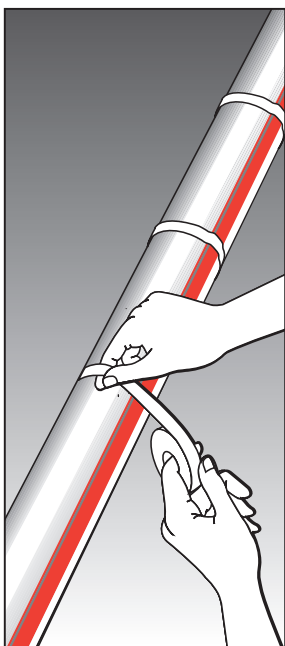

Commercial heat-tracing: Installation and Maintenance Manual



**Self-Regulating
Heating Cable Systems**

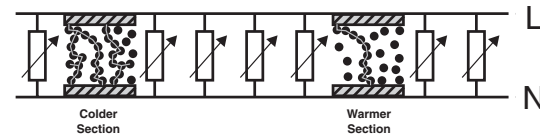
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General information

Use of the manual

The Installation and Maintenance manual is for Tyco Thermal Controls self-regulating heating cable systems on thermally insulated pipes. For gutters and downpipes, consult the Technical Handbook (Ref. CDE-0518). For self-regulating ground or surface snow melting consult INST-159 only. For information regarding other applications contact your Tyco Thermal Controls representative.

Self-Regulating Cables



- ▶ Power output varies with temperature.
- ▶ As pipe temperature increases, power output decreases.
- ▶ At high temperatures, the polymer expands, reducing the number of the conductive paths, and thus reducing current flow.
- ▶ At low temperatures, there are many conductive paths, allowing current to flow between the conductors.

Important

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

2

Conditions for safe use

| Cable type | HWAT-L | HWAT-M | HWAT-R | FS-A-2X | FS-B-2X | FS-C-2X | FS-C10-2X |
|---|--|---------------------|---------------------|--|--|---|--|
| | Hot water temperature maintenance | | | Frost protection for pipes | | Frost protection of pipes/ Temperature maintenance | Frost protection for pipes |
| Nominal voltage | 230 VAC | 230 VAC | 230 VAC | 230 VAC | 230 VAC | 230 VAC | 230 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 | 10 W/m at 5°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. 25 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 | 180 m 20 A |
| Min. bending radius | 10 mm | 10 mm | 10 mm | 10 mm | 10 mm | 10 mm | 10 mm |
| Max. continous exposure temperature | 65°C | 65°C | 80°C | 65°C | 65°C | 95°C | 90°C |
| Max. exposure temperature (power-on condition – 800 h. cumulative) | 85°C | 85°C | 90°C | 85°C | 85°C | 95°C | 90°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 | 16 x 6.8 |
| 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 | 0.14 kg/m |
| Approvals | BS / ÖVE / VDE / SEV / CSTB / SVGW / DVGW / CE / VDE | | | | | | |
| Control units | QWT-05 HWAT-ECO | HWAT-ECO | HWAT-ECO | AT-TS-13 AT-TS-14 RAYSTAT-CONTROL RAYSTAT-ECO RAYSTAT-CONTROL-11-DIN | AT-TS-13 AT-TS-14 RAYSTAT-CONTROL RAYSTAT-ECO RAYSTAT-CONTROL-11-DIN | AT-TS-13 AT-TS-14 RAYSTAT-CONTROL RAYSTAT-CONTROL-11-DIN | RAYSTAT-CONTROL-10 RAYSTAT-ECO-10 RAYSTAT-CONTROL-11-DIN AT-TS-13* AT-TS-14* *maximum circuit of 150m |
| Connection system | | | | | | | |
| Junction box | – | – | – | – | – | JB16-02 | JB16-02 |
| Connection kit | RayClic | RayClic | RayClic | RayClic | RayClic | CE20-01 | CE20-01 CE25-21 |
| 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 | JB-SB-08 |

Warning

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 a Tyco Thermal Controls approved end seal.

| Cable type | FroStop-Green | FroStop-Black | GM-2X | 8BTV2-CT | EM2-XR | EM2-R | R-ETL-A | T2Red |
|---|--|---|--|---|----------------------------|----------------------------|--|--------------------------|
| | Frost Protection for pipes | Frost protection of pipes / Ice and snow protection of gutters and downpipes | Ice and snow protection of gutters and downpipes | Drain heating for ramp drainage systems | Ramp and accessway heating | Ramp and accessway heating | Frost protection for pipes | Underfloor heating |
| Nominal voltage | 230 VAC | 230 Vac | 230 VAC | 230 VAC | 230 VAC | 230 VAC | 230 VAC | 230 VAC |
| Nominal power output (on insulated metal pipes) | 10 W/m at 5°C | 16 W/m at 5°C | 36 W/m in ice and 18 W/m in air at 0°C | 26W/m at 5°C | 90 W/m at 0°C | 80 W/m at 0°C | 10 W/m at 5°C | 60-100 W/m ² |
| C-type circuit-breaker according to selected kit | max. 16 A | max. 16 A | max. 20 A | max. 16 A | max. 50 A | max. 32 A | max. 10 A | max. 20 A |
| Max. circuit length | 100 m 16 A | 80 m 16 A | 80 m 20 A | 80 m 16 A 0°C startup | 85 m 50 A | 75 m 32 A | 100 m 10 A | 100 m |
| Min. bending radius | 10 mm | 10 mm | 10 mm | 10 mm | 50 mm | 50 mm | 35 mm | 35 mm |
| Max. continuous exposure temperature | 65°C | 65°C | 65°C | 65°C | 100°C | 90°C | 65°C | 65°C |
| Max. exposure temperature (power-on condition – 800 h. cumulative) | 65°C | 65°C | 85°C | 85°C | 110°C | 90°C | 65°C | 65°C |
| Max. dimensions in mm (W x H) | 12.5 x 5.3 | 12.5 x 5.3 | 13.7 x 6.2 | 13.7 x 6.2 | 18.9 x 9.5 | 13.7 x 6.2 | 8,5 x 5,8 | 6,0 x 8,7 |
| Weight | 0.13 kg/m | 0.13kg/m | 0.13 kg/m | 0.13kg/m | 0.27 kg/m | 0.13 kg/m | 0.07 kg/m | – |
| Approvals | BS / ÖVE / VDE / SEV / CSTB / SVGW / DVGW / CE / VDE | | | | | | CE / VDE | |
| Control units | AT-TS-13 AT-TS-14 RAYSTAT-ECO-10 RAYSTAT-CONTROL-10 RAYSTAT-CONTROL-11-DIN | EMDR-10 / HTS-D AT-TS-13 AT-TS-14 RAYSTAT-ECO-10 RAYSTAT-CONTROL-10 RAYSTAT-CONTROL-11-DIN | EMDR-10 HTS-D | VIA-DU-20 EMDR-10 | VIA-DU-20 | VIA-DU-20 | AT-TS-13 AT-TS-14 RAYSTAT-CONTROL RAYSTAT-ECO | Raychem TA Raychem TC |
| Connection system | | | | | | | | |
| Junction box | JB16-02 | JB16-02 | – | JB16-02 | VIA-JB2 | JB-82 | JB16-02 | – |
| Connection kit | CE20-01 | CE20-01 | RayClic CCE-03-CR | C25-21 E-06 CE25-21 | VIA-CE1 | CCE-04-CT | CE-ETL/T2Red | CE-ETL/T2Red |
| Support bracket | JB-SB-08 | JB-SB-08 | included in the kit | JB-SB-08 | – | – | – | – |

Warning

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 a Tyco Thermal Controls approved end seal.

3 Heating cable selection

Check the design specification to make sure the proper heating cable is installed on each pipe or surface. Refer to Tyco Thermal Controls product literature or the TraceCalc software to select the proper heating cable for each application.

Look-up Table: The following table shows which heating cables are

| Application | Protection for Pipes | Temperature Maintenance | Protection of Gutters | Ice/Snow Protection of Ground Surfaces | Underfloor heating/warming |
|---------------|----------------------|-------------------------|-----------------------|--|----------------------------|
| FS-A-2X | ✓ | | | | |
| FS-B-2X | ✓ | | | | |
| FS-C-2X | ✓ | | | | |
| FS-C10-2X | ✓ | | | | |
| FroStop-Green | ✓ | | | | |
| FroStop-Black | ✓ | | ✓ | | |
| HWAT-L | | ✓ | | | |
| HWAT-M | | ✓ | | | |
| HWAT-R | | ✓ | | | |
| GM-2X | | | ✓ | | |
| 8BTV2-CT | | | ✓ | | |
| EM2-XR | | | | ✓ | |
| EM2-R | | | | ✓ | |
| R-ETL-A | ✓ | | | | |
| T2-Red | | | | | ✓ |

4 Heating cable storage

Heating cable storage

- ◆ Store the heating cable in a clean, dry place
- ◆ Temperature range: -40°C to +60°C
- ◆ Protect the heating cable from mechanical damage

5 Product checks

5.1 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 Tyco Thermal Controls' 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.

5.2 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, or consult Tyco Thermal Controls product literature for design.**
- ▶ Protect all heating cable ends from moisture, contamination and mechanical damage or other interference if left exposed before component installation.

5.3.1 Heating cable on pipe attachment recommendations

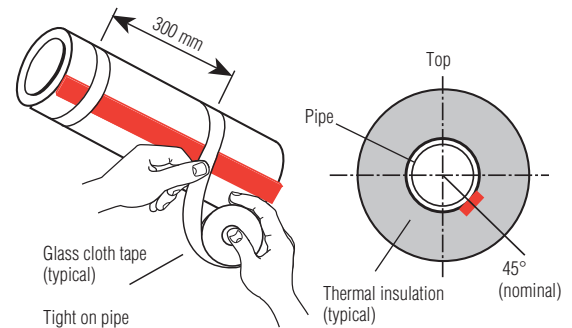
- ▶ The heating cable may be installed straight, spiralled or in multiple runs as required by the design specification, Tyco Thermal Controls' product literature or TraceCalc software.
- ◊ **Do not** use metal attachments, vinyl electrical tape or duct tape as heating cable damage may result.
- ◊ Self-regulating technology allows for the multiple overlapping of the heating cable on to itself.

5.3.2 Heating cable, non-pipe fixing recommendations

- ▶ For snow and ice protection applications, the heating cable should be fixed in place using one of the Tyco Thermal Controls recommended fixing methods, including spacer rail or connection to a reinforcement grid.
- ▶ For gutter applications, the heater should be held in place within the gutter using recommended fixing clips as supplied by the manufacturer.
- ▶ For underfloor heating applications, the heater shall be installed using the fixing devices of the manufacture or installed in the T2Reflecta heat reflector product.

5.4 Straight tracing

- ▶ Straight trace the pipe unless the design calls for spiralling.
- ▶ On horizontal pipes, fix on lower quadrant (5 O'clock or 7 O'clock positioning on pipe) and not on bottom of pipe.
- ▶ Read the kit installation instructions and plan the component location before permanently attaching the cable to the pipe.
- ▶ Thermally insulate and weatherproof to specification.



Tyco Thermal Controls attachment tapes:

- GT66 Self-adhesive glass cloth tape General purpose tape.
- ATE-180 Aluminium fixing tape. Using only if required for the system design (Typically for temperature maintenance applications such as HWAT.)

5.5 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.
- ▶ Raychem heating cable can be cut-to-length without affecting the heat output per metre.

5.6 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 or Tyco Thermal Controls product literature or TraceCalc software 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.

6

Components installation

General notes:

Select the required components from Tyco Thermal Controls product literature or use the TraceCalc software. 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.

- ▶ Raychem self-regulating and power-limiting heating cables are parallel circuit design. **Do not** twist the conductors together as this will result in a short circuit.

6.1 Components required

- ▶ For the installation of all components refer to the relevant component installation instructions.
- ▶ Required for each heating cable run:
Power connection and end-seal.
- ▶ As required:
Splice
Tee-splice: junction box, three connection kits and three insulation entry kits.
Accessories (pipe straps, fixing tape, support brackets, labels, etc)

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 (e.g. heatshrink end seals) in place with self-adhesive glass cloth tape.

7 Thermostats and control systems

- ▶ In temperature-sensitive applications, thermostatic control may be necessary. Furthermore, for maximum energy efficiency, Tyco Thermal Controls require the installation and use of an approved controller for the application.
- ▶ Follow the installation instructions supplied with the thermostat or control. Use the proper wiring diagram for the heating cable layout and control method desired.



8 Thermal insulation and marking

8.1

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.

8.2

Insulation installation hints

- ▶ 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, have 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 areas where valve stems, support brackets etc. exit the insulation are appropriately insulated and sealed.

Marking

- ◆ Install “Electric Traced” signs along piping at suitable intervals (5 m intervals recommended) on alternate sides as a warning.
- ◆ Mark on outside of insulation the location of heating cable components.
- ◆ For outdoor de-icing and snow melting applications, the presence of heat-tracing shall be made evident by the posting of caution signs or marking where clearly visible.



Power supply and electrical connection

9.1**Electrical loading**

Size overcurrent protective devices according to the design specification or applicable Tyco Thermal Controls product literature. If devices other than those specifically identified are used, consult the Tyco Thermal Controls representative for the appropriate sizing information.

9.2**Residual current (earth fault) protection**

Tyco Thermal Controls requires the use of a 30 mA residual current device to provide maximum safety and protection from fire. Where design results in a higher leakage current, a maximum 300 mA residual current device may be used. Ground fault protection is required in any installation.

The metal braid covering the trace heater shall be connected to an earth terminal for electrical protection of the circuit.

10 Heating cable testing

10.1 Recommendations

Tyco Thermal Controls recommends insulation resistance test before installing heating cable; before installing thermal insulation; prior to initial start-up; and as part of the periodic maintenance.

10.2 Test method

After completing heating cable installation, the insulation resistance between the conductors and the braid should be checked using a 2.500 VDC megger tester. Minimum readings should be 100 Megohms regardless of the heating cable length. The installer should record the original values for each circuit on the installation record sheet (see page 17).

11 Operation, maintenance and pipe repairs

11.1 Heating cable operation

- ▶ **Temperature exposure must not exceed that specified in Tyco Thermal Controls 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.
-

11.2 Inspection and maintenance

De-energise all power circuits before installation or servicing and maintenance.

- ▶ 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.
-

11.3 Piping systems repair and maintenance

- ▶ Isolate heating cable circuit.
- ▶ 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 8. Check correct functioning of electrical protection systems.

12 Heating cable damage

Heating cable damage

- ▶ **Do not repair damaged heating cable.** Remove entire damaged section and splice in a new length using the appropriate Raychem splice kits.
- ▶ **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.

Troubleshooting guide

A **Symptom:** Overcurrent protection trips or blows.

Probable Causes

Corrective Actions

- | | | | |
|---|---|---|--|
| 1 | Electrical fault at: a damaged heating cable b faulty splices or tees c end seal d connection | 1 | Investigate and remedy (see note 1): |
| 2 | Circuit oversized | 2 | Resize or redesign within Technical Databook Guidelines. (If larger protection is required, ensure supply cables are compatible). |
| 3 | Start-up below design temperature | 3 | a design for lower start-up temperatures. b reheat pipe from alternative heat source to within exposure temperatures given in Product Data Sheets. c energize part of circuit followed by remainder (e.g. in sequence). |
| 4 | Defective electrical protection | 4 | Replace. |

B **Symptom:** RCD trips.

Probable Causes

Corrective Actions

- | | | | |
|---|--|---|--|
| 1 | Earth fault at: a damaged heating cable b faulty splices or tees c end seal d connection | 1 | Investigate and remedy (see note 1): |
| 2 | Excessive moisture in: a junction boxes b splices and tees c end seals | 2 | Dry out and reseal or remake immediately. Perform insulation resistance test. (100 M Ω minimum) |
| 3 | High leakage currents due to a combination of excessive lengths of power cable and heating cable. | 3 | Redesign |
| 4 | Mains borne disturbances | 4 | Redesign distribution, guidance is available from Tyco thermal controls. |
| 5 | Defective RCD | 5 | Replace. |

C **Symptom:** No power output.

Probable Causes

Corrective Actions

-
- | | |
|---|---|
| <p>1 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)</p> | <p>1 Restore supply voltage a following A and B (page 20) b re-tighten terminals NB: If excessive heating has occurred due to high resistance, replace terminals or crimps c locate damage and repair</p> |
| <p>2 Control thermostat is connected in the normally open position</p> | <p>2 Reconnect to normally closed position</p> |
| <p>3 High resistance connection at: a junction box terminals b splices and tees</p> | <p>3 Locate and remedy by: a re-tighten b repair NB: If excessive heating has occurred due to high resistance, replace terminals or crimps</p> |
-

D **Symptom:** Low pipe temperature.

Probable Causes

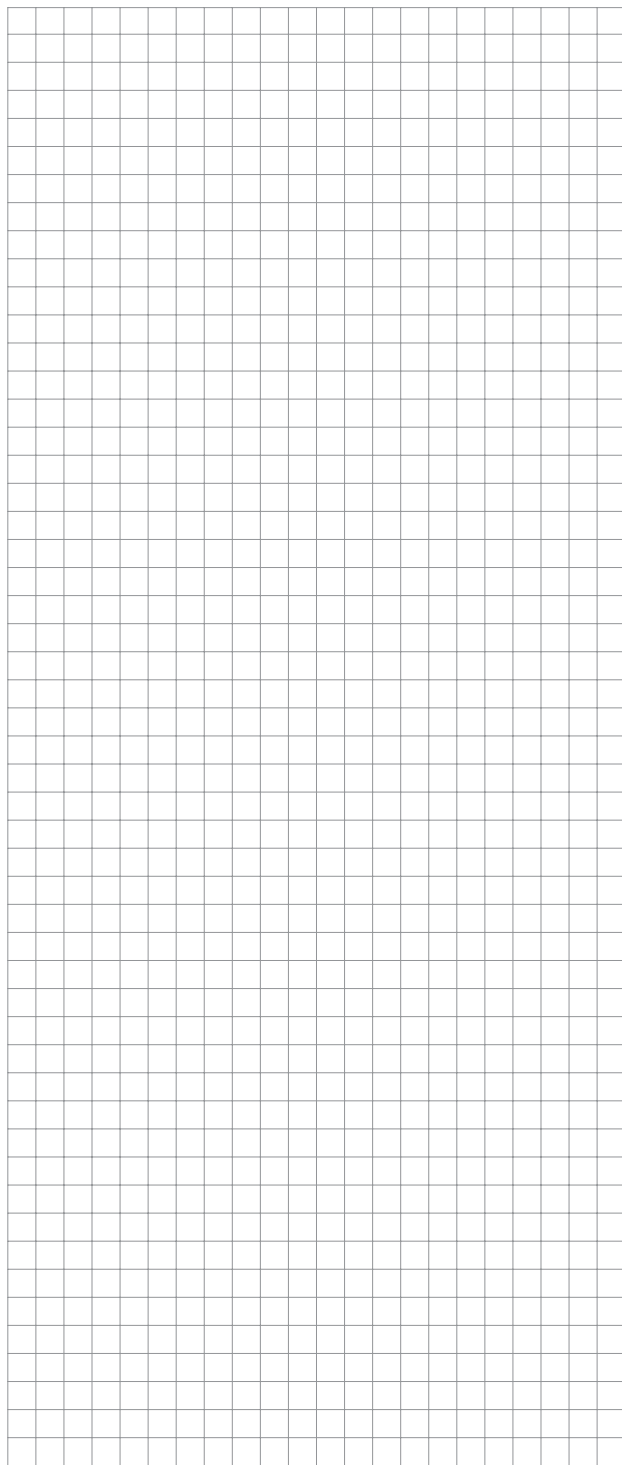
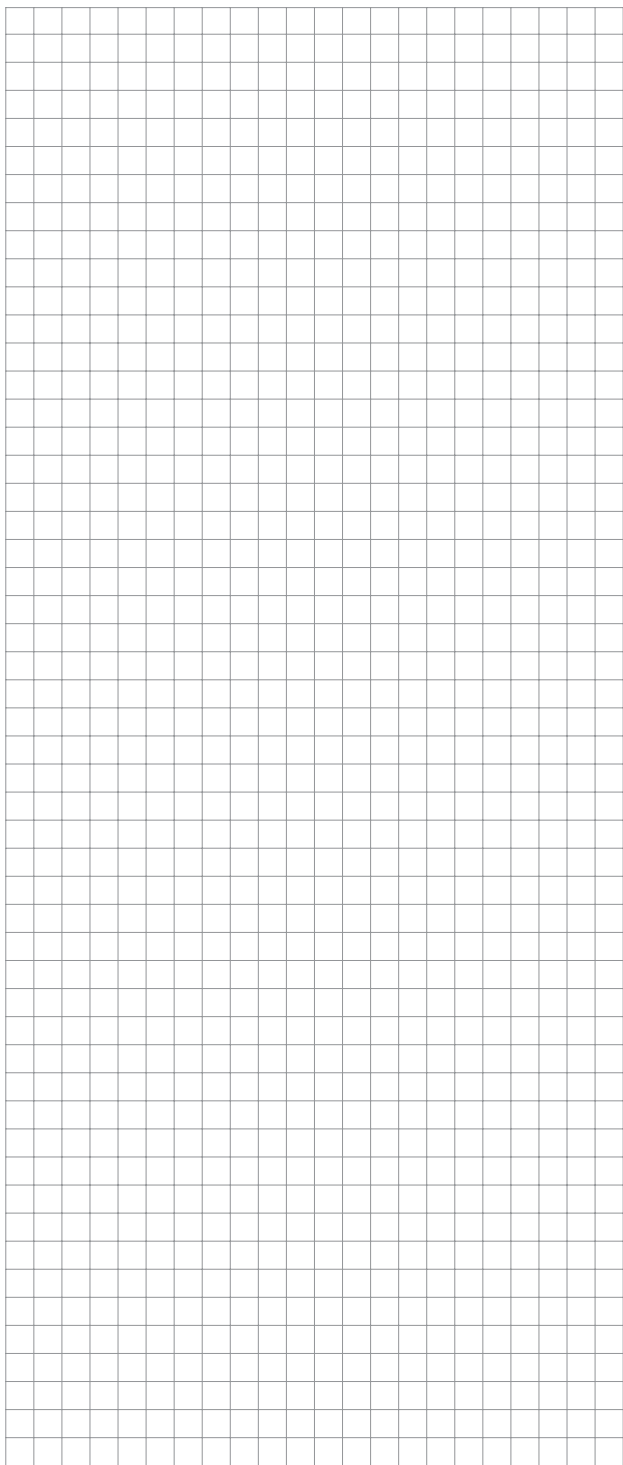
Corrective Actions

-
- | | |
|--|---|
| <p>1 Wet thermal insulation</p> | <p>1 Remove and replace with dry insulation of correct specification and ensure complete weatherproofing</p> |
| <p>2 Design error</p> | <p>2 a check with competent authority for design conditions b modify to meet Tyco Thermal Controls recommendations</p> |
| <p>3 Incorrect setting or operation of controls e.g., thermostats.</p> | <p>3 Repair or reset to correct level of operation</p> |
| <p>4 Heating cable has been exposed to excessive temperature beyond rating.</p> | <p>4 Replace</p> |
-

Note:

Locate faults by the following steps:

- | | |
|---|---|
| <p>1 Visually inspect the power connections, splices and end seals for correct installation.</p> <p>2 Look for signs of damage at: a) Valves, pumps, flanges and supports. b) Areas where repairs or maintenance work has been carried out.</p> <p>3 Look for crushed or damaged insulation and cladding along the pipe.</p> | <p>4 If after 1, 2 and 3 above the fault has not been located, then either: a) Consult Tyco Thermal Controls 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.</p> |
|---|---|
-



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Important: All information, including illustrations, is believed to be reliable. Users, however, should independently evaluate the suitability of each product for their particular application. Tyco Thermal Controls makes no warranties as to the accuracy or completeness of the information, and disclaims any liability regarding its use. Tyco Thermal Controls' only obligations are those in the Tyco Thermal Controls Standard Terms and Conditions of Sale for this product, and in no case will Tyco Thermal Controls or its distributors be liable for any incidental, indirect or consequential damages arising from the sale, resale, use or misuse of the product. Specifications are subject to change without notice. In addition, Tyco Thermal Controls reserves the right to make changes, without notification to the Buyer, to processing or materials that do not affect compliance with any applicable specification.

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