Base Load Power Hub (BLPH)
Hydrogen Vent Q-43004

INSTALLATION OPERATING AND MAINTENANCE MANUAL (IOM)
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Self-regulating and power limiting heating cable systems -- Installation and Maintenance Manual

1.1 INTRODUCTION

1.1.1PROJECT OVERVIEW

Crosswind, a Shell and Eneco joint venture, was awarded the tender to develop the offshore Hollandse Kust Noord (HKN) wind farm, located 18.5km off the coast of Netherlands near the town of Egmond aan Zee. The consortium plans to have HKN operational in 2023 with an installed capacity of 759MW generating at least 3.3TWh per year. This is sufficient renewable power to supply more than 1 million Dutch households with green electricity.

Offshore wind farms produce intermittent electricity and balancing these dips and peaks and integrating this electricity into the national energy system requires new technologies. For this reason, the offshore wind farm will include several new technologies that could be implemented at full-scale in the future. The new technologies being explored include a floating solar park, a short-duration battery storage as well as long-term storage via green hydrogen produced by water electrolysis and subsequently consumed in a fuel cell. The combination of these individual measures, herein referred to as the Base Load Power Hub (BLPH) will ensure a continuous power supply regardless of the wind situation.

Project Location

The Hollandse Kust Noord (HKN) wind farm is located 18.5km off the coast of the Netherlands near the town of Egmond aan Zee.

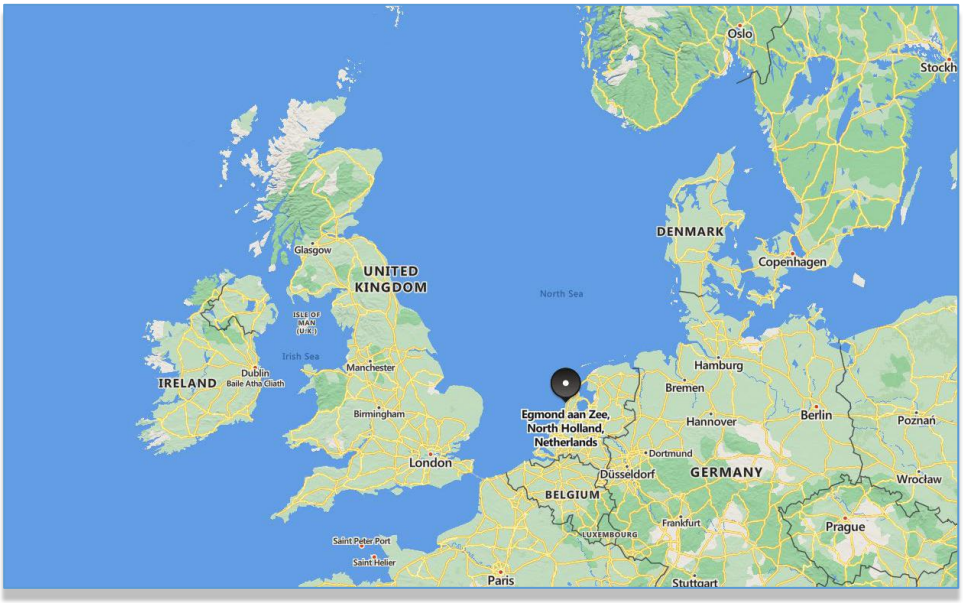


Figure 1 HOLLANDSE KUST NOORD WIND PARK Location Map



Figure 2 - Wind Park Details

The wind farm will consist of No. 69 x 11.5MW wind turbine generators each to be installed on a dedicated monopile structure. A 70th monopile located on coordinates E 590719.1, N 5841602.3 is reserved for installing the platform accommodating the BLPH. The monopile structure was designed and installed by Van Oord Offshore Wind (VooW) and therefore not part of the BLPH scope.

1.1.2 Project Concept

All components included in the BLPH will be integrated onshore on a topside and installed in an offshore location within the boundaries of the HKN wind farm. At its simplest, the BLPH will store energy during periods of high electricity generation from renewable sources (a wind turbine generator and the floating solar PV farm) and release it during periods of low generation. In practice. It is expected that the energy stored will supplement generation from renewable sources to ensure that at least 1.0MW of power is exported to the electrical grid regardless of wind/solar availability.

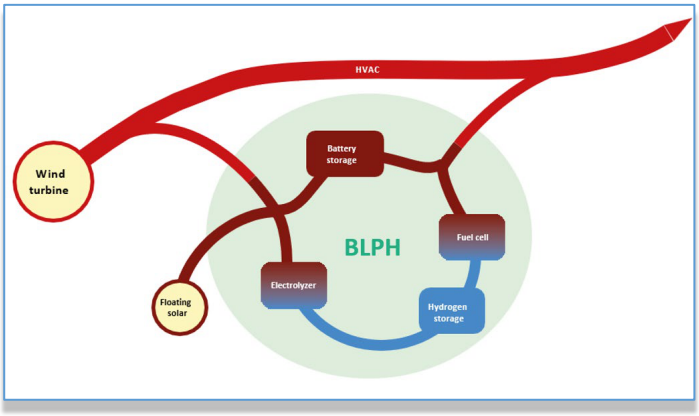


Figure 3 – BLPH Concept

Electricity in the BLPH will be stored in the form of electrons in a battery energy storage system (BESS) as well as converted into green hydrogen via water electrolysis. When the power output from the connecting wind turbine drops to below 1 MWe, the BLPH will return its stored energy to supplement the remaining power output. This will be by

discharging the BESS, while stored hydrogen will be converted back into electricity using a fuel cell to extend the discharge duration.

The purpose of the BLPH s to function as a testbed for the integration of energy storage technologies with renewable generation. It is expected that equipment installed on the BLPH will operate as Normally Unmanned Installation for at least two (2) years with no or minimal maintenance and it will have its own independent control room with the ability to communicate with Crosswind's control room.

2. DOCUMENT SCOPE

This Document describes the instruction, operation and maintenance details of the Hydrogen Vent.

2.1 REFERENCES DOCUMENTS

REFERENCE DRAWINGS

To the present manual are enclosed the following reference drawings:

Drawing No.	Rev.	Description	Notes
1724000887-MAC-DA-00003	02	GENERAL ARRANGEMENTS DRAWINGS, INCLUDING FOUNDATION LOADS-HYDROGEN VENT	NA
1724000887-MAC-DD-00005	01	DETAILED DRAWING WITH PART LIST - HYDROGEN VENT	NA
1724000887-MAC-CA-00004	02	MECHANICAL CALCULATION – HYDROGEN VENT	NA

TECHNICAL SPECIFICATIONS

To the present manual are enclosed the following technical specifications :

Specification No.	Rev.	Description	Notes
123A90-DDL-MAC-MR-50042-MR FOR VENT	00	MATERIAL REQUISITION FOR HYDROGEN VENT – Q-43004	NA
123A90-DDL-MAC-DS-50044-TDS	00	TECHNICAL DATASHEET – HYDROGEN VENT PACKAGE	NA

2.2 DEFINITIONS AND ABBREVIATIONS

COMPANY or Client (CPY):	CROSSWIND
CONTRACTOR (CTR):	ROSETTI MARINO S.p.A.
PROJECT:	HOLLANDSE KUST NOORD WIND PARK Project
PROJECT ITEM:	HYDROGEN VENT
MAKER (ETE):	ENCORE THERMO ENGINEERING SRL
BESS	BATTERY ENERGY STORAGE SYSTEM
BLPH	Base Load Power Hub
BTV	Self regulating cable
CNR	National Research Council
COD	Codification
DA	General arrangement drawing

DDL	Deliverables Document List
DEP.	Department
DS	Datasheet
EDMS	Engineering data management system
EN	European norm
EPA	Environmental Protection agency
ETS	Electronic Thermostat
HKN	Hollandse Kust Noord
HTV	Self regulating cable
IEEE	Institute of electrical and electronics engineers
IOM	Installation operating and maintenance manual
JBM	Integrated power tee connection
JBU	Junction box for modular system
LP	Liquid penetrant
MDMT	Minimum Design Metal Temperature
MR	Material requisition
NGC	Next generation controller
NPS	Nominal pipe size
OSHA	Occupational safety and health administration
VooW	Van Oord Offshore Wind
VPL	Power limiting cable
WP	Work package

Table 1 - Definitions and Abbreviations

2.3 PROJECT DATA

DESIGN CODE	ASME VIII DIV.1 + EUROCODE
MAX. GAS FLOW	13485 kg/h
AMBIENT TEMPERATURE	-8.4/+25°C
OPERATING PRESSURE	ATM barg
DESIGN TEMPERATURE	-10/ +80°C
DESIGN PRESSURE	3.5 barg
CORROSION ALLOWANCE	3mm (for carbon steel only)
HYDROTEST PRESSURE	5.5 barg
AREA CLASSIFICATION	ZONE 2 IIC T 1
MDMT	-29°C
FLUID GROUP	1
CATEGORY	IV
MODULE	G
SEISMIC	N/A
WIND VELOCITY	28 m/s
TYPRE OF FLUID	HYDROGEN GAS
WELDING EFFICIENCY	0.85
RADIOGRAPHY	

3. VENT TIP

3.1 GENERAL INTRODUCTION

The Vent Tips described in the present manual are used to guarantee the gas high combustion efficiency.
These tips are passive systems, i.e. without parts in motion.

3.2 OPERATION PRINCIPLES

The vent tips type SVT are equipment indifferently used for continuous or discontinuous service, for vent systems that does not foresee the primer of the flame even in the presence of any flammable gas.
In any case, the tips are carried out with highly refractory steels, selected to guarantee continuously the flame presence at their exit without that it causes any damages to the equipment.
In case that the flame presence on the tip is not acceptable, it will be necessary to foresee particular systems that guarantee the extinguishing of the flame.

3.3 APPLICABLE CODES, STANDARDS, AND REGULATIONS

The planning activities and the carrying out of the vent tips type SVT are done in compliance with the following rules and procedures:

Process design	:	API RP 521
Materials	:	ASTM – UNI
Welding procedures	:	ASME IX

3.4 GUARANTEES

The described documents within the present manual are covered by functional and construction guarantee for the whole period foreseen in the contract of supply.

To be noted that these guarantees will be declined in case that Encore Thermoengineering has not been contacted for the foreseen verifications after the installation, for the start-up and for the first commissioning operation.

Furthermore, to be noted that to maintain the validity of the foreseen guarantee, any possible intervention for modification or tampering with the supplied products, it should be obligatory to agree with Encore Thermoengineering which will authorize the intervention by written.

3.5 CONSTRUCTION FEATURES

The materials for the carrying out of the vent tips type SVT are selected on the base of the specific needs deriving from the process conditions.
For a detailed determination of the materials used and for the building features please refer to the drawings enclosed.
In general, the vent tips type SVT are made of a flanged connection to allow the installation to the conduct of gas feeding (riser), of a vertical shell complete with windshield, and with systems for the detection of the flame (optional).

The vent tips type SVT do not suffer for the use weather conditions except the limits indicated in the technical specification enclosed to the present manual.

3.6 REQUIRED UTILITIES

There are not required utilities for the correct use of the equipment.
If there is the need to prevent air infiltration in the system upstream of the tip, the entire system should be kept fluxed with a quantity of inert gas directly proportional to the dimensions of the tip and of its accessories.
For these quantities refer to the enclosed technical specification

3.7 TYPES AND CODIFICATION

The specific features of vent tips type SVT can be deduced from the table below.
This on the base of the identification abbreviation of the tip written on the drawing and on the plate of the equipment.

TE-	COD 1	SVT	COD 2

	Codification tag	Description
COD 1	-	Vent tip inlet connection diameter in inches

	Figure position											Accessories
COD 2	1	2	3	4	5	6	7	8	9	10	11	
Nr. 0=NO	x											Nr. of thermocouples for control of the tip flame
Inch 0=NO		x										Extinguisher inlet connection diameter
Inch 0=NO			x									Sample relieving flange diameter
Nr. 0=NO				x								Connections quantity for sample relieving
1=SI 0=NO					x							Refractory inner coating
Nr. 0=NO						x						Anti-noise shell
												Nr. of thermocouples for flame alarm inside the tip

Example: TE-12"- SVT-3/1.5/0/0//0/1
Vent tip diameter 12" with 3 thermocouples for tip flame detection, with extinguisher inlet diameter of 1.1/2”, without sample relieving, without internal refractory lining, with one thermocouple for flame detection inside the tip.

3.8 OPERATING PROCEDURES

3.8.1 – INSTRUCTION FOR RECEIVING AND STORING OF THE MATERIALS:
Materials are supplied completed of packing necessary to preserve the quality of the good.
Once received the unit, check the state of the packing and of the delivered good and proceed to its storing according to the following:
Vent tip: in covered area

- Electric and instrumental accessories: in closed area
- Mechanical accessories: in covered area

3.8.2 – INSTRUCTION FOR INSTALLATION:
After taking the materials out of the packing install them following this procedure:

- accurately clean the line to eliminate the possible present deposits.
- Install the vent tip through the special connection flange putting between the proper gasket, being sure to follow the correct positioning foreseen on the drawing and assembly schemes.
- Install the different control accessories through the proper connections and proceed to their electric or pneumatic connection.

For the assembly indications of the accessories refer to the enclosed manuals of installation, use and maintenance of the single component.
Connect, if it is foreseen, the snuffing line to the corresponding flanged connection putting between the right gaskets.
Check all connections.
3.8.3 – INSPECTION AFTER INSTALLATION
After the installation and before proceeding to the starting of the system, it is necessary to carry out the following checks:

- Check that all the equipment and the accessories are connected in the proper way.
- Check that all electric connections are carried out correctly. At this point we advise to do a blank test of all the foreseen accessories to check the right correspondence of the signals.

3.8.4 – UTILIZATION
Ended up the described checks, the equipment is ready to be used in the limits of use indicated in the technical specification.
3.8.4.1 – START-UP PROCEDURES
No procedure is necessary for the start-up.
3.8.4.2 – PROGRAMMED SHUT-DOWN PROCEDURES
No procedure is necessary for the programmed shut-down.
3.8.4.3 - EMERGENCY SHUT-DOWN PROCEDURES
No procedure is necessary for the emergency shutdown.
3.8.4.4 – NORMAL OPERATION PROCEDURES
No procedure is necessary for the normal use.
In any case if one of these events happens:

- Discharge in emergency of elevated quantity of fluid.
- accidental primer and stabilization of the flame on the exit opening of the tip or inside it.
- Explosion inside the tip or the conveying pipe of the gases

We recommend carrying out an accurate check of the tip and of its components.

3.9 INSPECTION AND MAINTENANCE

To guarantee the correct functioning of the supplied equipment and to avoid permanent damages on them, it is necessary to plan periodical interventions of maintenance according to what is reported below.
The good knowledge of those indications and the regular carrying out of the inspections and the maintenance activities allow to avoid operating mistakes and sudden stops of the equipment.
It is advisable to read carefully this section and do not hesitate to contact our technical offices if the instructions are not clear or exhaustive enough.
The inspection and maintenance schemes indicate the interval of intervention, which we recommend to follow.
These indications are to be considered the minimal to do.
Running the plant these schemes can be improved for what concerns the interval and also adding other check and maintenance activities.

Encore Thermoengineering is not responsible for possible damages to persons or things caused by the bad installation, incorrect use of the equipment or by the non-carrying out of the inspection and maintenance activity.

MAINTENANCE CALENDAR				
Intervention Object	Intervention description	Reference document	Tools	Frequency (months)
Tip shell and windshield	Check that they are free of oxidation and buckling and well preserved If necessary, clean accurately	1724000887-MAC-DD-00005	Various spanners Inox brush Pulivapor Detergents Acids for cleaning	12
Seal flanges and connections	Check and grease the bolts and nuts of the connections Check the sealing and the tightening of the joints Substitute the sealing gaskets	1724000887-MAC-DD-00005	Various spanners Grease Spare parts	12

4. SELF SUPPORTING TYPE FLARE RISER

4.1 GENERAL INTRODUCTION

The Riser is carried out with pipes of thickness and diameter fixed with the process dimensioning, according to the capacities to handle and their chemical-physical conditions and following a structural calculation of mechanical stability specific of each single job.
The quality of the material is fixed in relation to the features of the process and of mechanical resistance and in compliance with the client requests.
The Riser is calculated from the structural point of view to be self-supporting.

4.2 OPERATION PRINCIPLES

The Riser is planned and carried out to allow the flow of fluids to be kept under the conditions specified by the client from the inlet point up to the top tip.
The height of the Riser is calculated according to law and good technique, to limit the fall-out of polluting substances and of radiation to the ground within the requested limits.

4.3 APPLICABLE CODES, STANDARDS AND REGULATIONS

The planning activities and the carrying out of the Riser are done in compliance with the following rules and procedures:

Process design	:	API RP 520
	:	API RP 521
	:	OSHA
	:	EPA
Mechanical design	:	CNR-UNI 10012/1973
	:	CNR-UNI 10011/1985
	:	CNR-UNI 10027/1985
	:	UBC Code
	:	AISC Code
Materials	:	ASTM – UNI -EN
Welding procedures	:	DIN EN ISO 15614-1

4.4 GUARANTEE

The described documents within the present manual are covered by functional and construction guarantee for the whole period foreseen in the contract of supply.

To be noted that these guarantees will be no more valid in case during erection, commissioning and start-up activities (if Thermoengineering qualified and skilled engineers would not be required in accordance with the contractual rates) the recommendation of this operating manual are not strictly observed.

Furthermore, to be noted that to maintain the validity of the foreseen guarantee, any possible intervention for modification or tampering with the supplied products, it should be obligatory to agree with Thermoengineering which will authorize the intervention by written.

4.5 CONSTRUCTIVE FEATURES AND UTILIZATION LIMITS

The Riser is supplied in prefabricated (pre-engineered) parts (trunks) to assemble on site through welded couplings.
The trunks of the riser do not suffer for the weather conditions of use except the limits deriving from the used material, from the superficial treatments and from the chemical features of the process flux.

Normally in the first part (low part) are applied all the nozzles for the process and instrument connection, manhole, hand hole, etc.
The building features and the materials used are noticeable from the drawings enclosed.

4.6 OPERATING PROCEDURES

4.6.1 – INSTRUCTION FOR RECEIVING AND STORING OF THE MATERIALS:
The materials are supplied completed of the necessary packing to preserve the quality of the good.
Once received the unit, check the state of the packing and of the good supplied and store it in a covered area.

4.6.2 – INSTRUCTION FOR INSTALLATION:
In case of supply in more parts, each single part is supplied loose to be assembled in the yard as follows:

- Through flanged couplings for small diameters
- Through welding for big diameters

The trunks are given completely prefabricated (pre-engineered) and completed of supports for stairs, platforms, and other accessories.
The choice of the step of prefabrication and of assembly completion before the positioning of the Riser has to be done on the base of the assembly needs and of the means at disposal for the lifting and the moving of the materials.
Particular care has to be taken for the stays connection and for their pre-tension, which has to be done according to what is foreseen in the proceeding enclosed
The lifting and material handling must be done only after having spotted and checked the lifting and slinging points of the materials.

4.6.3 – INSPECTION AFTER INSTALLATION
At the end of the installation and before starting the system it will be necessary to do some checks as:

- Check that all the accessories are properly connected
- Check that all the bolted connections have been carried out correctly.
- Check the welding carried out on site through non-destructive checks (Rx, LP, etc.)

It is advisable to ask for the attendance of a Thermoengineering technician to assist to the described verifications and the start-up operation in order to maintain valid the foreseen guarantee (see chapter 4 guarantee).

4.6.4 – UTILIZATION

4.6.4.1 – START-UP PROCEDURES
No particular procedure is necessary for the start-up.
4.6.4.2 – PROGRAMMED SHUT-DOWN PROCEDURES
No particular procedure is necessary for the programmed shut-down.
4.6.4.3 - EMERGENCY SHUT-DOWN PROCEDURES
No particular procedure is necessary for the emergency shut-down.
4.6.4.4 – NORMAL OPERATION PROCEDURES
No particular procedure is necessary for the normal operation.

4.7 INSPECTION AND MAINTENANCE

To guarantee the correct functioning of the supplied equipment and to avoid permanent damages on them, it is necessary to plan periodical interventions of maintenance according to what is reported below.
The good knowledge of those indications and the regular carrying out of the inspections and the maintenance activities allow to avoid operating mistakes and sudden stops of the equipment.
It is advisable to read carefully this section and do not hesitate to contact our technical offices if the instructions are not clear or exhaustive enough.
The inspection and maintenance schemes indicate the interval of intervention, which we recommend to follow.
These indications are to be considered the minimal to do.
Running the plant these schemes can be improved for what concerns the interval and also adding other check and maintenance activities.

Encore Thermoengineering is not responsible for possible damages to persons or things caused by the bad installation, incorrect use of the equipment or by the non-carrying out of the inspection and maintenance activity.

MAINTENANCE CALENDAR				
Intervention object	Intervention description	Reference document	Particular tools	Frequency (months)
Connections sealing	Check and grease the tie-rods and nuts of all connections Check and grease the foundation tie-rods. Tightening of the joints	1724000887-MAC-DD-00005	Various spanners Grease	12

5. VERTICAL LIQUID SEAL

5.1 GENERAL REFUSAL

The vertical seal is carried out with tubes or sheets of thickness and diameter fixed with the process dimensioning, according to the capacities to handle and their chemical-physical conditions and following a structural calculation of mechanical stability specific of each single job.
The quality of the material is fixed in relation to the features of the process and of mechanical resistance requested by the project.
The water seal is fixed to the foundation and directly coupled to the vertical pipe of the vent-hole flare.

5.2 OPERATION PINCIPLES

The aim of the specific liquid seal is:

- To keep the waste gas pressure under a certain value in the system upstream of water seal.
- To prevent the air entrance in the system caused by the different pressures and temperatures upstream of water seal.
- To avoid the burn back into the system during no flow or very low gas flow rate

When the value waste gas pressure is under a certain value the waste gas cannot overcome the barrier made of water .
When the pressure of the waste gas exceeds the water head, the waste gas overcome the barrier of liquid and it vents to the flare.
The high of the water head is fixed according to the needs of the process and the guidelines of the international rules.

5.3 APLLICABLE CODES, STANDARDS AND REGULATIONS

The planning activities and the carrying out of the water seal are done in compliance with the following rules and procedures:

Process design	:	API RP 520
	:	API RP 521
	:	ASME VIII Division 1 & 2
	:	SHELL DEP.
Mechanical design	:	CNR-UNI
	:	ASME VIII Division 1 & 2
	:	UBC Code
	:	AISC Code
Materials	:	ASTM – UNI
Welding procedures	:	ASME IX

5.4 GUARNTEE

The described documents within the present manual are covered by functional and construction guarantee for the whole period foreseen in the contract of supply.

To be noted that these guarantees will be no more valid in case during erection, commissioning and start-up activities (if Thermoengineering qualified and skilled engineers would not be required in accordance with the contractual rates) the recommendation of this operating manual are not strictly observed.

Furthermore, to be noted that to maintain the validity of the foreseen guarantee, any possible intervention for modification or tampering with the supplied products, it should be obligatory to agree with Thermoengineering which will authorize the intervention by written.

5.5 CONSTRUCTION FEATURES:

The liquid seal is supplied in a single piece completely prefabricated and tested ready to be assembled in the yard through welded to flare riser.
The equipment does not suffer for the weather conditions of use except the limits deriving from the used material, from the superficial treatments and from the chemical features of the process flux.
Normally on the water seal are applied all the connection nozzles to the process tubes, the nozzles for the connection of the control instruments, and accessories.
The building features and the materials used are noticeable from the drawings and the technical specification enclosed.
The water seal drum is supplied without any water refilling and automatically discharge system.
In order to guarantee a correct functionality, we suggest foreseeing an automatic hydraulic refilling system in function of the inside liquid level measurement of water seal.
Furthermore, it is suggested to install an open syphon to evacuate the liquid in excess. In this case it will be necessary to consider a min. total height of syphon equal to 1.5-time maximum flare pressure drop at max. gas discharge case from the top of the syphon (at the same level to the normal liquid level inside of water seal, to syphon bottom.
For other arrangements of this devices, we suggest contacting Thermoengineering.

5.6 REQUIRED UTILITIES

To keep the system safe, it is necessary to check and to refill, if necessary, the liquid (water and glycol (50%)) every six months, considering that the liquid consumption is 0,12 l/h..
It is also necessary to put in constantly a certain quantity of inert gas (N2 CO2 etc.) or combustible gas to guarantee an oxygen concentration of less than 6% inside the riser and so to prevent the production of potentially explosive mixtures.
The "purge" gas has to be put in the water seals. As "purge" gas it is not advisable to use steam or gas with high dew point, because it is necessary to take into account that the gas volume put in, could change considerably due to the gas cooling inside the system.

5.7 OPERATING PROCEDURES

5.7.1 INSTRUCTION FOR RECEIVING AND STORING OF THE MATERIALS :

The materials are supplied completed of the necessary packing to preserve the quality of the good.
Once received the unit, check the state of the packing and of the good supplied and store it in a covered area, even if there are not particular contra-indications for the storage of the good in an open area, considering to protect the flange faces.

5.7.2 INSTRUCTION FOR INSTALLATION:

The liquid seal is normally supplied completely pre-assembled and ready to be installed after the fastening to the ground foundation through the proper screws.

The rising and the material handling has to be done only after having spotted and checked the raising and slinging points of the equipment.

The connection with the pipe is carried out as follows:

- Through flanged couplings
- Through direct welding over the reduction cone

Once placed, it is necessary to clean accurately the tank before the installation of all the foreseen accessories.

All the services to the water seal (gas entrance, level controls, etc.) have to be connected to the water seal through the proper flanged connections putting the proper gaskets and taking into account the special instructions for each single component.

5.7.3 INSPECTION AFTER INSTALLATION

At the end of the installation and before starting the system it will be necessary to do some checks as:

- Check that all the accessories are properly connected
- Check that all the bolted connections have been carried out correctly.
- Check the welding carried out in yard through non-destructive checks (Rx, Lpt, etc.)

5.7.4 UTILIZATION

START-UP PROCEDURES

- Clean accurately the tank and fill it up to the working level.
- Carry on a seal test of all connections and equipment connected to the liquid seal.

All the system of control, drainage and warming up of the liquid have to be tested in order to work in complete safety.

PROGRAMMED SHUT-DOWN PROCEDURES

During the planned stop has to be scheduled the carrying out of the following procedure:

- Emptying of the tank and accurate cleaning
- Interception of the gas entrance lines and services through blind plates

EMERGENCY SHUT-DOWN PROCEDURES

During the emergency stop it has to be carried out the same procedure as for the planned stop.

NORMAL OPERATION PROCEDURES

No procedure is necessary for the normal operation of the seal because the checks of levels and fluid temperature (if foreseen) have been automatically carried out. Periodically and according to the type of plant where the seal is installed, it has to be foreseen a cleaning of the liquid through the proper inside weir.

For this operation proceed as follows:

- Acting on the on-off and drainage valves restore the liquid inside the level indicator.
- Restore the original level.

5.8 INSPECTION AND MAINTENANCE

To guarantee the correct functioning of the supplied equipment and to avoid permanent damages on them, it is necessary to plan periodical interventions of maintenance according to what is reported below. The good knowledge of those indications and the regular carrying out of the inspections and the maintenance activities allow to avoid operating mistakes and sudden stops of the equipment. It is advisable to read carefully this section and do not hesitate to contact our technical offices if the instructions are not clear or exhaustive enough. The inspection and maintenance schemes indicate the interval of intervention, which we recommend to follow. These indications are to be considered the minimal to do. Running the plant these schemes can be improved for what concerns the interval and also adding other check and maintenance activities.

Encore Thermoengineering is not responsible for possible damages to persons or things caused by the bad installation, incorrect use of the equipment or by the non-carrying out of the inspection and maintenance activity.

MAINTENANCE CALENDAR				
Intervention object	Intervention description	Reference document	Particular tools	Frequency (months)
Connections sealing	Check and grease the tie-rods and nuts of all connections Check and grease the foundation tie-rods. Check the connections of the services	1724000887-MAC-DD-00005	Various spanners Grease	12
Seal vessel	the liquid consumption is based on the assumption of the refilling of water and glycol every 6 months	1724000887-MAC-DS-00004	na	6

nVent

RAYCHEM

Self-regulating and power limiting heating cable systems

Installation and Maintenance Manual



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Register for your extended warranty on nVent.com/RAYCHEM.

ATEX/UKEX

	Certificate No	Code
BTV	SGS20ATEX0048X (BAS21UKEX0497X)	Ⓔx II 2 G Ex 60079-30-1 eb IIC T6 Gb Ⓔx II 2 D Ex 60079-30-1 tb IIIC T80°C Db or Ⓔx II 2 G Ex 60079-30-1 eb mb IIC T6 Gb Ⓔx II 2 D Ex 60079-30-1 mb tb IIIC T80°C Db Tmin –60°C
QTVR	SGS20ATEX0050X (BAS21UKEX0498X)	Ⓔx II 2 G Ex 60079-30-1 eb IIC T4 Gb Ⓔx II 2 D Ex 60079-30-1 tb IIIC T130°C Db or Ⓔx II 2 G Ex 60079-30-1 eb mb IIC T4 Gb Ⓔx II 2 D Ex 60079-30-1 mb tb IIIC T130°C Db Tmin –60°C
XTV(R)	SGS20ATEX0049X (BAS21UKEX0499X)	Ⓔx II 2 G Ex 60079-30-1 eb IIC T* Gb Ⓔx II 2 D Ex 60079-30-1 tb IIIC T**°C Db or Ⓔx II 2 G Ex 60079-30-1 eb mb IIC T* Gb Ⓔx II 2 D Ex 60079-30-1 mb tb IIIC T**°C Db Tmin –60°C (* ** see schedule)
KTV	SGS20ATEX0051X (BAS21UKEX0500X)	Ⓔx II 2 G Ex 60079-30-1 eb IIC T226°C(T2) Gb Ⓔx II 2 D Ex 60079-30-1 tb IIIC T226°C Db or Ⓔx II 2 G Ex 60079-30-1 eb mb IIC T226°C(T2) Gb Ⓔx II 2 D Ex 60079-30-1 mb tb IIIC T226°C Db Tmin –60°C (* ** see schedule)
HTV	PTB21ATEX1003X (BAS21UKEX0649X)	Ⓔx II 2 G Ex 60079-30-1 eb IIC T* Gb Ⓔx II 2 D Ex 60079-30-1 tb IIIC T**°C Db or Ⓔx II 2 G Ex 60079-30-1 eb mb IIC T* Gb Ⓔx II 2 D Ex 60079-30-1 mb tb IIIC T**°C Db Tmin –60°C (* ** see schedule)
VPL	SGS20ATEX0045X (BAS21UKEX0503X)	Ⓔx II 2 G Ex 60079-30-1 eb IIC T* Gb Ⓔx II 2 D Ex 60079-30-1 tb IIIC T**°C Db or Ⓔx II 2 G Ex 60079-30-1 eb mb IIC T* Gb Ⓔx II 2 D Ex 60079-30-1 mb tb IIIC T**°C Db Tmin –60°C (* ** see schedule)

IECEx

	Certificate No	Code
BTV	IECEx BAS 20.0011X	Ex 60079-30-1 eb IIC T6 Gb Ex 60079-30-1 tb IIIC T80°C Db or Ex 60079-30-1 eb mb IIC T6 Gb Ex 60079-30-1 mb tb IIIC T80°C Db Tmin –60°C
QTVR	IECEx BAS 20.0013X	Ex 60079-30-1 eb IIC T4 Gb Ex 60079-30-1 tb IIIC T130°C Db or Ex 60079-30-1 eb mb IIC T4 Gb Ex 60079-30-1 mb tb IIIC T130°C Db Tmin –60°C
XTV(R)	IECEx BAS 20.0012X	Ex 60079-30-1 eb IIC T* Gb Ex 60079-30-1 tb IIIC T**°C Db or Ex 60079-30-1 eb mb IIC T* Gb Ex 60079-30-1 mb tb IIIC T**°C Db Tmin –60°C (* ** see schedule)

	Certificate No	Code
KTV	IECEx BAS 20.0014X	Ex 60079-30-1 eb IIC T226°C(T2) Gb Ex 60079-30-1 tb IIIC T226°C Db or Ex 60079-30-1 eb mb IIC T226°C(T2) Gb Ex 60079-30-1 mb tb IIIC T226°C Db Tmin –60°C (* ** see schedule)
HTV	IECxPTB21.0007X	Ex 60079-30-1 eb IIC T* Gb Ex 60079-30-1 tb IIIC T**°C Db or Ex 60079-30-1 eb mb IIC T* Gb Ex 60079-30-1 mb tb IIIC T**°C Db Tmin -60°C (* ** see schedule)
VPL	IECEx BAS 20.0008X	"Ex 60079-30-1 eb IIC T* Gb Ex 60079-30-1 tb IIIC T**°C Db or Ex 60079-30-1 eb mb IIC T* Gb Ex 60079-30-1 mb tb IIIC T**°C Db Tmin –60°C (* ** see schedule)"

Product name in SAP	Certificate No	Code
BTV CABLE	TC RU C-BE. МЮ62.B.00054/18	1Ex e IIC T6 Gb X 1Ex e mb II C T6 Gb X Ex tb IIIC T80°C Db X Ex tb mb IIIC T80°C Db X Ta –60°C…+56°C IP66
QTVR CABLE	TC RU C-BE. МЮ62.B.00054/18	1Ex e IIC T4 Gb X 1Ex e mb IIC T4 Gb X Ex tb IIIC T130°C Db X Ex tb mb IIIC T130°C Db X Ta –60°C…+56°C IP66
XTV CABLE	TC RU C-BE. МЮ62.B.00054/18	1Ex e IIC T* Gb X 1Ex e mb IIC T* Gb X Ex tb IIIC T* Db X Ex tb mb IIIC T* Db X Ta –60°C…+56°C IP66
KTV CABLE	TC RU C-BE. МЮ62.B.00054/18	1Ex e IIC 226°C (T2) Gb X 1Ex e mb IIC 226°C (T2) Gb X Ex tb IIIC T226°C Db X Ex tb mb IIIC T226°C Db X Ta –60°C…+56°C IP66
HTV CABLE	ЕАЭС RU C-BE. АЖ58.B.01728/21	1Ex e mb 60079-30-1 IIC 180°C (T3)…215°C (T2) Gb X Ex tb 60079-30-1 IIIC 180°C … 215°C Db X
VPL CABLE	TC RU C-BE. МЮ62.B.00054/18	1Ex e IIC T* Gb X 1Ex e mb IIC T* Gb X Ex tb IIIC T* Db X Ex tb mb IIIC T* Db X Ta –60°C…+56°C IP66

BSA cables are EAC certified to TR CU 004/2011

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 nVent 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.

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

Specific conditions of use

The following limiting temperatures for the end seals, splices and power connections shall not be exceeded:
+110°C for the S-20 and E-20
+260°C for the E-40 and S-40
+150°C for the C-150-E, S-150 and E-150
+151°C for the E-100, E-100-L and JBS-100
+155°C for the JBM-100 and T-100
+110°C for the C25-21 and C25-100
+180°C for the C25-100-METAL/C3/4-100-METAL

The E-100, E-100-L, JBM-100, JBM-100-L, JBS-100, JBS-100-L and T-100 have limiting temperatures based on an internal component in these accessories. When located on a pipe or other work piece surface, a maximum pipe temperature of 250°C will not cause the limiting temperatures of 151°C or 155°C to be exceeded

The end seals, splices and power connections have the following associated ambient temperatures:
–60°C to +56°C for the E-20 and S-20
–60°C to +56°C for the E-40 and S-40
–55°C to +56°C for the T-100, JBM-100, JBS-100, JBU-100 and E-100
–40°C to +56°C for the JBS-100-L, JBM-100-L, and JBU-100-L
–55°C to +55°C for the C-150-E, S-150 and E-150
–40°C to +40°C for the E-100-L
–55°C to +110°C for the C25-21 and C25-100
–60°C to +180°C for the C25-100-METAL / C3/4-100-METAL / C25-100-METAL-NP / C3/4-100-METAL-NP / C25-100-METAL-SS

- The assembly of glands, splices and end terminations shall be carried out in accordance with the manufacturing instructions.
- The heating element supply circuit must include an electrical protection device in conformity with Clause 4.4 of IEC 60079-30-1. For the JBM-100-L, JBU-100-L and JBS-100-L this shall be limited to 20 A maximum when used at ambient temperatures above 40°C.
- The minimum installation temperature of the heating cables is –60°C. The minimum bending radii at specific temperatures are shown on the next pages of this document.
- The supply to the heating unit must be terminated in a suitably certified terminal enclosure.
- At ambient temperatures above 40°C temperature resistant power cable suitable for temperatures above 90°C and metal glands must be used.
- The minimum installation temperature for E-20 and S-20 is –20°C.
- The installer is to carry out a dielectric strength test on Ex equipment in which the C25-21, C25-100 and C25-100-METAL / C3/4-100-METAL / C25-100-METAL-NP / C3/4-100-METAL-NP / C25-100-METAL-SS connection kit is fitted. No dielectric breakdown shall occur. (Alternatively, an insulation resistance test may be undertaken in accordance with IEC 60079-30-2)

Rated Voltage

BTV1, QTVR1, KTV1, XTV(R)1, HTV1, VPL1: 110 V, 120 V
BTV2, QTVR2, KTV2, XTV(R)2, HTV2, VPL2: 230 V, 277 V, VPL4: 400 V, 480 V

	BSA	BTV	QTVR	XTV	XTVR	KTV	HTV	VPL
Min. Bending Radius (mm)								
−60°C ≤ T < −20°C	35	35	35	51	51	26	25	19
−20°C ≤ T < −10°C	30	30	30	35	35	20	20	15
−10°C ≤ T < 0°C	25	25	25	25	25	15	15	15
0°C ≤ T < +10°C	20	20	20	20	20	15	15	15
T ≥ +10°C	10	12	12	12	12	12	13	12
Minimum Installation Temperature	−60°C	−60°C	−60°C	−60°C	−60°C	−60°C	−60°C	−60°C

	BSA	BTV	QTVR	XTV	XTVR	KTV	HTV	VPL
Max. continuous operating Temp °C (energized)	65	65	110	121	150	150	205	See table below
Max. intermittent exposure Temp °C (1000 h cumulative, energized/ de-energized)	85	85	110	250	***250	250	**260	–
Max. continuous exposure Temp °C (de-energized)	65	65	110	160	160	160	205	260
Self-limiting Temperature in accordance with IEC/EN 60079-30-1		T6	T4	T3 (T2: 20XTV2, 15/ 20XTV1)	T3 (T2: 20XTVR2, 15/ 20XTVR1)	T2	T3 (T2: 20HTV, 28HTV2)	T*
Power Limiting Temperature (*By design)	–	–	–	–	–	–	–	T*

** 2000 hours for HTV, for durations applicable to other exposure temperatures between 205°C and 260°C, contact nVent.
*** 2000 hours for XTVR

Maximum continuous operating temperature table (heating cable energized)

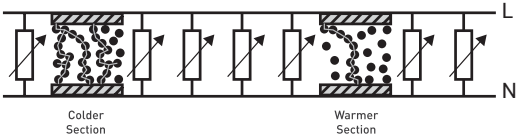
Cable	110 V	230 V	254 V	277 V	400 V	480 V
5VPL1-CT	235°C	–	–	–	–	–
10VPL1-CT	215°C	–	–	–	–	–
15VPL1-CT	190°C	–	–	–	–	–
20VPL1-CT	150°C	–	–	–	–	–
5VPL2-CT	–	230°C	225°C	225°C	–	–
10VPL2-CT	–	210°C	200°C	195°C	–	–
15VPL2-CT	–	180°C	145°C	105°C	–	–
20VPL2-CT	–	150°C	–	–	–	–
5VPL4-CT	–	–	–	–	230°C	230°C
10VPL4-CT	–	–	–	–	215°C	205°C
15VPL4-CT	–	–	–	–	195°C	160°C
20VPL4-CT	–	–	–	–	150°C	150°C

1. GENERAL INFORMATION

Use of the manual

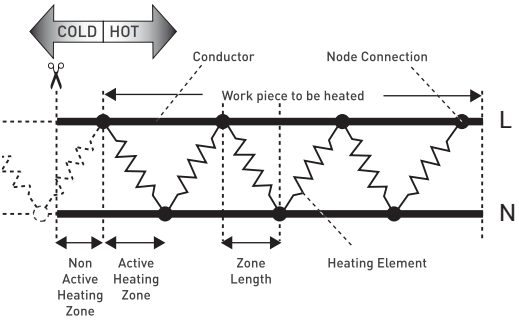
The Installation and Maintenance manual is for nVent RAYCHEM self-regulating and power limiting heating cable systems on thermally insulated pipes and vessels only.
For information regarding other applications contact your nVent representative.

BSA, BTV, QTVR, XTV(R), KTV, HTV self regulating heating 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.

VPL power limiting heating cables



Important

For the nVent 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. HEATING CABLE SELECTION

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.

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

Heat tracing system design documentation

The heat tracing system documentation shall be retained for each heat tracing circuit for as long as the system is in use.

3. HEATING CABLE INSTALLATION

Persons involved in the installation and testing of electric heat tracing systems shall be suitably trained in all special techniques required. Installation shall be carried out under the supervision of a qualified person

De-energise all power circuits before installation or servicing

The insulation resistance of the heating cable shall be measured and recorded after installation and shall not be less than 100 Megaohms

3.1 Heating cable storage

- Keep ends of heating cable and kit components dry before and during installation
- Temperature range: –40°C to +60°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 nVent 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:

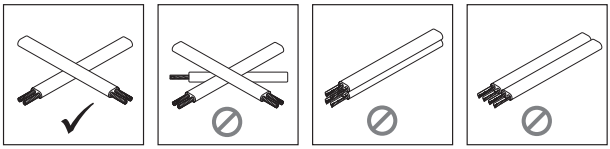
- Use a reel holder that pays out smoothly with little tension.
- Keep heating cable strung loosely but close to the pipe being traced to avoid interference with supports and equipment.
- Pay out designed length and mark (i.e. with fixing tape) on cable while still on reel.

- 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, or consult nVent product literature for design.
- 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

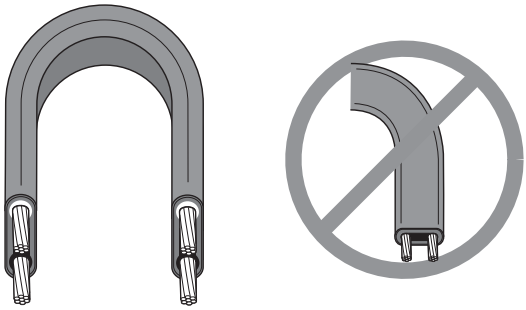
- The heating cable may be installed straight, spiralled or in multiple runs as required by the design specification, nVent product literature or TraceCalc software.
  - Do not use metal attachments, vinyl electrical tape or duct tape as heating cable damage may result.
  - Self-Regulating technology allows for the multiple overlapping of the heating cable on to itself.
- Power Limiting technology dictates that the heating cable can be overlapped only once on to itself. If VPL cables are installed parallel to each other, please allow for minimum 15 mm clearance.

For VPL heating cable only:



- Fix in place with a minimum of two wraps 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. 6)

Bend the cable only in upright position



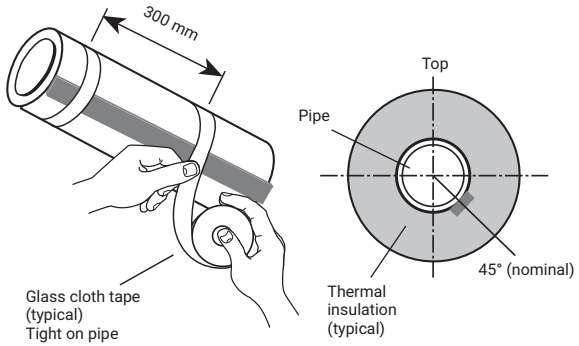
- The heating cable does not bend easily in the flat plane.
  Do not force such a bend, as the heating cable may be damaged.

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 power limiting 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.

Figure 1

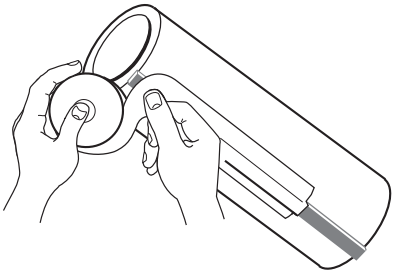


nVent attachment tapes:

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

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

Figure 2



ATE-180 Aluminium tape

Use only if the design requires it.

ATE-180 improves the heat transfer and increases the power output of the heating cable.

Attach the heating cable to the pipe as shown in Figure 2.

3.4.2 Spiral tracing

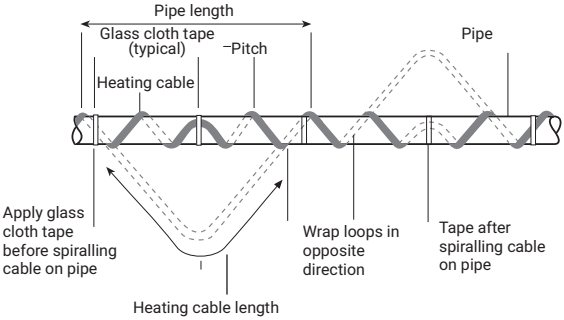
- Alternative spiralling methods are shown in Figures 2a and 2b.
- Only spiral heating cable on pipe when called for by design.
- To prevent overheating, be sure the location of the power limiting heating cable is planned so that the active heating zone will not extend into the component. Read the kit 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	NPS	Spiral Ratio				
(mm)	(inches)	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	1¼	310	210	170	140	130
40	1½	350	240	190	160	140
50	2	430	300	240	200	180
65	2½	520	360	290	240	210
80	3	630	430	350	290	260
90	3½	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.

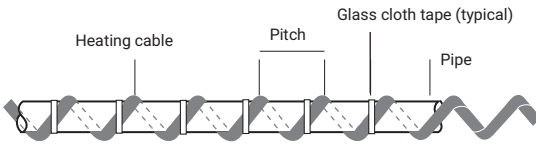
Figure 2a



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.
- nVent RAYCHEM heating cable can be cut to length without affecting the heat output per metre.

3.6 Typical installation details

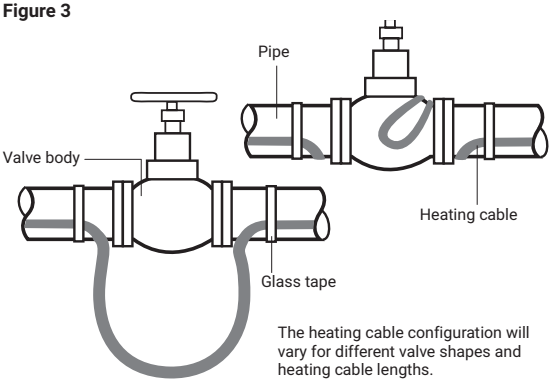
- Typical installation details for fixing heating cable to pipe fittings are shown hereafter.

General notes:

- Trace pipe fittings as shown to allow easy maintenance.
- Consult the design specification or nVent 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.

3.6.1 Valve

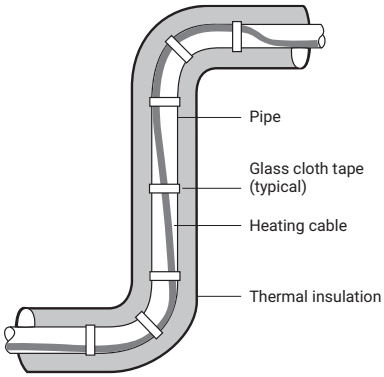
Figure 3



- 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).

3.6.2 Elbow

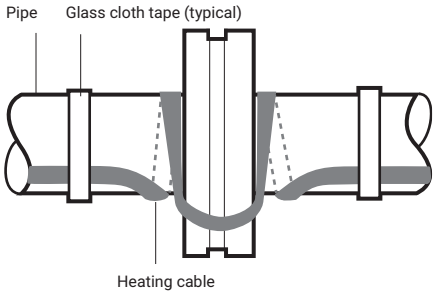
Figure 4



- Fix heating cable to outside (long) radius of elbow
- Fix with self-adhesive glass cloth tape
- Thermally insulate and weatherproof to specification

3.6.3 Flange

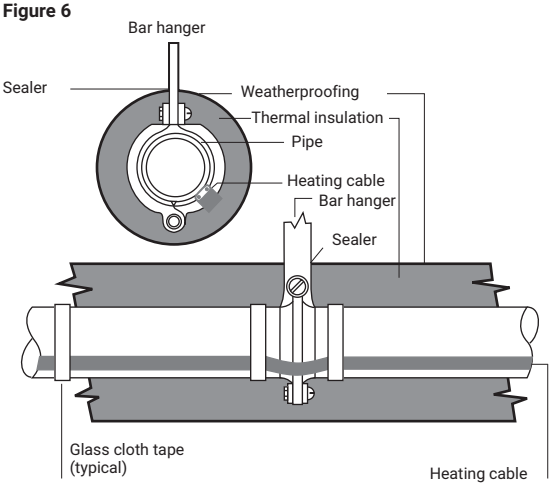
Figure 5



- Additional heating cable is 2-3 times diameter of pipe (typical)
- Fix with self-adhesive glass cloth pipe
- Thermally insulate and weatherproof to specification

3.6.4 Pipe bar hanger

Figure 6

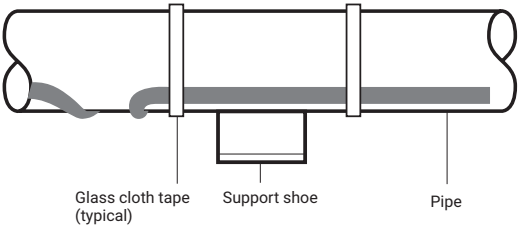


- Do not clamp heating cable with support. Heating cable must be over the support
- No additional heating cable is required for bar or rod pipe hangers unless called for in the design specification, then use loop length specified
- Fix with self-adhesive glass cloth tape
  Thermally insulate and weatherproof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

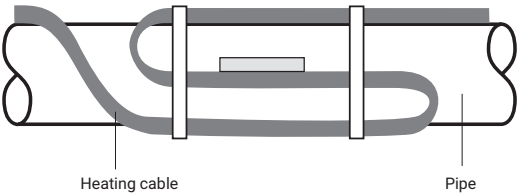
3.6.5 Pipe support shoe

Figure 7

Side view



Bottom view



- Refer to design specification for additional heating cable length
- Fix with self-adhesive glass cloth tape
- Thermally insulate and weatherproof to specification

4. COMPONENTS INSTALLATION

General notes:

Select the required components from nVent product literature or use the TraceCalc software.

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 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.

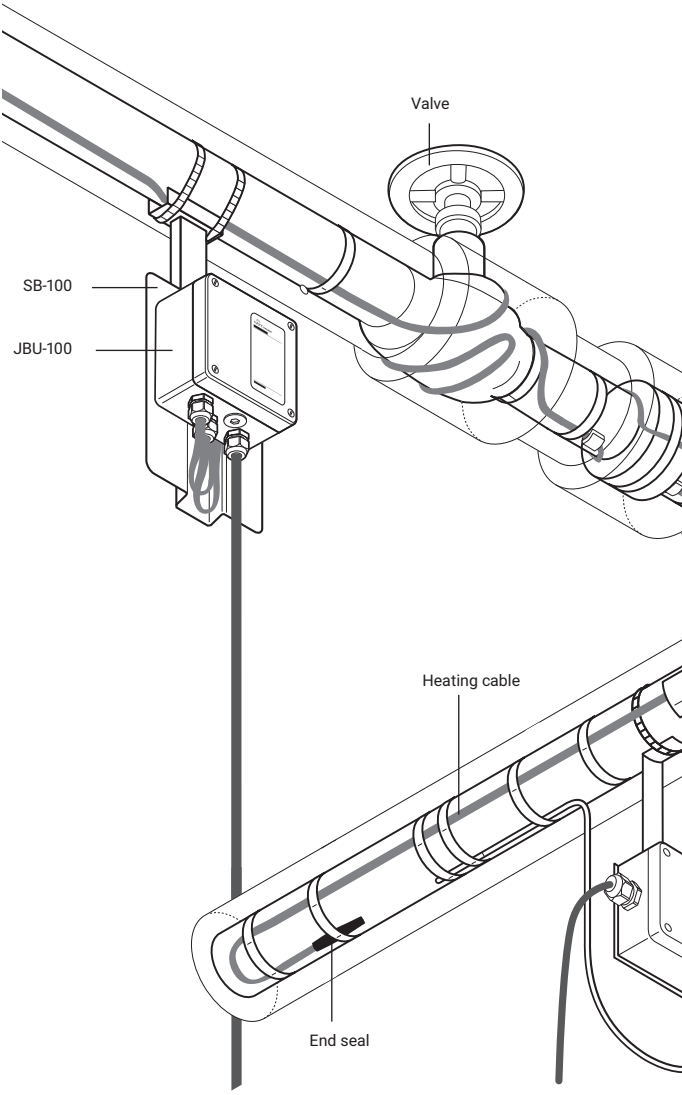
4.1 Components required

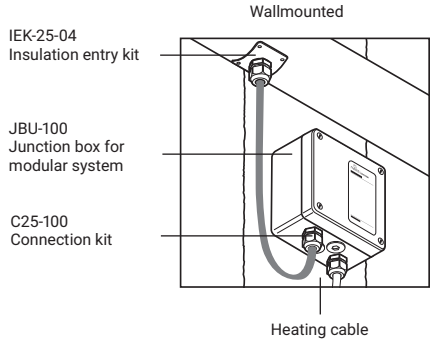
- For the installation of all components refer to the relevant component installation instructions.
- Required for each heating cable run:
  Power connection and insulation entry kit
  End seal.
- As required:
  Splice. Tee-splice. Junction box. Three connection kits and three insulation entry kits.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

4.2 Typical systems installation

Below components are not suitable for BSA. You can find the solutions for BSA in DOC2210 or contact your local nVent representative.

Figure 8a




Wallmounted
IEK-25-04
Insulation entry kit
JBU-100
Junction box for
modular system
C25-100
Connection kit
Heating cable

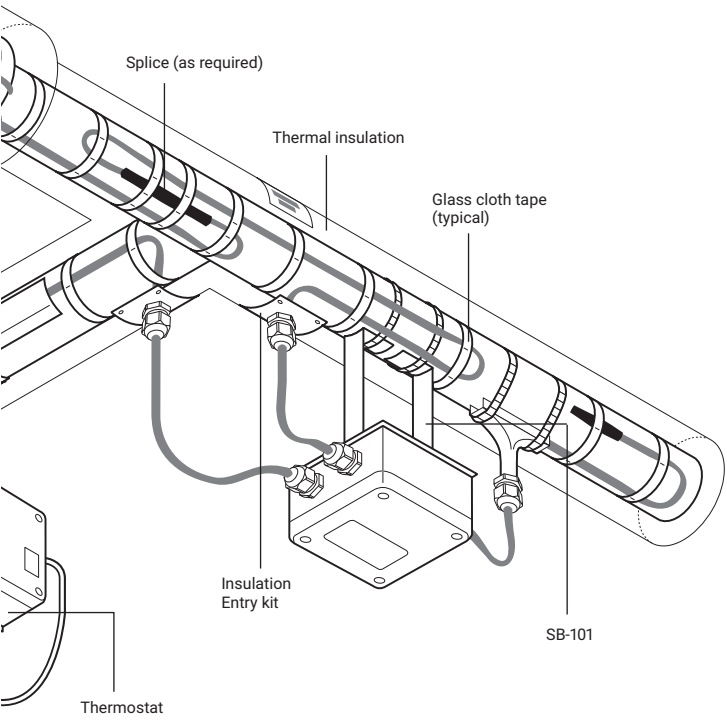
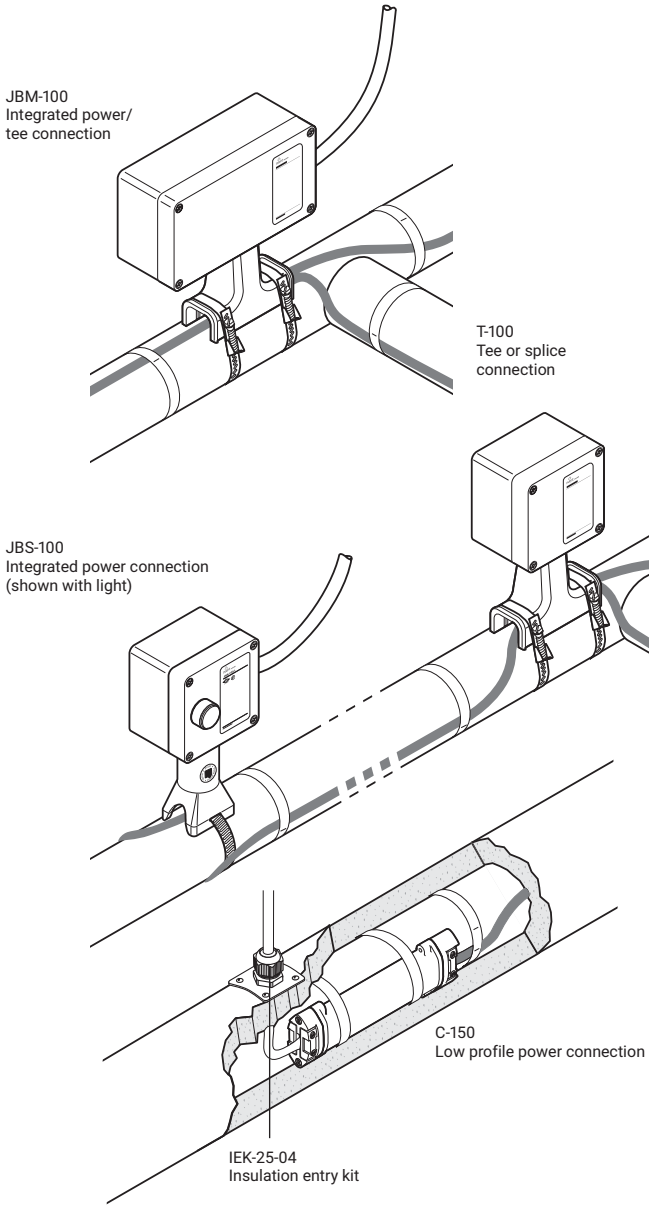
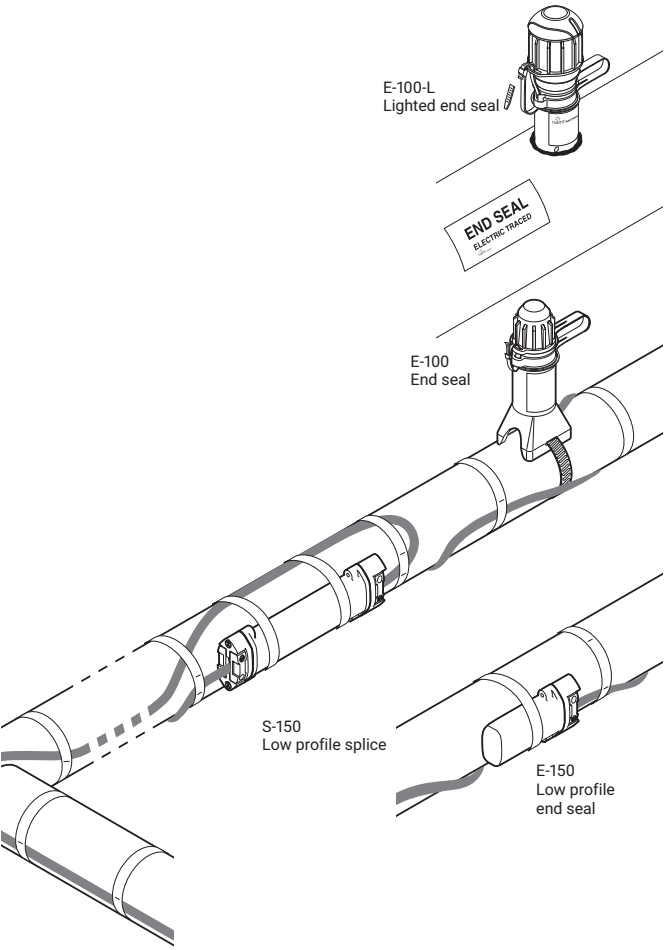

Splice (as required)
Thermal insulation
Glass cloth tape
(typical)
Insulation
Entry kit
SB-101
Thermostat

Figure 8b

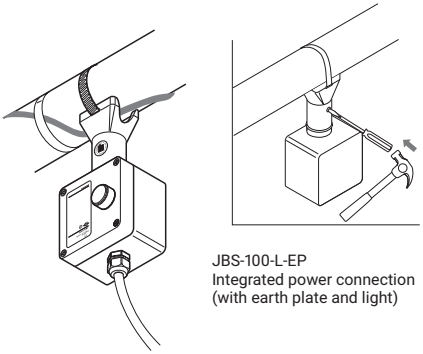

JBM-100
Integrated power/
tee connection
T-100
Tee or splice
connection
JBS-100
Integrated power connection
(shown with light)
C-150
Low profile power connection
IEK-25-04
Insulation entry kit


E-100-L
Lighted end seal
END SEAL
ELECTRIC TRACED
E-100
End seal
S-150
Low profile splice
E-150
Low profile
end seal

4.3 Component installation hints

- On horizontal pipes locate junction boxes below pipe wherever possible. Pinch out drainhole in the stand when installing upside down.
- 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.

Figure 9a



JBS-100-L-EP
Integrated power connection
(with earth plate and light)

- 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.

5. THERMOSTATS

- In temperature-sensitive applications, thermostatic control may be necessary. If maximum temperature is a concern, consult your nVent representative for design assistance.
- nVent RAYCHEM control and monitoring products are designed for use with Self-Regulating and Power-Limiting heat-tracing systems. Thermostats, controllers and control and monitoring systems are available. Compare features of these products in the table below. For additional information on each product, refer to product datasheets or contact your nVent representative.
- Follow the installation instructions supplied with the thermostat. Use the proper wiring diagram for the heating cable layout and control method desired.

	Mechanical Thermostats	ETS-05	NGC-20	Elexant 40x0i	NGC-30	NGC-40
Control						
Ambient sensing	X	X	X	X	X	X
Line sensing	X	X	X	X	X	X
Pasc			X	X	X	X
Monitoring						
Ambient temperature		X	X	X	X	X
Pipe Temperature		X	X	X	X	X
Ground Fault			X	X	X	X
Current			X	X	X	X
Voltage			X	X	X	X
Location						
Pipe mount		X	X	X		
Field Mount		X	X	X	X	X
Substation				X	X	X

- Controllers shall meet the requirements from clause 4.5.3 in IEC/IEEE 60079-30-1.

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

- 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 places where valve stems, support brackets, thermostat capillaries, etc exit the cladding are sealed.

6.3 Marking

- For power limiting heating cable install label: LAB-I-35 as shown (typical) in figures 10a & 10b

Figure 10a

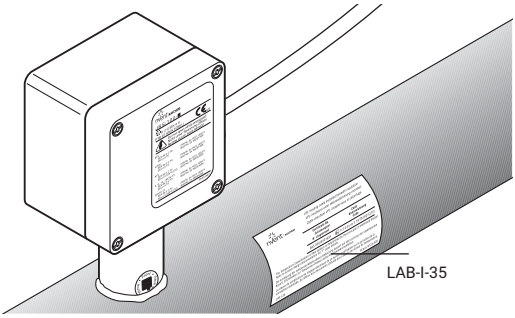
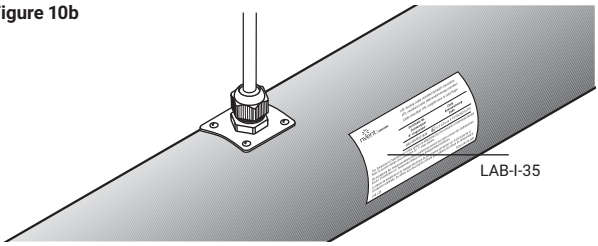
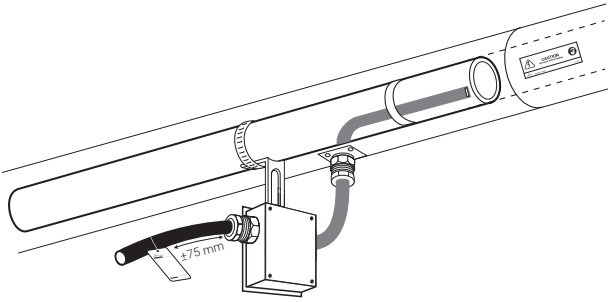


Figure 10b



- The presence of the heating cables shall be made evident by the posting of warning labels or caution labels (“Electric Traced”) on the cladding. Labels are to be applied at maximum 3 meter intervals and on alternate locations along the circuit.
- Install “Electric Traced” signs 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.

Figure 10c



7. POWER SUPPLY AND ELECTRICAL PROTECTION

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

7.1 Electrical loading

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

7.2 Ground fault equipment protection is required for each circuit

The metal sheath/braid of the heating cable must be connected to a suitable earthing terminal

7.3 Residual current (earth fault) protection

nVent insists on the use of a 30 mA residual current device to provide maximum safety and protection. However, where there is a marked increase in nuisance tripping, a maximum 300 mA residual current device may be used.

For heating cables installed in a hazardous area, the use of residual current devices is normally a condition of their approval.

8. HEATING CABLE TESTING

8.1 Recommendations

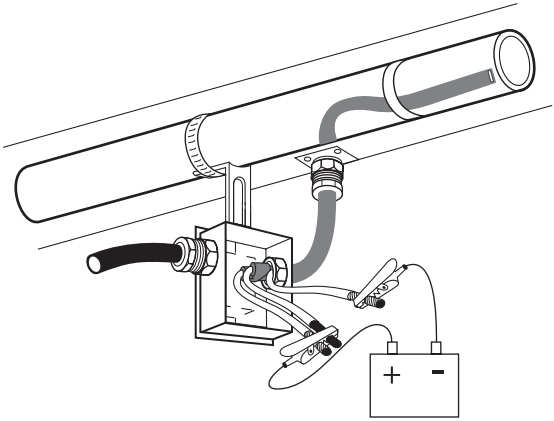
nVent recommends insulation resistance test before installing heating cable; before installing thermal insulation; prior to initial start-up; and as part of the periodic maintenance.
(see Section 9.2).

8.2 Test method

After completing heating cable installation, the insulation resistance between the conductors and the braid should be checked (see Figure 11) using a 2500 VDC megger. Minimum readings should be 100 MegaOhms regardless of the heating cable length. The installer should record the original values for each circuit on the installation record sheet
(see page 33). If a thermostat is installed, it should be bypassed.

Figure 11

Test between heating cable and braid



Capacitance test method

This method uses capacitance measurement (nF) to approximate the location of a fault where the heating cable has been severed. It also gives an estimate of total heating cable length in a non-severed circuit. This reading must be taken at the power connection and will only work when the heating cable has passed IR testing. This information is used to calculate the heating cable output per linear metre or to determine if the maximum length has been exceeded.

Record the capacitance reading from one end of the heating cable. The capacitance reading should be measured between both bus wires twisted together (positive lead) and the braid (negative lead).

Multiply the measured capacitance with the heating cable's capacitance factor as listed in the following table.

Example:

20HTV2-CT

Recorded capacitance = 16.9 nF

Capacitance factor = 2.96 m/nF
Fault location = 16.9 nF x 2.96 m/nF
= 50 m from reading location

As an alternative, capacitance values from both the front and back end can be used. The ratio of one capacitance value taken from one end (A) divided by the sum of both A and B (A + B) and then multiplied by 100 yields the distance from the first end, expressed as a percentage of the heating circuit length.

Heating cable capacitance factors (m/nF)

Cable catalog number	Capacitance factor	Cable catalog number	Capacitance factor
3BTV1-CR	2.29	20XTVR2-CT	2.71
3BTV2-CT	2.29	5XTVR1-CT	3.08
5BTV1-CR	2.29	10XTVR1-CT	2.68
5BTV2-CT	2.29	15XTVR1-CT	2.68
8BTV1-CR	1.68	20XTVR1-CT	2.77
8BTV2-CT	1.68	5KTV1-CT	3.29
10BTV1-CR	1.68	5KTV2-CT	3.38
10BTV2-CT	1.68	8KTV1-CT	3.14
10QTVR1-CT	1.43	8KTV2-CT	3.2
10QTVR2-CT	1.43	15KTV1-CT	2.96
15QTVR2-CT	1.01	15KTV2-CT	3.02
15QTVR1-CT	1.01	20KTV1-CT	2.83
20QTVR1-CT	1.01	20KTV2-CT	3.08
20QTVR2-CT	1.01	3HTV1-CT	3.2
4XTV2-CT-T3	3.29	3HTV2-CT	3.51
5XTV1-CT-T3	3.29	5HTV1-CT	3.2
5XTV2-CT-T3	3.38	5HTV2-CT	3.38
8XTV2-CT-T3	3.38	8HTV1-CT	2.80
10XTV1-CT-T3	3.14	8HTV2-CT	3.38
10XTV2-CT-T3	3.26	10HTV1-CT	2.8
12XTV2-CT-T3	3.26	10HTV2-CT	3.2
15XTV1-CT-T3	2.96	12HTV1-CT	2.93
15XTV2-CT-T3	3.02	12HTV2-CT	3.14
20XTV1-CT-T2	2.83	15HTV1-CT	2.83
20XTV2-CT-T2	3.08	15HTV2-CT	2.99
3XTVR2-CT	3.57	20HTV1-CT	2.65
5XTVR2-CT	3.51	20HTV2-CT	2.96
8XTVR2-CT	3.11	28HTV2-CT	2.56
10XTVR2-CT	3.20	All VPL-CT	2.86
12XTVR2-CT	2.99		
15XTVR2-CT	2.87		

9. OPERATION, MAINTENANCE AND PIPE REPAIRS

Caution: Consult the heat tracing system documentation prior to maintenance/repair/modification.

9.1 Heating cable operation

- Temperature exposure must not exceed that specified in nVent 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

- Visual inspection: Exposed heating cable and pipe insulation should be checked periodically to make sure that no physical damage has occurred.
- Upon completion of maintenance/repair/modification, the insulation resistance of the heating cable shall be measured and recorded and shall not be less than 100 Megaohms
- 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

- After maintenance/repair/modification, test the operation of the earth-fault device of each affected circuit or equivalent.
- 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 6. Check correct functioning of electrical protection systems.

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 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.

11. TROUBLESHOOTING GUIDE

- Refer to the Troubleshooting guide on pages 34-37.
  If the problem persists after following the guide procedures, contact your nVent representative immediately.

INSTALLATION RECORD SHEET

INSTALLATION RECORDS FOR:		CIRCUIT NO.							
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

MAINTENANCE CHECKS FOR:		CIRCUIT NO.				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								

Megger test (bypass thermostat if applicable)	Reading								
	Initial								
	Date								
Circuit voltage	Panel								
	Connection terminals								
All boxes and thermostats have been firmly closed	Initial								
	Date								
Locations of low profile components are marked on the cladding	Initial								
	Date								

REMARKS & COMMENTS:

Troubleshooting guide

A Symptom: Overcurrent protection trips or blows
Probable Causes:

1 Electrical fault at
- a damaged heating cable
- b faulty splices or tees
- c end seal
- d connection

2 Circuit oversized

3 Start-up below design temperature

4 Defective electrical protection

B Symptom: RCD trips
Probable Causes:

1 Earth fault at:
- a damaged heating cable
- b faulty splices or tees
- c end seal
- d connection

2 Excessive moisture in:
- a junction boxes
- b splices and tees
- c end seals

3 High leakage currents due to a combination of excessive lengths of power cable and heating cable.

4 Mains borne disturbances

5 Defective RCD

Corrective Actions

1 Investigate and remedy (see note 1):

2 Resize or redesign within Technical Databook Guidelines. (If larger protection is required, ensure supply cables are compatible).

3 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 followed by remainder (e.g. in sequence

4 Replace

Corrective Actions

1 Investigate and remedy (see note 1):

2 Dry out and reseal or remake immediately. Perform insulation resistance test. (10 MΩ minimum)

3 Redesign

4 Redesign distribution, guidance is available from nVent

5 Replace

C Symptom: No power output.
Probable Causes

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)

2 Control thermostat is connected in the normally open position

3 High resistance connection at:
- a junction box terminals
- b splices and tees

D Symptom: Low pipe temperature.
Probable Causes:

1 Wet thermal insulation

2 Design error

3 Incorrect setting or operation of controls e.g., thermostats.

4 Heating cable has been exposed to excessive temperature beyond rating.

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

1 Restore supply voltage
   a following A and B (page 29)
   b re-tighten terminals
      NB: If excessive heating has occurred due to high resistance, replace terminals or crimps
   c locate damage and repair

2 Reconnect to normally closed position

3 Locate and remedy by:
   a re-tighten
   b repair
      NB: If excessive heating has occurred due to high resistance, replace terminals or crimps

Corrective Actions

1 Remove and replace with dry insulation of correct specification and ensure complete weatherproofing

2 a check with competent authority for design conditions
   b modify to meet nVent recommendations

3 Repair or reset to correct level of operation

4 Replace

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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