ENGINEERING
TOMORROW

Installation Instruction

Danfoss PX Pipe Trace Heating System

Table of contents

1 Overview

This manual introduces the installation and operation of trace heating circuits using the following self-regulating trace heaters:

- Danfoss PX Pipe Trace Heating System

The self-regulating trace heater features a temperature-dependent resistive element between two parallel copper conductors, that regulates and limits the heat output of the trace heater according to the ambient temperature. If the ambient temperature rises, the power output of the trace heater is reduced. This self-regulating property prevents overheating which would cause damage to the trace heater. Even crossing or overlapping with other trace heaters (or other portions of the same trace heater) are possible.

The heating system is set up as a fixed equipment heating system for pipes in ordinary areas. Thanks to the parallel design the trace heater can be cut and installed to any required length as specified in table on page 7.

Multiple options for connection, splicing and end-termination of the heating circuit are available to meet the individual requirements on site. A large variety of accessories allows for easy customization and extensibility.

2 Safety

For safe installation and operation of the Danfoss PX Pipe Trace Heating System, all technical requirements and instructions given in this manual must be followed.

⚠ WARNING:

Risk of fire or electrical shock. Follow these guidelines to avoid personal injury or material damage.

- All electrical systems and installations must comply with Danfoss requirements and be installed in accordance with the relevant electrical codes and any other applicable national and local codes.
- The US and Canadian electrical codes require ground fault protection to be provided for all trace heating circuits.
- Install the trace heater circuit carefully.
- Use the trace heater in accordance with the intended purpose and strictly comply with the operational data specified in section Technical Data.
- The bending radius of the trace heater must be at least 1" (25 mm). Do not bend on the narrow axis.
- To avoid short circuits, do not connect the trace heater bus wires together.
- Keep all components and the trace heaters dry before and during installation
- Each heating circuit must be marked with electrical warning labels (see section Accessories).
- Keep these instructions for future reference. If applicable, leave them with the end user.
- De-energize before installation or servicing.
- Use only original Danfoss accessories.

3 Certifications / Approvals

Self-regulating trace heater Danfoss PX.

4 Technical data

Ambient temperature range	-67 °F to +185 °F / -55 °C to +85 °C
Operation temperatures	-40 °F to +149 °F /-40 °C to +65 °C
Voltage	110 to 120 VAC / 208 to 254 VAC
Heat output	3 to 10 W/ft / 10 to 33.6 W/m
Resistance	Grounding braid: < 18.2 Ω/km
Dimensions polyolefin outer jacket	0.46" x 0.23" (11.6 x 5.8 mm)
Minimum bending radius	1" (25 mm) Do not bend in an upright position.

5 Personnel requirements

The personnel executing installation and maintenance tasks must have acquired the skills and specialized knowledge relating to the types of protection and types of devices concerned. At least, the personnel must have:

- a general understanding of the relevant electrical engineering
- a basic knowledge of quality assurance, including the principles of auditing documentation, traceability of measurements and calibration of measurement instruments.

6 System design

A heating circuit with self-regulating trace heaters usually consists of:

- Power supply cable connection;
- End-termination.

The following pages list all compatible components for the PX heating system. The respective installation instructions are included in the scope of delivery.

7 Power connection components

The following components can be used for power connection with the PX Pipe Trace Heating System:

	**Power connection kit Cable to Junction Box with ½" NPT cable gland** For connection of self-regulating trace heaters in a junction box. Electrical insulation is ensured by heat shrink tubes. Junction is not included. Includes end-temination.	Catalog No.:	088L0023

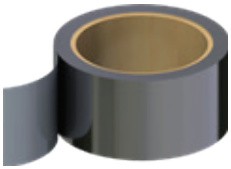
8 End-termination

The following components can be used for end-termination with the PX Pipe Trace Heating System.

	**End-termination** Heat shrinkable end cap for insulation of the end of the trace heater. Includes 5 kits.	Catalog No.:	088L1457

9 Accessories

The following original Danfoss accessories are available for the PX Pipe Trace Heating System.

	**Aluminium adhesive tape** application under trace heaters for better heat distribution.	Catalog No.:	088L0409
	**Electrical warning label** Warning label for trace heater circuits	Catalog No.:	088L0412

10 Trace heater installation

Preparation

Before installing any electric trace heating, the person installing must check if the trace heating has been designed and planned correctly. It is particularly essential to verify the following points:

- complete project planning documentation, operating instructions and installation instructions.
- correct selection of the trace heater and accessories with respect to:
  - calculation of heat losses;
  - max. permissible operating temperature;
  - max. permissible ambient temperature;
  - temperature class;
  - heating circuit length.

Before installing, make sure that all piping and equipment is properly installed and pressure tested.

Maximum heating circuit length

The following table shows the maximum circuit lengths in m (ft) for the different trace heater types with standard circuit breaker amperages. Breaker sizing should be based on the National Electrical Code, Canadian Electrical Code or any other local or applicable code.

NOTICE: If the required trace heater length exceeds the maximum heating circuit length you must install multiple heating circuits.

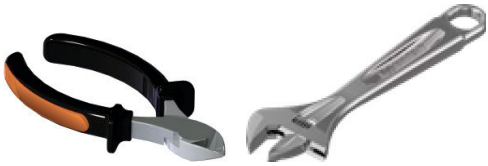
Power output / Trace heater type	Start-up temp. °F (°C)	Maximum heating circuit length in ft. (m)								
		Operating Voltage: 120 VAC			Operating Voltage: 208 VAC			Operating Voltage: 240 VAC		
		20 A	30 A	40 A	20 A	30 A	40 A	20 A	30 A	40 A
PX-F3 (3 W/ft)	+50 (+10)	312 (95)	312 (95)	312 (95)	591 (180)	591 (180)	591 (180)	673 (205)	673 (205)	673 (205)
	0 (-18)	295 (90)	312 (95)	312 (95)	551 (168)	591 (180)	591 (180)	597 (182)	640 (195)	640 (195)
	-20 (-29)	246 (75)	312 (95)	312 (95)	476 (145)	591 (180)	591 (180)	505 (154)	623 (190)	640 (195)
	-40 (-40)	240 (73)	312 (95)	312 (95)	420 (128)	558 (170)	591 (180)	479 (146)	623 (190)	640 (195)
PX-F5 (5 W/ft)	+50 (+10)	262 (80)	262 (80)	262 (80)	486 (148)	492 (150)	492 (150)	525 (160)	525 (160)	525 (160)
	0 (-18)	197 (60)	262 (80)	262 (80)	394 (120)	492 (150)	492 (150)	394 (120)	525 (160)	525 (160)
	-20 (-29)	161 (49)	262 (80)	262 (80)	328 (100)	443 (135)	476 (145)	328 (100)	525 (160)	525 (160)
	-40 (-40)	157 (48)	256 (78)	262 (80)	312 (95)	394 (120)	476 (145)	315 (96)	512 (156)	525 (160)
PX-F8 (8 W/ft)	+50 (+10)	190 (58)	207 (63)	207 (63)	344 (105)	377 (115)	377 (115)	381 (116)	413 (126)	413 (126)
	0 (-18)	125 (38)	184 (56)	207 (63)	246 (75)	312 (95)	344 (105)	246 (75)	374 (114)	413 (126)
	-20 (-29)	105 (32)	177 (54)	207 (63)	203 (62)	289 (88)	322 (98)	210 (64)	348 (106)	404 (123)
	-40 (-40)	98 (30)	164 (50)	207 (63)	190 (58)	272 (83)	302 (92)	197 (60)	328 (100)	387 (118)
PX-F10 (10 W/ft)	+50 (+10)	148 (45)	167 (51)	180 (55)	262 (80)	312 (95)	312 (95)	295 (90)	335 (102)	361 (110)
	0 (-18)	98 (30)	138 (42)	148 (45)	190 (58)	256 (78)	295 (90)	197 (60)	276 (84)	295 (90)
	-20 (-29)	85 (26)	125 (38)	131 (40)	164 (50)	230 (70)	269 (82)	171 (52)	236 (72)	262 (80)
	-40 (-40)	72 (22)	115 (35)	118 (36)	131 (40)	180 (55)	230 (70)	131 (40)	197 (60)	230 (70)

NOTICE: Automatic circuit breaker has to be “C” tripping characteristic.

Required tools / equipment

The following tools are required for installation of the PX Pipe Trace Heating System: **1**

- Wire cutters
- 2 adjustable wrenches (up to 1" (25 mm)); for installation of an insulation bushing only)

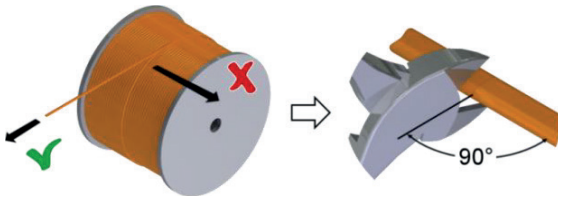


Unrolling the trace heater

⚠ WARNING:
Risk of short cuts and/or material damage. Keep the trace heater ends dry before and during installation. Observe the trace heater's installation instructions.

Unroll the required trace heater in a straight line and cut to the correct length. Cut off the trace heater ensuring a straight cut. **2**

Do not bend or pinch the trace heater, or pull it over sharp edges.



Installation on pipes

This step is necessary for plastic pipes only since plastic pipes conduct heat less efficiently than metal pipes do. For metal pipes continue with step 4. **3**

Place aluminium tape where the trace heater will be attached for better heat distribution.

CAUTION: Risk of injury and/or material damage. Never tread on or drive over the trace heater. Do not use it as a loop for stepping on.

4

Preferably install the trace heater in a straight line around the pipe. This saves time, helps to avoid installation mistakes and prevents damage to the trace heater during the thermal insulation work. Furthermore the trace heater can be easily localised later on.

The trace heater should be installed spirally only if this is expressly specified in the project planning.

NOTICE: When installing allow for an additional length of trace heater for assembling splice connections, tee branches, end seals etc. (approx. 1.6 ft (0.5 m) for each).

5

Preferably install the trace heater in the lower half of the pipe, but not on the lowest point. This prevents mechanical damage and allows for better heat distribution.

If you use multiple heating tapes, position them with an offset of 90".

Fastening

At first, select the correct fastening material: 6

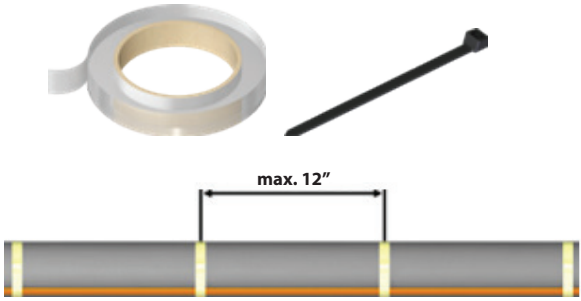
Preferably use Danfoss adhesive tapes with adequate temperature resistance.

Never use PVC insulating tape or self-adhesive tapes containing PVC or VC.

You might also use cable ties. Make sure that they have adequate temperature resistance and resistance to chemicals.

Do not use metal fixtures.

Fasten the trace heater with the adhesive tape or zip ties at intervals of at least 12" (300 mm). 7



NOTICE: In order to ensure good heat transmission the trace heater must have a flat, flush fit over the whole length. If necessary, reduce the distances between the fixing points.

Apply the pipe's insulation according to the manufacturer's installation instructions. 8

Apply an electrical warning label every 10 ft. on a clearly visible place.

Installation on functional elements

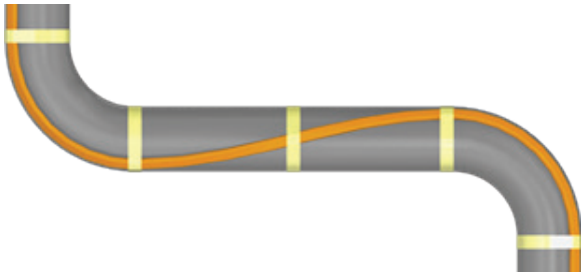
Always install the trace heater on fittings, valves etc. in such a way, that these are easily accessible and replaceable and heating circuits do not have to be cut up. Therefore, always leave a sufficiently large trace heater loop. **9**

Through the higher heat losses from fittings, valves, flanges etc a greater length of trace heater is required. This additional requirement is specified in the project planning documents.

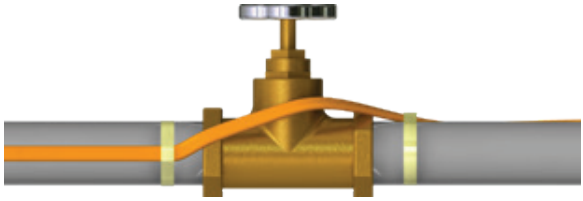
The following illustrations show typical types of installation.

NOTICE: The bending radius of the trace heater must be at least 1" (25 mm). Do not bend in an upright position.

Installation on bends: **10**

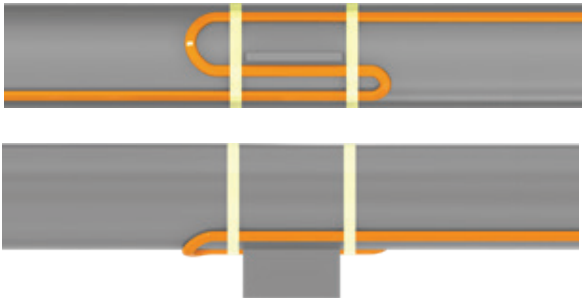


Installation on valves: **11**

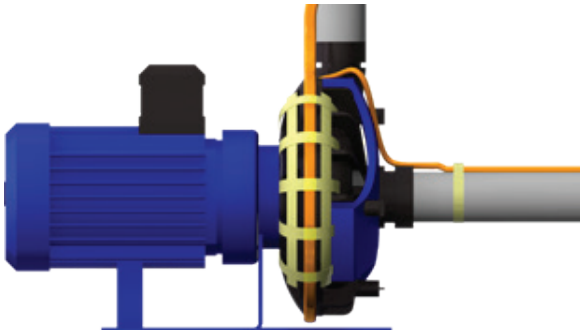


Installation on pressure gauges: **12**

Installation on fixed points: **13**



Installation on pumps: **14**



11 Tests and putting into operation

Measurement of the insulation resistance

The measurement of the insulation resistance is used to determine damage to the trace heater and possible installation faults. It must be carried out at the following times:

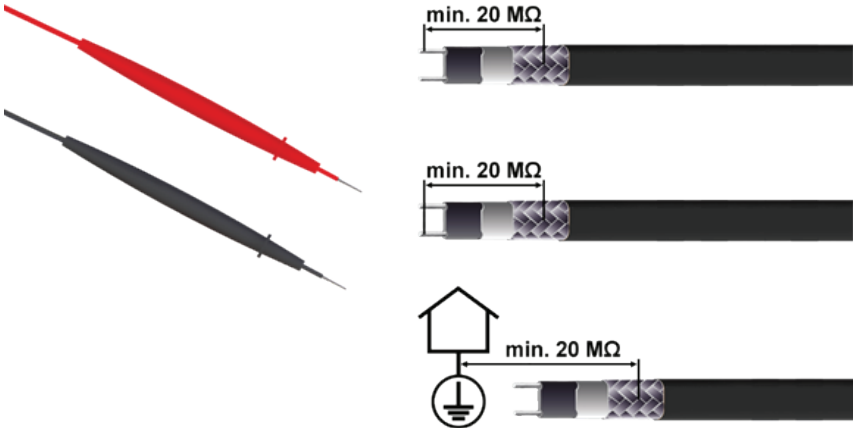
- Preliminary test (shortly before beginning installation of the trace heater on the construction site);
- Acceptance test (after the complete installation of the heating circuit or fitting of the thermal insulation);
- Final inspection (immediately after completion of work on the thermal insulation);
- Upon commissioning ;
- Before switching on the installation.

To do the measurement, proceed as follows:

- Use an isolation tester with a minimum testing voltage of 500 VDC and a maximum testing voltage of 2500 VDC. Recommended testing voltage: 1500 VDC. Required insulation resistance: > 20 MΩ.
- Measure the resistance between each bus wire of the trace heater and the grounding braid.
- Measure the resistance between the grounding braid and the earth potential (for this measurement the heating circuit must not be grounded yet).

⚠ WARNING:

Risk of fire or electrical shock. If the insulation resistance is insufficient you must fix the heating circuit before putting it into operation.



NOTICE: The heating circuit must not be grounded.

Acceptance test and acceptance test report

After completion of the installation work (before fitting the thermal insulation) each heating circuit must be accepted, if possible in the presence of the client.

All further tests must also be documented in an acceptance test report.

After completion of work on the thermal insulation final inspection and acceptance of the individual heating circuits is recommended. Usually, this is the task of the client or the final customer (final inspection).

Putting into operation

Each heat tracing system can only be put into operation if the following conditions are fulfilled:

- The acceptance test reports for each heating circuit are available and the perfect state of the trace heating system has been confirmed.
- The thermal insulation has been completely installed and is in a dry condition.
- It has been ensured that the heating circuit is operated in conformance with the technical data specified by Danfoss.

NOTICE: Upon a cold start, additional heating power is required for heating up tanks and pipes. When starting the system you should allow sufficient time for heat up.

12 Operation

During operation of the electric trace heating system you must ensure that all components of the system are operated within the operating data specified by Danfoss.

This applies particularly to observation of the maximum temperature. Operation within these operating data is a precondition for possible later warranty claims.

System documentation

Complete documentation must be carried out for each system, from the project planning stage, through installation and putting into operation up to periodic maintenance of the trace heating system.

This documentation should include the following:

- Project planning documents;
- Heat loss calculation;
- Selection of the trace heater;
- Piping plans with division of heating circuits;
- Circuit diagrams;
- Up to date piping plans;
- Acceptance reports;
- Reports on repair work and any operations carried out on the tank/pipe system, trace heating system and thermal insulation;
- Inspection reports.

13 Maintenance

Visual and functional inspection

Check the thermal insulation for possible damage, missing seals, cracks, damage to the outer jacket, missing thermal insulation bushings for trace heaters and cables, penetrated water or chemicals. If the thermal insulation is damaged the trace heater should be checked for possible damage.

Damaged trace heaters should be replaced.

Parts subject to wear should be replaced (e.g. seals, locking plates etc).

Check the junction box, connection enclosure and enclosures of temperature regulators for corrosion and possible mechanical damage. Make sure that all enclosure covers are properly in place.

Check the temperature regulator connecting cables and capillary tube systems for damage and that their installation is protected against mechanical damage.

Electrical inspection

Measurement of the insulation resistance should be seen as a permanent part of regular maintenance. For instructions on how to perform the test refer to section Measurement of the insulation resistance on page 13.

Inspection intervals

For frost protection installations inspections should be carrried out annually before the heating period begins.

For plants designed to maintain process temperatures, inspections should be carried out at regular intervals, but at least twice a year.

Personnel training courses

Regular maintenance should be carried out by trained, experienced maintenance personnel.

It is recommended that maintenance personnel is supported in learning new developments in application technology and maintenance by regular service.

Repairwork on piping or thermal insulation

Make sure that the plant is isolated for safety before all repairwork.

Take care that the heat tracing system is not damaged during repairwork on the pipes or insulation.

After completion of the repairwork:

- Make sure that the heating circuits are properly installed anew according to the project planning documentation.

  ⚠ WARNING:

  Risk of fire or electrical shock due to damaged components. Remember that self-regulating trace heaters are designed to be installed only once.

  Carry out a visual, functional and electrical test (refer to Section Tests and putting into operation on page 13).

14 Troubleshooting

Problem	Possible cause	Remedy
Trace heater remains cold	No power supply	Check the supply line
	Trace heater or cold lead cable not properly connected	Connect the trace heater and cold lead cable according to the installation instructions
	Control unit adjusted incorrectly	Adjust the control unit according to the installation instructions
Automatic circuit breaker disengages	Automatic circuit breaker defective	Replace the automatic circuit breaker
	Automatic circuit breaker has wrong tripping characteristics, e. g. “B” instead of “C”	Install an automatic circuit breaker with Type C tripping characteristics
	Nominal circuit breaker size is insufficient	Install an automatic circuit breaker with higher capacity (Refer to section “Maximum heating circuit length”)
	Maximum heating circuit length has been exceeded	Split the heating circuit into separate circuits
	End seal has not been installed	Install the end seal according to the installation instructions
	Short circuit	Identify the cause and remedy the fault (e. g. ensure that tape tails are not twisted)
	Humidity inside the connection system or end seal	Replace the connection system / end seal
Ground fault protection is disengaged	Trace heater damaged	Replace the trace heater at the point where it is damaged
	Moisture in the junction box / connection system	Dry the junction box / connection system
	Maximum monitoring length of the ground fault protection has been exceeded	Be sure that the conduit drain is installed and breathing properly. Install additional ground fault protection devices
	Ground fault protection defective	Replace the ground fault protection device(s)

15 Acceptance report

Contactor to complete for system owner

☐ Acceptance test of the heating system	☐ Inspection before commissioning	☐ Maintenance and re-commissioning

Project information

Project	
Customer	

Heating circuit type

☐ Roof and gutter de-icing	☐ Pipe trace heating

Visual inspection

☐ Trace heaters	☐ Connection components	☐ Control units

Carried out: _____ _____
Date Signature, Company

Functional test

Connect the trace heater to the power supply (a temporary connection to the construction site power supply is also possible). The ground fault protection devices and automatic circuit breakers must not be triggered. Each heating cable end must be warm after approx. 5 to 10 minutes (test by hand).

Carried out: _____ _____
Date Signature, Company

Insulation resistance test

Use an isolation tester with a minimum testing voltage of 500 VDC and a maximum testing voltage of 2500 VDC. Recommended testing voltage: 1500 VDC. Required insulation resistance: > 20 MΩ. Measure the resistance between each bus wire of the trace heater and the grounding braid. Measure the resistance between the grounding braid and the earth potential (for this measurement the heating circuit must not be grounded yet).

Heating Circuit No.				
Trace heater length	ft. (m)	ft. (m)	ft. (m)	ft. (m)
Insulation resistance at _____V	> MΩ	> MΩ	> MΩ	> MΩ

Carried out: _____ _____
Date Signature, Company

Remarks: _____

_____

_____ _____ _____
City/Date Qualified electrician Name / Signature Customer Name / Signature

NOTICE: Claims under warranty will not be considered if the acceptance report is not filled in completely.

16 Limited product warranty

Scope

This limited product warranty is running for a period of 2 years from the date of purchase. It applies for all Danfoss products and accessories, that are subject of this manual, against:

- faulty components, and
- faulty manufacturing.

Not covered are any damages caused by:

- accidents,
- improper installation, operation, maintenance or repairs,
- neglect, or
- alteration.

Furthermore Danfoss cannot be hold liable under this warranty for:

- installation or removal costs,
- loss or damage to property,
- loss of revenue or anticipated profits, or
- any other damages or costs directly or indirectly related to the warranty issue.

If all warranty conditions are met, Danfoss will, at its sole discretion:

- repair the concerning product,
- replace the concerning product, or
- refund the purchasing price.

Conditions

The limited product warranty is subject to the following conditions:

- proper installation, operation and maintenance in compliance with the state of the technology and the product documentation
- presence of completely filled in acceptance reports for all installation, maintenance and repairwork operations

How to claim the warranty

To claim the limited product warranty, you have to:

- Notify Danfoss or your local Danfoss representative by written correspondence or email within 30 days after identification of a possible warranty issue.
- If requested, you must provide any warranty related information to Danfoss, such as:
  project planning documents,
  acceptance reports for installation, operation, maintenance or repairwork,
  etc.

Applicability of implied warranties, state or provincial laws

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

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

17 Safety

For safe installation and operation of the Danfoss PX Pipe Trace Heating System, all technical requirements and instructions given in this manual must be followed.

⚠ WARNING:

Risk of fire or electrical shock. Follow these guidelines to avoid personal injury or material damage.

- All electrical systems and installations must comply with Danfoss requirements and be installed in accordance with the relevant electrical codes and any other applicable national and local codes.
- The US and Canadian electrical codes require ground fault protection to be provided for all trace heating circuits.
- Install the trace heater circuit carefully.
- Use the trace heater in accordance with the intended purpose and strictly comply with the operational data specified in section Technical Data.
- The bending radius of the trace heater must be at least 1" (25 mm). Do not bend on the narrow axis.
- To avoid short circuits, do not connect the trace heater bus wires together.
- Keep all components and the trace heaters dry before and during installation
- Each heating circuit must be marked with electrical warning labels (see section Accessories).
- Keep these instructions for future reference. If applicable, leave them with the end user.
- De-energize before installation or servicing.
- Use only original Danfoss accessories.

⚠ WARNING:

Risk of short cuts and/or material damage. Keep the trace heater ends dry before and during installation. Observe the trace heater's installation instructions.

⚠ WARNING:

Risk of fire or electrical shock. If the insulation resistance is insufficient you must fix the heating circuit before putting it into operation.

⚠ WARNING:

Risk of fire or electrical shock due to damaged components. Remember that self-regulating trace heaters are designed to be installed only once.

18 Sécurité et avertissements

Afin de garantir la sécurité lors de l'installation et du fonctionnement du système de traçage électrique Danfoss PX, l'ensemble des exigences techniques et des consignes mentionnées dans le présent manuel doivent impérativement être respectées.

⚠ AVERTISSEMENT:

Risque d'incendie ou d'électrocution. Suivez ces consignes pour éviter toute blessure ou dommage matériel.

- Tous les systèmes et installations électriques doivent satisfaire aux exigences imposées par la société Danfoss et doivent être installés conformément aux normes électriques en vigueur ainsi qu'aux autres prescriptions nationales et locales applicables.
- Les normes électriques américaines et canadiennes imposent une protection contre les défauts à la terre pour tous les circuits de traçage électrique.
- La pose du circuit de traçage électrique doit être réalisée avec le plus grand soin.
- Utilisez le câble chauffant conformément à l'usage prévu et en respectant les caractéristiques de fonctionnement spécifiées à la section Caractéristiques techniques.
- Le rayon de courbure du câble chauffant ne doit pas être inférieur à 1" (25 mm). Ne pas courber le câble chauffant sur la tranche.
- Pour éviter un court-circuit, ne jamais raccorder ensemble les deux conducteurs du câble chauffant.
- Conservez tous les éléments et les câbles chauffants au sec avant et pendant l'installation.
- Chaque circuit de traçage doit être clairement identifié au moyen d'étiquettes de danger électrique (cf. section Accessoires).
- Conservez ces instructions pour un usage ultérieur. Le cas échéant, remettez-les à l'utilisateur final.
- Mettre hors tension avant toute installation ou opération de maintenance.
- Utilisez exclusivement des pièces et accessoires d'origine Danfoss.

⚠ AVERTISSEMENT:

Risque de court-circuit et/ou de dommages matériels. Conservez les extrémités du câble chauffant au sec avant et pendant toute la durée de l'installation. Respectez les consignes d'installation des câbles chauffants.

⚠ AVERTISSEMENT:

Risque d'incendie ou d'électrocution. Si la résistance d'isolement est insuffisante, le circuit de traçage devra être réparé avant d'être mis en service.

⚠ AVERTISSEMENT:

Risque d'incendie ou d'électrocution dû à la présence de composants endommagés. N'oubliez pas que les c âbles chauffants autorégulés sont conçus pour n'être installés qu'une seule fois.

Vous pouvez trouver des instructions en Français ici: lx.danfoss.com

ENGINEERING
TOMORROW

Danfoss
11655 Crossroads Circle
Baltimore, MD 21220 USA
Phone: 1-888-DANFOSS (326-3677)
Fax: 416-352-5981
lx.danfoss.com