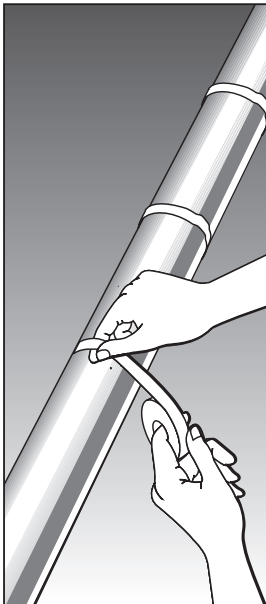




RAYCHEM

Constant Wattage Parallel Circuit Heating Cable Systems

INSTALLATION AND
MAINTENANCE MANUAL



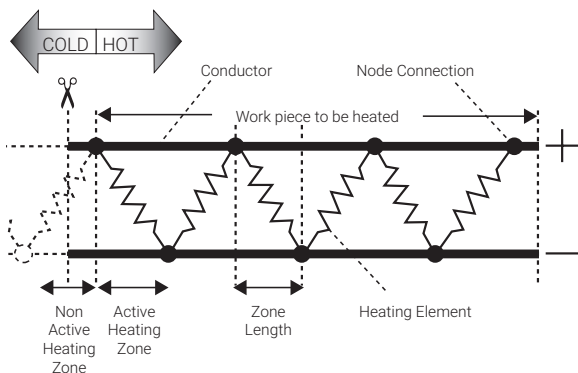
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1 GENERAL INFORMATION

USE OF THE MANUAL

The Installation and Maintenance manual is for nVent RAYCHEM FHT and FMT constant wattage parallel circuit heating cable systems on thermally insulated pipes and vessels only. For information regarding other applications contact your nVent representative.

Heating Cable Technology



Important

For the warranty to apply, the instructions that are included in this manual and product packages must be followed. The installation must also be compatible with local requirements applicable to electric heat tracing systems.

The design of electrical resistance heat tracing systems shall be overseen by persons knowledgeable of heat tracing following the design methodology for explosive atmospheres as specified by the manufacturer.

Area Classification - Ordinary

FMT Rated Voltage: 190-277 Vac

FHT2 Rated Voltage: 190-277 Vac

FHT4 Rated Voltage: 385-415 Vac

AREA CLASSIFICATION - HAZARDOUS, ZONE 1, ZONE 2, ZONE 21 OR 22

| | |
|--|--|
| FHT2 and FHT4 (All Types) SGS20ATEX0044X ⊕ II 2 G Ex 60079-30-1 IIC T* Gb ⊕ II 2 D Ex 60079-30-1 IIIC T**°C Db min -60°C (* ** see schedule) | FMT (All Types) SGS20ATEX0044X ⊕ II 2 G Ex 60079-30-1 IIC T* Gb ⊕ II 2 D Ex 60079-30-1 IIIC T**°C Db min -40°C (* ** see schedule) |
|--|--|

| | |
|--|--|
| FHT2 and FHT4 (All Types) IECEX BAS 20.0007X II 2 G Ex 60079-30-1 IIC T*Gb II 2 DEx 60079-30-1 IIIC T**CDb min -60°C (* ** see schedule) | FMT (All Types) IECEX BAS 20.0007X II 2 G Ex 60079-30-1 IIC T*Gb II 2 DEx 60079-30-1 IIIC T**CDb min -40°C (* ** see schedule) |
|--|--|



TC RU C-BE.MIO62.B.05969

FMT (All Types)
1 Ex e II 2 T6 ... T2 Gb X
Ex tb IIIC T85°C ... 200°C Db X IP66
-40°C ... +56°C

FHT2 and FHT4 (All Types)
1 Ex e II 2 T6 ... T2 Gb X
Ex tb IIIC T85°C ... 200°C Db X IP66
-60°C ... +56°C

Specific conditions of use

1. The following limiting temperatures for the exposure of the end seals and splices shall not be exceeded: 180°C continuous operation and 200°C intermittent operation for the E-150-F and CS-150-F
2. The assembly of glands, splices and end terminations shall be carried out in accordance with the installation instructions
3. The heating element supply circuit must include an electrical protection device in conformity with clause 4.3 of EN/IEC 60079-30-1
4. The minimum bending radius is 25 mm for the types FMT and FHT cables
5. The supply of the heating unit must be terminated in a suitably certified terminal enclosure

| | FMT | FHT |
|--|---|---|
| Minimum Bending Radius at Minimum Installation Temperature | 25 mm | 25 mm |
| Minimum Installation Temperature | -40°C | -60°C |
| Maximum Withstand Temperature (continuous, de-energised) | 200°C | 260°C |
| Temperature classification | Refer to design tables below or use nVent design software | Refer to design tables below or use nVent design software |
| Minimum clearance | 50 mm | 50 mm |

Design tables for non-hazardous areas

| | Maximum allowed surface temperature (°C) (= limiter setpoint) | | |
|-----------|--|-------------------|-------------------|
| | 230 V a.c. | 254 V a.c. | 277 V a.c. |
| 10FMT2-CT | 158 | 153 | 144 |
| 20FMT2-CT | 129 | 116 | 97 |
| 30FMT2-CT | 94 | 71 | 36 |
| 10FHT2-CT | 229 | 225 | 219 |
| 20FHT2-CT | 209 | 199 | 187 |
| 30FHT2-CT | 184 | 168 | 143 |
| 40FHT2-CT | 154 | 130 | 87 |

| | Maximum allowed surface temperature (°C) (= limiter setpoint) | | |
|-----------|--|-------------------|-------------------|
| | 385 V a.c. | 400 V a.c. | 415 V a.c. |
| 10FHT4-CT | 250 | 250 | 249 |
| 20FHT4-CT | 224 | 221 | 218 |
| 30FHT4-CT | 212 | 208 | 205 |

Design tables for hazardous areas

| | Maximum allowed surface temperature (°C) (= limiter setpoint) | | | | |
|-------------------|--|-----------------------|-----------------------|-----------------------|-----------------------|
| 230 V a.c. | T6 (85°C) | T5 (100°C) | T4 (135°C) | T3 (200°C) | T2 (260°C) |
| 10FMT2-CT | 8 | 26 | 69 | 147 | - |
| 20FMT2-CT | - | - | 19 | 109 | - |
| 30FMT2-CT | - | - | - | 65 | - |
| 10FHT2-CT | 8 | 26 | 69 | 147 | 225 |
| 20FHT2-CT | - | - | 19 | 109 | 200 |
| 30FHT2-CT | - | - | - | 65 | 169 |
| 40FHT2-CT | - | - | - | 8 | 131 |

| Maximum allowed surface temperature (°C) (= limiter setpoint) | | | | | |
|--|----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| 254 V a.c. | T6 (85°C) | T5 (100°C) | T4 (135°C) | T3 (200°C) | T2 (260°C) |
| 10FMT2-CT | - | 12 | 56 | 137 | - |
| 20FMT2-CT | - | - | - | 88 | - |
| 30FMT2-CT | - | - | - | 23 | - |
| 10FHT2-CT | - | 12 | 56 | 137 | 218 |
| 20FHT2-CT | - | - | - | 88 | 185 |
| 30FHT2-CT | - | - | - | 23 | 140 |
| 40FHT2-CT | - | - | - | - | 81 |

| Maximum allowed surface temperature (°C) (= limiter setpoint) | | | | | |
|--|----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| 277 V a.c. | T6 (85°C) | T5 (100°C) | T4 (135°C) | T3 (200°C) | T2 (260°C) |
| 10FMT2-CT | - | - | 37 | 122 | - |
| 20FMT2-CT | - | - | - | 53 | - |
| 30FMT2-CT | - | - | - | - | - |
| 10FHT2-CT | - | - | 37 | 122 | 207 |
| 20FHT2-CT | - | - | - | 53 | 161 |
| 30FHT2-CT | - | - | - | - | 90 |
| 40FHT2-CT | - | - | - | - | - |

| Maximum allowed surface temperature (°C) (= limiter setpoint) | | | | | |
|--|----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| 385 V a.c. | T6 (85°C) | T5 (100°C) | T4 (135°C) | T3 (200°C) | T2 (260°C) |
| 10FHT4-CT | 34 | 52 | 94 | 171 | 249 |
| 20FHT4-CT | - | - | 40 | 128 | 216 |
| 30FHT4-CT | - | - | - | 105 | 202 |

| Maximum allowed surface temperature (°C) (= limiter setpoint) | | | | | |
|--|----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| 400 V a.c. | T6 (85°C) | T5 (100°C) | T4 (135°C) | T3 (200°C) | T2 (260°C) |
| 10FHT4-CT | 30 | 48 | 90 | 169 | 247 |
| 20FHT4-CT | - | - | 30 | 121 | 212 |
| 30FHT4-CT | - | - | - | 95 | 195 |

| Maximum allowed surface temperature (°C) (= limiter setpoint) | | | | | |
|--|--------------|---------------|---------------|---------------|---------------|
| 415 V a.c. | T6 (85°C) | T5 (100°C) | T4 (135°C) | T3 (200°C) | T2 (260°C) |
| 10FHT4-CT | 25 | 44 | 87 | 166 | 246 |
| 20FHT4-CT | - | - | 18 | 112 | 206 |
| 30FHT4-CT | - | - | - | 82 | 187 |

Heating system documentation requirements

The heat tracing system documentation shall be retained for each heat tracing circuit for as long as the system is in use. As a minimum, the heat tracing system documentation shall include the following information as applicable:

For heat tracing systems according to stabilized design method

1. Heat tracing circuit identification.

Heat tracing system design parameters:

2. Pipe size or workpiece dimensions.
3. Temperature to be maintained or the maximum process / exposure temperature.
4. Maximum ambient temperature.
5. Heating cable type.
6. Operating voltage.
7. Trace ratio.
8. Length or dimensions of heating cable.
9. Maximum workpiece temperature.
10. Temperature class or maximum sheath/surface temperature as applicable.
11. Thermal insulation type, size, and thickness.
12. Thermal insulation cladding specification, if applicable.

For heat tracing systems according to controlled design method

1. Heat tracing circuit identification.
2. Heat tracing system design parameters:
3. Location of the sensor of the temperature controller / limiter on the pipe / workpiece.
4. Details of the mounting of the sensor in accordance with 4.5.3, a), b) or c).

5. Temperature to be maintained or the maximum process / exposure temperature.
6. Maximum ambient temperature.
7. Temperature controller / limiter set point.
8. Heating cable type.
9. Operating voltage.
10. Trace ratio.
11. Length or dimensions of heating cable.
12. Temperature class or maximum sheath/surface temperature as applicable.

Warning

The purchaser should make the manufacturer aware of any external effects or aggressive substances that the equipment may be exposed to.

As with any electrical equipment or wiring installation operating at line voltages, heating cable and component damage or incorrect installation that allows the penetration of moisture or contamination can lead to electrical tracking, arcing and potential fire hazard.

Do not connect heating cable conductors together or this will result in a short circuit.

Any unconnected heating cable end must be sealed with an approved end seal.

To prevent fire or explosion in hazardous areas, verify that the maximum sheath temperature of the heating cable is below the auto-ignition temperature of the gases in the area. For further information, see design documentation.

2 HEATING CABLE SELECTION

Check the design specification to make sure the proper heating cable is installed on each pipe or vessel. Refer to nVent product literature to select the proper heating cable for each thermal, chemical, electrical and mechanical environment.

3 HEATING CABLE INSTALLATION

3.1 Heating cable storage

- Store the heating cable in a clean, dry place
- Temperature range: -40°C to $+60^{\circ}\text{C}$
- Protect the heating cable from mechanical damage

3.2 Pre-installation checks

Check materials received:

- Review the heating cable design and compare the list of materials to the catalogue numbers of heating cables and electrical components received to confirm that proper materials are on site. The heating cable type is printed on its outer jacket.
- Temperature exposure must not exceed that specified in the product literature. Exceeding these limits will impair product performance. Check that expected exposure is within these limits.
- Ensure that the heating cable voltage rating is suitable for the service voltage available.
Do not energize cable when it is coiled or on the reel.
- Inspect heating cable and components for in-transit damage. An insulation resistance test (see section 8) on each reel is recommended.

Check piping to be traced:

- Ensure all pressure testing is complete and pipework has final paint coating.
- Walk the system and plan the routing of the heating cable on the pipe.
- Check pipework against specification drawing.
If different consult design authority.
- Inspect piping for burrs, rough surfaces, sharp edges etc. which could damage the heating cable.
Smooth off or cover with layers of glass cloth tape or aluminium foil.

3.3 Heating cable handling

Heating cable handling tips:

- Paint and pipe coatings must be dry to the touch before heating cable installation.
- When pulling the heating cable, **avoid**:
 - Sharp edges
 - Excessive pulling force
 - Kinking and crushing
 - Walking on it, or running over it with equipment

Heating cable pulling tips:

- Use a reel holder that pays out smoothly with little tension.
- Keep heating cable strung loosely but close to the pipe being traced to avoid interference with supports and equipment.
- Pay out designed length and mark (i.e. with fixing tape) on cable while still on reel.
- Leave the appropriate amount of heating cable at all power connection, splice, tee and end seal locations. (Refer to component installation instructions)
- Add additional heating cable to trace the fittings and supports or for spiralling as required by the design specifications.
- Protect all heating cable ends from moisture, contamination and mechanical damage or other interference if left exposed before component installation.

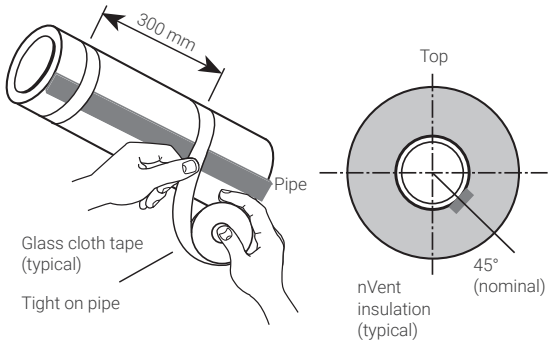
3.4 Heating cable attachment recommendations

- The heating cable may be installed straight, spiralled or in multiple runs as required by the design specification.
- **Do not** use metal attachments, vinyl electrical tape or duct tape as heating cable damage may result.
- Fix in place with a minimum of two wraps of the appropriate self-adhesive glass cloth tape (see figure 1) or plastic cable ties at 300 mm intervals and additionally where necessary.
- Plastic cable ties must have a temperature rating that matches the system exposure temperature.
- The heating cable's minimum bend radius must not be exceeded (refer to p. 2)
The heating cable's minimum spacing between turns must not be exceeded (refer to p. 2)

3.4.1 Straight tracing

- Straight trace the pipe unless the design calls for spiralling (see 3.4.2).
- On horizontal pipes fix on lower quadrant as shown in Figure 1 and not on bottom of pipe.
- To prevent overheating, be sure the location of the heating cable is planned so that the active heating zone will not extend into the component. Read the kit installation instructions and plan the component location before permanently attaching the cable to the pipe.
- Ensure that the active heating zones are located where heat is required i.e. on the pipe.
- Thermally insulate and weatherproof to specification.
- When installing nVent RAYCHEM constant wattage parallel circuit heating cables ensure that they do not overlap or cross.

Figure 1

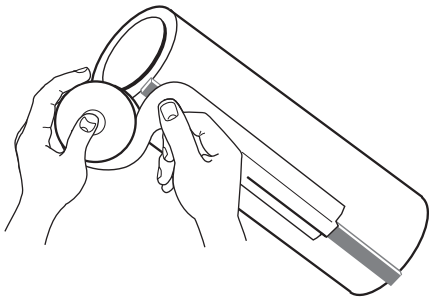


nVent RAYCHEM Attachment tapes:

GT66 Self-adhesive glass cloth tape
General purpose tape. Not for stainless-steel pipes or for installation temperatures <4°C.

GS54 Self-adhesive glass cloth tape
Recommended for use on stainless-steel and cupra-nickel surfaces and for installation temperatures <4°C.

Figure 2



ATE-180

Aluminium tape
Use only if the design requires it.

3.4.2 Spiral tracing

- Alternative spiralling methods are shown in Figures 2a and 2b.
- Only spiral heating cable on pipe when called for by design.
- To prevent overheating, be sure the location of the heating cable is planned so that the active heating zone will not extend into the component. Read the kit installation instructions and plan the component location before permanently attaching the cable to the pipe.
- Ensure that the active heating zones are located where heat is required i.e. on the pipe.

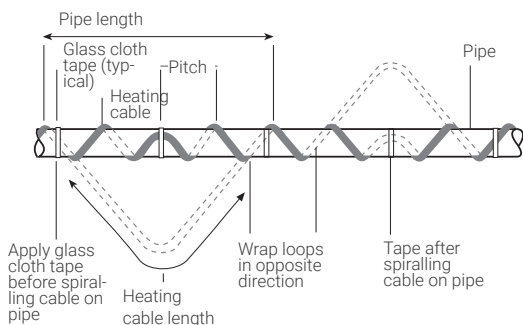
Spiral Pitch Table (mm).

| NB (mm) | NPS (inches) | Spiral Ratio – Metres of cable per metre of pipe | | | | |
|------------|------------------|--|------|-----|-----|-----|
| | | 1.1 | 1.2 | 1.3 | 1.4 | 1.5 |
| 25 | 1 | 250 | 170 | 140 | 110 | 100 |
| 32 | 1 ^{1/4} | 310 | 210 | 170 | 140 | 130 |
| 40 | 1 ^{1/2} | 350 | 240 | 190 | 160 | 140 |
| 50 | 2 | 430 | 300 | 240 | 200 | 180 |
| 65 | 2 ^{1/2} | 520 | 360 | 290 | 240 | 210 |
| 80 | 3 | 630 | 430 | 350 | 290 | 260 |
| 90 | 3 ^{1/2} | 720 | 490 | 390 | 330 | 290 |
| 100 | 4 | 800 | 560 | 440 | 370 | 330 |
| 125 | 5 | 990 | 680 | 550 | 460 | 400 |
| 150 | 6 | 1180 | 810 | 650 | 550 | 480 |
| 200 | 8 | 1520 | 1050 | 840 | 710 | 620 |

Example: For pipe of 80 mm NB (3" NPS) requiring 1.3 metres of heating cable per metre of pipe, pitch is 350 mm.

- Thermally insulate and weatherproof to specifications.
- When installing nVent RAYCHEM constant wattage parallel circuit heating cables ensure that they do not overlap or cross.

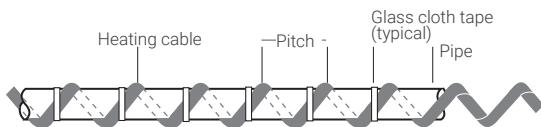
Figure 2a



Heating cable length = pipe length x spiral ratio
Refer to design specification for spiral ratio

- Step 1 Make starting loop as shown
- Step 2 Grasp loop and wind around pipe
- Step 3 Space evenly and attach to pipe
Thermally insulate and weatherproof to specification

Figure 2b



- Refer to design specification for spiral pitch
- Mark the pipe at the spiral pitch or use a simple length gauge
- Fix the heating cable as installation progresses
- Thermally insulate and weatherproof to specification

3.5 Cutting the heating cable

- Cut the heating cable to length after it is attached to the pipe.
Before cutting it, confirm the tracing allowance as per Sections 3.3 and 3.6.

3.6 Typical installation details

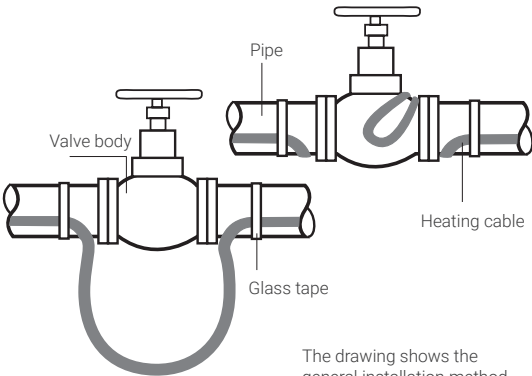
- Typical installation details for fixing heating cable to pipe fittings are shown hereafter.

General notes:

- Trace pipe fittings as shown to allow easy maintenance.
- Consult the design specification for the tracing requirements for fittings and supports.
- Follow the recommendations for cutting and stripping heating cables; they are included in the component installation instructions.

3.6.1 Valve

Figure 3

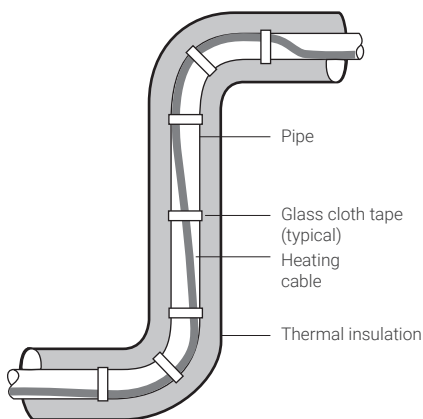


The drawing shows the general installation method. The heating cable configuration will vary for different valve shapes and heating cable lengths.

- Refer to design specification for additional heating cable length.
- Fix with self-adhesive glass cloth tape.
- Thermally insulate and weatherproof to specification (including valve stem).
- **No overlapping or crossing of the heating cable.**

3.6.2 Elbow

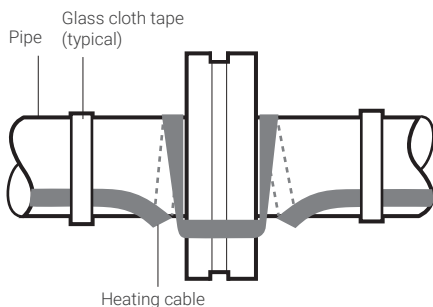
Figure 4



- Fix heating cable to outside (long) radius of elbow
Fix with self-adhesive glass cloth tape
- Thermally insulate and weatherproof to specification
- **No overlapping or crossing of the heating cable.**

3.6.3 Flange

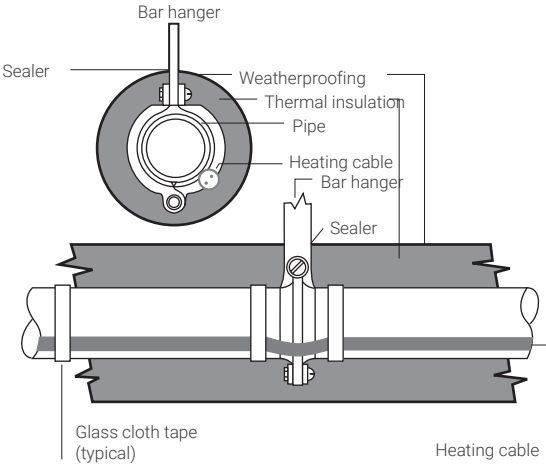
Figure 5



- Additional heating cable is 2 times diameter of pipe
Fix with self-adhesive glass cloth pipe
- Thermally insulate and weatherproof to specification
- **No overlapping or crossing of the heating cable.**

3.6.4 Pipe bar hanger

Figure 6

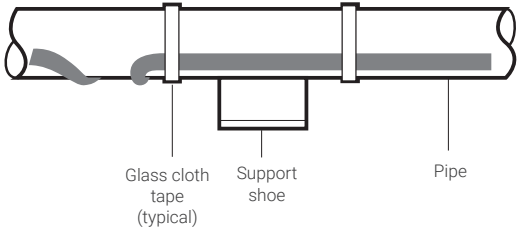


- **Do not** clamp heating cable with support. Heating cable must be over the support
- No additional heating cable is required for bar or rod pipe hangers unless called for in the design specification, then use loop length specified
- Fix with self-adhesive glass cloth tape
- Thermally insulate and weatherproof to specification
- **No overlapping or crossing of the heating cable.**

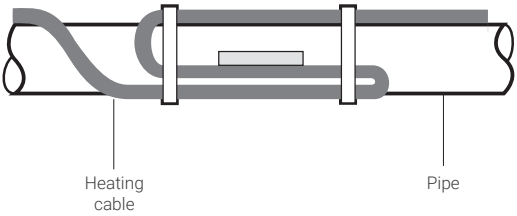
3.6.5 Pipe support shoe

Figure 7

Side view



View from under



- Refer to design specification for additional heating cable length
- Fix with self-adhesive glass cloth tape
- Thermally insulate and weatherproof to specification
- **No overlapping or crossing of the heating cable.**

4 COMPONENTS INSTALLATION

General notes:

Use the Design Specification to select required components.

nVent RAYCHEM component kits (including power connections, splices and end seals) must be used to satisfy Standards and Approval Body requirements.

Installation instructions included in the kit must be followed, including those for preparation of the heating cable conductors for connections. Before assembly, use the guide given in the instructions to ensure that the kit is correct for the heating cable and environment.

- nVent RAYCHEM constant wattage parallel circuit heating cables are parallel circuit design. **Do not** twist the conductors together as this will result in a short circuit.

4.1 Components required

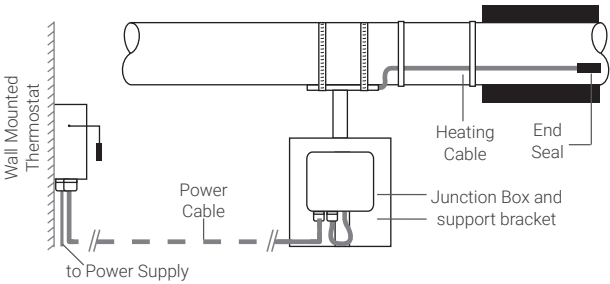
- For the installation of all components refer to the relevant component installation instructions.
- Required for each heating cable run:
Power connection and insulation entry kit
End seal.
- As required:
Accessories (pipe straps, fixing tape, support brackets, labels, etc)

4.2 Component installation hints

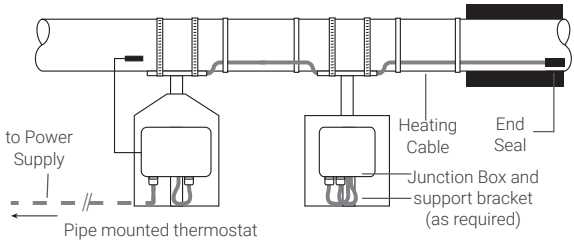
- On horizontal pipes locate junction boxes below pipe wherever possible.
- Locate junction boxes for easy access but not exposed to mechanical abuse.
- Position junction boxes so that power cable and heating cable entries do not point upwards.
- Fix lids in place where access not required.
- Confirm junction box stopping plugs are correct for application and fixed firmly in place.

- Route heating cable from junction box to insulation entry so as to avoid possible mechanical damage.
- **Do not** strain heating cable as it exits/enters junction boxes and insulation entries.
- Ensure heating cable is fixed above pipe straps such as used for junction box support brackets.
- Fix all low profile components in place with self-adhesive glass cloth tape.

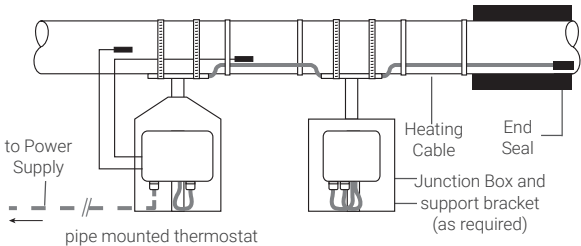
4.3 Typical Installations



Ambient Sensing System



Line Sensing System



Line Sensing System with Temperature Limit

5 THERMOSTATS

- nVent RAYCHEM constant wattage parallel circuit heating cables ALWAYS require temperature control.
- The FMT and FHT range of heating cables may be used in an electric surface heating system in a hazardous area that meets the requirements of a stabilised design within the constraints of the certification.
- If a stabilised design cannot be achieved, then a thermostat control with a limiter that complies with the appropriate requirements shall be used. The limiter shall be set to ensure that the maximum temperature of the surface to be heated does not exceed that specified in the certification for a given output in a specific temperature classification.
- ALWAYS install the correct and suitably approved thermostat as detailed in the design specification.
- Follow the installation instructions supplied with the thermostat. Use the proper wiring diagram for the heating cable layout and control method desired.

5.1 Requirements for temperature control devices for EPLs Gb and Db

1. A temperature limiter or similar control device shall de-energize the system to prevent exceeding the maximum permissible sheath temperature. Any device used for temperature control shall satisfy requirements for EPLs Gb and/or Db.

Additionally a high temperature limit function shall:

2. Operate independently from the temperature controller.
3. De-energize the heating cable when the set point of the high temperature limiter is reached.
4. Annunciate when the high temperature limit function is activated.
5. Have a high limit function that requires acknowledgement to be reset.
6. Mechanically or electronically lock the high limit set point of the device to prevent unauthorized access.
7. Have a safety function that de-energizes the circuit if the temperature sensor malfunctions.
8. Be possible to re-set only after the normal operating conditions have been returned, or if the switching state is monitored continuously
9. Be evaluated to a minimum of 100,000 cycles of endurance when multiple devices are used for controlling and limiting.

Requirements for temperature control devices for EPLs Gc and Dc

A single temperature controller may be specified provided that it incorporates annunciation of failure conditions and has been evaluated for a minimum of 250 000 cycles of operation. Alternatively, temperature control devices according to 4.5.3.2 may be specified.

- If a single temperature controller with failure annunciation is specified, provision of adequate monitoring of such an annunciation, such as 24 h surveillance, shall be made.

6 THERMAL INSULATION AND MARKING

6.1 Pre-insulation checks

- Visually inspect the heating cable and components for correct installation and damage. (See Section 10 if damaged.)
- Insulation resistance (Megger) testing (as per Section 8) is recommended prior to covering the pipe with thermal insulation.

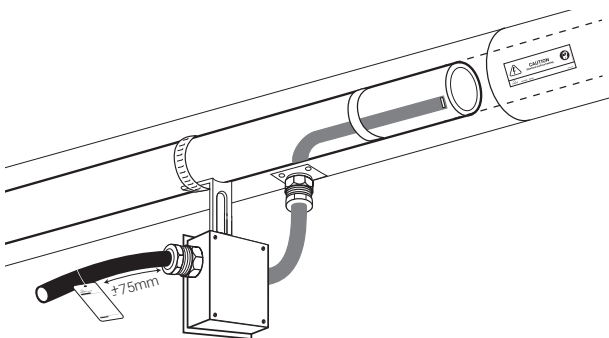
6.2 Insulation installation hints

- The electrically conductive covering of this heating cable shall be connected to a suitable earthing terminal.
- Correct temperature maintenance requires properly installed and dry thermal insulation.
- Thermally insulate and weatherproof to design specification.
- Check insulation type and thickness against the design specification.
- To minimize potential heating cable damage, insulate as soon as possible after tracing.
- Check that all pipework, including fittings, wall penetrations and other areas, has been completely insulated.
- Ensure that heating cable is not damaged during installation of cladding for example by drills, self tapping screws and sharp edges of cladding.
- Check that all insulation entry kits are fitted correctly and sealed.
- Ensure that all places where valve stems, support brackets, thermostat capillaries, etc exit the cladding are sealed.

6.3 Marking

- Install warning labels along piping at suitable intervals (3 m intervals recommended) on alternate sides as a warning.
- Mark on outside of insulation the location of heating cable components.

“When the FMT or FHT heating cable is used in hazardous area, install aluminium tag plate LAB-EX-FxT on the power cable at approximately 75mm from the junction box”



7 POWER SUPPLY AND ELECTRICAL PROTECTION

7.1 Electrical loading

Size overcurrent protective devices according to the design specification.

7.2 Electrical Protection of heat tracing systems for use in explosive atmospheres.

The following provisions need to be provided for each circuit:

1. A means of isolating all line conductors from the supply.
2. Over-current protection provided for each branch circuit.
3. A means of protecting against earth faults by disconnecting all line conductors.
 - a. For TT and TN systems, each heating cable or heating cable branch circuit, the electrical protection shall be capable of interrupting high impedance earth faults as well as short-circuit faults. This shall be accomplished by an earth-fault protective device, or a controller with earth-fault interruption capability for use in conjunction with suitable circuit protection. The preferred trip level is nominal 30 mA or 30 mA above any inherent capacitive leakage characteristic of the heating cable as specified by the heating cable supplier.
 - b. For IT systems, an electrical insulation monitoring device shall be installed to disconnect the supply whenever the electrical resistance is not greater than 50 Ohm/V of rated voltage.

Exception: Where conditions of maintenance and supervision ensure that only qualified persons service the installed systems, and continued circuit operation is necessary for the safe operation of the equipment or processes, earth-fault detection without interruption is acceptable if alarmed in a manner to assure an acknowledged response.

The requirements of 1, 2 and 3 may be performed by one device.

8 HEATING CABLE TESTING

8.1 Recommendations

nVent recommends an insulation resistance test

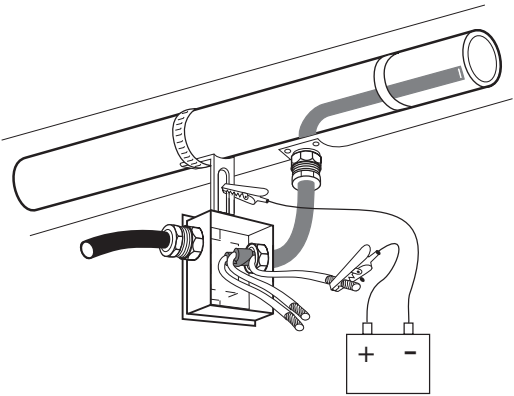
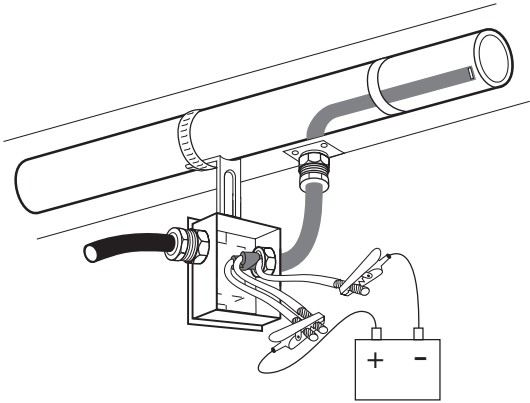
- before installing heating cable.
- before installing thermal insulation.
- prior to initial start-up.
- and as part of the periodic maintenance.
(see Section 9.2).

8.2 Test method

After completing heating cable installation, the insulation resistance between the conductors and the braid or metal pipe should be checked (see Section 6.1) using a 2500 VDC megger™. Minimum readings should be 20 Megohms regardless of the heating cable length. The installer should record the original values for each circuit on the installation record sheet (see page 27).

Figure 4

Test A: Test between heating cable and braid
Test B: Test between heating cable braid and pipe



9 OPERATION, MAINTENANCE AND PIPE REPAIRS

9.1 Heating cable operation

- **Temperature exposure must not exceed that specified in the product literature. Exceeding those limitations will shorten the service life and may permanently damage the heating cable.**
- Pipe insulation must be complete and dry to maintain the correct temperature.

9.2 Inspection and maintenance

- Consult the heat tracing system documentation prior to maintenance /repair /modification.
- Visual inspection: Exposed heating cable and pipe insulation should be checked periodically to make sure that no physical damage has occurred.
- Meggering: The system should be meggered regularly. When meggering the insulation resistance from the main supply panel, it is recommended that the test is performed between L/N (together) and PE. Freeze protection systems should be meggered before the winter months each year (see section 8). Temperature maintenance systems should be tested at least twice a year. Function testing of electrical protection and temperature control systems should be carried out at regular intervals.
- The Periodic Inspection Record on the following pages should be filled out during maintenance of each circuit in your system.

9.3 Piping systems repair and maintenance

- Isolate heating cable circuit and protect the heating cable from mechanical or thermal damage during pipe repair work.
- Check heating cable installation after pipe repairs and restore thermal insulation following the recommendations in Section 6. Check correct functioning of electrical protection systems.
- After maintenance/repair/modification, test the operation of the earth-fault device of each affected circuit.
- In the event of an earth fault or over current interruption, the device shall not be reset until the cause of the trip has been investigated by qualified personnel.
- Upon completion of maintenance/repair/modification, the insulation resistance of the heating cable shall be measured and recorded after installation and shall not be less than 20 Megaohm.

10 HEATING CABLE DAMAGE

- **Do not repair damaged heating cable.**
Remove entire damaged section and splice in a new length using the appropriate nVent RAYCHEM components.
- **Replace damaged heating cable at once.**
Damage allowing moisture and contamination to enter the heating cable may result in arcing earth faults and potential fire hazards.
- Heating cable exposed to fire or flame may cause further fire damage if powered.
Remove from service at once and replace before re-use.

11 TROUBLESHOOTING GUIDE

- Refer to the Troubleshooting guide on pages 30-33. If the problem persists after following the guide procedures, contact your nVent representative immediately.

INSTALLATION RECORD SHEET

CIRCUIT No. _____

| INSTALLATION RECORDS FOR: | | | | | | | | | |
|---|----------------------|--|--|--|--|--|--|--|--|
| Circuit breaker number | | | | | | | | | |
| Drawing reference number | | | | | | | | | |
| Megger test on pipe before insulating (bypass thermostat if applicable) | Reading Initial | | | | | | | | |
| | Date | | | | | | | | |
| Megger test after insulating (bypass thermostat if applicable) | Reading Initial | | | | | | | | |
| | Date | | | | | | | | |
| Circuit voltage | Panel | | | | | | | | |
| | Connection terminals | | | | | | | | |
| Insulation complete and sealed | Initial | | | | | | | | |
| | Date | | | | | | | | |
| Locations of low profile components are marked on the cladding | Initial | | | | | | | | |
| | Date | | | | | | | | |

REMARKS & COMMENTS:

INSPECTION AND MAINTENANCE RECORD SHEET

| | | | | | | | | | | |
|-------------|--|--|--|--|--|--|--|--|--|--|
| CIRCUIT NO. | | | | | | | | | | |
|-------------|--|--|--|--|--|--|--|--|--|--|

| MAINTENANCE CHECKS FOR: | | MONTH: | | | | | | | | YR.: | |
|---|---------|---------------|--|--|--|--|--|--|--|-------------|--|
| No signs of overheating, moisture, or corrosion, etc. | Initial | | | | | | | | | | |
| | Date | | | | | | | | | | |
| In connection systems Heating cable and cable glands tight Connection terminals tight Earth connection tight Insulation in good condition | Initial | | | | | | | | | | |
| | Date | | | | | | | | | | |
| Thermostats set properly and capillaries are protected | Initial | | | | | | | | | | |
| | Date | | | | | | | | | | |

TROUBLESHOOTING GUIDE

| Symptom | Probable Causes |
|--|---|
| Overcurrent protection trips or blows. | Electrical fault at: a. damaged heating cable b. faulty splices or tees c. end seal d. connection |
| | Circuit oversized |
| | Start-up below design temperature |
| | Defective electrical protection |

| Symptom | Probable Causes |
|------------|--|
| RCD trips. | Earth fault at: a. damaged heating cable b. faulty splices or tees c. end seal d. connection |
| | Excessive moisture in: a. junction boxes b. splices and tees c. end seals |
| | High leakage currents due to a combination of excessive lengths of power cable and heating cable. |
| | Mains borne disturbances |
| | Defective RCD |

| | Corrective Actions |
|--|---|
| | Investigate and remedy (see note 1): |
| | Resize or redesign |
| | <ul style="list-style-type: none"> a. redesign for lower start-up temperatures. b. preheat pipe from alternative heat source to within exposure temperatures given in Product Data Sheets. c. Energize part of circuit |
| | Ersetzen |

| | Corrective Actions |
|--|---|
| | Investigate and remedy (see note 1): |
| | Dry out and reseal or remake immediately. Perform insulation resistance test. (10 MΩ minimum) |
| | Redesign |
| | Redesign distribution, guidance is available from nVent RAYCHEM |
| | Replace. |

| Symptom | Probable Causes |
|------------------|---|
| No power output. | Loss of supply voltage due to: a overcurrent or residual current protection operating b loose terminals in junction box c loss of supply cable continuity (e.g., open circuited from damage) |
| | Control thermostat is connected in the normally open position or limit thermostat is tripped |
| | High resistance connection at: a junction box terminals b splices and tees |
| | |

| Symptom | Probable Causes |
|----------------------|---|
| Low pipe temperature | Wet thermal insulation |
| | Design error |
| | Incorrect setting or operation of controls e.g., thermostats. |

Note:

Locate faults by the following steps:

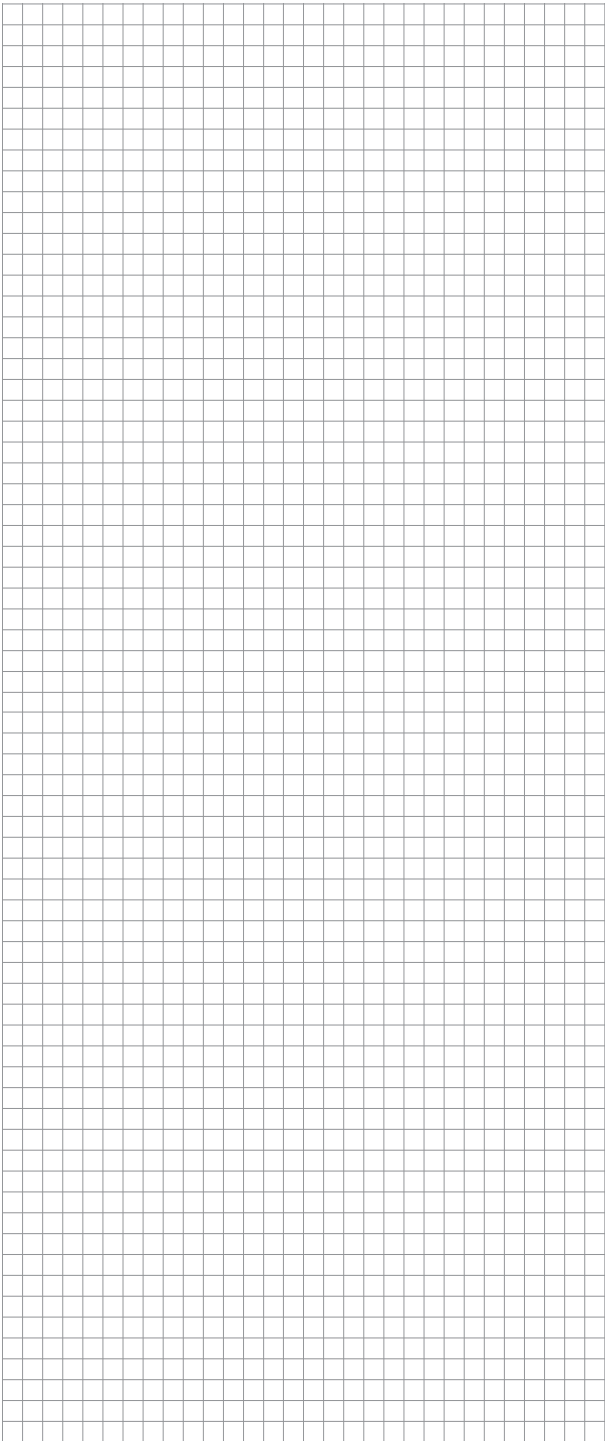
- 1 Visually inspect the power connections, splices and end seals for correct installation.
- 2 Look for signs of damage at:
 - a) Valves, pumps, flanges and supports.
 - b) Areas where repairs or maintenance work has been carried out.
- 3 Look for crushed or damaged insulation and cladding along the pipe..

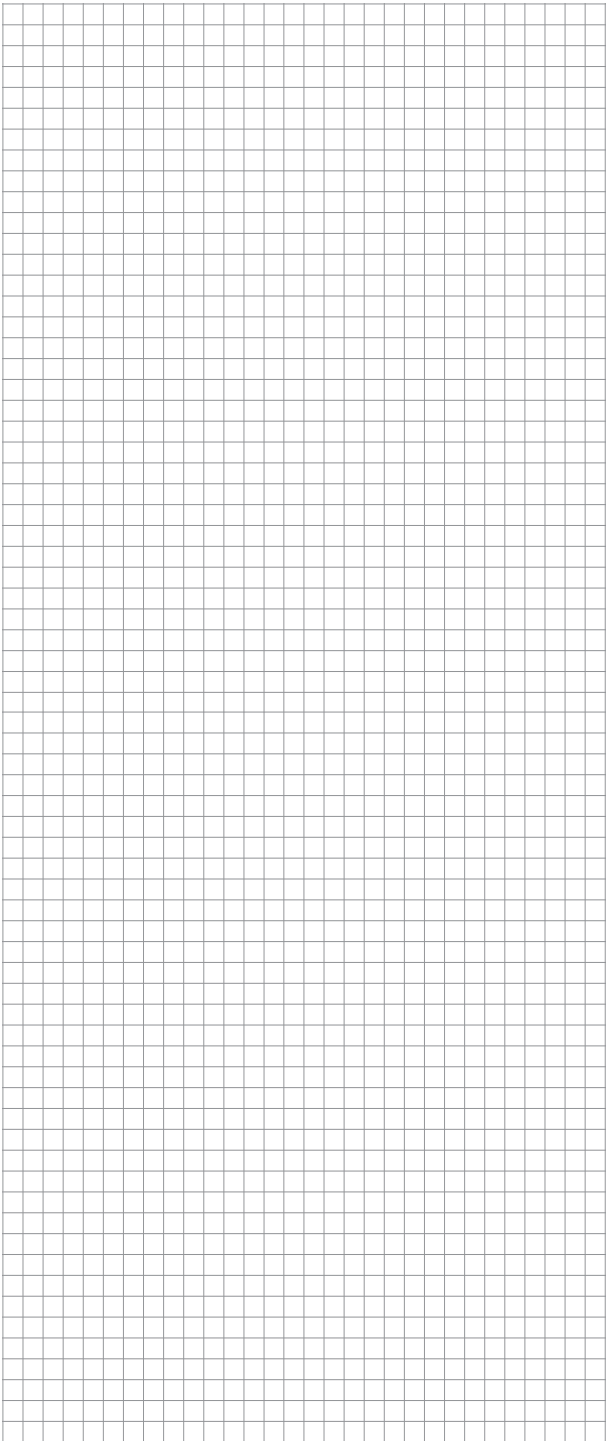
| | Corrective Actions |
|--|---|
| | Restore supply voltage a. following A and B (page 26) b. re-tighten terminals NB: If excessive heating has occurred due to high resistance, replace terminals or crimps c. locate damage and repair |
| | Reconnect to normally closed position |
| | Locate and remedy by: a. retighten b. repair NB: If excessive heating has occurred due to high resistance, replace terminals or crimps |
| | |

| | Corrective Actions |
|--|--|
| | Remove and replace with dry insulation of correct specification and ensure complete weatherproofing |
| | a. check with competent authority for design conditions b. modify to meet nVent RAYCHEM recommendations |
| | Repair or reset to correct level of operation |

- 4 If after 1, 2 and 3 above the fault has not been located, then either:
- a) Consult nVent for further assistance.
 - b) Where local practices and conditions allow (e.g., non hazardous areas) isolate one section of heating cable from another by cutting in half and testing (e.g., Insulation Resistance) both halves until general area of damage is found.

Remove insulation and expose fault.





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