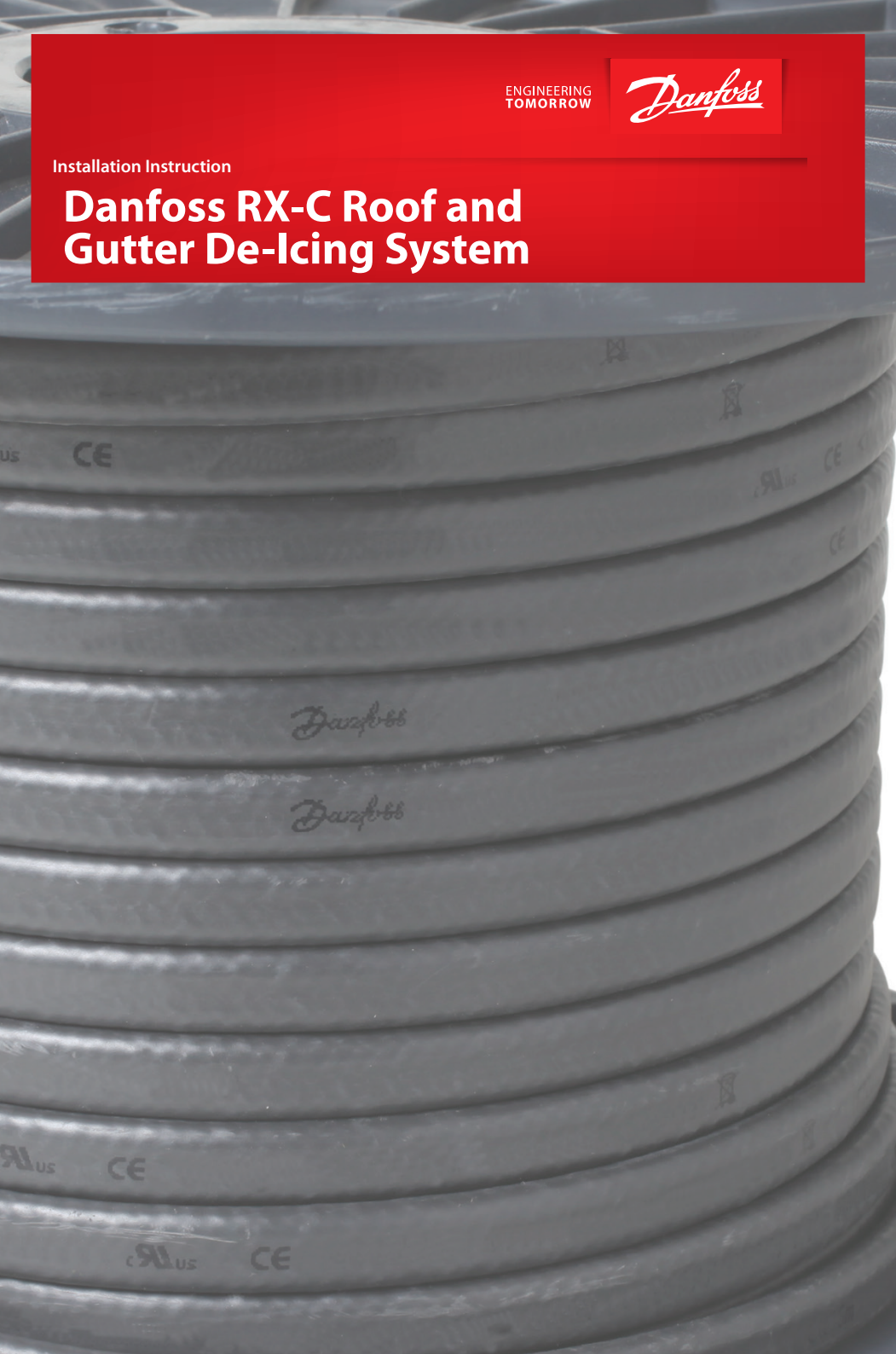
ENGINEERING
TOMORROW

Installation Instruction

Danfoss RX-C Roof and Gutter De-Icing System



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1 Overview

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

- Danfoss RX-C Roof and Gutter De-Icing 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 as given from table on page 13.

The heating system is set up as a fixed equipment heating system for roof and gutter de-icing in ordinary locations. Thanks to the parallel design the trace heater can be cut and installed to any required length.

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 RX-C trace heater the 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 connection system and trace heaters carefully.
- Use the trace heater and connection system 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.
- Any defective component of the kit must be replaced before installation.
- 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.
- Beware of hot surfaces when using the heat gun.
- 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

Danfoss RX-C self-regulating trace heater for roof and gutter de-icing.

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	5 W/ft @ 50 °F / 15 W/m @ 10 °C
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 on the narrow axis.

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:

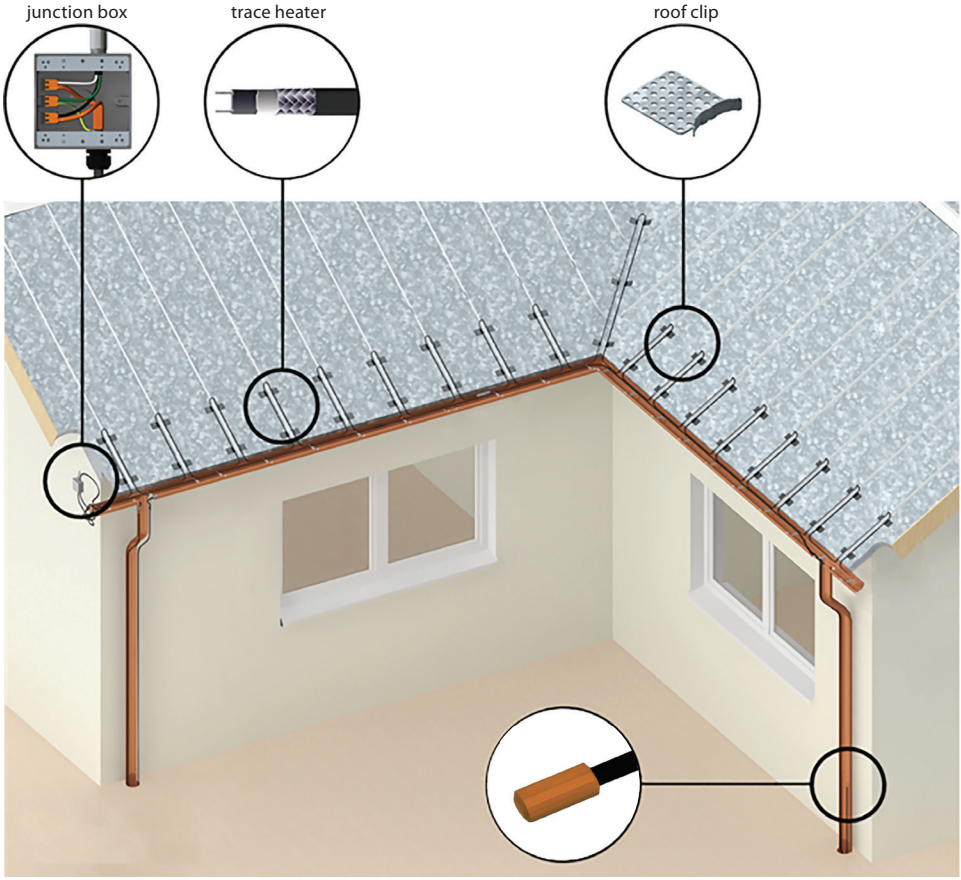
- a general understanding of the relevant electrical engineering (Qualified Electrician)
- a working knowledge and understanding of the relevant standards for electrical installations in general and trace heating in particular
- a basic knowledge of quality assurance, including the principles of auditing 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;
- Control and monitoring units (optional).

The following figure shows a sample trace heating system including typical components:



The following pages list all compatible components for the RX-C heating system for roof and gutter applications. The respective installation instructions are included in the scope of delivery.

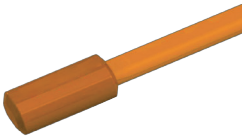
7 Power connection components

The following components can be used for power connection with the RX-C trace heater:

	**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 trace heater splices / junctions with the RX-C trace heater:

	**End-termination –** Connecto NA B-E Silicone end seal for insulation of the end of the trace heater. Includes 5 x endcap and 2 x Silicone adhesive.	Catalog No.:	088L0767
	**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 Danfoss RX-C Roof and Gutter De-Icing System applications:

NOTICE: To ensure compliance with the existing technical regulations, use only original accessories from Danfoss. The use of original accessories from Danfoss is a precondition for the consideration of any warranty claims.

	**Downspout Edge Protection Plate** Spaceclip for self-limiting cables. One per kit.	Catalog No.:	088L3002
	**RX-C Roof Clips** The clips are designed to secure the cables to asphalt shingles, metal seam roofs, and gutters. 50 per bag.	Catalog No.:	088L3001

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;
  - min. permissible start-up temperature;
  - max. permissible operating temperature;
  - max. permissible ambient temperature.

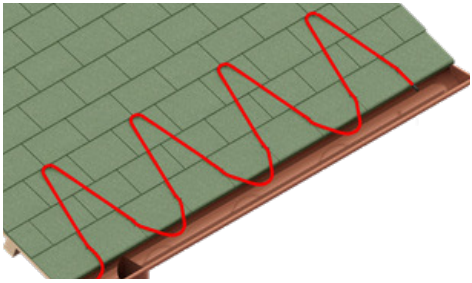
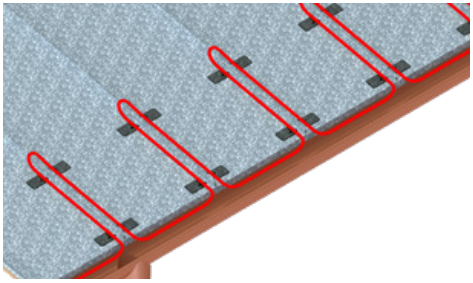
Before installing, make sure that the roof covering, gutters and downspouts are properly installed.

Determination of the trace heater length

The total required trace heater length is determined by the length of the roof, the number of valleys and dimensions of gutters and downspouts.

Step 1

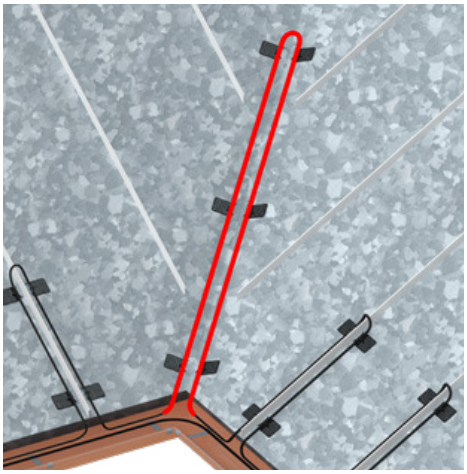
Determine the required trace heater length for the roof.

Standard sloped roofs		Standing seam roofs	
			
Roof overhang	Roof multiplier	Roof overhang	Loop height
12 in (30 cm)	2	12 in (30 cm)	18 in (45 cm)
24 in (60 cm)	3	24 in (60 cm)	30 in (75 cm)
36 in (90 cm)	4	36 in (90 cm)	42 in (105 cm)
length for roofs = roof edge length * roof multiplier		length for roofs = roof edge length + loop height * number of seams	

Step 2

Determine the required trace heater length for valleys.

Snow and ice often accumulate in valleys. The trace heater should be routed up and down the valley to maintain a clear path of melted snow. Add approximately 6 ft. (180 cm) of heating cable for each valley.

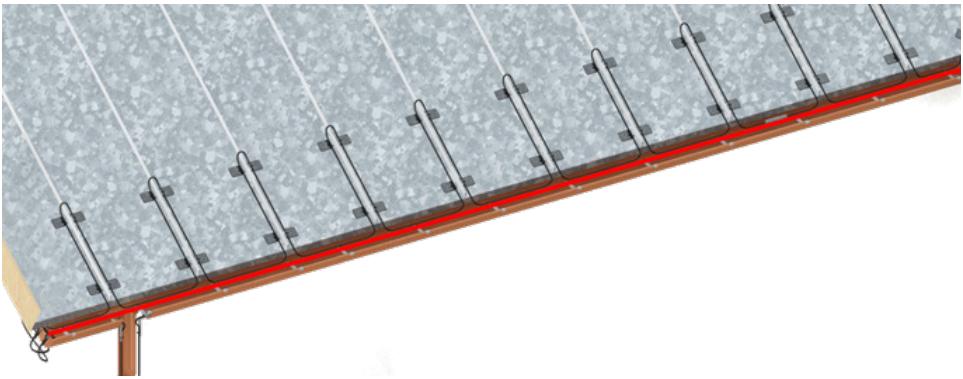


length for valleys = number of valleys * 6 ft. (180 cm)

Step 3

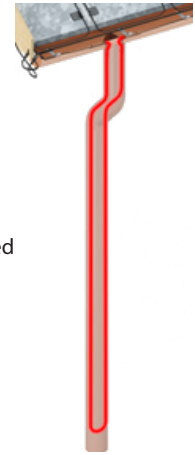
Determine the required trace heater length for gutters.

To allow melted snow and ice to be evacuated, the trace heater must be routed through the gutters. In large gutters, multiple trace heaters are necessary.



Gutter width	Number of trace heaters
< 4 ¾" (12 cm)	1
< 9 ½" in (24 cm)	2
> 9 ½" in (24 cm)	3 or more
length for gutters = gutter length * number of trace heaters	

Separate cable in gutter using clips, 3" separation.



Step 4

Determine the required trace heater length for downspouts.

To allow melted snow and ice to be evacuated, the trace heater must be routed through downspouts (down and up).

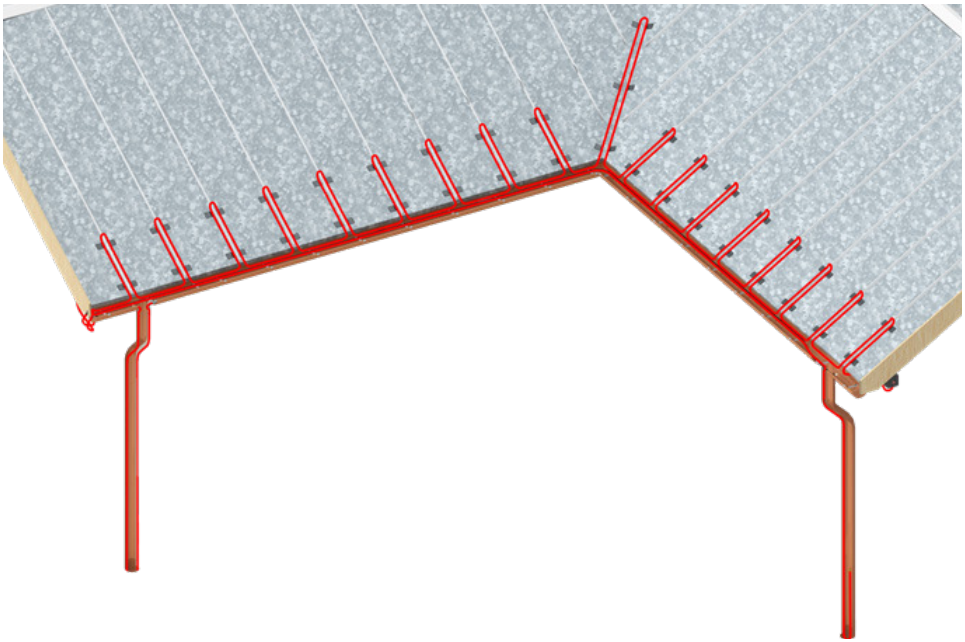
NOTICE: Always use a Downspout protector plate when entering and exiting the downspouts.

length for downspouts = length of all downspouts * 2

Step 5

Determine the total required trace heater length.

Add the calculated lengths of all sections together to obtain the total required trace heater length.



Section	Calculation method	Cable length
Roof	*standard sloped roofs:* roof edge length * roof multiplier *standing seam roofs:* roof edge length + loop height * number of seams	
Valleys	number of valleys * 6 ft. (180 cm)	
Gutters	gutter length * number of trace heaters	
Downspouts	length of all downspouts * 2	
TOTAL REQUIRED LENGTH		_____

Number of heating circuits

The following table shows the maximum circuit lengths in ft (m) for the Danfoss RX-C Roof and Gutter De-Icing System for different installation locations 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. Use only circuit breakers with type C tripping characteristics.

⚠ WARNING:

Risk of fire, electrical shock or dysfunction. Observe the maximum amperage of all components of the trace heating circuit. If the required trace heater length exceeds the maximum heating circuit length you must install multiple heating circuits.

Power output / Location	Start-up temp. °F (°C)	Maximum heating circuit length in ft. (m) based on circuit breaker sizing								
		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
On roofs and valleys and in gutters and downspouts	ice water	131 (40)	131 (40)	131 (40)	230 (70)	230 (70)	230 (70)	262 (80)	262 (80)	262 (80)

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

Required tools / equipment

The following tools are required for installation of the Danfoss RX-C Roof and Gutter De-Icing System:

- Hammer
- Cross-head screwdriver

The following protective equipment is required:

- Safety gloves

Recommended adhesive for metal roofs:

- Roof Clip Glue RX-C Roof Clip Adhesive (10.3 fl. oz. tube)

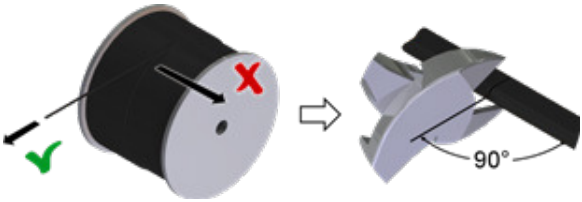
Unrolling the trace heater

⚠ 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.

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

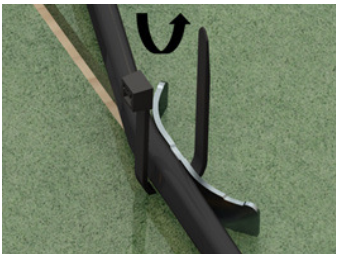


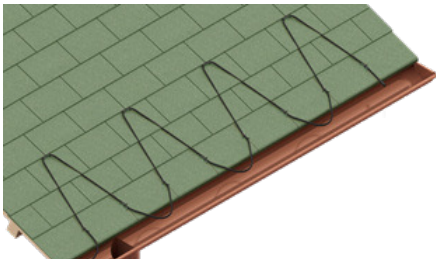
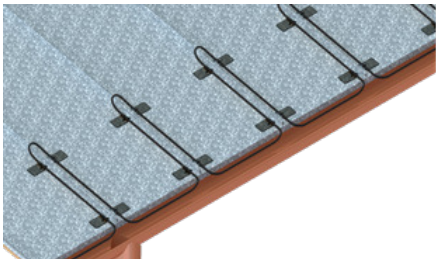
Trace heater fixation on roofs

Attach the clip to the roof as follows:

For metal roofs use adhesive
(for adhesive selection refer to page 11):

Attach the trace heater to the clip using UV-resistant cable ties.



Standard sloped roofs			Standing seam roofs		
On standard sloped roofs, locate the trace heater in a triangle pattern according to the following table:			On sloped roofes with standing seams, run the trace heater along the seams according to the following table:		
Roof overhang	**Loop height**	**Loop spacing**	**Roof overhang**	**Loop height**	**Loop spacing**
12 in (30 cm)	18 in (45 cm)	24 in (60 cm)	12 in (30 cm)	18 in (45 cm)	on every seam
24 in (60 cm)	30 in (75 cm)	24 in (60 cm)	24 in (60 cm)	30 in (75 cm)	on every seam
36 in (90 cm)	42 in (105 cm)	24 in (60 cm)	36 in (90 cm)	42 in (105 cm)	on every seam
					
NOTICE: The bending radius of the trace heater must be at least 1" (25 mm); do not bend in an upright position.			**NOTICE:** The bending radius of the trace heater must be at least 1" (25 mm); do not bend in an upright position.		
Use as many roof clips as necessary to provide proper fixation of the trace heater.			Use as many roof clips as necessary to provide proper fixation of the trace heater.		

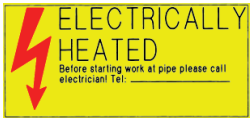
Placement of connection / splice kits

All connection / splice kits must be placed in a dry place, e.g.:

- under roof overhangs
- under gutters
- on the edge of the roof gutter

Application of warning labels

Apply electrical warning labels on a clearly visible place.



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:

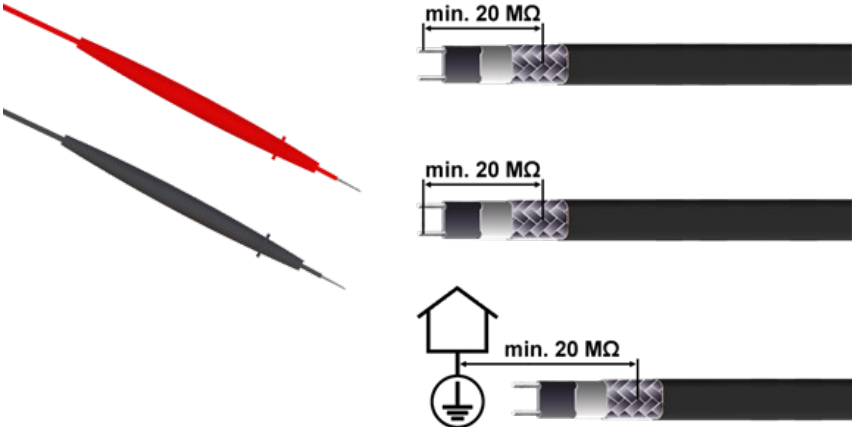
- Preliminary test (shortly before beginning installation of the trace heater on the construction site; refer to section Acceptance Report on page 19)
- Acceptance test (after the complete installation of the heating circuit or fitting of the thermal insulation; refer to section Acceptance Report on page 19)
- 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 (refer to section Acceptance Report on page 19).

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

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.
- All components of the heating circuit are completely installed and are in working order.
- It has been ensured that the heating circuit is operated in conformance with the technical data specified by Danfoss.

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
- Manuals of all of the components of the heating system
- Heat loss calculation
- Selection of the trace heater
- Layout plans with division of heating circuits
- Circuit diagrams
- Acceptance reports
- Reports on repair work and any operations carried out on the de-icing system
- Inspection reports

13 Maintenance

Visual and functional inspection

Remove any deposit of leaves, mud etc. from gutters and downspouts.

Regulary check the trace heater for possible damage.

Damaged trace heaters must be replaced.

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

Check junction boxes, splices and end-terminations for corrosion and possible mechanical damage. Make sure that all enclosure covers are properly in place.

If present, check the temperature regulator (Thermostat/automatic sensing system) 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 14.

Inspection intervals

Inspections should be carried out annually before the heating period begins.

Personnel training courses

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

Repairwork on roofs and gutters

Make sure that all power circuits are de-energized before beginning any repairwork.

Take care that the heat tracing system is not damaged during repairwork on roofs and gutters.

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 14).

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

Protocol type

☐ 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 RX-C trace heater the 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 connection system and trace heaters carefully.
- Use the trace heater and connection system 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.
- Any defective component of the kit must be replaced before installation.
- 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.
- Beware of hot surfaces when using the heat gun.
- 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 fire, electrical shock or dysfunction. Observe the maximum amperage of all components of the trace heating circuit. If the required trace heater length exceeds the maximum heating circuit length you must install multiple heating circuits.

⚠ 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 de l'utilisation du câble chauffant RX-C, il est impératif de respecter les exigences techniques ainsi que les consignes mentionnées dans le présent manuel.

⚠ 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 système de connexion et des câbles chauffants doit être réalisée avec le plus grand soin.
- Utilisez le câble chauffant et le système de connexion adaptés à l'usage prévu et répondant aux 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.
- Tout élément défectueux dans le kit doit être remplacé avant l'installation.
- 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.
- Soyez prudent lors de l'utilisation du pistolet à air chaud, certaines surfaces peuvent devenir brûlantes.
- 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 d'incendie, d'électrocution ou de dysfonctionnement. Respectez l'ampérage maximal de tous les composants du circuit de traçage électrique ! Si la longueur de traçage requise dépasse la longueur maximale autorisée pour le circuit de traçage, plusieurs circuits de traçage devront être installés.

⚠ 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 câbles chauffants autorégulés sont conçus pour n'être installés qu'une seule fois.

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

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