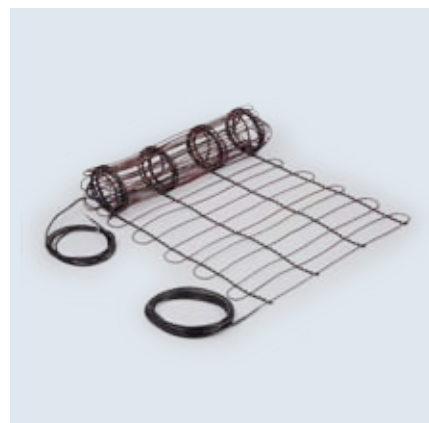


ENSTO

FROST PROTECTION SOLUTIONS

Building Technology



Contents

Frost protection cables	2
– for water and drain pipes as well as outdoor areas	
Frost protection control	8
– energy-saving control units for various requirements	
Mounting and installation accessories	10
– assure safe assembly and practical use	
Electric frost protection	14
– simple structural applications	
Water and drain pipes	20
Rainwater systems	22
Outdoor areas	28
Frost protection products	36

FROST PROTECTION CABLES

– for water and drain pipes as well as outdoor areas

By means of self-regulating heating cables, heat-resistant cables and ready-made heating mats, it is easy to plan and realize functional frost protection solutions for water and drain pipes important to a property, as well as for outdoor areas.



Series-resistant cables

Tash series-resistant cables represent an economical frost protection solution for outdoor areas, pipes and tanks. Ensto's Ulla frost protection mats are ideally suited for the frost protection of vehicle access ramps, entrances and pavements. Series-resistance cables are ready-assembled in the mat.



Tash-cable

Self-regulating cables

The Optiheat cable is specially designed for frost protection of water and drain pipes as well as roofs and stairways. The self-regulating power output of the cable changes with any change in environmental

temperature, and the cable's own temperature remains stable. The power consumed by the cable varies in accordance with the properties of its location.



Optiheat-cables

Plug'n Heat cable

The Plug'n Heat frost protection cable is fitted with a schuko-plug, and is superbly designed for keeping piping and water meters ice-free. It can also be installed as a retrofit solution. The cabling is made of food provision-tested materials to ensure that it is also appropriate for use inside drinking water pipes.



Plug'n Heat

SIZING AND SELECTION

See the table for a summary of the sizing of frost protection solutions and the selection of a control thermostat. For sizing instructions, see the system-specific descriptions.

	MAX. POWER PER METER W/m	INSTALLATION POWER W/m OR W/m ²	CABLES						CONTROL		
			OPTIHEAT 9	OPTIHEAT 10	OPTIHEAT 15/30	OPTIHEAT 25	TASH	PLUG 'N HEAT	ECO500	ECO900*	ECO910
WATER PIPES			> 1.3 x heat loss								
Plastic pipe	10		*	*				*	*		
Plastic, installation inside pipe	9		*					*	*		
Metal pipe	20		*	*	*	*	*	*	*	*	
DRAIN PIPES			> 1.3 x heat loss								
Plastic pipe	10		*	*				*	*		
Metal pipe	20		*	*	*	*	*	*	*	*	
RAIN WATER SYSTEMS											
Plastic gutter	10	20–60 W/m			*	*			*	*	
Metal gutter	20	20–60 W/m			*	*			*	*	
Roof valley > 300 mm	20	200 W/m ²			*	*			*	*	
OUTDOOR AREAS											
Covered outdoor area		200 W/m ²			*	*			*	*	
Other outdoor areas		300 W/m ²			*	*			*	*	
Heavy traffic		400 W/m ²				*			*	*	

* ECO900 needs sensors



A workable solution for outdoor areas can be achieved either with Tash-series-resistant cables or by self-regulating Optiheat-cables.

To keep outdoor areas such as vehicle access ramps, pavements, loading platforms or entrances ice-free, the heating cables are installed into the sand or concrete beneath the surface layer. Melting efficiency is maximized when the area to be kept ice-free is insulated from below. When installing heating

cables into sand, the granular size of the sand must be 0.063–2 mm. It is important in installation that the cable sheath is not damaged and that the cable does not shift during levelling. A surface layer of slabs, concrete or asphalt is placed on top of the sand. When installing heating cables in concrete they

are fixed to the reinforcement mesh with, e.g. cable ties. Care should be taken not to damage the cables.

Tash-series-resistant cables or self-regulating Optiheat-cables are suited for frost protection of outdoor areas.

TASH SERIES-RESISTANT CABLES

The planning stages for the frost protection solution implemented using Tash series-resistant cables are as follows:

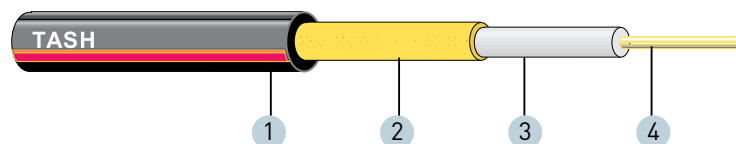
1. the installation power output is specified
2. maximum loading of the cable is inspected
3. the cable is selected based on the power and the length
4. the required cable length is calculated
5. the installation spacing is determined
6. total output, power per square metre output and cable power per metre output are inspected

Maximum loadings for Tash-cables

	P_{max}
Concrete	30 W/m
Sand	25 W/m
Water	50 W/m
On the surface of a metal pipe	20 W/m
On the surface of a plastic pipe	10 W/m
Metal gutters	20 W/m
Plastic gutters	10 W/m

Tash-cable is a series-resistant cable suited for installation in areas of different forms and also for large outdoor areas. With single-conductor cables, a loop is formed during installation so that both cold cables are connected to the junction box.

(PICTURE PROVIDED FOR GUIDANCE ONLY)



Cable installation

Tash series-resistant cables are of single conductor type. The heating cable is not connected directly to a junction box: rather, a separate connecting lead is used, i.e., a cold lead. With single-conductor cables, a loop is formed during installation so that both cold cables are connected to the junction box.

Cable thermal efficiency

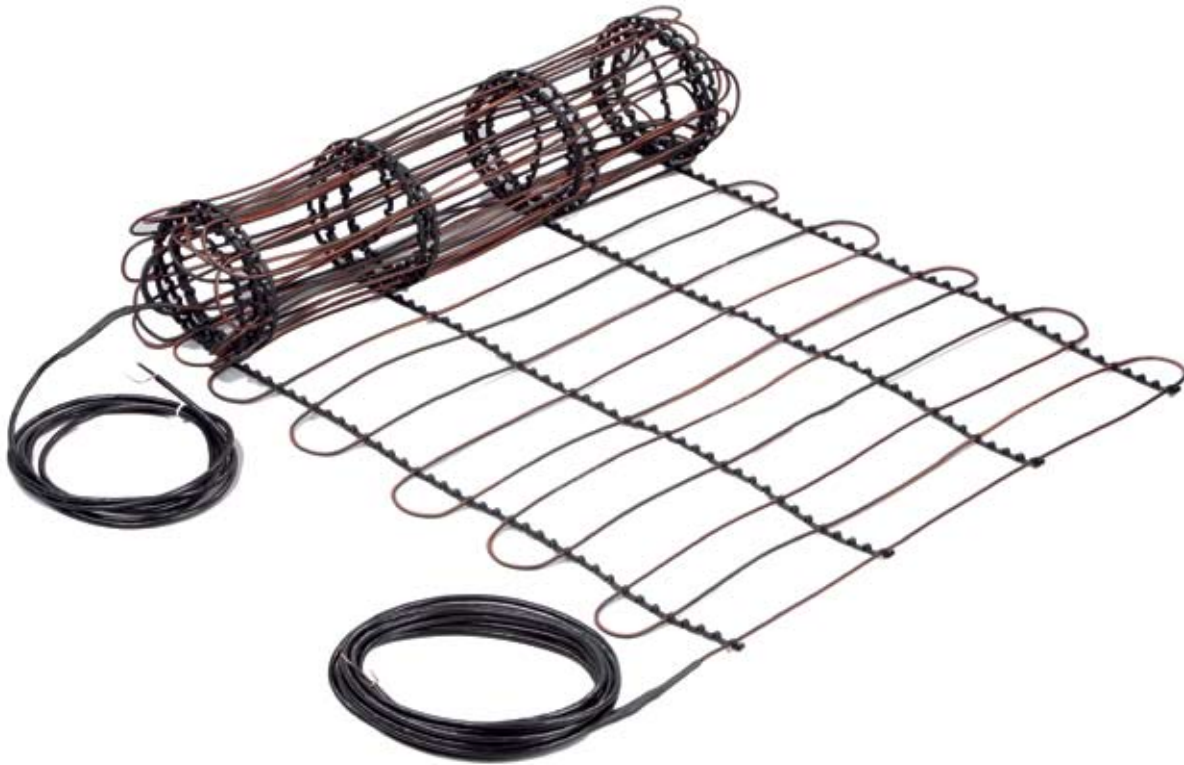
Cable thermal efficiency is inversely proportional to its length, i.e., with increase in length, output power declines and correspondingly increases as the length shortens. Cable manufacturers state the highest permitted temperature and maximum metric output, i.e., the minimum permitted length for cables.

1. Sheath
2. Copper braid
3. Insulation
4. Conductor

ULLA300 -FROST PROTECTION MATS

Factory manufactured and tested, Ulla300 frost protection mats can be used for keeping vehicle entrance ramps, entrances and pavements ice-free. They can be installed quickly and easily in both concrete and sand. The ready-made mat is easily laid in place, and the installation spacing is always

correct. The mat is easy to shape by cutting the installation strips. The output is 300 W/m^2 and the nominal voltage is 230 V. The standard width of the frost protection mats is 0.95 m and the length can be from 2–12 m. One cold cable end is 5 meters and the other is mat length + 5 metres.

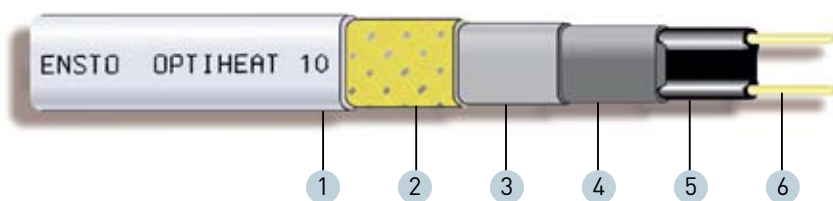


Ulla300

SELF-REGULATING OPTIHEAT CABLE

The core of the cable is formed by two copper conductors coated with semiconducting material. The current passes between the conductors through the heat-resistant material. The resistivity of the conductors declines with a drop in temperature and increases with

a rise in temperature. The current and the cable power depends on the temperature. A self-regulating cable is used to keep the temperature stable, regardless of what the temperature is. The cable parts can be used in various environments, so their metric efficiencies may vary.



1. Sheath
2. Shielding
3. Insulation
4. Bonded jacket (not in Optiheat 9)
5. Self-regulated core material
6. Conductor

The purchase costs for self-regulating heating cables are higher than for series-resistant cable, but in overall costs it is highly competitive. It is well suited for use in small heating spaces as well as in pipework.

Self-regulating cable can be cut to the desired length. The maximum length for installation is determined on the basis of the protective, device-based design current protecting the cable.

Cable resistance is small when a self-regulating cable is cold. For this reason, the voltage causes a power peak of approximately 1.5 times in comparison to the nominal current when connected to the cable. The protective device must be measured in accordance with the operating temperature. The Miniature Circuit Breaker (MCB) must be type C.

MAXIMUM INSTALLATION LENGTHS

	10 A	16 A
OPTIHEAT 9		
On the surface of a pipe +10 °C	100 m	-
Inside a pipe +10 °C	60 m	-

OPTIHEAT 10		
On the surface of a pipe +10 °C	140 m	205 m
On the surface of a pipe -15 °C	90 m	140 m

OPTIHEAT 15/30		
On the surface of a pipe +10 °C	104 m	139 m
On the surface of a pipe ±0 °C	95 m	139 m
On the surface of a pipe -15 °C	78 m	122 m
On the surface of a pipe -25 °C	70 m	113 m
In ice water	60 m	80 m

OPTIHEAT 25		
On the surface of a pipe +10 °C	55 m	88 m
Inside a pipe +10 °C	40 m	60 m

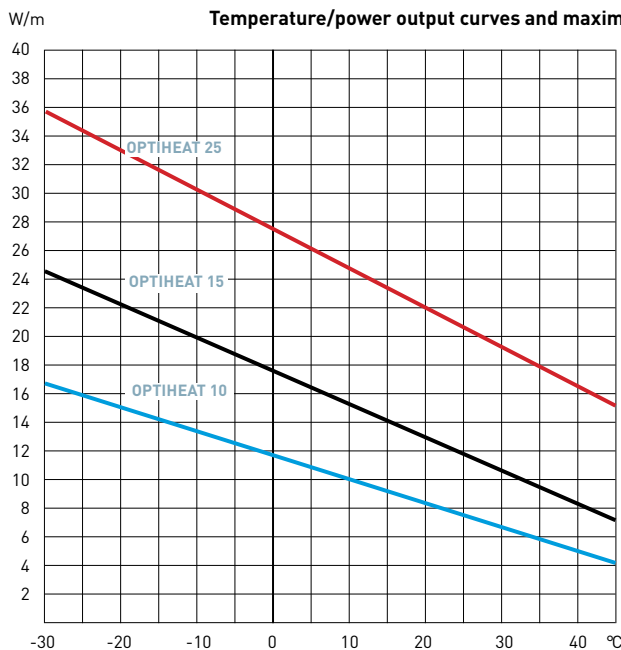
Maximum cable installation lengths for certain switch-on temperatures when the cable surface and surrounding temperatures are the same.

Optiheat 15/30 is a self-regulating twin-conductor cable. It is easy to size and install and suits excellent for frost protection of small areas like concrete constructions and staircases.

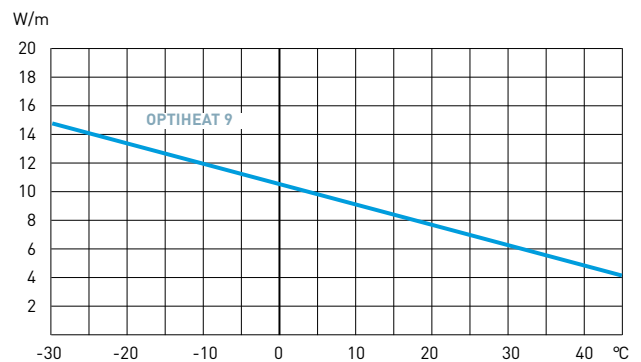
(PICTURE PROVIDED FOR GUIDANCE ONLY)



Temperature/power output curves and maximum installation lengths for Optiheat-cables



Change of Optiheat 10, Optiheat 15 and Optiheat 25 heating power output when the surrounding temperature changes



Change of Optiheat 9 heating power output when the surrounding temperature changes

FROST PROTECTION CONTROL

– Energy-saving control units for various requirements

By using our ECO control equipment, frost protection always functions as required while at the same time saving energy. Our control equipment is appropriate not only for pipes and outdoor areas but also for demanding frost protection control systems.



The EC0500 controls the frost protection of pipes

The EC0500 thermostat controls the frost protection of pipes. The sensor is installed to the top surface of the pipe when the heating cable is used inside the pipe. When the cable is used on the outside of the pipe, the sensor must be installed on the opposite side in the coldest spot. The adjustment range is $+2\text{ }^{\circ}\text{C}$... $+35\text{ }^{\circ}\text{C}$.



Thermostat for frost protection of pipes

The EC0910 controls the frost protection of outdoor areas and rainwater systems

There are two sensors in the EC0910 thermostat: a ground sensor and one measuring the temperature of the air. Both sensors are used in the frost protection control of outdoor areas. In maintaining ice-free conditions in rainwater systems, one sensor measures air temperature. The thermostat is mounted on a DIN rail, and the adjustment range is $-30\text{ }^{\circ}\text{C}$... $+15\text{ }^{\circ}\text{C}$.



DIN-rail mounted thermostat with two sensors

The EC0900 is suitable for demanding frost protection control solutions

The EC0900 is a fully-automatic control unit ensuring frost protection for outdoor areas and rainwater systems. The equipment sensors identify ice, moisture and temperature, so the device is ideally suited for frost protection control solutions in varying freezing conditions. The control equipment is mounted in the distribution board. The unit's LCD display continuously displays the temperature and moisture information. Various sensors must be connected to the unit, depending on the required application.



Fully-automatic control unit for DIN-rails

MOUNTING AND INSTALLATION ACCESSORIES

– assure safe assembly and practical use

Tash and Optiheat connection supplies and other accessories for heating cables and heating mats make up an easily assembled and reliable whole.



Tash connection accessories

11

Tash connection kit includes shrink joints, branch joints, extensions and joints for cold cables. Connection cables must be in accordance with the installation environment.



Tash-connection kit

Optiheat connection accessories

With the Optiheat connection supply series, shrink joints, branch joints, extensions and cold cable joints as well as other joints can be connected directly to the junction box. The cable is led from the point of installation to the junction box either as it is or in a protective tube. A pressure resistance lead-through is also provided in the connection accessories for laying the cables inside a water pipe.



Optiheat-connection kit

Mounting accessories and strain relieves

Mounting accessories also include heat-resistant tape and galvanised mesh, by which the heating cable is attached to the surface of the pipe or valve in order to achieve favourable thermal transfer. By means of a plastic mounting strip, the correct gaps are maintained throughout all stages of the work. A strain relief is used for installing the heating cables to the downpipe.



Strain relief



Mounting strip



Galvanised mesh



Fixing strip

Selection of mounting and installation accessories

This table will provide help in selecting heating cable accessories. Selection of the right accessories will ensure the proper functioning of frost protection solutions in the given conditions.

WATER PIPE FROST PROTECTION		ACCESSORIES	OPTIHEAT 9	OPTIHEAT 10	OPTIHEAT 15/30	OPTIHEAT 25	TASH	PLUG'N HEAT
PLASTIC PIPE	LT20 FIBREGLASS TAPE	*	*					*
	EFPLP1 CONNECTION KIT	*	*					
	EFPLP2 CONNECTION KIT	*	*					
PLASTIC, INSTALLED IN PIPE	EFPLV1 PRESSURE RESISTANCE LEAD-THROUGH	*						*
	EFPLP1 CONNECTION KIT	*						
	EFPLP2 CONNECTION KIT	*						
METAL PIPES	LT20 FIBREGLASS TAPE	*	*	*	*	*	*	*
	SV10 GALVANISED MESH	*	*	*	*	*	*	*
	ALU50 ALUMINUM TAPE	*	*	*	*	*	*	*
	EFPLP1 CONNECTION KIT	*	*	*	*	*	*	*
	EFPLP2 CONNECTION KIT	*	*	*	*	*	*	*
	EFPLP4 CONNECTION KIT						*	
WATER PIPE FROST PROTECTION								
PLASTIC PIPE	LT20 FIBREGLASS TAPE	*	*					*
	SV10 GALVANISED MESH	*	*					*
	EFPLP1 CONNECTION KIT	*	*					
	EFPLP2 CONNECTION KIT	*	*					
METAL PIPE	LT20 FIBREGLASS TAPE	*	*	*	*	*	*	*
	SV10 GALVANISED MESH	*	*	*	*	*	*	*
	ALU50 ALUMIINUM TAPE	*	*	*	*	*	*	*
	EFPLP1 CONNECTION KIT	*	*	*	*	*	*	*
	EFPLP2 CONNECTION KIT	*	*	*	*	*	*	*
	EFPLP4 CONNECTION KIT						*	

RAINWATER SYSTEM	ACCESSORIES	OPTIHEAT 9	OPTIHEAT 10	OPTIHEAT 15/30	OPTIHEAT 25	TASH	PLUG'N HEAT
PLASTIC GUTTER	PPN6/8 MOUNTING STRIP	*	*			*	
	VP300 STRAIN RELIEF		*	*		*	
	EFPLP1 CONNECTION KIT	*	*				
	EFPLP2 CONNECTION KIT	*	*				
	EFPLP4 CONNECTION KIT				*		
METAL GUTTER	PPN6/8 MOUNTING STRIP			*		*	
	VP300 STRAIN RELIEF			*		*	
	EFPLP1 CONNECTION KIT		*				
	EFPLP2 CONNECTION KIT		*				
	EFPLP4 CONNECTION KIT				*		
ROOF VALLEYS	PPN6/8 MOUNTING STRIP			*		*	
	EFPLP1 CONNECTION KIT		*				
	EFPLP2 CONNECTION KIT		*				
	EFPLP4 CONNECTION KIT				*		
OUTDOOR AREAS							
INSTALLATION IN SAND	PPN6/8 MOUNTING STRIP			*		*	
	EFPLP1 CONNECTION KIT		*				
	EFPLP2 CONNECTION KIT		*				
	EFPLP4 CONNECTION KIT				*		
INSTALLATION IN CONCRETE	PPN6/8 MOUNTING STRIP			*		*	
	XBC1230 FIXING STRIP		*	*			
	EFPLP1 CONNECTION KIT		*				
	EFPLP2 CONNECTION KIT		*				
	EFPLP4 CONNECTION KIT				*		
INSTALLATION ON TOP OF CONCRETE	PPN6/8 MOUNTING STRIP			*		*	
	XBC1230 FIXING STRIP		*	*			
	EFPLP1 CONNECTION KIT		*				
	EFPLP2 CONNECTION KIT		*				
	EFPLP4 CONNECTION KIT				*		

ELECTRIC FROST PROTECTION

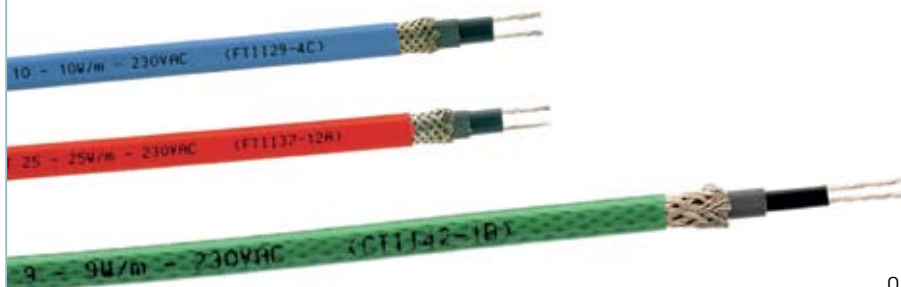
– simple structural applications

The electrical control of frost protection is quick and effective. This energy-efficient solution requires the correct power sizing and heating control in accordance with requirements.



Frost protection for water and drain pipes

Frost protection control prevents frozen pipes from causing water damage. Primary place for the heating cable is on the surface of a water pipe, but a cable may also be installed inside the water pipe as required.



Optiheat cables

Frost protection for rainwater systems

By means of frost protection control over rainwater systems, water-freezing in connection with temperature changes in rainwater gutters and roof structures is prevented. Heavy ice masses damage structures and can be dangerous for those walking in the vicinity. The melt waters route must be looked after all the way to the rainwater drains.



Optiheat cable

Frost protection for outdoor areas

By using frost protection for outdoor area, the pavements of a property are kept safe to walk on. Planning begins from the clarification of installation site conditions and the structure of the area to be heated. In addition to ice-free maintenance, run-off route planning for melt waters must also be kept in mind



Tash cable

Sizing frost protection of pipework

In planning the heating of pipes, we proceed as follows:

1. Thermal losses in the pipe are determined (table or by calculation)
2. Heating efficiency is measured: 1.3–1.5 x thermal loss
3. Length of the heating cable is calculated.
4. On the basis of the cable tables, the appropriate specific resistance of the cable is specified.
5. The type of cable is chosen that achieves sufficient installation output.
6. Check that the total output is adequate and that the highest permitted metric output is not exceeded.
7. If the power per metre output exceeds what is permitted, the length of the heating cable is extended with several cable loops heating the pipe.

The thermal efficiency and cable type for the piping system are determined in accordance with material, size and thermal losses.

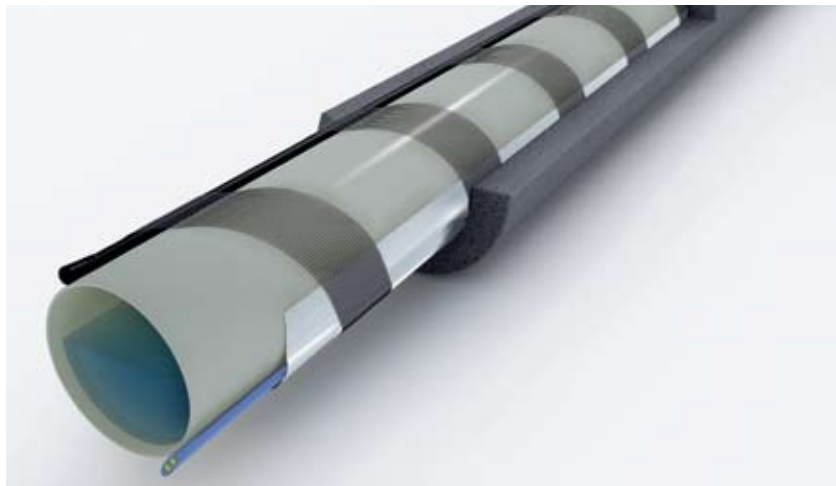
The following should be noted with Tash series-resistant cabling:

- highest permitted power per metre output (plastic pipe 10 W/m, metal pipe 20 W/m)
- the cable does not crisscross
- the heating cable is generally installed along the pipe
- the cabling is always installed as loops, two heating cables go to the pipe

WATER PIPE MATERIAL	MAX. CABLE POWER / M PUT	HEATING CABLE
PLASTIC	10	Optiheat 9 Optiheat 10 Plug 'n Heat Tash
METAL	25	Optiheat 10 Optiheat 25 Plug 'n Heat
METAL	20	Tash
PLASTIC / METAL HEATING CABLE INSIDE PIPE	10	Optiheat 9 Plug 'n Heat

Heating cables: max. power per metre output

	P_{max}
Plastic pipe	10 W/m
Metal pipe	
- inside pipe submerged in water (Tash)	50 W/m
- on pipe surface (Tash)	20 W/m
- inside pipe (Optiheat25)	25 W/m
Heating inside pipe	9 W/m



Optiheat 10 heating cable

for heating plastic and metal pipes. Take sensor position into account. An aluminium tape divides heat more evenly and a galvanised mesh is used here, the pipe is also insulated.

(PICTURE PROVIDED FOR GUIDANCE ONLY)

Thermal loss table for pipe (W/metre of pipe)

Instructions for reading the table

Thermal loss table for pipe

An uncertainty factor of 1.3 to 1.5 should be applied to the values in the table. The thermal loss table for pipes is used for determining how much power per metre of pipe is required for keeping the pipe water unfrozen.

1. The first column shows the outer pipe diameter.
2. The second column gives the insulation thickness.
3. In the next columns, the values 20 °C to 60 °C refer to the temperature difference between the pipe and environment. When you want to keep the pipe unfrozen in an environment where the temperature can get as low as -30 °C, you should select the 40 °C column for perusal. With regard to dimensioning, the insulation's thermal conductivity is 0.035 W/m². (Mineral wool: +10 °C.)

Note: Holder rings (brackets) and valves have not been taken into consideration regarding sizing..



Example

A plastic pipe's outer diameter is 48 mm, insulation thickness 50 mm, and temperature difference 35 °C. This translates into a heat loss of 7.8 W/m. Here, 1.4 is selected as the uncertainty factor, for a design power of 7.8 x 1.4 = 10.92 W/m. Since the maximum metric load on the surface of the plastic pipe is 10 W/m, Optiheat 10 is selected as the heating cable.

OUTER DIAMETER OF PIPE pipe diam.	INSULATION THICKNESS mm	TEMPERATURE T _{pipe} - T _{diam.} DIFFERENCE				
		20 °C	30 °C	40 °C	50 °C	60 °C
14	20	3,3	4,9	6,5	8,1	9,8
	30	2,6	4,0	5,3	6,6	7,9
	40	2,3	3,5	4,6	5,8	6,9
	50	2,1	3,1	4,2	5,2	6,3
21	20	4,1	6,2	8,2	10,3	12,4
	30	3,3	4,9	6,5	8,1	9,8
	40	2,8	4,2	5,6	7,0	8,4
	50	2,5	3,8	5,0	6,3	7,5
27	20	4,8	7,3	9,7	12,1	14,5
	30	3,8	5,6	7,5	9,4	11,3
	40	3,2	4,8	6,4	8,0	9,6
	50	2,8	4,3	5,7	7,1	8,5
34	20	5,7	8,5	11,3	14,1	17,0
	30	4,3	6,5	8,6	10,8	13,0
	40	3,6	5,5	7,3	9,1	10,9
	50	3,2	4,8	6,4	8,0	9,6
42	20	6,5	9,5	12,5	15,5	18,5
	30	5,0	7,4	9,9	12,4	14,9
	40	4,1	6,2	8,2	10,3	12,4
	50	3,6	5,4	7,2	9,0	10,8
48	20	7,3	10,5	13,7	16,9	20,1
	30	5,4	8,1	10,8	13,6	16,3
	40	4,5	6,7	9,0	11,2	13,5
	50	3,9	5,9	7,8	9,8	11,7
60	20	8,5	12,5	16,5	20,5	24,5
	30	6,3	9,5	12,7	15,9	19,0
	40	5,2	7,8	10,4	13,0	15,6
	50	4,5	6,7	9,0	11,2	13,5
76	20	10,5	15,5	20,5	25,5	30,5
	30	7,6	11,3	15,1	18,9	22,7
	40	6,1	9,2	12,2	15,3	18,3
	50	5,2	7,9	10,5	13,1	15,7
89	20	12,5	18,5	24,5	30,5	36,5
	30	8,5	12,8	17,1	21,3	25,6
	40	6,9	10,3	13,7	17,1	20,6
	50	5,8	8,8	11,7	14,6	17,5
114	20	15,5	22,5	29,5	36,5	43,5
	30	10,4	15,6	20,8	26,0	31,2
	40	8,3	12,4	16,5	20,7	24,8
	50	7,0	10,5	14,0	17,5	21,0
168	20	20,5	29,5	38,5	47,5	56,5
	30	14,3	21,2	28,3	35,3	42,4
	40	11,7	17,5	23,4	29,2	35,1
	50	10,0	14,5	19,5	24,5	29,5
219	20	25,5	36,5	47,5	58,5	69,5
	30	17,1	25,7	34,2	42,8	51,3
	40	14,1	21,1	28,2	35,2	42,3
	50	12,0	17,5	23,4	29,2	35,1
273	20	30,5	43,5	56,5	69,5	82,5
	30	20,5	29,5	38,5	47,5	56,5
	40	17,1	25,7	34,2	42,8	51,3
	50	14,1	21,1	28,2	35,2	42,3
342	20	36,5	51,5	66,5	81,5	96,5
	30	24,5	34,5	44,5	54,5	64,5
	40	20,5	29,5	38,5	47,5	56,5
	50	17,1	25,7	34,2	42,8	51,3
426	20	43,5	60,5	77,5	94,5	111,5
	30	28,5	39,5	50,5	61,5	72,5
	40	24,5	34,5	44,5	54,5	64,5
	50	20,5	29,5	38,5	47,5	56,5
510	20	50,5	69,5	88,5	107,5	126,5
	30	33,5	46,5	59,5	72,5	85,5
	40	28,5	39,5	50,5	61,5	72,5
	50	24,5	34,5	44,5	54,5	64,5
606	20	58,5	80,5	102,5	124,5	146,5
	30	39,5	54,5	69,5	84,5	99,5
	40	33,5	46,5	59,5	72,5	85,5
	50	28,5	39,5	50,5	61,5	72,5
714	20	66,5	91,5	116,5	141,5	166,5
	30	44,5	61,5	79,5	97,5	115,5
	40	37,5	51,5	66,5	81,5	96,5
	50	31,5	43,5	56,5	69,5	82,5
834	20	75,5	103,5	131,5	159,5	187,5
	30	50,5	69,5	88,5	107,5	126,5
	40	42,5	58,5	74,5	90,5	106,5
	50	36,5	50,5	64,5	78,5	92,5
966	20	85,5	116,5	147,5	178,5	209,5
	30	56,5	79,5	102,5	127,5	152,5
	40	47,5	66,5	84,5	102,5	119,5
	50	40,5	56,5	71,5	86,5	101,5
1110	20	95,5	130,5	161,5	192,5	223,5
	30	63,5	89,5	114,5	140,5	166,5
	40	53,5	75,5	95,5	116,5	137,5
	50	45,5	64,5	81,5	98,5	115,5
1266	20	105,5	143,5	174,5	205,5	236,5
	30	70,5	100,5	127,5	154,5	181,5
	40	59,5	85,5	106,5	129,5	152,5
	50	50,5	73,5	92,5	112,5	133,5
1434	20	115,5	159,5	191,5	223,5	255,5
	30	77,5	108,5	139,5	169,5	197,5
	40	65,5	92,5	117,5	143,5	171,5
	50	55,5	79,5	100,5	122,5	145,5
1614	20	125,5	175,5	207,5	239,5	271,5
	30	83,5	115,5	145,5	177,5	205,5
	40	70,5	98,5	124,5	151,5	177,5
	50	60,5	84,5	106,5	129,5	152,5
1806	20	135,5	183,5	215,5	247,5	279,5
	30	90,5	123,5	155,5	187,5	215,5
	40	76,5	105,5	132,5	161,5	187,5
	50	65,5	90,5	113,5	140,5	165,5
2010	20	145,5	193,5	223,5	255,5	287,5
	30	97,5	131,5	163,5	197,5	225,5
	40	82,5	112,5	140,5	171,5	197,5
	50	70,5	96,5	120,5	147,5	171,5
2226	20	155,5	203,5	231,5	263,5	295,5
	30	103,5	139,5	171,5	207,5	237,5
	40	87,5	118,5	147,5	177,5	205,5
	50	75,5	102,5	126,5	154,5	181,5
2454	20	165,5	213,5	239,5	271,5	303,5
	30	110,5	147,5	181,5	215,5	247,5
	40	93,5	125,5	156,5	187,5	215,5
	50	80,5	108,5	134,5	161,5	187,5
2706	20	175,5	223,5	247,5	279,5	311,5
	30	117,5	155,5	191,5	223,5	257,5
	40	99,5	131,5	163,5	197,5	225,5
	50	85,5	113,5	140,5	171,5	197,5
2976	20	185,5	233,5	255,5	287,5	319,5
	30	125,5	163,5	201,5	231,5	265,5
	40	105,5	135,5	169,5	205,5	237,5
	50	90,5	117,5	144,5	177,5	205,5
3258	20	195,5	243,5	263,5	295,5	327,5
	30	131,5	171,5	207,5	247,5	283,5
	40	110,5	143,5	174,5	215,5	255,5
	50	95,5	123,5	151,5	187,5	225,5
3552	20	205,5	253,5	271,5	303,5	331,5
	30	139,5	179,5	215,5	257,5	295,5
	40	117,5	147,5	181,5	223,5	265,5
	50	100,5	126,5	154,5	197,5	237,5
3864	20	215,5	263,5	279,5	311,5	335,5
	30	147,5	183,5	223,5	263,5	299,5
	40	123,5	155,5	181,5	223,5	265,5
	50	105,5	134,5	156,5	197,5	237,5
4182	20	225,5	273,5	287,5	319,5	343,5
	30	155,5	187,5	227,5	267,5	303,5
	40	131,5	159,5	187,5	223,5	265,5
	50	110,5	139,5	163,5	197,5	237,5
4512	20	235,5	283,5	295,5	327,5	351,5
	30	163,5	193,5	231,5	271,5	307,5
	40	137,5	163,5	191,5	231,5	267,5
	50	115,5	143,5	169,5	205,5	239,5
4854	20	245,5	293,5	303,5	335,5	359,5
	30	171,5	197,5	235,5	275,5	311,5
	40	143,5	167,5	191,5	231,5	269,5
	50	120,5	147,5	174,5	205,5	241,5
5208	20	255,5	303,5	311,5	343,5	367,5
	30	179,5	203,5	239,5	279,5	315,5
	40	149,5	171,5	195,5	235,5	273,5
	50	125,5	151,5	177,5	207,5	243,5
5574	20	265,5	313,5	319,5	351,5	375,5
	30	187,5	207,5	243,5	283,5	319,5
	40	155,5	175,5	199,5	239,5	277,5
	50	130,5	155,5	181,5	215,5	247,5
5952	20	275,5	323,5	327,5	359,5	383,5
	30	195,5	213,5	247,5	287,5	323,5
	40	163,5	179,5	203,5	243,5	281,5
	50	135,5	159,5	183,5	219,5	251,5
6342	20	285,5	333,5	335,5	367,5	391,5
	30	203,5	217,5	251,5	291,5	327,5
	40	167,5	183,5	207,5	247,5	285,5
	50	139,5	163,5	187,5	223,5	259,5
6744	20	295,5	343,5	343,5	375,5	403,5
	30	213,5	223,5	255,5	295,5	333,5
	40	175,5	187,5	211,5	251,5	293,5
	50	143,5	167,5	191,5	227,5	263,5
7158	20	305,5	353,5	351,5	383,5	415,5
	30	223,5	233,5	263,5	303,5	341,5
	40	183,5	193,5	215,5	255,5	295,5
	50	149,5	171,5	195,5	231,5	267,5
7584	20	315,5	363,5	359,5	391,5	427,5
	30	233,5	243,5	267,5	307,5	345,5
	40	191,5	197,5	219,5	259,5	299,5
	50	155,5	175,5	199,5	235,5	273,5
8022	20	325,5	373,5	367,5	403,5	439,5
	30	243,5	253,5	271,5	311,5	349,5
	40	197,5	203,5	223,5	263,5	303,5
	50	163,5	183,5	203,5	243,5	277,5
8472	20	335,5	383,5	375,5	415,5	451,5
	30	253,5	263,5	275,5	315,5	353,5
	40	207,5	207,5	227,5	267,5	307,5
	50	169,5	187,5	207,5	247,5	281,5
8934	20	345,5	393,5	383,5	427,5	463,5
	30	263,5	273,5	283,5	319,5	357,5
	40	213,5	213,5	233,5	271,5	311,5
	50	175,5	193,5	211,5	251,5	285,5
9408	20	355,5	403,5	391,5</		

Installation of frost protection for pipework

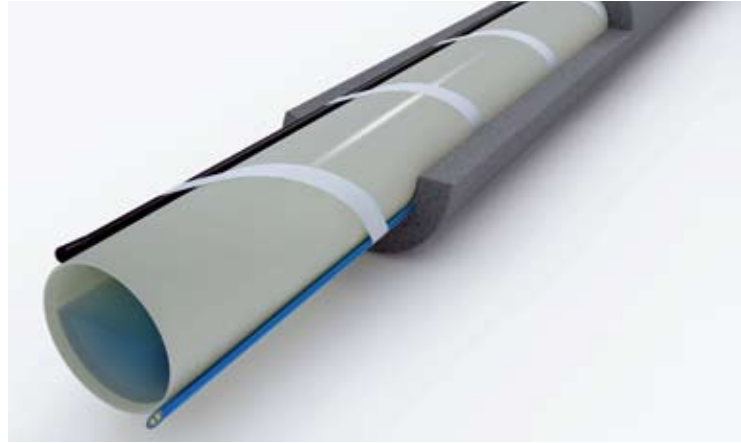
Heating cable external to the pipe

The heating cable is installed horizontally next to the pipe (5 o'clock). When two heating cables are used, the cables are installed on the bottom edge (at 5 and 7 o'clock). The heating cable is attached to the pipe so that the cable is fixed to the surface of the pipe.

The thermostat sensor controlling heating is placed on the opposite side from the heating cable.

The following may be used for mounting:

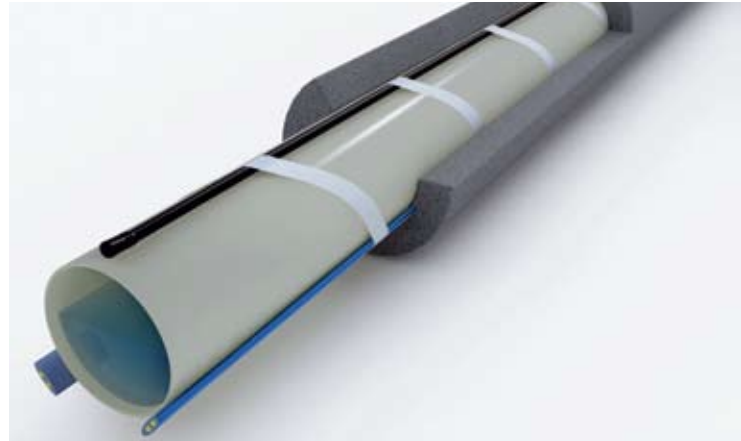
- heat-resistant fiberglass tape (LT20)
- heat-compensating aluminium tape (ALU50) applied along the pipe
- galvanised mesh (SV10)



One heating cable

The sensor is on the opposite side.

(PICTURE PROVIDED FOR GUIDANCE ONLY)



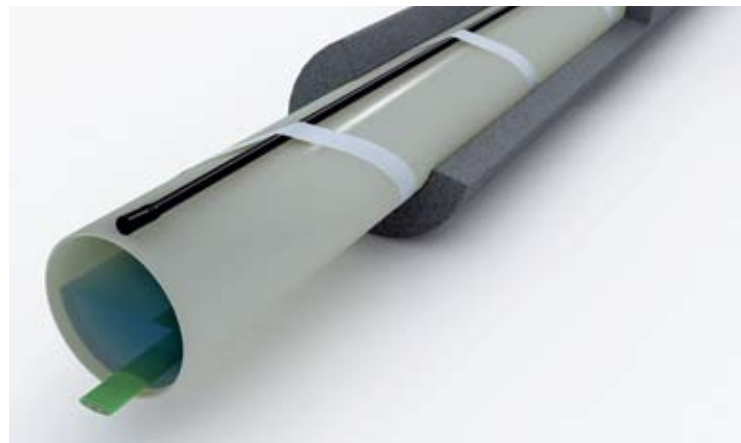
Two heating cables

Two heating cables are required for pipes with a large diameter (over 50 mm). The sensor is attached to the upper surface of the pipe.

(PICTURE PROVIDED FOR GUIDANCE ONLY)

Heating cable inside the pipe

The heating cabling inside the water pipe is conveyed to the pipe by a pressure resistant lead-through (EFPLV1). The cable is horizontal at the lower edge of the pipe in installation. The thermostat sensor is mounted on top of the pipe.



Heating cable inside the pipe.

(PICTURE PROVIDED FOR GUIDANCE ONLY)

Controlling pipeline frost protection

A pipeline frost protection system must always be controlled with an operating switch. A thermostat can be used to activate heating only when necessary, thus avoiding the unnecessary waste of energy.

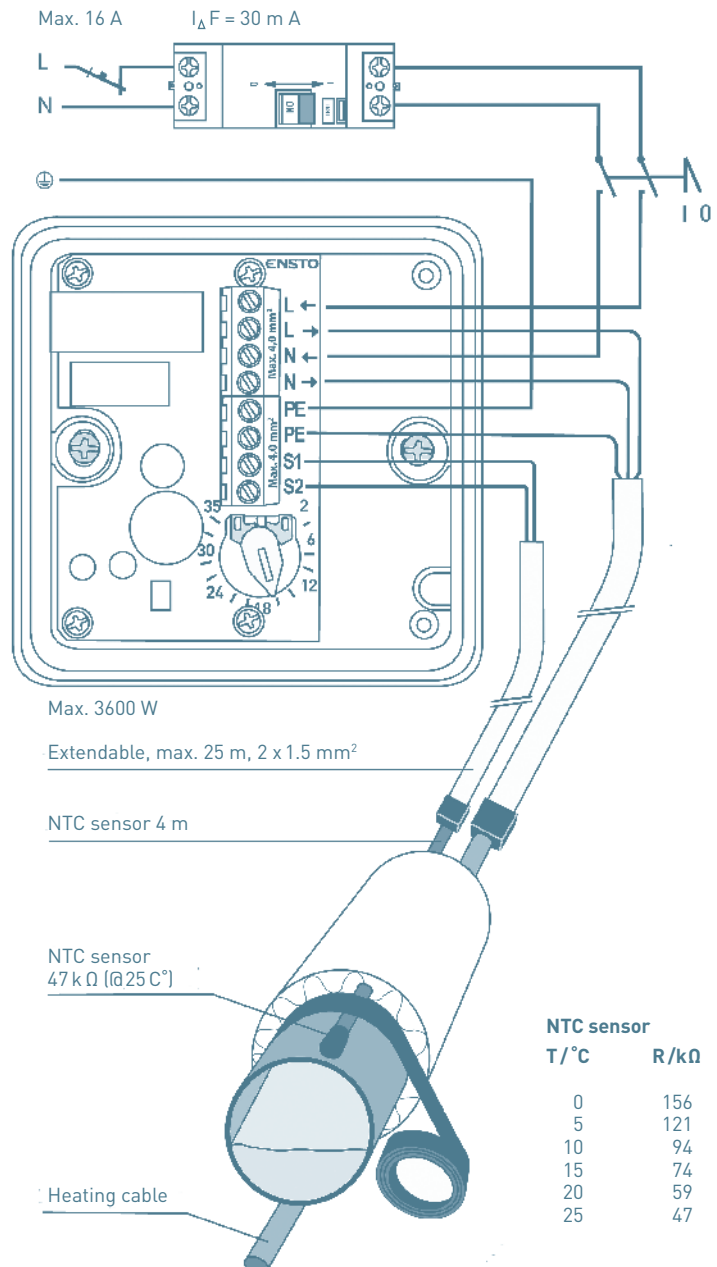
A self-regulating cable (Optiheat) can also be used without a thermostat, but the use of a thermostat or operating switch is recommended.

Ready-made Plug'n Heat cables can be directly connected to the socket outlet when heating is required.

Heating implemented with series-resistant cables (Tash) is always controlled with a thermostat. The thermostat sensor is mounted on top of the pipe.



EC0500 thermostat



Frost protection of water pipes

Heating cables can be used for preventing water pipes that are vital to a property from being frozen, and for preventing water damage. Near outer walls, the impact of cold bridges is prevented by heating and insulating water pipes and their shutoff valves.

The heating power and cable type of pipes are determined on the basis of the pipe material and size as well as thermal loss. Pipe size, installation environment, and insulation are the factors that affect heat loss most.

Heat loss calculation is based on the principle that the insulation remains dry and does not have cracks etc.. A tolerance factor of 1.3–1.5 x the heat loss value is used in the design (in the table on page 17).

Self-regulating cables (Optiheat) and series-resistant cables (Tash) are suitable for frost protection of pipes. The maximum metric outputs of heating cables can be found in the table on page 16.

The heating cable is usually installed on the pipe surface, but it can also be installed inside pipes if so required. In these cases, a heating cable, tested for compliance with regulations for operations involving foodstuffs and designed for drinking-water pipes, must be used.



Near the outer wall, the creation of cold bridges is prevented by heating and insulating the water pipe, water gauge, and shutoff valve.

(PICTURE PROVIDED FOR GUIDANCE ONLY)



The heating cable in a water pipe is inserted into the pipe via a pressure-resistant lead-through (EFPLV1).

(PICTURE PROVIDED FOR GUIDANCE ONLY)

Plug'n Heat

Factory made Plug'n Heat cables are equipped with a plug. The cables have fluoropolymer sheaths and are tested for compliance with regulations on use with foodstuffs, meaning that they can be installed in drinking-water pipes too. The heating cables are directly inserted into the pipes via a pressure resistant lead-through EFPLV1. Thanks to the plug, the cables can be plugged directly into a socket outlet, for use whenever heating is required. Additional protection for heating cables must always be provided by means of a fault current guard that is either in the distribution board or integrated with the socket outlet.



Frost protection of valves (also applicable for brackets)

The pipe's normal frost protection sizing is sufficient. At the valve, an extra cable loop is made in order to offset heat loss through the valve shaft to outside the insulation. The valve and pipe must be insulated. The extra cable loop also provides flexibility for cases in which the valve has to be replaced.



Rainwater system sizing and designing

For narrow gutters in Southern Finland, the design and power for keeping a rainwater system ice-free is sufficient if it is approx. 20 W/m, i.e., one Tash cable per gutter is adequate. Greater heating power requires installation of more than one heating cable in the gutter.

Self-regulating heating cables (Optiheat 15/30) or series resistant cables (TASH) may be used as

heating cables for rainwater systems. Self-regulating heating cable (Optiheat) is the most appropriate for small application areas in which a regulator or thermostat is not necessarily needed. For these sites, a temperature control system is also recommended, especially if there are several downpipes. For large-scale applications TASH cable and control system is recommended.

	GUTTER WIDTH mm	INSTALLATION OUTPUT PER E.G. GUTTER METRE W/m	INSTALLATION OUTPUT PER SURFACE TO BE HEATED W/m ²
RAINWATER GUTTER, HORIZONTAL/VERTICAL < 150		20-60	
RAINWATER GUTTER, HORIZONTAL	> 150		200
ROOF VALLEY	> 150		200

Installation of frost protection for rainwater system

A rainwater system consists of a heating cable as well as mounting accessories and heat control device.

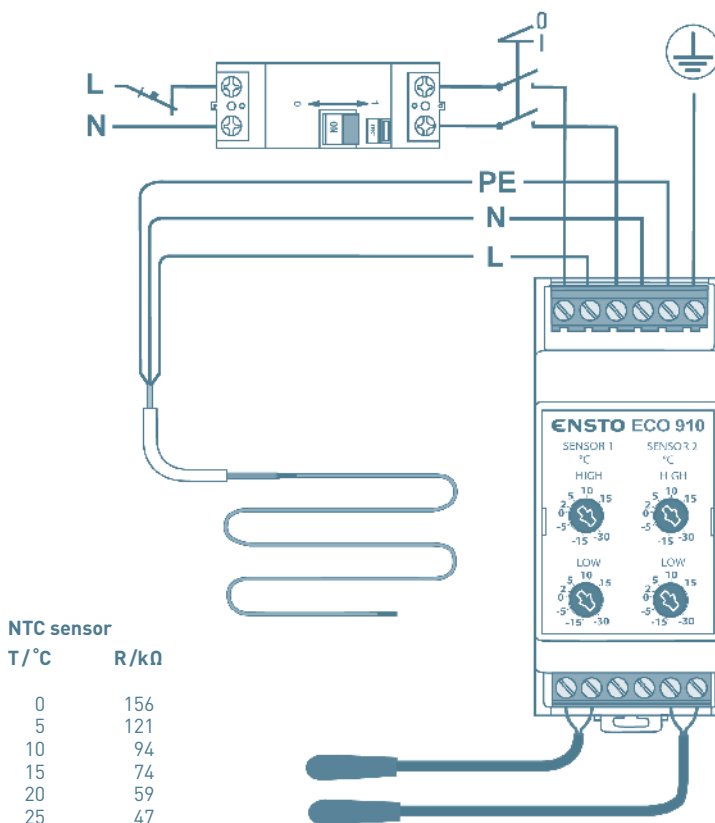
A cable is fastened to the top ends of the vertical gutters with cable clamps. In long vertical gutters, support cable wire is also used. Cable clamps are mounted, if required, on the horizontal gutters.

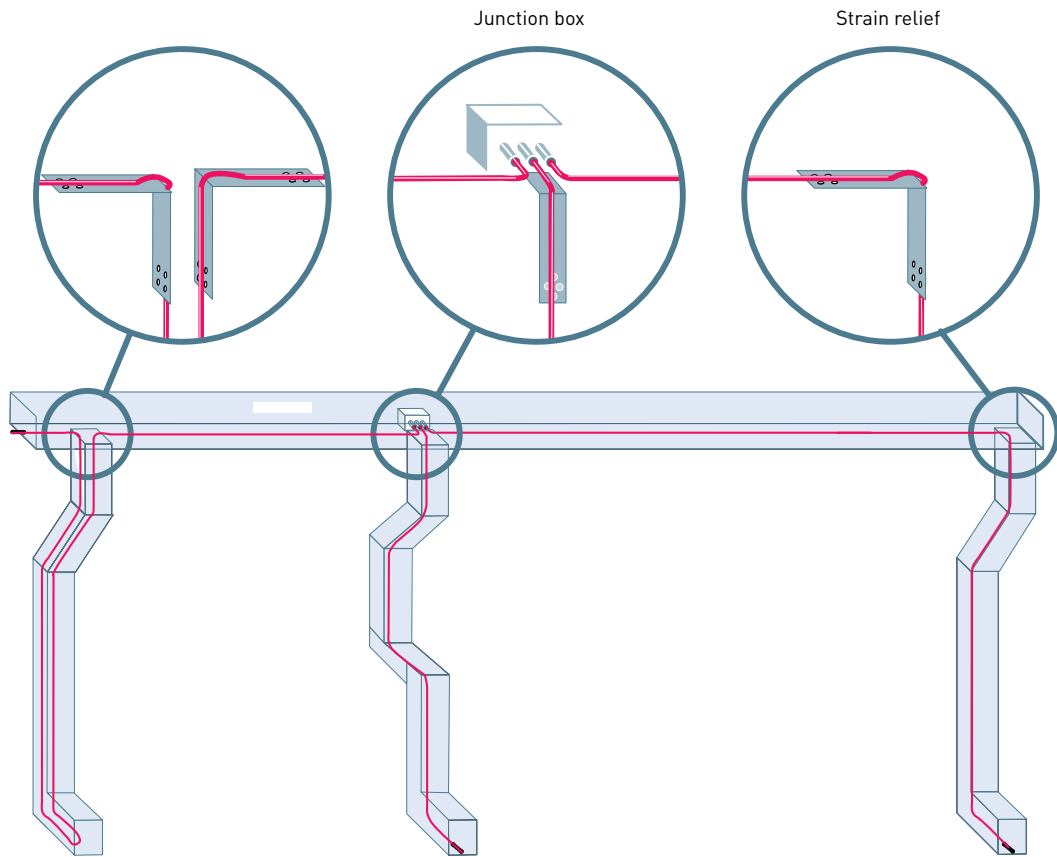
Optiheat cables can lie freely along the gutters

Tash series-resistant cables are fixed to the gutters. Plastic mounting strips, plastic-coated cable clamps or cable wire supports combinations are used on horizontal sections.

Rain water wells on the roof must be protected from freezing in order to prevent ice damage to the wells and roof structures. In rain water well heating applications, the cable should extend for quite a distance into a warm area, since otherwise downspouts cool across a fairly long distance downwards. Roof wells usually include a factory-installed heating cable to which the supply voltage is connected.

HEATING CABLE	THERMOSTAT	SENSOR	CONNECTION ACCESSORIES	MOUNTING ACCESSORIES
OPTIHEAT 15/30	ECO910		EFPLP1 EFPLP2 EFPLP3	VP300
TASH	ECO910		EFPLP4	VP300 PPN8 PPN6 XBC1230
TASH	ECO900	ECOA903 ECOA904	EFPLP4	VP300 PPN8 PPN6 XBC1230





The frost protection cable and the sensors are attached by using a PPN6/8 mounting strip. The top end of the down-pipe is equipped with a VP300 strain relief unit. The rainwater system must be kept free of leaves.

(PICTURE PROVIDED FOR GUIDANCE ONLY)



Frost protection of rainwater systems in a detached house applying Optiheat heating cabling

Design and installation of frost protection for rainwater gutters

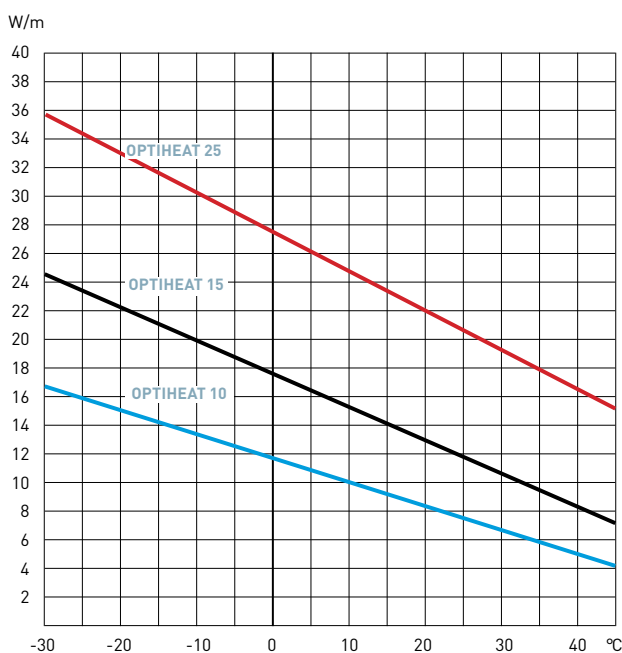
The metric output of the Optiheat 15/30 heating cable is 19 W/m–16 W/m in an environment with a temperature of $-5\text{ }^{\circ}\text{C}$... $+5\text{ }^{\circ}\text{C}$. In ice water, its metric power output is around 30 m.

One or more heating cables are installed in the horizontal sections and downpipe of the rainwater gutter in order to achieve the desired installation output. In the southernmost parts of Finland, one cable is sufficient for narrow gutters; more cables are required in other parts of Finland and for wider gutters (i.e., those with a diameter of over 150 mm).

The heating cable is installed as a loop in horizontal gutters, with the cable ending at the bottom end of the downpipe. Optiheat cables can be left free or inserted into an aluminium pipe. The cable is mounted using a strain relief (VP300) at the top end of a downpipe and, if required, a plastic-coated cable clamp at the bottom end.

Heating cables are connected to junction boxes. If required, a cold lead that is connected to the heating cable by a cable joint e.g. connection kit EFPLP2 can be used. The termination kit has to be used in the other end of the cable.

In Optiheat cables, the switching current is around 1.5 x the operating current. Since around 60 metres of heating cable in ice water can be installed in a group protected with a 10 A circuit breaker, heating is connected to a single group. The heating is controlled via an ECO910 thermostat. See the wiring diagram on page 22.



Alteration of Optiheat 10, Optiheat 15, and Optiheat 25 heating cables' power output as the ambient temperature changes.

Optiheat heating cables' temperature/power output curves and maximum installation lengths

MAXIMUM INSTALLATION LENGTHS	10 A	16 A
OPTIHEAT 9		
On pipe surface $+10\text{ }^{\circ}\text{C}$	100 m	–
Inside pipe $+10\text{ }^{\circ}\text{C}$	60 m	–
OPTIHEAT 10		
On pipe surface $+10\text{ }^{\circ}\text{C}$	140 m	205 m
On pipe surface $-15\text{ }^{\circ}\text{C}$	90 m	140 m
OPTIHEAT 15/30		
On pipe surface $+10\text{ }^{\circ}\text{C}$	104 m	139 m
On pipe surface $\pm 0\text{ }^{\circ}\text{C}$	95 m	139 m
On pipe surface $-15\text{ }^{\circ}\text{C}$	78 m	122 m
On pipe surface $-25\text{ }^{\circ}\text{C}$	70 m	113 m
In ice water	60 m	80 m
OPTIHEAT 25		
On pipe surface $+10\text{ }^{\circ}\text{C}$	55 m	88 m
Inside pipe $+10\text{ }^{\circ}\text{C}$	40 m	60 m

Maximum cable installation lengths with certain switching temperatures at which the cable's surface temperature is still the same as the ambient temperature.

Frost protection of roof valleys

With heating that has been installed in the roof valleys, ice that has possibly accumulated in the eaves of the roof can be melted. As installation output, approx. 200 W/m² is used, which is approx. 45 W/m in the example site.

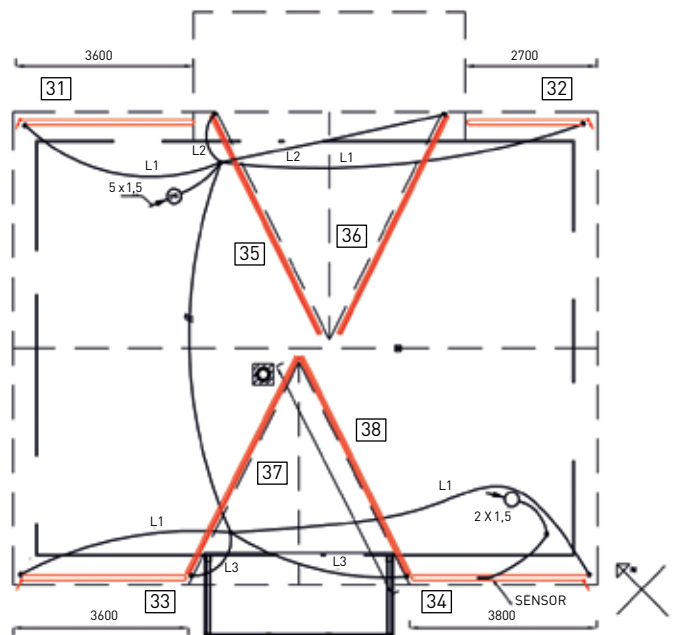
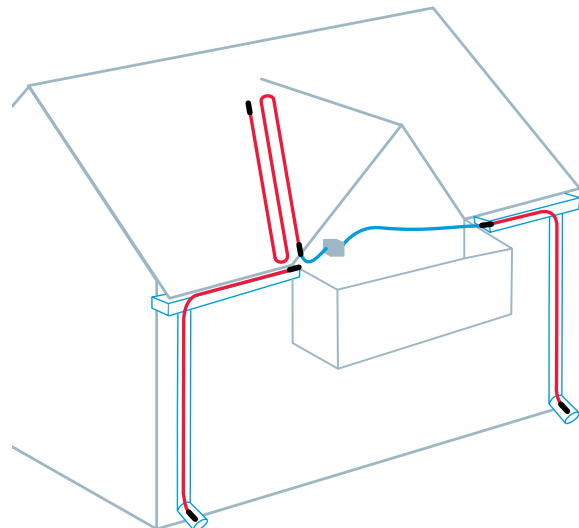
At the operating temperature, the power per metre output of Optiheat 15/30 heating cable is approx. 18 W/m. Three cables are thus installed in the roof valley.

Cable length is compared to the Optiheat 15/30 cable's maximum installation length for creation of an installation.

	OUTPUT/GUTTER LENGTH W/m	OPTIHEAT 15/30, TOTAL NUMBER OF CABLES
HORIZONTAL GUTTER	30	2
VERTICAL GUTTER	15	1
ROOF VALLEY	45	3

POS.	HORIZONTAL GUTTER, m	VERTICAL GUTTER, m	LENGTH OF HEATING CABLE, m
31	3.6	5.8	(2 x 3.6 + 5.8) = 13.0
32	2.7	5.8	(2 x 2.7 + 5.8) = 11.2
33	3.6	5.8	(2 x 3.6 + 5.8) = 13.0
34	3.8	5.8	(2 x 3.8 + 5.8) = 13.4
Total			50.6

POS.	ROOF GUTTER, m	LENGTH OF HEATING CABLE, m
35	5.2	(3 X 5.2) = 15.6
36	5.2	(3 X 5.2) = 15.6
37	5.2	(3 X 5.2) = 15.6
38	5.2	(3 X 5.2) = 15.6
Total		62.4



A rainwater system in an industrial hall using Tash series-resistant cabling

If the design power in the gutter is 20–50 W/m, 30 W/m is selected. The installation output of the Tash cable can be maximum 20 W/m in a metal gutter, so it is installed as loops, approx. 15 W/m.

EXAMPLE
Rainwater gutter length (A+B):
 $4 \times 25 \text{ m} + 2 \times 5.8 \text{ m} + 3 \times 6.7 \text{ m}$
 $\approx 132 \text{ m}$

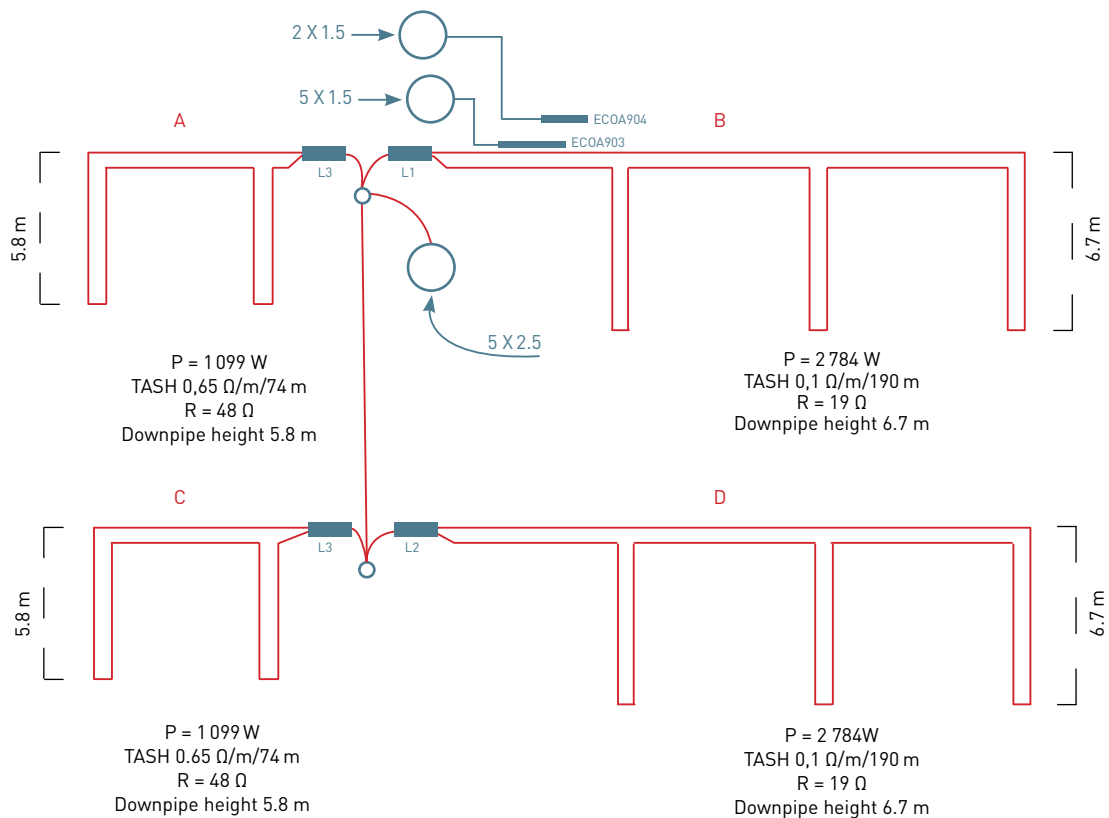
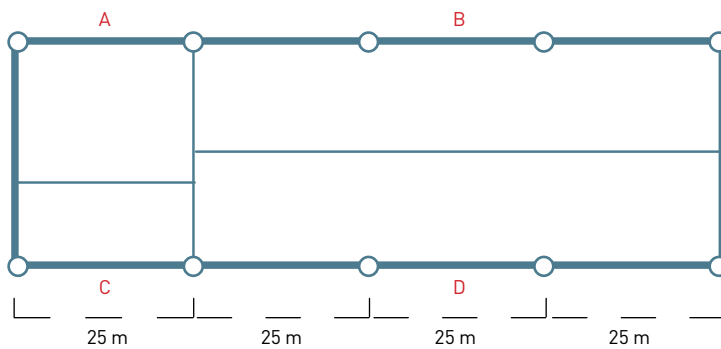
Heating cable (A+B):
length $2 \times 132 \text{ m} = 264 \text{ m}$

Heating output P_1
 $= 15 \text{ W/m} \times 264 \text{ m} = 3960 \text{ W}$

To be installed either to the principal voltage or distributed to two links.

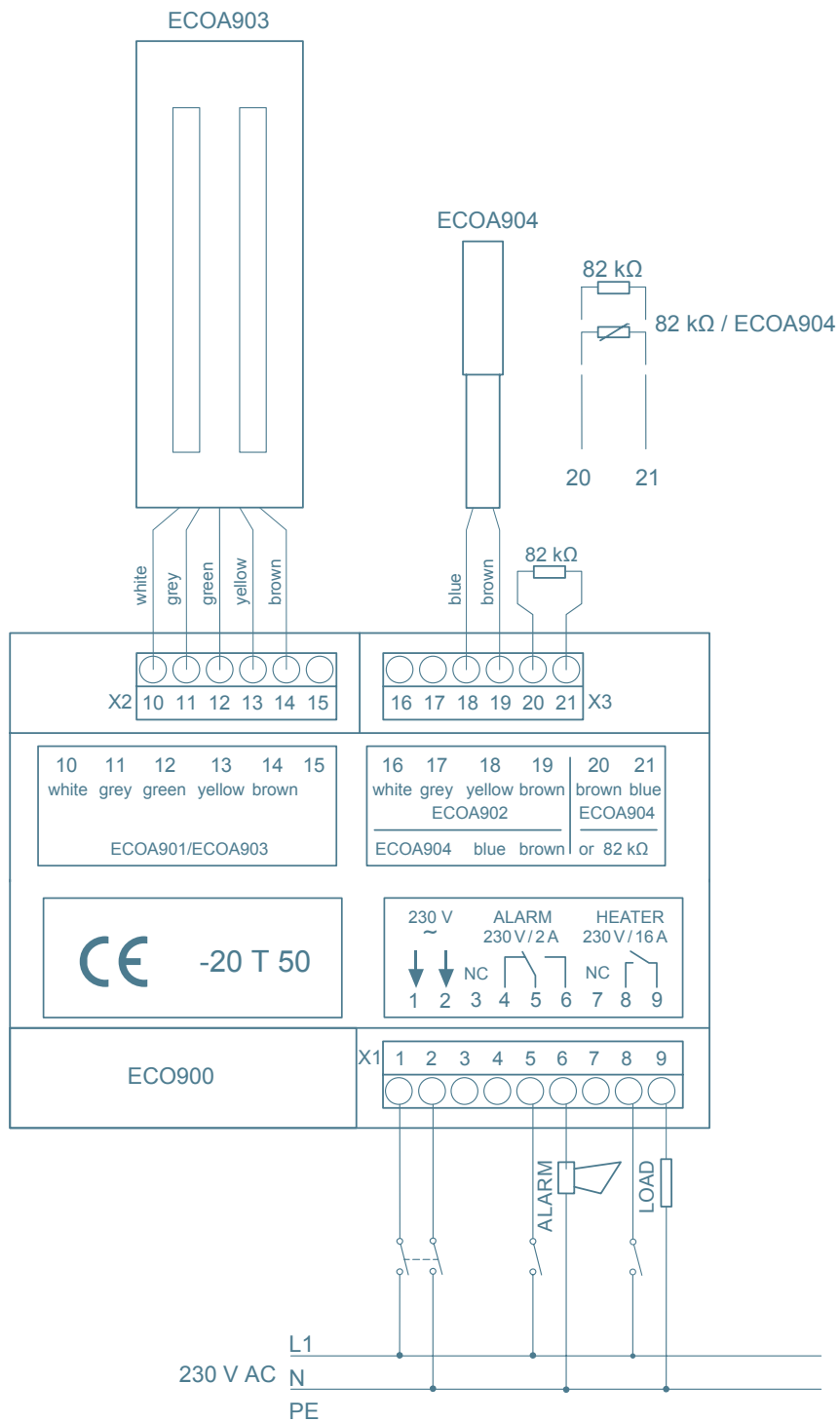
Total output
 $(A + B + C + D) = 7920 \text{ W}$

Heating is connected to the 3 x 16 A group.



EXAMPLE

	LOOP A (= LOOP C)	LOOP B (=LOOP D)
Gutter length + downpipe length	25 m + 2 x 5.8 m ≈ 37 m	3 x 25 + 3 x 6.7 m ≈ 95 m
Required power output 30 W/m	1 110 W	2 850 W
Heating cable length	2 x 37 m = 74 m	2 x 95 m = 190 m
Heating cable resistance	$(230V)^2 / (1\ 110\ W \times 74\ m)$ ≈0.64 Ω/m	$(230V)^2 / (2\ 850\ W \times 190\ m)$ ≈0.1 Ω/m
Selecting heating cable	Tash 0.65 Ω/m	Tash 0.1 Ω/m
Installation power	1 099 W	2 784 W
TOTAL POWER (A+B+C+D)	2 x (1 099 W + 2 784 W) = 7 766 W	



Outdoor areas: frost protection sizing and planning

The power per square meter used in a frost protection solution for an outdoor area depends on factors including the purpose of use and structures.

Installation site conditions and the structure of the areas to be heated are always the starting points in the design and implementation of frost protection. The melt water route must be designed in co-operation with other designers in order to prevent melt water from causing problems elsewhere on the site.

The heating cable is selected on the basis of the area and the heating output required. The cables used are self-regulating (Optiheat) and series-resistant cables (Tash) as well as ready-made mats.

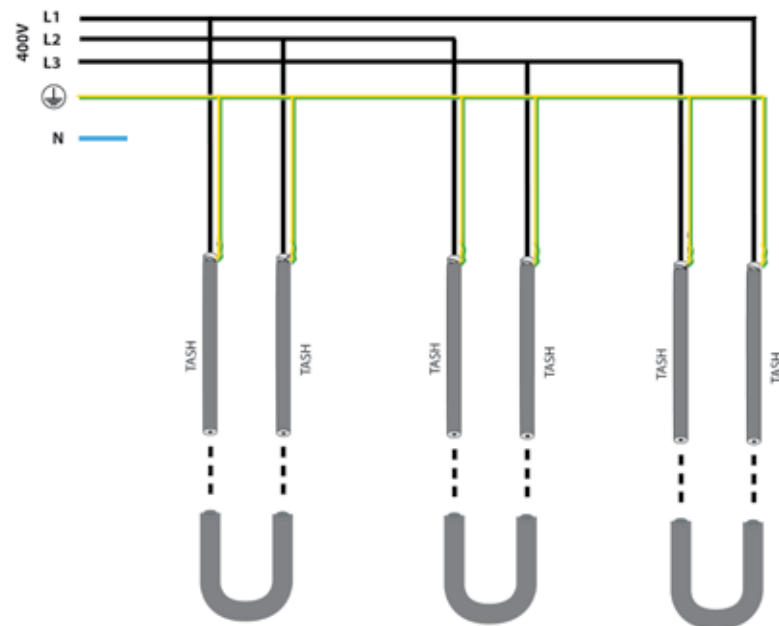
The process of designing a frost protection system:

- select the cable type
- select the suitable power per metre output or specific resistance
- determine the installation spacing
- select the control system

INSTALLATION SITE		INSTALLATION POWER, W/m ²
PAVEMENTS (PROTECTED FROM WIND)		150–200
PAVEMENTS (UNPROTECTED)		200–250
OUTDOOR STEPS AND AREAS IN FRONT OF DOORS		200–300
PARKING AREAS AND ROADWAYS		250–300
LOADING AREAS (INSULATED)		250–300
LOADING AREAS (UNINSULATED)		300–400

HEATING CABLE TYPE	CHARACTERISTICS	USE
SELF-REGULATING CABLE (OPTIHEAT)	Easy to design and install High cable cost	Small areas Concrete structures, steps, etc.
FROST PROTECTION MAT (ULLA)	Quick to install Stable installation power Only one power per square meter output	Suited to areas of all sizes Concrete and sand
SERIES-RESISTANT CABLE (TASH)	Low cable cost Requires careful planning	Versatile areas Large areas Concrete and sand

TASH 400V CONNECTION



Frost protection of vehicle access ramps

If the traffic using the vehicle access ramp is light, the frost protection control cables are installed on the ramp only at the location of the wheels. When heavy traffic uses the ramp or it is steep, the frost protection heating cables are installed throughout the entire area. If the area has slopes, the route for melting water must also be protected from freezing.

EXAMPLE 1

Light vehicle access ramp frost protection can be maintained with an Ulla frost protection mat (300 W/m²). In this case, 10 metres long and 4 metres wide, two Ulla mats (300.10) are chosen at the location of the wheels, producing a total frost protection output of 6 kW. Heating is regulated either with the ECO900 control system or the ECO910 frost protection control thermostat.

EXAMPLE 2

An alternative is to install Tash cabling to a strip 0.5 metres wide at the location of the wheels. The cabling is installed into the concrete with maximum load of the cable at 30 W/m. The heating cable must not be installed across the movement joint.

Total output forms 3 kW (1 500 W/strip). A suitable Tash cable can be chosen from the sizing tables. The load output is 1 500 W and maximum load 30 W/m, i.e., cable type Tash 0.65 Ω is chosen.

Since the total output is rather small (3.1 kW), an ECO 910 frost protection control thermostat is selected for control purposes. The two sensors in the thermostat enable both ground and air temperature measurement.

Frost protection of entrance area

The self-regulating cable is selected according to the size of the area and the required output. The metric output of the Optiheat 15/30 cable varies with the temperature.

Outdoor heating is usually required with an outdoor temperature of -5 °C to 5 °C. In these cases, the cable's metric output (**P** metric) is around 19 W/m-16 W/m.

The required cable length is calculated on the basis of the cable's metric output $l_{\text{cable}} = \frac{P_{\text{length}}}{P_{\text{metric}}}$

The cable installation spacing is calculated by dividing the installation



With light traffic, it suffices to install frost protection cables only on the wheel routes on the ramp (installation in concrete). In the

inclined area, freezing of melt water must be prevented also.

(PICTURE PROVIDED FOR GUIDANCE ONLY)



Heavy traffic requires frost protection cables to be installed throughout the ramp area (installation in concrete).

In the inclined area, freezing of melt water must be prevented also. (PICTURE PROVIDED FOR GUIDANCE ONLY)

area (**A** installation) by the heating cable length (**l** cable).

$$d = \frac{A_{\text{installation}}}{l_{\text{cable}}}$$

Heating is controlled by ECO910 frost protection thermostat installed in the panel board or by an operating switch.

Designing and installing the frost protection of loading area

EXAMPLE 1: The loading area is 24 m long and 4 m wide 300 W/m² is used as the installation output, since the underlay of the installation site is insulated. A 300 m² Ulla frost protection mat is selected, with six mats chosen for the area, four for the large turnaround area and two underneath the wheels.

The total frost protection output comes to 6 x 3.6 kW = 21.6 kW. Frost protection is controlled by means of the ECO900 control system. The ECOA901 snow and ice sensor is installed outside the heated area, with the temperature and humidity sensor, ECOA902, installed in the heated area. Frost protection mats are installed in

the sand or concrete located underneath the heated layer's (in this case, the asphalt's) surface layer.

Heating cable is installed around the rainwater well in order to prevent melt water from freezing, and around the drain output pipe below the ground frost level.

EXAMPLE 2:

Frost protection of the inclined area, designed for heavy traffic, is implemented with Tash cables throughout the area. There is no insulation underneath the sand, yielding a 400 m² design power. The total frost protection output is 24 m x 4 m x 400 m² = 38.4 kW, controlled by the ECO900 control system.

A Tash cable with a 25 W/m load output is selected from the tables. The Tash 0.45 cable fulfils these requirements with a 400 V voltage. In total, 12 cables are required. The length is 122 m and output 2 921 W. Cable connections are shown on page 28.

The total output is 12 x 2 921 W = 35.05 kW, the output per square metre 35.05 W/96 m² = 365 m², and the installation spacing 8 m²/122 m = 6.5 cm. The cables are installed in the sand or concrete that is under the heated layer (usually tile or asphalt).

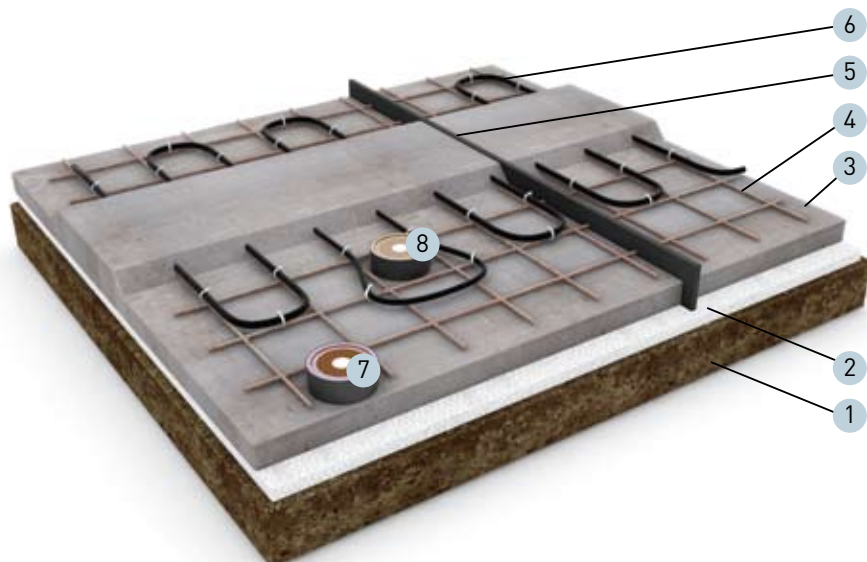
Installation examples



Installation of an Ulla frost protection mat in the sand underneath the asphalt. There is insulation underneath the sand.

1. Soil / gravel
2. Insulation
3. Sand or concrete
4. Ulla frost protection unit
5. Snow and ice sensor
6. Temperature and humidity sensor
7. Asphalt

(PICTURE PROVIDED FOR GUIDANCE ONLY)



Installation of a Tash heating cable in concrete with an expansion joint. No insulation underneath the concrete.

1. Soil / gravel
2. Sand
3. Concrete
4. Reinforcement mesh
5. Expansion joint
6. Tash heating cable
7. Snow and ice sensor
8. Temperature and humidity sensor

(PICTURE PROVIDED FOR GUIDANCE ONLY)

Installation of frost protection systems in outdoor areas

Heating cables are usually installed in the sand or concrete (N.B. not in asphalt!) underneath the heated layer's surface layer. Optimal frost protection efficiency is achieved by insulating the frost-protected area from underneath.

The heating cable is installed at a minimum depth of 5 cm in order to prevent, for instance, traffic from damaging it. The heating cable may not be installed across movement joints. Installation areas are designed in such a manner that only connecting leads (cold leads) cross movement joints.

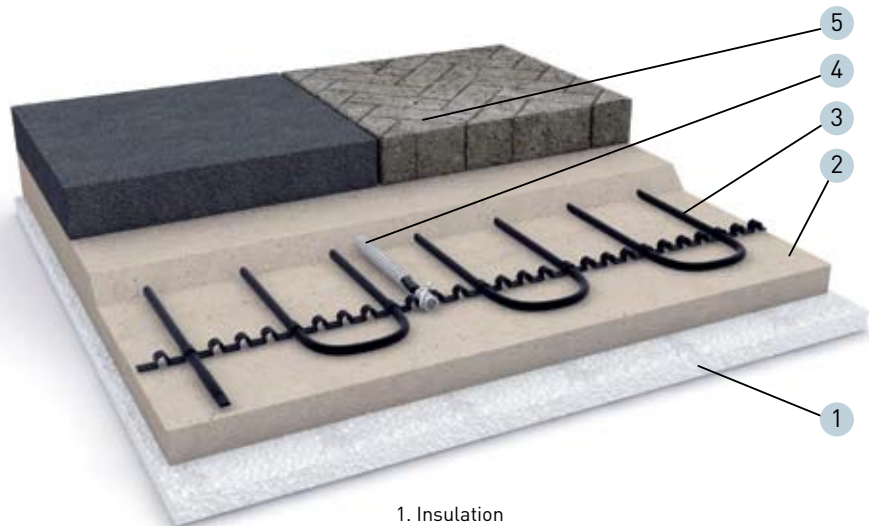
Installation in sand

In a paved or asphalted area, the heating cable is installed in the installation sand underneath the surface layer. The grain size of installation sand is 0.063 to 2 mm. There should be around 3 cm of sand between the insulation and the heating cable. Either an Ulla frost protection mat or a series-resistant Tash cable is used as the heating cable.

A thin layer of sand is spread over the installed cable and manually leveled using a long-handled leveler with an edge that is either rounded or protected with a strip of felt. The cable's outer sheath must not be damaged and the cable must not come loose from its fastenings. A surface layer is laid over the sand, for example tiles, concrete or asphalt.

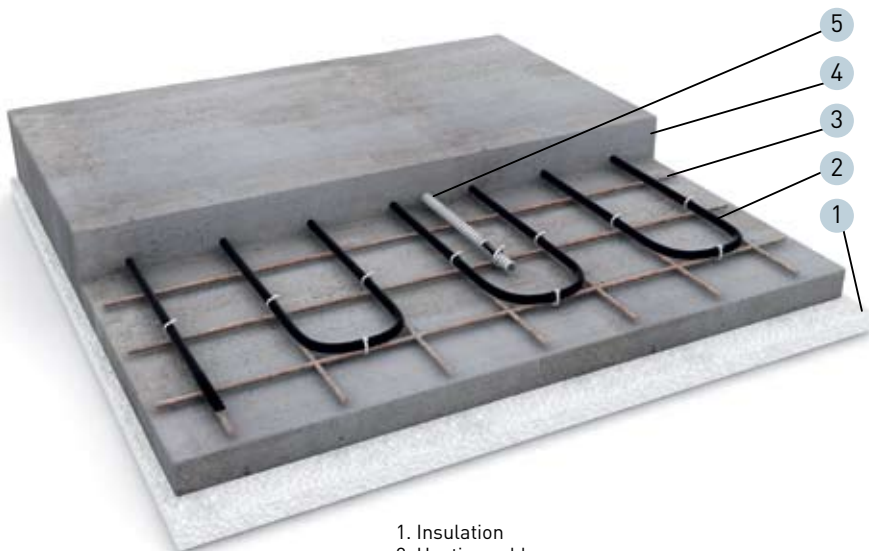
Installation in concrete

The heating cable is loosely attached to the reinforcement mesh (with, for example, a cable tie) without damaging the cable's outer sheath. In order to aid in any later troubleshooting and repairs, the cable is laid on top of the reinforcement mesh.



1. Insulation
2. Sand
3. Ulla frost protection mat
4. Sensor
5. Pavement, asphalt, or concrete

(PICTURE PROVIDED FOR GUIDANCE ONLY)



1. Insulation
2. Heating cable
3. Reinforcement mesh
4. Concrete
5. Sensor

(PICTURE PROVIDED FOR GUIDANCE ONLY)

Cold rooms and refrigerated warehouses where the temperature is continuously below $-20\text{ }^{\circ}\text{C}$ cool the surrounding floor even when there is good floor insulation. Due to this, all structures connected to the ground/soil, such as foundations and floors, conduct heat away from the ground, causing the ground/soil to freeze. Frost in the ground will then cause damage.

An installed power of around $15\text{--}20\text{ W/m}^2$ is sufficient for the floor structure of a cold room, with a maximum installation spacing of 50 cm .

The amount of thermal loss directed downwards is affected by the U-value of the floor structure, desired ground temperature and the temperature of the cold room.

EXAMPLE

Cold room indoor temperature $-25\text{ }^{\circ}\text{C}$
 Ground temperature $+4\text{ }^{\circ}\text{C}$
 Floor structure U value $0.1\text{ W/m}^2\text{ }^{\circ}\text{C}$

Thermal loss of the floor

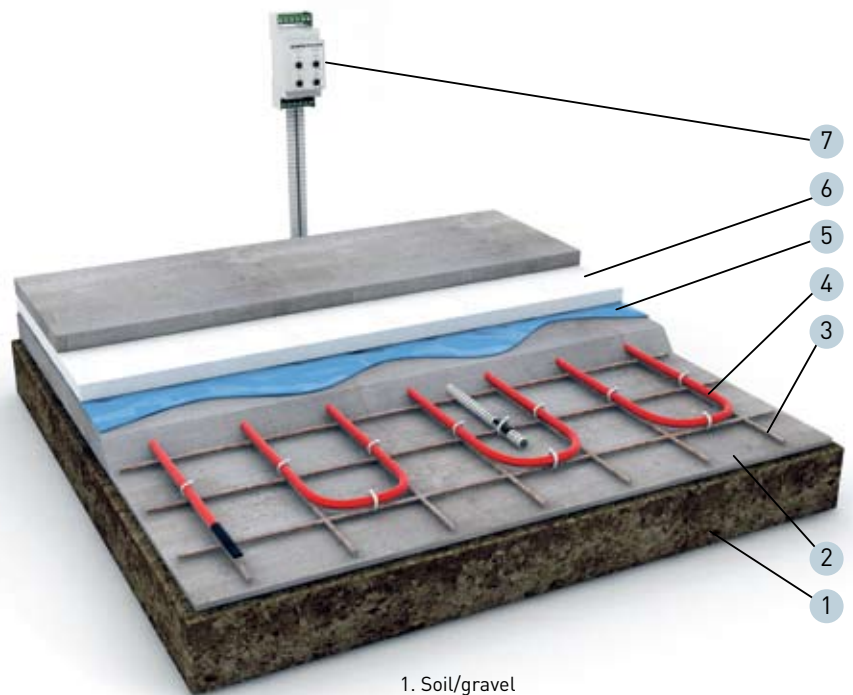
Thermal loss per square meter Φ/A
 $\Phi/A = dt * U$

dT = difference between the temperatures of the cold room and the floor ($^{\circ}\text{C}$)

U = thermal conductance of the floor structure ($\text{W/m}^2\text{ }^{\circ}\text{C}$)

The cables are installed in the floor in the same way as in normal concrete structures. For safety reasons, two parallel loops and two floor thermostats are recommended. The cables are installed underneath minimum of 5 cm of insulation in the area because the aim is to keep the ground under the insulation free of ice. If there are movement joints, the installation areas of the heating cables are distributed into sections in the room, so that only cold cables are installed across the movement joints.

Doors and doorways are also subject to freezing, so their structures must be protected from freezing with heating cables. This prevents structural damage and the doors can be operated flawlessly and will close properly.



- 1. Soil/gravel
- 2. Concrete
- 3. Reinforcement mesh
- 4. Tash or Tassu heating cable
- 5. Moisture barrier
- 6. Insulation
- 7. Thermostat

(PICTURE PROVIDED FOR GUIDANCE ONLY)

Frost protection of parking area by using Tash series-resistant cables

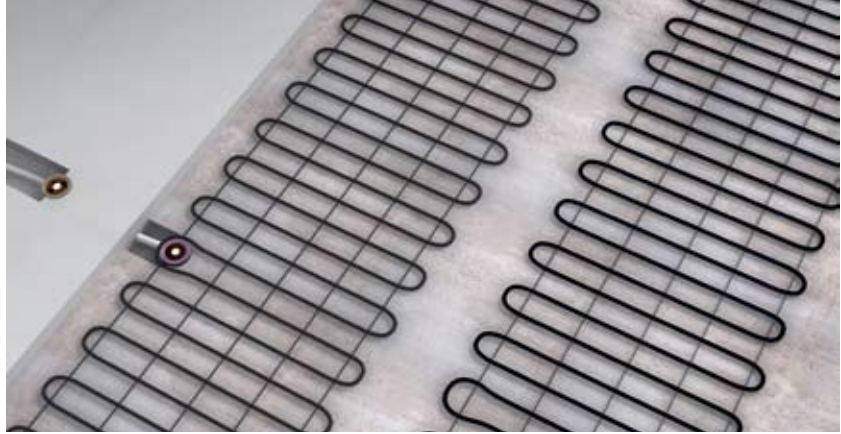
EXAMPLE

Outdoor area 155 m² installation in concrete

Surface area to be heated 155 m², installation output selected: 300 W/m². Design power achieved: 155 m² x 300 W/m² = 46.5 kW.

The highest permitted power per metre output for Tash cable as installed in concrete is 30 W/m. The installation spacing for the cable comes to = (30 W/m)/(300 W/m²), i.e., 0.10 m. The total length of the thermal cable is, at minimum, 155 m²/0.1 m = 1550 m.

When the installation is distributed to three three-phase groups, the output of each group comes to 15.5 kW and the output and length of each individual cable is 5.16 kW and 172 m. The installation area of one



cable is thus $A = 155 \text{ m}^2 / 9$ meaning 17.2 m². After this, the cable can be selected from the Tash cables sizing table. Heating is regulated by the ECO900 control system.

The snow and ice sensor is installed external to the area to be heated, and the temperature and moisture sensor to the area to be heated.

(PICTURE PROVIDED FOR GUIDANCE ONLY)

Frost protection of outdoor steps using Tash cables

EXAMPLE

10 steps, installation width 0.9 metres, step advance 0.5 metres.

Surface area to be heated: 10 x 0.9 m x 0,5 m = 4.5 m².

Installation power output selected: 300 W/m², Design power achieved: 4.5 m² x 300 W/m² = 1 350 W.

The highest permitted power per metre output for Tash cable when installed in concrete is 30 W/m. The installation spacing for the cable comes to = (30 W/m)/(300 W/m²), i.e., 0.10 m.

Five cables are installed to one step. Per step, the amount of cabling required is 5 x 0.9 m, i.e., 4.5 m.

The total length of the heating cable is:

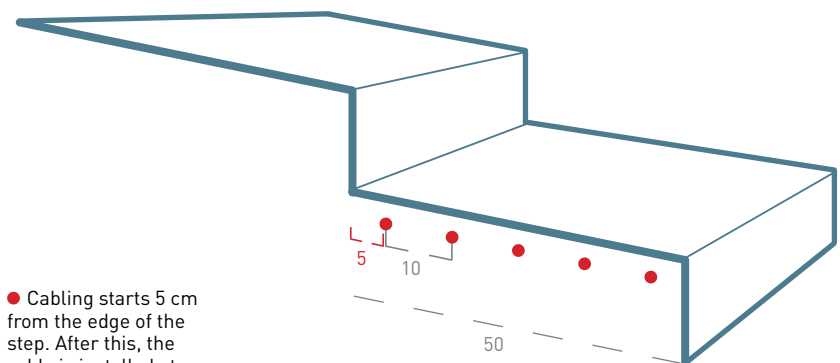
- steps 10 x 4.5 m = 45 m
- step ascent 9 x 0.15 m = 1.35 m
- return to connection point 9 x 0.5 + 9 x 0.15 = 5.8 m total: 52 metres.

The specific resistance of the cable is 0.75 Ω/m, and Tash cable 0.82 Ω/m is selected from the sizing tables. Installation power output is to 1 240 W, heating cable power per metre output is 24 W and installation power per square metres output is 275 W/m². Heating is controlled by installing an ECO910 frost protection control thermostat to the panel board.



Series-resistant Tash cables are always installed as loops, with the cold leads led back to the connection box.

(PICTURE PROVIDED FOR GUIDANCE ONLY)



● Cabling starts 5 cm from the edge of the step. After this, the cable is installed at 10 cm intervals.

Heating cables can be used to maintain the required temperature of various tanks in order to prevent excessive increases in the viscosity of the liquids within. Heating also prevents freezing damage to the structures.

When choosing the heating cable, all possible thermal losses in the tank and its base must be taken into account. These thermal losses are dependent on the tank's shape, size, understructure type (foundation or stand), the insulation thickness used, the required temperature and the surrounding temperature.

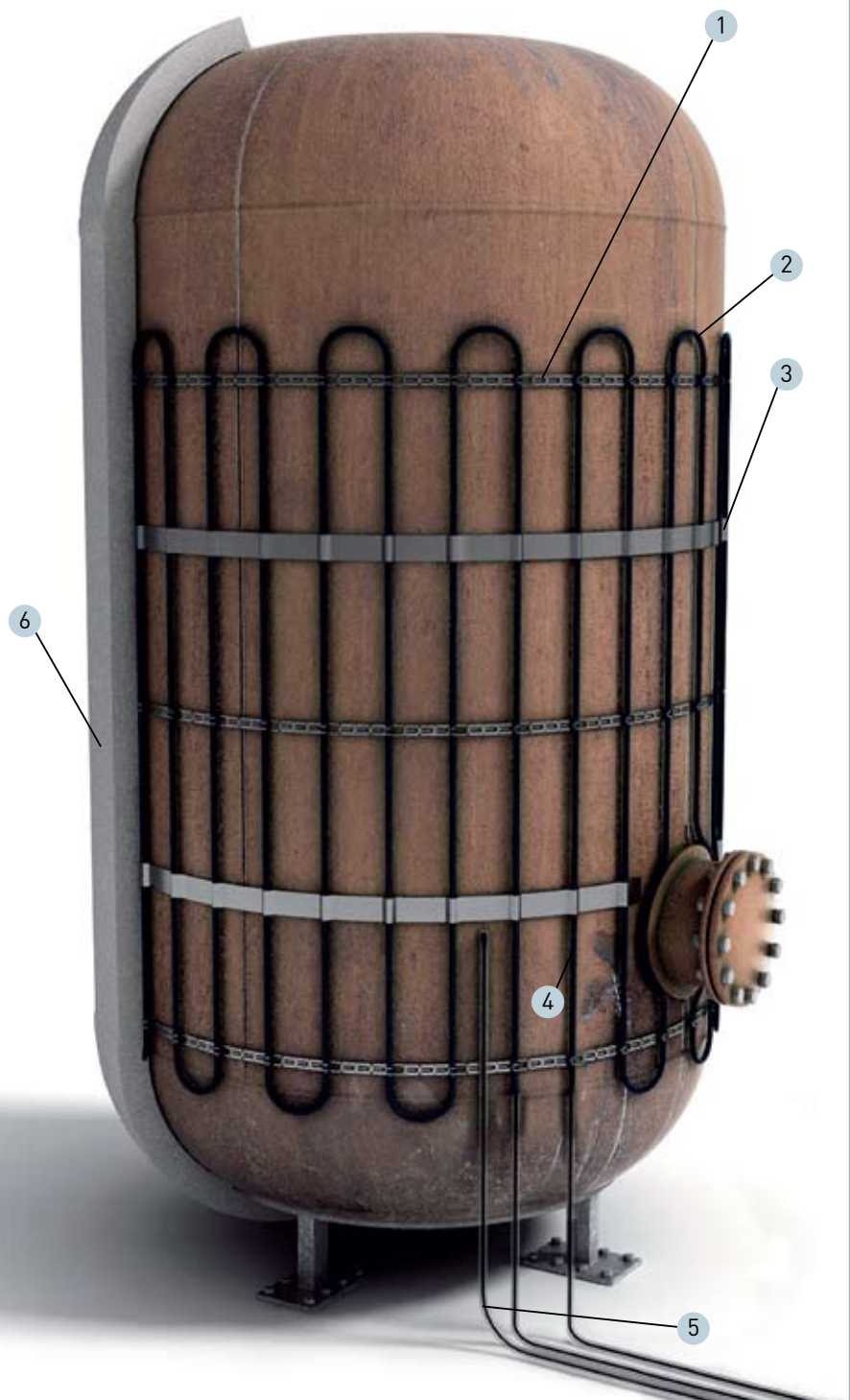
The tank pipes must also be protected from freezing and insulated. Around one third of the tank's top section can be left uncabled, but the entire tank must be carefully insulated.

The appropriate control units are the ECO500 and the ECO910 thermostats.

Stored liquids have a tendency to somehow escape their container. Thus, it is recommended to check whether the liquid in question can cause cable corrosion, and select the correct cable type for the application. Similarly, easily evaporating liquids may result in an environment classification that requires special solutions.

1. Fixing ribbon
2. Tash heating cable
3. Aluminium tape
4. Heating cable / cold lead joint
5. Sensor
6. Insulation

(PICTURE PROVIDED FOR GUIDANCE ONLY)



FROST PROTECTION PRODUCTS

The high quality of our products guarantees reliable performance for years to come.

Ulla300 -cable heating mat	37
Plug'n Heat -heating cable	37
Tash single-conductor heating cables	37
Optiheat 9	37
Optiheat 10 and 25	38
Optiheat 15/30	38
Tash accessories	38
Optiheat accessories	38
Heating cable attachment accessories	38
Frost protection thermostats	39
EC0500 thermostat	39
EC0910 thermostat	39
Appendixes	40

Frost protection systems EFP

Ulla300 -cable heating mat

Factory-made and tested Ulla300-cable heating mats for preventing vehicle access ramps, entrances and pavements from freezing. Can be rapidly and easily laid in concrete, sand and asphalt. A ready-to-connect mat is easy to lay in place, the gaps always being correct. It can be shaped without cutting the installations strips. The output is 300 W/m². Nominal voltage 230 V. Standard width of mats are 0.95 m, and lengths at 1-m intervals from 2 to 12 m. Cold ends MCMK 5 meter and length of mat + 5 m.

TYPE	CODE	DESCRIPTION	PACK.QTY
ULLA300.2	64 100 81 688 020	0.95 x 2 m, 2 m ² , 600 W	1/6
ULLA300.3	64 100 81 688 037	0.95 x 3 m, 3 m ² , 900 W	1/6
ULLA300.4	64 100 81 688 044	0.95 x 4 m, 4 m ² , 1200 W	1/6
ULLA300.5	64 100 81 688 051	0.95 x 5 m, 5 m ² , 1400 W	1/6
ULLA300.6	64 100 81 688 068	0.95 x 6 m, 6 m ² , 1800 W	1/6
ULLA300.7	64 100 81 688 075	0.95 x 7 m, 7 m ² , 1900 W	1/6
ULLA300.8	64 100 81 688 082	0.95 x 8 m, 8 m ² , 2500 W	1/6
ULLA300.9	64 100 81 688 099	0.95 x 9 m, 9 m ² , 2800 W	1/6
ULLA300.10	64 100 81 688 105	0.95 x 10 m, 10 m ² , 3000 W	1/6
ULLA300.11	64 100 81 688 112	0.95 x 11 m, 11 m ² , 3100 W	1/6
ULLA300.12	64 100 81 688 129	0.95 x 2 m, 12 m ² , 3600 W	1/6



Plug'n Heat -heating cable

A cable, fitted with a plug, for keeping piping, water meters and other frost-prone places ice-free. The heating cable is a self-regulating cable, making a thermostat unnecessary. It can also be installed inside drinking water pipes. Length of connection leads 2.5 m. Power rating 9 W/m. Voltage 230 V. IP 68.

TYPE	CODE	DESCRIPTION	PACK.QTY
EFPPH2	64 100 81 684 220	2 m, 18 W	1/24
EFPPH4	64 100 81 684 244	4 m, 36 W	1/24
EFPPH6	64 100 81 684 268	6 m, 54 W	1/24
EFPPH10	64 100 81 684 305	10 m, 90 W	1/24
EFPPH15	64 100 81 684 350	15 m, 135 W	1/24
EFPPH20	64 100 81 684 404	20 m, 180 W	1/24



Tash single-conductor heating cables

The TASH single-conductor series resistant cables are designed for keeping outdoor areas, pipes and containers icefree. Outer sheath of synthetic rubber resistant to chemicals. Max loading 30 W/m (concrete), 25 W/m (sand), 20 W/m (pipe surface). Operating temperature under current 80 °C, momentarily 160 °C. Max voltage 500 V. Min. bending radius 5x outside diameter of cable.

TYPE	CODE	DESCRIPTION	PACK.QTY
TASH0.1	64 100 04 301 500	Tash-series resistant cable, 0.1 ohm/m	1/2000
TASH0.17	64 100 04 301 562	Tash-series resistant cable, 0.17 ohm/m	1/2000
TASH0.21	64 100 04 301 517	Tash-series resistant cable, 0.21 ohm/m	1/2000
TASH0.32	64 100 04 301 326	Tash-series resistant cable, 0.32 ohm/m	1/2000
TASH0.45	64 100 04 301 579	Tash-series resistant cable, 0.45 ohm/m	1/2000
TASH0.65	64 100 04 301 593	Tash-series resistant cable, 0.65 ohm/m	1/2000
TASH0.82	64 100 04 301 586	Tash-series resistant cable, 0.82 ohm/m	1/2000
TASH1	64 100 04 301 661	Tash-series resistant cable, 1.0 ohm/m	1/2000
TASH1.5	64 100 04 301 609	Tash-series resistant cable, 1.5 ohm/m	1/2000
TASH3	64 100 04 301 616	Tash-series resistant cable, 3 ohm/m	1/2000
TASH10	64 100 04 301 647	Tash-series resistant cable, 10 ohm/m	1/2000



Optiheat 9

For keeping drinking water pipes from freezing indoors and outdoors. Fluoropolymer sheath. Cable dimensions 7.3 x 5.3 mm. Min. bending radius 35 mm.

TYPE	CODE	DESCRIPTION	PACK.QTY
EFPO9	64 100 04 313 091	Optiheat 9, output 9 W/m, green, 1000 m/drum	1/1000



Frost protection systems EFP

Optiheat 10 and 25

For preventing water pipes and drainpipes from freezing. Optiheat 10 is intended for plastic piping, whereas Optiheat 25 is intended for metal piping. Polyolefin sheath. Cables have a bonded jacket to ensure watertightness and mechanical durability. Cable dimensions 11.5 x 5.5 mm. Min. bending radius 25 mm.

TYPE	CODE	DESCRIPTION	PACK.QTY
EFPO10	64 100 04 313 107	Optiheat 10, output 10 W/m, blue	1/1000
EFPO25	64 100 04 313 251	Optiheat 25, output 15 W/m, red	1/1000



Optiheat 15/30

For keeping rainwater drainage systems, roofs and stairways from freezing. Can also be used for underfloor heating of small areas. Outer sheath of polyolefin, which is extremely resistant to UV radiation. Cables have a bonded jacket to ensure watertightness and mechanical durability. Cable dimensions 10.5 x 6.0 mm. Min. bending radius 25 mm.

TYPE	CODE	DESCRIPTION	PACK.QTY
EFPO15	64 100 04 313 305	Optiheat 15, output 15 W/m, black	1/1000



Tash accessories

By using EFPLP4 connection kit a twin-conductor heating cable can be connected to a cold cable or another heating cable. The kit can also be used for connecting cold cables to both ends of a single conductor cable.

TYPE	CODE	DESCRIPTION	PACK.QTY
EFPLP4	64 186 77 630 767	Joining kit for single conductor Tash- and Lask heating cables	1/50



Optiheat accessories

EFPLP1 joining kit containing joint and shrink accessories for the watertight extension of a cable by means of a connector cable (MMJ or MMCK) and a termination accessory. EFPLP2 joining kit for connecting a heating cable to a junction box or a termination accessory. The cable is laid from the point of installation to the box either as it is or in a protective tube. The kit includes a cable-shaped rubber seal. EFPLV1 pressure resistant lead-through for laying Optiheat 9 and Plug'n Heat cables inside a water pipe.

TYPE	CODE	DESCRIPTION	PACK.QTY
EFPLP1	64 186 77 630 002	Extension sleeve + termination accessory	1/20
EFPLP2	64 186 77 630 019	Junction box + termination accessory	1/20
EFPLP3	64 186 77 630 026	Optiheat – Optiheat extension	1/20
EFPLV1	64 186 77 630 033	Lead-in for Optiheat 9-cable for water pipes	1/12



Heating cable attachment accessories

LT20 heat resistant tape for attaching a heating cable for piping. ALU50 aluminium tape, which is attached to the surface of the pipe in the same direction as the cable. SV10 is used for improving heat exchange to the pipe surface or valve. XBC1230 fixing strip, to which the heating cable is attached to ensure the correct gaps. PPN6 plastic mounting strip for attachment of Tash heating cable and assurance of correct gaps. PPN8 plastic mounting cable fixing strip for 2-conductor Tash heating cable attachment and to ensure correct gap. VP300 cable strain reliever for use when laying a heating cable in a drainpipe.

TYPE	CODE	DESCRIPTION	PACK.QTY
LT20	64 186 77 631 764	Heat resistant tape, 12 mm x 20 m	1/16
ALU50	64 186 77 631 702	Aluminium tape, 50 mm x 50 m	1/10
SV10	64 186 77 631 795	Galvanized mesh, 50 mm x 10 m	1/10
XBC1230	64 100 13 290 024	Galvanised attachment ribbon 20 m, installation gap 30 mm	1/10
PPN6	64 186 77 631 771	Plastic mounting, 6 mm	100/400
PPN8	64 100 13 290 611	Plastic mounting, 8 mm	100/400
VP300	64 186 77 632 082	Strain relief	1/20



Frost protection systems EFP

Frost protection thermostats

Fully automatic snow- and ice melting control unit. Heat- and humidity informations. LCD-display with continuous information of temperature and humidity. Available versions in Finnish, Swedish, German, English, Czech and French. Diagnosis of faults and potential-free information in case of fault situation. Possibility of manual steering. DIN-rail mounting. 230 V.

TYPE	CODE	DESCRIPTION	PACK.QTY
ECO900	64 186 77 630 866	Control device of frost protection in outdoor areas, ramps and roofs	1/180
ECOA901	64 186 77 630 873	Heated snow and ice sensor for ground installation	1/128
ECOA902	64 186 77 630 880	Humidity and temperature sensor for ground installation	1/128
ECOA903	64 186 77 630 897	Heated snow and ice sensor for rainwater guttering, Length 4 m, extend. to 50 m, 2 x 1.5 mm ²	1/180
ECOA904	64 186 77 630 903	Sensor for temperature measurement in gutters. Length 4 m, extend. to 50 m, 2 x 1.5 mm ²	1/180



EC0500 thermostat

For frost protection control of pipes. Nominal voltage 230V. Nominal current 16 A res. Max load 3600 W. Adjustment range +2 ... +35 °C. Sensor 4 m, extendable up to 25 m with 2 x 1.5 mm². Sensor 47 kohm / 25 °C. Box AP9. IP55. The sensor is installed to the top surface of the pipe when the cable is used inside the pipe. When using the cable outside the pipe, the sensor must be installed opposite of the heating cable, to the presumably coldest spot.

TYPE	CODE	DESCRIPTION	PACK.QTY
EC0500	64 186 77 635 830	Electronic thermostat, 3600 W, for frost protection of drain pipes	1/1



EC0910 thermostat

DIN rail mounted frost protection thermostat with two sensors. Frost protection thermostat suits for the control of frost protection in outdoor areas, ramps, roofs and rainwater systems. Both two sensors are used for frost protection in outdoor areas and one sensor for frost protection in rainwater systems. Adjustment range of thermostat is -30 ... +15 °C, IP20. Operating voltage 230 V. Maximum load 16 A. Sensor 47 kohm / 25°C. Length of sensor cable 4 m (extendable up to 25 m).

TYPE	CODE	DESCRIPTION	PACK.QTY
EC0910	64 186 77 636 141	Frost protection thermostat, DIN-rail mounted	1/540



Index of product types

TYPE	PAGE NR	TYPE	PAGE NR	TYPE	PAGE NR
ALU50	37	EFPPH15	36	TASH10	36
ECO500	38	EFPPH2	36	TASH3	36
ECO900	38	EFPPH20	36	ULLA300.10	36
ECO910	38	EFPPH4	36	ULLA300.11	36
ECOA901	38	EFPPH6	36	ULLA300.12	36
ECOA902	38	LT20	37	ULLA300.2	36
ECOA903	38	PPN6	37	ULLA300.3	36
ECOA904	38	PPN8	37	ULLA300.4	36
EFPLP1	37	SV10	37	ULLA300.5	36
EFPLP2	37	TASH0.1	36	ULLA300.6	36
EFPLP3	37	TASH0.17	36	ULLA300.7	36
EFPLP4	37	TASH0.21	36	ULLA300.8	36
EFPLV1	37	TASH0.32	36	ULLA300.9	36
EFPO10	37	TASH0.45	36	VP300	37
EFPO15	37	TASH0.65	36	XBC1230	37
EFPO25	37	TASH0.82	36		
EFPO9	36	TASH1	36		
EFPPH10	36	TASH1.5	36		

Index of EAN-codes

EAN-CODE	PAGE NR	EAN-CODE	PAGE NR	EAN-CODE	PAGE NR
64 100 04 301 326	36	64 100 81 684 244	36	64 186 77 630 026	37
64 100 04 301 500	36	64 100 81 684 268	36	64 186 77 630 033	37
64 100 04 301 517	36	64 100 81 684 305	36	64 186 77 630 767	37
64 100 04 301 562	36	64 100 81 684 350	36	64 186 77 630 866	38
64 100 04 301 579	36	64 100 81 684 404	36	64 186 77 630 873	38
64 100 04 301 586	36	64 100 81 688 020	36	64 186 77 630 880	38
64 100 04 301 593	36	64 100 81 688 036	36	64 186 77 630 897	38
64 100 04 301 609	36	64 100 81 688 044	36	64 186 77 630 903	38
64 100 04 301 616	36	64 100 81 688 051	36	64 186 77 631 702	37
64 100 04 301 647	36	64 100 81 688 068	36	64 186 77 631 764	37
64 100 04 301 661	36	64 100 81 688 075	36	64 186 77 631 771	37
64 100 04 313 091	36	64 100 81 688 082	36	64 186 77 631 795	37
64 100 04 313 107	37	64 100 81 688 099	36	64 186 77 632 082	37
64 100 04 313 251	37	64 100 81 688 105	36	64 186 77 635 830	38
64 100 04 313 305	37	64 100 81 688 112	36	64 186 77 636 141	38
64 100 13 290 024	37	64 100 81 688 129	36		
64 100 13 290 611	37	64 186 77 630 002	37		
64 100 81 684 220	36	64 186 77 630 019	37		



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