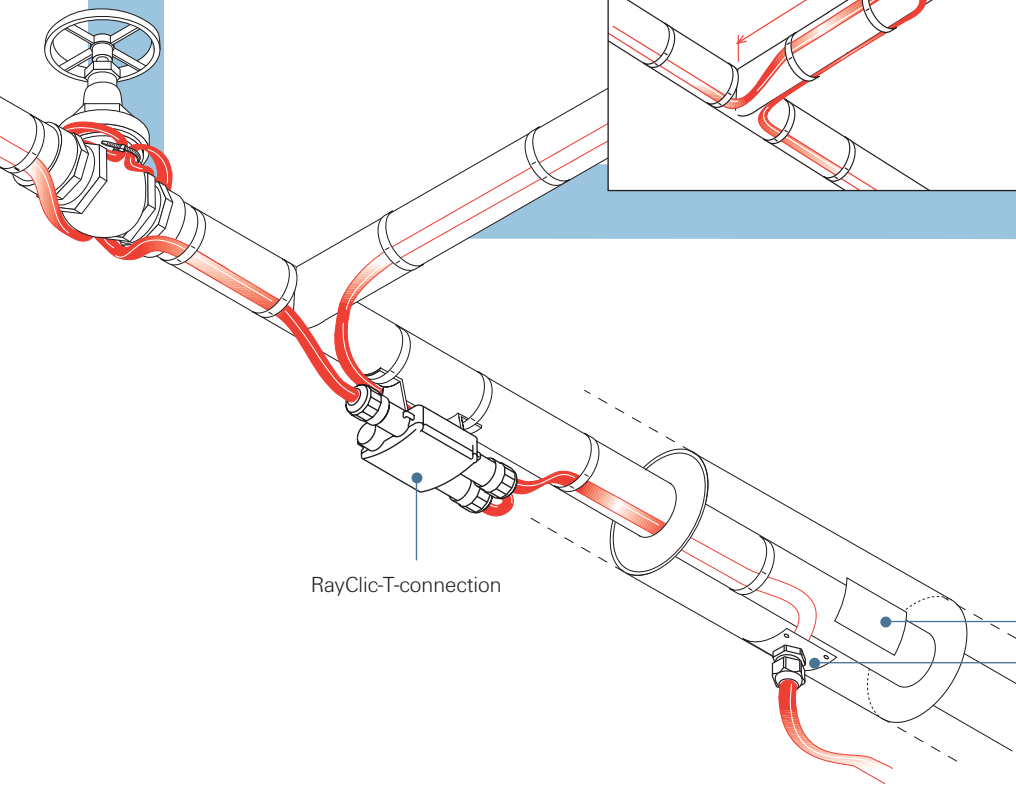
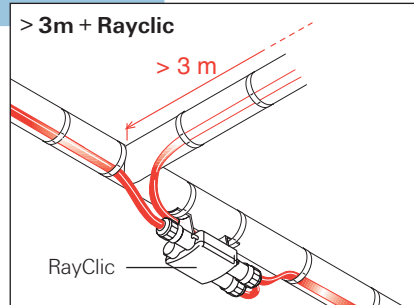
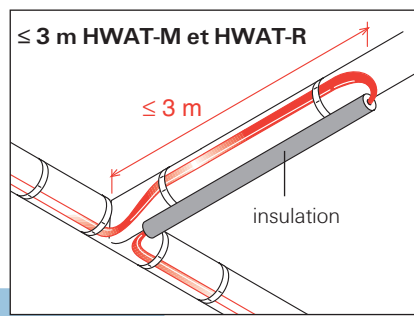
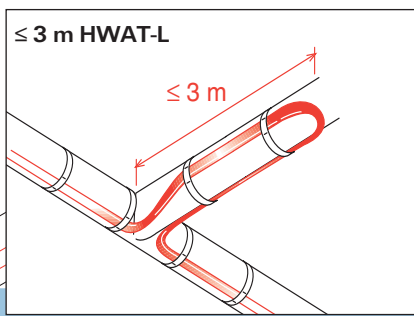


Temperature maintenance around valves:

- Valves up to 2" (DN 50): install the HWAT heating cables in a straight line
- $\geq 2"$: lay as shown
- Always insulate valves



Wall/Floor transit
The thickness of thermal insulation must be continuous otherwise compensate by adding heating cable.



General installation instructions

Checklist for problem-free installation and safe operation

Typical installation schedule for hot water temperature maintenance

General order of events

- The system is designed and the installation planned
- The pipework is pressure tested or otherwise checked for leaks
- The HWAT-L/M/R cable is tested and then installed on the designated pipes
- The components are installed and each circuit is tested
- The correct thermal insulation is applied, without delay, labelled and the system test repeated
- The supply voltage cables and circuit breakers are installed to each circuit
- The system is commissioned (see "System start-up" below)

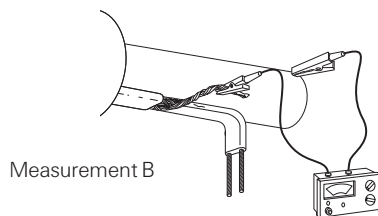
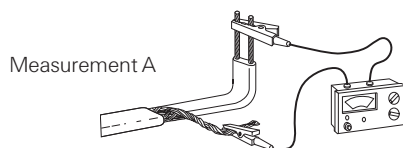
Circuit protection, testing and operation for all systems

Circuit protection

- Supply voltage 230 VAC, 50 Hz
- The required protective measures of the relevant regulations must be complied with.
- C type circuit breaker (anti-surge fuse)
- Residual current device (rcd 30 mA) required. Maximum approx. 500 m of self-regulating heating cable can be monitored per rcd

Testing

- Visual inspection for damage and fault-free installation of the accessories
- Proper installation of the system
- Heating cable affixed to all necessary pipes
- No mechanical damage to heating cable (e.g. cuts, cracks, etc.)
- No thermal damage
- Proper connection of all components including power supplies
- Insulation resistance measurement when heating cable is received and before and after installation of the thermal insulation. The test voltage should be 2500 VAC, but it must not be lower than 500 VAC. The insulation resistance, irrespective of the cable length, must not be less than 100 Mohms.
If the resistance falls below this value, the source of the fault must be investigated, eliminated, and re-tested.
 - Measurement A: Phase and neutral to the braid
 - Measurement B: Braid to the pipework
- After switching on, the cable ends must be warm after 5 to 10 minutes



Instructions for the placing of the heat insulation

- For problem-free operation of the self-regulating heating cables, the material quality and thickness of the thermal insulation should be in accordance with the design parameters, and this insulation must be installed correctly
- All parts of the pipework, including valves, wall transit points, etc. must be fully insulated

Operation / System start-up

- 1) For small installations, turn on the circuit breakers and preferably leave the system overnight for the water to warm up and stabilise
- 2) For bigger installations or for a faster start-up, first turn on the main water heater and open the outlet/tap at the end of the pipework run until the water feels warm and then turn on the circuit breakers
If the piping system is closed, such as by pressure-reducing valves or isolation valves, you must provide some method of pressure relief to allow for thermal expansion of the water during heat-up
- Under normal operating conditions, the heating cables are maintenance-free. Tyco Thermal Controls recommend that the insulation resistance should be checked periodically and compared with the original values. If the reading falls below the minimum value (100 Mohms) determine the cause and rectify before re-use
- The specified maximum ambient and operating temperatures should not be exceeded
- In the event of repair to the pipework, the heating cable must be protected against damage. Correct function of the electrical protection system should be maintained. To prevent shock or personal injury, turn off the power at the circuit breaker before testing or working on the heating cable or piping

- Following the completion of the repair work, the circuit should once again be tested (see above)
- All the important parts of the controls, thermostats, etc. must be checked for correct operation once a year, normally in the autumn

Only for hot water temperature maintenance

Newly installed heating cables have lower power at start-up of the installation. The nominal power will be reached after approximately 4 weeks of continuous operation

- The maintenance temperature should be 5°C to 10°C below the hot water temperature in the boiler

Standard assembly times

The actual assembly times achieved may deviate according to the conditions on site.

Pipework

Assembly of heating cable on pipes including fastening,
standard installation: 25 m/hour

Connection system

(electrical connection)

RayClic-CE-02	2 min/pc.
RayClic-S-02/RayClic-PS-02	4 min/pc.
RayClic-T-02/RayClic-PT-02	6 min/pc.
RayClic-X-02	8 min/pc.
RayClic-E-02	1 min/pc.

Heat-shrink connection system

(electrical connection)

C25-21	15 min/pc.
E-06	5 min/pc.
CE20-01	20 min/pc.

Other

Testing, visual inspection, insulation resistance measurement (2x)	10 min/heating circuit
Connecting the heating circuit in the switch box	10 min/heating circuit

General installation instructions

Trouble shooting guide

Fault	Possible causes	Measures
Circuit-breaker trips:	Circuit breaker wrong type: e.g. type B instead of C:	Change to C Type
	Circuit breaker undersized	If the power supply cable permits, install a larger circuit breaker
	Circuit too long	Split the circuit on 2 circuit breakers
	Short-circuit/earth fault	Eliminate short-circuit/earth fault (cable ends should not be twisted)
	Circuit breaker faulty	Replace faulty circuit breaker
	No end seal	Install end seal
	Conductor (or cable) twisted	Untwist and install end seal
	RCD residual current device trips:	More than 500 m of frost protection heating cable installed per rcd
Earth fault at connection or in end seal		Rectify earth fault
Cable damaged		Repair cable where damaged
Moisture in the junction box		Eliminate moisture
Pipeline does not become warm - Heating cable cold:	Circuit-breaker has tripped	See section circuit breaker
	Residual current device has tripped	See section residual current device
	No mains voltage	Switch on
	Cable or cold lead not connected	Connect cable or cold lead
	Cable not inserted correctly in connection system or end seal	Insert cable according to installation instructions (fully insert cable)
Water temperature is not maintained but the cable gives high output:	No insulation	Insulation according to tables in design guides
	Insulation thickness insufficient	Insulation according to tables in design guides
	Insulation wet	Dry insulation
	Cold water is running from the boiler	Test boiler temperature
	Cold water is pumping through mixer tap into the hot water pipe.	Test the mixer tap
	Insulation according to tables in design guides.	

Technical data

Choice of accessoires

Cable type	Hot water temperature maintenance				Frost protection for pipes				Frost protection for gutters and downpipes				Snow melting for ramps, access ways, and footpaths												
	HWAT-L	HWAT-M	HWAT-R	FS-A-2X	FS-B-2X	FS-C-2X	GM-2X	8BTV-2-CT	EM2-XR	EM2-MI	EM2-CM	EM4-CW	HWAT-L	HWAT-M	HWAT-R	FS-A-2X	FS-B-2X	FS-C-2X	GM-2X	8BTV-2-CT	EM2-XR	EM2-MI	EM2-CM	EM4-CW	
Colour																									
Nominal voltage	230 VAC	230 VAC	230 VAC	230 VAC	230 VAC	230 VAC	230 VAC	230 VAC	230 VAC	230 VAC	230 VAC	230 VAC	230 VAC	230 VAC	230 VAC	230 VAC	230 VAC	230 VAC	230 VAC	230 VAC	230 VAC	230 VAC	230 VAC	230 VAC	400 VAC
Nominal power output (*on insulated metal pipes)	7 W/m at 45°C	9 W/m at 55°C	12 W/m at 70°C	10 W/m at 5°C	26 W/m at 5°C	31 W/m at 5°C 22 W/m at 40°C	36 W/m in ice and 18 W/m in air at 0°C	18 W/m in air at 0°C 36 W/m in ice at 0°C	90 W/m at 0°C	30 W/m	300 W/m ²	25 W/m	7 W/m at 45°C	9 W/m at 55°C	12 W/m at 70°C	10 W/m at 5°C	26 W/m at 5°C	31 W/m at 5°C 22 W/m at 40°C	36 W/m in ice and 18 W/m in air at 0°C	18 W/m in air at 0°C 36 W/m in ice at 0°C	90 W/m at 0°C	30 W/m	300 W/m ²	25 W/m	7 W/m at 45°C
C-type circuit-breaker according to selected kit	max. 20 A	max. 20 A	max. 20 A	max. 16 A	max. 16 A	max. 16 A	max. 20 A	max. 20 A	max. 16 A	max. 16 A	max. 16 A	max. 20 A	max. 20 A	max. 20 A	max. 16 A	max. 16 A	max. 16 A	max. 20 A	max. 20 A	max. 50 A	max. 20 A	max. 20 A	max. 20 A	max. 20 A	
Max. circuit length	180 m 20 A	100 m 20 A	100 m 20 A	150 m 16 A	105 m 16 A	90 m 16 A	80 m 20 A	80 m 20 A	85 m 50 A	136 m	21 m (12.6 m ²)	250 m	180 m 20 A	100 m 20 A	105 m 16 A	105 m 16 A	90 m 16 A	80 m 20 A	80 m 20 A	85 m 50 A	136 m	21 m (12.6 m ²)	250 m	180 m 20 A	
Min. bending radius	10 mm	10 mm	10 mm	10 mm	10 mm	10 mm	10 mm	10 mm	10 mm	10 mm	10 mm	10 mm	10 mm	10 mm	10 mm	10 mm	10 mm	10 mm	10 mm	50 mm	50 mm	50 mm	50 mm	30 mm	
Max. continous exposure temperature	65°C	65°C	80°C	65°C	65°C	95°C	65°C	65°C	65°C	65°C	65°C	65°C	65°C	65°C	65°C	65°C	65°C	65°C	65°C	100°C	250°C	250°C	65°C	65°C	
Max. exposure temperature (power-on condition – 800 h. cumulative)	85°C	85°C	90°C	85°C	85°C	95°C	85°C	85°C	85°C	85°C	95°C	85°C	85°C	85°C	85°C	85°C	85°C	85°C	85°C	110°C	250°C	250°C	65°C	65°C	
Max. dimensions in mm (W x H)	13.8 x 6.8	13.7 x 7.6	16.1 x 6.7	13.7 x 6.2	13.7 x 6.2	12.7 x 5.3	13.7 x 6.2	13.7 x 6.2	13.7 x 6.2	13.7 x 6.2	12.7 x 5.3	13.7 x 6.2	16.1 x 6.2	18.9 x 9.5	min 4.8; max. 6.3	5.0 x 7.0	5.0 x 7.0	5.0 x 7.0	5.0 x 7.0	min 4.8; max. 6.3	5.0 x 7.0	5.0 x 7.0	5.0 x 7.0	5.0 x 7.0	
Weight	0.12 kg/m	0.12 kg/m	0.14 kg/m	0.13 kg/m	0.13 kg/m	0.13 kg/m	0.13 kg/m	0.13 kg/m	0.13 kg/m	0.13 kg/m	0.13 kg/m	0.13 kg/m	0.13 kg/m	0.27 kg/m	–	–	–	–	–	–	–	–	–	–	–
Approvals	BS / ÖVE / VDE / SEV / CSTB / SVGW / DVGW / CE / VDE																								
Control units	QWT-04	HWAT-ECO	HWAT-ECO	AT-TS-13 AT-TS-14 RAYSTAT-CONTROL RAYSTAT-ECO	AT-TS-13 AT-TS-14 RAYSTAT-CONTROL RAYSTAT-ECO	AT-TS-13 AT-TS-14 RAYSTAT-CONTROL	EMDR-10 HTS-D	–	VIA-DU-20	VIA-DU-20	VIA-DU-20	VIA-DU-20	–	VIA-DU-20	VIA-DU-20	VIA-DU-20	AT-TS-13 AT-TS-14 RAYSTAT-CONTROL RAYSTAT-ECO	AT-TS-13 AT-TS-14 RAYSTAT-CONTROL RAYSTAT-ECO	AT-TS-13 AT-TS-14 RAYSTAT-CONTROL	–	VIA-DU-20	VIA-DU-20	VIA-DU-20	VIA-DU-20	
Connection system	BS / ÖVE / VDE / ERFA / CE																								
Junction box	–	–	–	–	–	JB 16-02	–	–	VIA-JB2	VIA-JB2	VIA-JB2	VIA-JB2	JB 16-02	VIA-JB2	VIA-JB2	VIA-JB2	–	–	–	–	VIA-JB-2	VIA-JB-2	VIA-JB-2	VIA-JB-2	
Connection kit	RayClic	RayClic	RayClic	RayClic	RayClic	CE20-01	RayClic	RayClic	RayClic	RayClic	CE20-01	RayClic	CE25-21 E-06	VIA-CE1	Pre-installed	Pre-installed	–	–	–	–	–	–	–	–	
Support bracket	included in the kit	included in the kit	included in the kit	included in the kit	included in the kit	JB-SB-08	included in the kit	included in the kit	included in the kit	included in the kit	JB-SB-08	included in the kit	JB-SB-08	–	–	–	–	–	–	–	–	–	–	–	

Approvals: BS/ÖVE/ERFA/CE