

www.flexelec.com



FLEXIBLE HEATING CABLES AND ELEMENTS
TEMPERATURE MAINTENANCE SYSTEMS



Headquarters and main factory

FLEXELEC S.A.S.

10, rue des frères Lumière - Z.A. du Bois Rond
69720 ST BONNET DE MURE - FRANCE
Tel: + 33 (0)4.72.48.30.90 - Fax: + 33 (0)4.78.40.82.81
E-mail: flexelec@omerin.com
www.flexelec.com

FLEXELEC Dept

OMERIN ASIA Pte Ltd
51 Goldhill Plaza #08-12/01
SINGAPORE 308900
Tel: + 65.6255.4778
Fax: + 65.6255.4779
E-mail: sales@omerin.com.sg

FLEXELEC (UK) Ltd

Unit 11 Kings Park Industrial Estate
Primrose Hill - KINGS LANGLEY
Hertfordshire - WD4 8ST - UK
Tel: + 44 (0) 1923.274477
Fax: + 44 (0) 1923.270264
E-mail: sales@omerin.co.uk

FLEXELEC Dept

OMERIN GmbH
Buchwiese 16
D-65510 IDSTEIN - GERMANY
Tel: + 49 (0) 6126.94.31-0
Fax: + 49 (0) 6126.83.99
E-mail: omeringmbh@omerin.com

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TEMPERATURE MAINTENANCE SYSTEMS

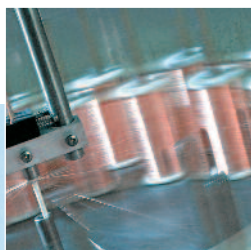
FLEXIBLE HEATING CABLES AND ELEMENTS

FLEXELEC



flexelec
GROUPE omerin

FLEXIBLE HEATING CABLES AND ELEMENTS
TEMPERATURE MAINTENANCE SYSTEMS



For more than 30 years, FLEXELEC has specialised in the design and production of flexible heating elements for all kinds of temperature maintenance.

The flexible heating elements designed by Flexelec owe their efficiency to three main characteristics:

- They can physically adapt to the most complex shapes for optimal energy and heat efficiency.
- They are easy to fit, which means that they can be used quickly to equip installations in which space is at a premium.
- In most situations their operating costs, in relation to the investment involved, make them the most economical option. This is due to the fact that they are made to measure.

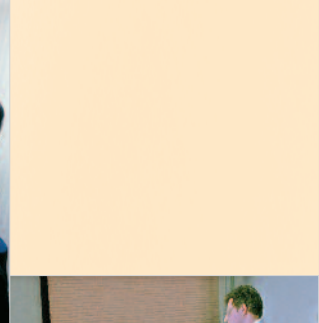
As a back-up to its production facility, Flexelec provides you with attentive and reactive staff who will assist you in your projects from start to finish. From design stage to the production of prototypes, we help you find the best solutions from both the technical and economic standpoints.

Our skills have been built up through constant product development. This means that today we can provide our customers with innovative solutions for a wide range of applications.

The refrigeration, building, transport, petrochemical and aeronautical industries are just some of the sectors to benefit from our know-how.

Choose Flexelec, and you'll soon see that you are at the focus of our attention.





■ AT YOUR SERVICE

Every day our engineering and technical staff work on developing new versions of our products to meet with the most demanding needs. Our ability to understand and adapt to the problems you are confronted with means that our product ranges are constantly being renewed and enriched in the quest for relevant and long-lasting solutions.

■ COMMITTED to INNOVATION and QUALITY

Flexelec's range of flexible heating elements is manufactured in accordance with quality requirements, not only from the technical standpoint, but also in the way in which our different departments work closely with each other and with our clients.

Flexelec has held ISO 9001 certification since 1994 and is proud to add every year to the list of countries in which its products are certified. This is just reward for our active policy and everyone's involvement.

The thermal, electrical, chemical and mechanical characteristics of our products are designed, validated and checked in our laboratory throughout the manufacturing process and then monitored during the years they are in production for optimum safety and traceability.

• teamwork



• customer service



• innovation

• quality





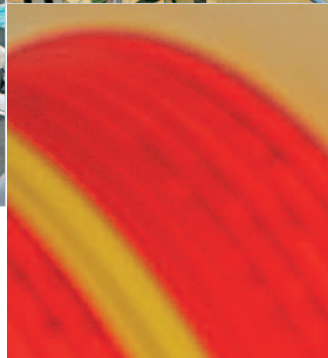
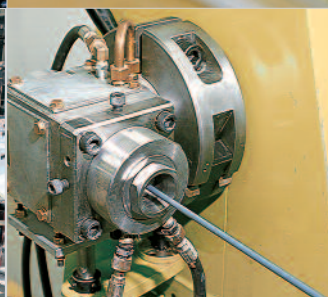
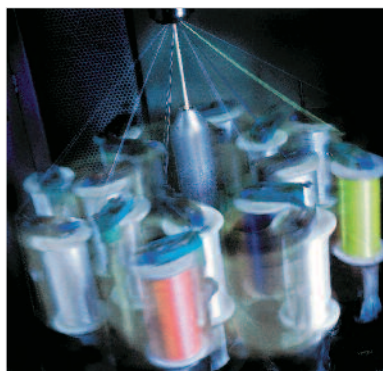
■ KNOW-HOW

Our production facilities, our expertise at all manufacturing stages and our in-depth market knowledge mean that we can offer a full range to meet our customers' specific requirements.

Via our website you can learn more about what we have to offer, download document updates in real time or contact us for more information.

www.flexelec.com

Choose FLEXELEC, and you'll soon see that you are the focus of our attention.





FSH/TP
Self-regulating cable

Characteristics

- Withstands continuous hot w
- Can be cut to length on site
- Will not self-destruct by ov
- Available as 15 and 30 W
- Power supply: 230 V
- Self-regulating

A REFERENCE GUIDE

Our catalogue is available on request in several languages and is updated on our website. It is intended to provide help with solving your technical issues.

You'll find our complete range of cables and flexible heating elements for temperature maintenance systems.

After the contents page, a guide organised by type of application will help you find your way around the catalogue and identify the products you're interested in.

The body of the catalogue presents the technical specifications for each product, including the following essential aspects:

- the main application
- an illustration of the product and the way it is built
- the characteristics and options available as standard
- the main ways in which the product can be used
- highlights of relevant certifications or standards
- any accessories or related technical advice

In the final part of the catalogue, glossaries and segmented questionnaires will help you take the first steps towards choosing the product which corresponds to your needs, and to find the answers to a number of technical questions for yourselves.



FLEXTRACE®

flexelec

www.flexelec.com

FSQ - FSD/T - FSG/TP - FSG/TF

Self-regulating cables for refrigeration

CE

The FSD range of flexible cables is a revolutionary product for temperature maintenance systems. It is a self-regulating cable that can be cut to length on site. It is available in 15 and 30 W/m versions. It is suitable for use in refrigeration systems. It is a self-regulating cable that can be cut to length on site. It is available in 15 and 30 W/m versions. It is suitable for use in refrigeration systems.

Technical specifications

Parameter	Value
Power (W/m)	15, 30
Operating temperature (°C)	-40 to +125
Storage temperature (°C)	-40 to +125
Max. length (m)	100
Max. diameter (mm)	10

FLEXMAT®

flexelec

www.flexelec.com

T - TA - TV

Silicon elastomer heater mats

UL CE

The T - TA - TV range of silicon elastomer heater mats is a revolutionary product for temperature maintenance systems. It is a self-regulating heater mat that can be cut to length on site. It is available in 15 and 30 W/m versions. It is suitable for use in refrigeration systems.

Technical specifications

Parameter	Value
Power (W/m)	15, 30
Operating temperature (°C)	-40 to +125
Storage temperature (°C)	-40 to +125
Max. length (m)	100
Max. diameter (mm)	10

WINDOW
WINE ST

Prevent mist or
fitting a heating
FLEXelec pro

Icons used

REFRIGERATION



Windows, cabinets and wine storage units



Refrigerating compressors



Cold room doors



Refrigerating units and air conditioning



Evaporators



Heat pumps



Cold room floors

BUILDING INDUSTRY



Cold water supply



Gutters and roofing



Hot water supply



Inside / outside flooring



Tunnels and pits



Access ramps



Fire networks and safety showers



Stadiums



Roads and circuits



Skating rinks



Heliports

INDUSTRY



Petrochemical



Plastics and composite materials



Chemical



Adhesives



Agro-food



Electric motors



Military



Household electrical



Aeronautics



Medical, pharmaceutical and cosmetics

TRANSPORT



Railway switches



Metros



Trains

MISCELLANEOUS APPLICATIONS



Aquariums and terrariums



Aerials



Special machines and instrumentation



Cash dispensers



Laboratories



Wind generators



Drinking troughs



Vacuum pumps



Printing industry



Batteries



Weather forecasting



Billiard tables



Sports equipment



Horticulture

BRAND NAMES USED

All the brand names given below are registered trademarks of FLEXELEC, omerin group:

FLEXELEC® : COMPANY NAME AND GENERAL TRADEMARK OF ALL PRODUCTS MADE BY FLEXELEC SAS

FLEXCORD® : HEATING CORDS

FLEXUNIT® : HEATING CABLES

FLEXDRAIN® : DRAIN-LINE CABLES

FLEXTAPE® : HEATING TAPES

STOPGEL® : READY-TO-USE CABLES

ANTIFREEZE® : READY-TO-USE CABLES

FLEXTRACE® : ELECTRIC HEAT TRACING CABLES

FLEXFLOOR® : UNDERFLOOR HEATING

FLEXBELT® : HEATING BELTS

FLEXMAT® : HEATING MATS

FLEXPLATE® : HEATING PLATES

FLEXDRUM® : DRUM HEATERS

FLEXKIT® : ACCESSORIES



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WORLDWIDE



FLEXELEC operates on an international scale, via a huge network of agents, distributors and fitters. Its know-how is recognised in over 80 countries.

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E-mail : omeringmbh@omerin.com

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REFRIGERATION



WINDOWS, DISPLAY CABINETS and WINE STORAGE

- Prevent mist or frost forming when opening glass doors by fitting a heating flex in the frames.

FLEXELEC products:

FLEXUNIT	CP - CP/T - CP/TW - CP/I - CP/IW	p 26
	CS - CS/T - CS/TW - CS/I - CS/IW	p 27
	CP1	p 28
	CS1	p 29
	CS2 - CS2/T - CS2/TW	p 30

- Prevent seals from sticking due to freezing in equipment running at below-zero temperatures and enable doors to open and close by fitting a heating element in the frames.

FLEXELEC products:

FLEXUNIT	CP - CP/T - CP/TW - CP/I - CP/IW	p 26
	CS - CS/T - CS/TW - CS/I - CS/IW	p 27
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	CS2 - CS2/T - CS2/TW	p 30

FLEXTRACE	FTS0 - FTS0/T	p 55
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- Allow water from defrost cycles to flow freely or help it to evaporate by internal or external tracing of piping, collector spouts or trays.

FLEXELEC products:

FLEXDRAIN	CSC - CSC/T - CSC/I	p 34
	CSC2	p 35



COLD ROOM DOORS

- Heat seals to allow doors to open and close by including a heating flex in a groove made in the frame opposite the seal. This stops the door from sticking due to freezing.

FLEXELEC products:

FLEXUNIT	CP - CP/T - CP/TW - CP/I - CP/IW	p 26
	CS - CS/T - CS/TW - CS/I - CS/IW	p 27
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	CS1	p 29
	CS2 - CS2/T - CS2/TW	p 30

FLEXTRACE	FSG - FSG/T - FSG/TP - FSG/TF	p 46
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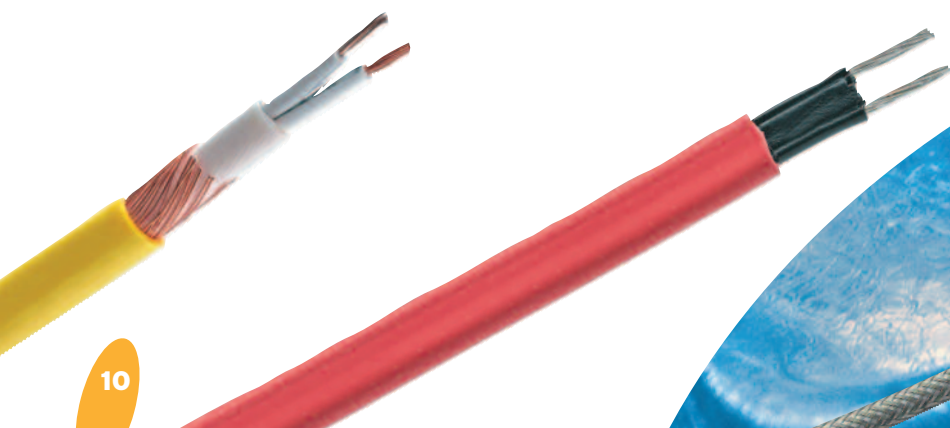
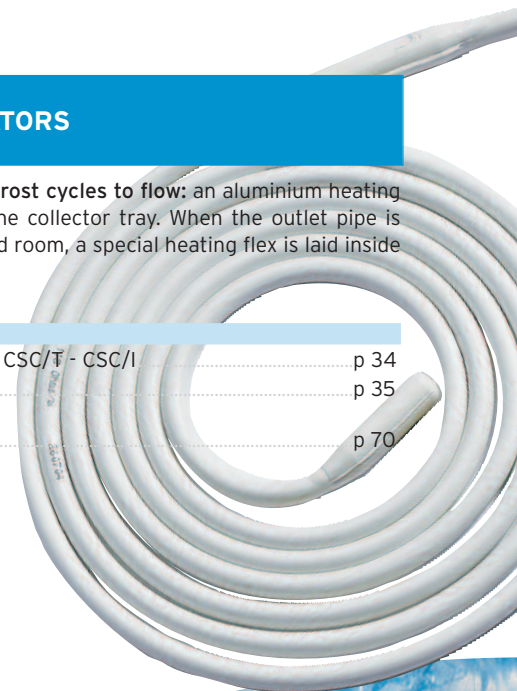
EVAPORATORS

- Allow water from defrost cycles to flow: an aluminium heating fabric is laid inside the collector tray. When the outlet pipe is located inside the cold room, a special heating flex is laid inside it.

FLEXELEC products:

FLEXDRAIN	CSC - CSC/T - CSC/I	p 34
	CSC2	p 35

FLEXMAT	A	p 70
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Flexible heating elements are used for many applications in the refrigeration industry, which is a major area of innovation and development for FLEXELEC products. These heating elements are always essential for the equipment to function properly, whether they are fitted in cold rooms, refrigerated vehicles or in supermarkets.



COLD ROOM FLOORS

- **Maintain the temperature of concrete sub-bases** by making a thermal barrier under the insulation. This prevents condensation which, as it expands due to freezing, could damage the floor of the building.
- **Prevent ice from forming on the surface of the floor** by laying the heating cable in the top concrete slab above the insulation, at the entrances and exits of freezing tunnels, unloading docks, etc.

FLEXELEC products:

FLEXFLOOR	KYCY	p 62
	KYCYR	p 63



REFRIGERATING COMPRESSOR

- **Separate the coolant from the lubricating oil** by fitting a heating collar around the compressor: this will protect against the absorption phenomenon caused by the low temperatures.

FLEXELEC products:

FLEXBELT	FCH	p 66
FLEXMAT	A	p 70



REFRIGERATING UNITS and AIR CONDITIONING

- **Protect fluids circulating in exchangers, pumps, collectors, tanks and piping from freezing**, to guard against malfunctioning and flow interference.

FLEXELEC products:

FLEXDRAIN	CSC2	p 35
	CSC2K	p 36
FLEXTRACE	FSG - FSG/T - FSG/TP - FSG/TF	p 46
	FTPO - FTPO/T	p 53
	FTSO - FTSO/T	p 55
FLEXBELT	FCH	p 66
FLEXMAT	A	p 70



HEAT PUMPS

- **Prevent ice from forming and assist evaporation** by including a heating cable in the bottom of the tank or along drain pipes.

FLEXELEC products:

FLEXDRAIN	CSC2	p 35
	CSC2K	p 36
FLEXTRACE	FSG - FSG/T - FSG/TP - FSG/TF	p 46
	FTPO - FTPO/T	p 53
	FTSO - FTSO/T	p 55
FLEXMAT	A	p 70

BUILDING INDUSTRY



COLD WATER SUPPLY

- **Protect the water supply** in housing, garages, car parks, gardens or on the roofs of buildings whose pipes need to be protected against freezing in winter. As heat insulation has made great progress, piping now runs through colder and colder areas. Not only do they need to be lagged, but also heat losses must be offset to prevent freezing..

FLEXELEC products:

FLEXTAPE	RP - RP/T - RP/I	p 38
STOPGEL - ANTIFREEZE	p 44
FLEXTRACE	FST - FST/T - FST/I - FST/TP - FST/TF	p 48
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HOT WATER SUPPLY

- **Reduce water consumption** when the tap-off point is distant from the boiler. In hotels, schools, leisure centres, offices and shopping centres, major savings can be made by not having to waste water while waiting until it runs hot. To achieve this, a heating cable is simply run along the piping under the lagging. This system can also be used in certain cases for periodic destruction of legionnaires' disease bacteria .

FLEXELEC products:

FLEXTRACE	FSH/TP	p 47
	FTP - FTP/T - FTP/I - FTP/TP	p 52
	FTSH - FTSH/T - FTSH/I - FTSH/TS - FTSH/TF	p 54



TUNNELS AND PITS

- As in the **Channel Tunnel**, flexible heating elements are used to keep fire mains and water mains up to temperature over very large distances.

FLEXELEC products:

FLEXTRACE	C1FS/I - C2FS/I - R3FS/I	p 59
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FIRE NETWORKS and SAFETY SHOWERS

- **Make sure that water is supplied** to fire hydrants and safety showers. Whatever the climate, it is vital that emergency services have operational equipment available, or automatic systems come into action as quickly and as efficiently as possible.

FLEXELEC products:

FLEXTAPE	RP - RP/T - RP/I	p 38
FLEXTRACE	FST - FST/T - FST/I - FST/TP - FST/TF	p 48
	FTP - FTP/T - FTP/I - FTP/TP	p 52
	FTSH - FTSH/T - FTSH/I - FTSH/TS - FTSH/TF	p 54



ROADS and CIRCUITS

- **Prevent accidents** on steep gradients of urban road networks, or enable vehicle testing circuits to be used for longer in the year by removing snow and stopping black ice from forming. Specially developed heating cables can be incorporated directly into the road surface while it is being laid.

FLEXELEC products:

FLEXFLOOR	KYX	p 64
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- **Fluidify bitumen and binder materials** during road works by high temperature heat-tracing of piping, pumps and underpasses.

FLEXELEC products:

FLEXTRACE	FTTH - FTTH/T - FTTH/I - FTTH/TF	p 57
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HELISTATIONS

- **Make helicopter landing safer** and make it easier for emergency medical teams to arrive on the scene by fitting heating cables that activate in the event of harsh weather conditions. Helistations or walkways are generally made of concrete or metal.

FLEXELEC products:

FLEXFLOOR	KYCY	p 62
	KYCYR	p 63

People working in the building and public works sectors have to handle a great many situations in which it is essential to maintain constant temperatures. Flexible heating elements are needed for this, either during building work or afterwards when the buildings are being used.



GUTTERS and ROOFING

- Stop snow and ice from building up in gutters, roof valleys, drainpipes or roofs. If these drainage systems are out of action, water could overflow and damage facades. Similarly, icicles that have formed along roof edges can be dangerous for passers-by, and snow building up on roofs with a small gradient can weaken the structure of the building.

FLEXELEC products:

FLEXTRACE	FTC	p 51
	FST/TP/30	p 48
FLEXFLOOR	KYCY	p 62
	KYCYR	p 63



INSIDE / OUTSIDE FLOORING

- Make use of the accumulating capacity of concrete slabs to heat rooms or patios by means of heating cables set into the slab. Underfloor heating is very comfortable as the temperature is the same throughout the room with fewer fluctuations. The system also takes up less space than conventional heating systems.

FLEXELEC products:

FLEXFLOOR	KYCY	p 62
	KYCYR	p 63



ACCESS RAMPS

- Keep accesses to shopping centres, hospitals, car park ramps, pedestrian crossings, walkways, bridges or loading dock platforms free from snow and black ice by using heating cables set into the concrete slab or asphalt.

FLEXELEC products:

FLEXFLOOR	KYCY	p 62
	KYCYR	p 63
	KYX	p 64



STADIUMS

- Make sure that sports events or training sessions take place in the best possible conditions. By laying the heating cable under the playing field they can be used whatever the weather conditions. By keeping the grass free of snow as it falls and preventing it from freezing it will last significantly longer.

FLEXELEC products:

FLEXFLOOR	KYCY	p 62
	KYCYR	p 63



SKATING RINKS

- Keep floor slabs at constant temperature by forming a thermal barrier under the insulation to prevent condensation from forming which, as it expands when freezing, could damage the floor of the building.

FLEXELEC products:

FLEXFLOOR	KYCY	p 62
	KYCYR	p 63

- Prevent ice removed during defrost cycles from building up and help it to run away by including a heating cable in the bottom of tanks, along gutters and drainpipes, etc.

FLEXELEC products:

FLEXTRACE	FTC	p 51
	FST/TP/30	p 48

INDUSTRY



PETROCHEMICAL

- **Keep process temperatures constant**, often in extreme conditions on account of the hydrocarbons being transported, or if the environment has been classified as a dangerous zone. The electrical heat tracing has in this case to be ATEX-qualified as explosion-proof, both for the cable and the junction boxes. The equipment traced can be gas or oil pipelines, conduits, tanks, pumps, etc.

FLEXELEC products:

FLEXTRACE	FST - FST/T - FST/I - FST/TP - FST/TF	p 48
	FSV - FSV/T - FSV/I - FSV/TF	p 49
	FSX - FSX/T - FSX/I - FSX/TF	p 50
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	FTTH - FTTH/T - FTTH/I - FTTH/TF	p 57
	CIFS/I - C2FS/I - R3FS/I	p 59
	ZFE/CGE/ATEX - ZFA/CGA/ATEX	p 60



CHEMICAL

- **Heat or temper vessels and tanks** containing corrosive substances by means of electrical heat tracing using heating cables or tapes that are highly resistant to different types of corrosion

FLEXELEC products:

FLEXTRACE	FST - FST/T - FST/I - FST/TP - FST/TF	p 48
	FSV - FSV/T - FSV/I - FSV/TF	p 49
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	FTSH - FTSH/T - FTSH/I - FTSH/TS - FTSH/TF	p 54
	FTTH - FTTH/T - FTTH/I - FTTH/TF	p 57
	CIFS/I - C2FS/I - R3FS/I	p 59
	ZFE/CGE/ATEX - ZFA/CGA/ATEX	p 60
FLEXDRUM	TCF - TCF/TV	p 72
	CF/B - CF/BP - CF/BC - CF/BCH	p 73
	CF/JL	p 74



AGRO-FOOD

- **Provide professionals, craftsmen or industrialists with perfectly tempered tools** so that they can work with delicate ingredients in ideal conditions. Temperature control is also very important, especially for chocolate, glucose and certain oils which could be damaged by overheating.

FLEXELEC products:

FLEXUNIT	TUY	p 32
FLEXTRACE	FST - FST/T - FST/I - FST/TP - FST/TF	p 48
	FSV - FSV/T - FSV/I - FSV/TF	p 49
	FSX - FSX/T - FSX/I - FSX/TF	p 50
	FTSH - FTSH/T - FTSH/I - FTSH/TS - FTSH/TF	p 54
	FTTH - FTTH/T - FTTH/I - FTTH/TF	p 57
FLEXDRUM	TCF - TCF/TV	p 74
	CF/B - CF/BP - CF/BC - CF/BCH	p 75
	CF/JL	p 76



MILITARY

- **Protect on-board electronics** in ships or planes, **simulate heat sources** for fine-tuning thermo-guided missiles: for such sensitive applications, customised flexible heating elements are used to attain extreme levels of performance and reliability.

FLEXELEC products:

FLEXMAT	T - TA - TV	p 68-69
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AERONAUTICAL

- **Control the manufacturing process** for helicopter blades to check material uniformity by placing silicon heating mats provided with temperature probes during in situ repair or maintenance operations.

FLEXELEC products:

FLEXMAT	T - TA - TV	p 68-69
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In an industrial environment, temperature control systems are essential for a number of manufacturing processes. FLEXELEC product ranges meet with the most demanding quality, precision and durability criteria.



PLASTICS and COMPOSITE MATERIALS

- Improve casting and drying during operations involving plastic moulding or resin impregnation of composite materials. Heating by means of flexible elements optimizes output rates and also quality by moulding to the complex shapes of the supports used.

FLEXELEC products:

FLEXCORD	C1S - C1S/T - C1S/I	p 23
	C1F - C1F/T - C1F/I	p 24
FLEXUNIT	CS - CS/T - CS/TW - CS/I - CS/IW	p 27
	CS2 - CS2/T - CS2/TW	p 30
FLEXMAT	T - TA - TV	p 68-69



ADHESIVES

- Control the temperature of adhesives, especially on flexible moving parts so that viscosity is always ideal without wasting time or materials when starting cycles. For this, hoses pipes are used to combine temperature and pressure constraints throughout the material transfer process.

FLEXELEC products:

FLEXUNIT	TUY	p 32
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ELECTRIC MOTORS

- Prevent short-circuit risks caused by condensation during cooling after using electric motors and occurring when restarting them. The special glass fibre heating tapes are approved for use in ATEX explosive environments.

FLEXELEC products:

FLEXTAPE	RSV	p 40
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HOUSEHOLD ELECTRICAL

- Produce a temperature cycle for a yoghurt maker, a towel dryer or, more surprisingly, for a portable footbath. The household electrical sector is a promising one for developing technical solutions using heating cords or cables.

FLEXELEC products:

FLEXCORD	C1P - C1P/T - C1P/I	p 22
	C1S - C1S/T - C1S/I	p 23
	C1F - C1F/T - C1F/I	p 24
FLEXUNIT	CP - CP/T - CP/TW - CP/I - CP/IW	p 26
	CS - CS/T - CS/TW - CS/I - CS/IW	p 27
	CP1	p 28
	CS1	p 29
	CS2 - CS2/T - CS2/TW	p 30



MEDICAL, PHARMACEUTICAL AND COSMETICS

- Prepare optimum conditions in which to develop, produce or administer medicines, prostheses or creams by keeping control of molecule conservation temperature indicators and excipient viscosity.

FLEXELEC products:

FLEXUNIT	CP - CP/T - CP/TW - CP/I - CP/IW	p 26
	CS - CS/T - CS/TW - CS/I - CS/IW	p 27
	CP1	p 28
	CS1	p 29
	CS2 - CS2/T - CS2/TW	p 30
FLEXMAT	T - TA - TV	p 68-69
FLEXDRUM	TCF - TCF/TV	p 74
	CF/B - CF/BP - CF/BC - CF/BCH	p 75
	CF/JL	p 76

TRANSPORT



RAILWAY SWITCHES

- Prevent snow and ice from building up on railway switches to allow them to operate properly. The switches are heated by means of a heating cable held in place by a composite strip.

Guard rails and slides are heated with plates fitted in strings so that the distance between them can be adjusted to focus power at critical points .

This system makes it possible to reduce the installed power for each set of switches. Cables and plates for switches are fully sealed, with a particularly high insulation resistance.

FLEXELEC products:

FLEXPLATE	PLA	p 72
FLEXTRACE	FTS3/IS	p 56



METROS

FLEXELEC has developed a complete range of heating cables and fitting systems especially for heating metro tracks.

The cables are customised for each project. They can be powered at 750V, which makes for very long circuits.

Operating conditions are very severe and require maximum flexibility. The solution chosen must be precisely tailored to meet with this need..

For over 20 years, FLEXELEC has been designing, supplying and fitting systems for number of transport networks in France and abroad. Cities such as Turin relied on these technologies for their new infrastructures for the prestigious 2006 Winter Olympics .

- Prevent ice or frost from forming on the third rail (pick-up rail) which drives the power car. Poor contact can lead to unscheduled stops and safety problems.

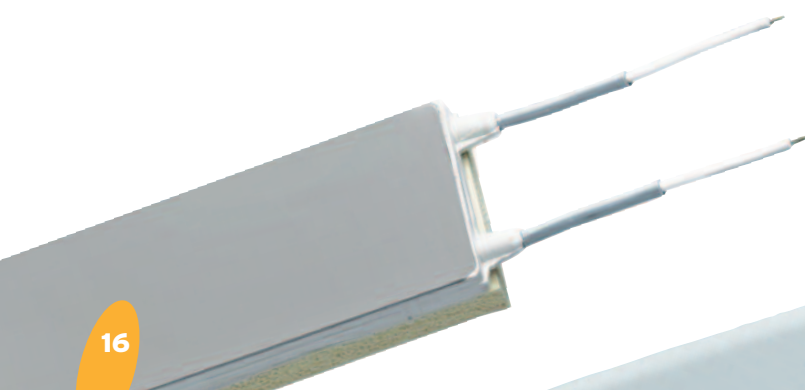
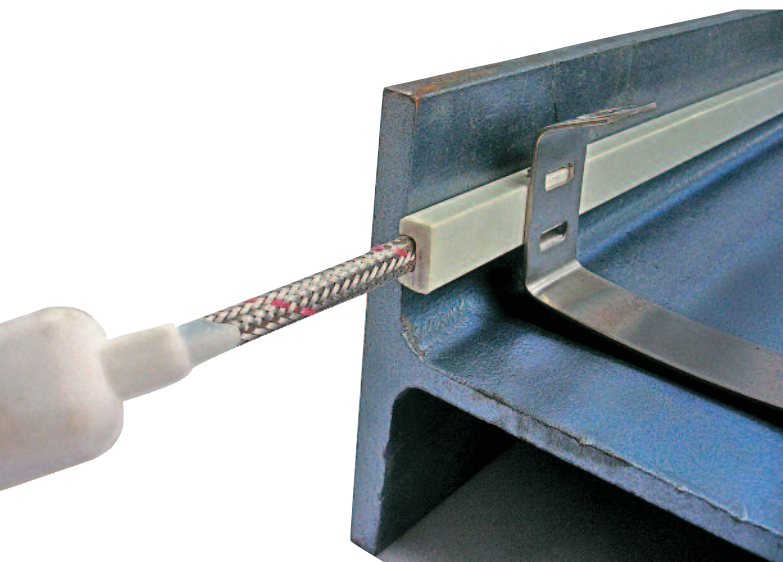
FLEXELEC products:

FLEXTRACE	FTS3/IS	p 56
	CIFS/I - C2FS/I - R3FS/I	p 59

- Make sure that tyres adhere properly to tracks, especially on overhead sections.

FLEXELEC products:

FLEXTRACE	FTS3/IS	p 56
	CIFS/I - C2FS/I - R3FS/I	p 59



Rail transport is one of FLEXELEC's key areas of expertise. Innovative solutions are proposed for an environment in which reliability and safety are paramount.



TRAINS

From the power car to the coaches, modern trains need efficient heating systems for several very special applications.

- The driver's hands and feet need to be kept comfortably warm in **and around his immediate environment**. Heating mats placed on the floor and on the dashboard provide close-up warmth to counter the fact that ambient heating in the locomotive is not enough in the harsh climate of many countries.

FLEXELEC products:

FLEXMAT T - TA - TV p 68-69

- In coach entrance vestibules a build-up of snow and ice is a source of risk for passengers as the floor becomes slippery. Heating cables fitted in the floor eliminate this danger while also improving comfort for those passengers travelling in the vestibule.

FLEXELEC products:

FLEXUNIT CP - CP/T - CP/TW - CP/I - CP/IW p 26
 CS - CS/T - CS/TW - CS/I - CS/IW p 27
 CP1 p 28
 CS1 p 29
 CS2 - CS2/T - CS2/TW p 30

FLEXPLATE PLA p 72

- Under the train, the speed and the outside temperature may cause piping and drinking water or waste water tanks to freeze. This can cause the toilets to seriously malfunction.

FLEXELEC products:

FLEXMAT T - TA - TV p 68-69

- The system that unfolds the pantograph is a sensitive part of the train since it is of prime importance in supplying electric power to it. Silicon fabrics are vulcanised directly to the stainless steel to ensure maximum power transfer.

FLEXELEC products:

FLEXMAT T - TA - TV p 68-69

- The coupling, and the cover plate which protects it, between coaches and locomotives must be accessible and easy to manoeuvre even in winter when freezing must be prevented.

FLEXELEC products:

FLEXMAT T - TA - TV p 68-69

MISCELLANEOUS APPLICATIONS



AQUARIUMS and TERRARIUMS

- Reproduce climate conditions identical to those of the original environment of the most fragile fish and reptile species. Heating cables provide homogeneity and perfect safety for any type of installation.

FLEXELEC products:

FLEXUNIT	CP - CP/T - CP/TW - CP/I - CP/IW	p 26
	CS - CS/T - CS/TW - CS/I - CS/IW	p 27
FLEXDRAIN	CSC - CSC/T - CSC/I	p 34



SPECIAL MACHINES and INSTRUMENTATION

- Work on the design of special machines as closely as possible to the desired temperatures, temper the finest and most fragile sensors or acquisition conduits so that they generate as few uncertainties as possible. Heating pipes are used by designers and developers working in these niche markets.

FLEXELEC products:

FLEXUNIT	TUY	p 32
FLEXDRAIN	CSC - CSC/T - CSC/I	p 34
FLEXTAPE	RS - RS/T - RS/I	p 39
FLEXMAT	T - TA - TV	p 68-69
	A	p 70



LABORATORIES

- Bring gas piping, vacuum pumps or baking analysis stands up to 450°C or 900°C, using the properties of glass fibre and silica fibre flexes and tapes. Prevent condensation at critical points in particle accelerators. State-of-the-art research laboratories are pushing FLEXELEC innovation to ever more high-performance developments.

FLEXELEC products:

FLEXUNIT	CV - CV/I	p 31
FLEXTAPE	RS - RS/T - RS/I	p 39
	RV - RV/I	p 41
	RVR	p 42
FLEXMAT	T - TA - TV	p 68-69



DRINKING TROUGHS

- Supply drinking water to animals, studs and farms, both inside unheated buildings and in fields. Electrical trace heating must be used in conjunction with electrical and mechanical protection to ensure safety for the animals.

FLEXELEC products:

FLEXTAPE	RP - RP/T - RP/I	p 38
	RS - RS/T - RS/I	p 39
STOPGEL - ANTIFREEZE	p 44
FLEXTRACE	FST - FST/T - FST/I - FST/TP - FST/TF	p 48
	FTP - FTP/T - FTP/I - FTP/TP	p 52
	FTSH - FTSH/T - FTSH/I - FTSH/TS - FTSH/TF	p 54



FLEXELEC's strength lies in its ability to discover and innovate. Customised manufacturing is often a necessity. Flexible heating elements continue to surprise by the range of new applications made possible, as well as more and more exotic future developments!



PRINTING INDUSTRY

- **Activate drying, preheat media or ink tanks.** The printing industry requires flexible heating elements to optimise output and the quality of its publications, often by means of customised resistors designed to fit the dimensions and requirements of each process.

FLEXELEC products:

FLEXMAT	T - TA - TV	p 68-69
	A	p 70



WEATHER FORECASTING

- **Eliminating problems of frost on wind and rain gauges and other weather-forecasting equipment** is a delicate technical challenge. So as not to influence readings, the heating elements are integrated into spaces or on very special shapes.

FLEXELEC products:

FLEXMAT	T - TA - TV	p 68-69
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SPORTS EQUIPMENT

- **Sports equipment materials** or the uses to which they are put are often a source of very special applications in which the flexible heating element is a real plus for manufacturers and users alike..

Example: drying amateur or professional ski boots, manufacturing ice hockey sticks..

FLEXELEC products:

FLEXTRACE	FST - FST/T - FST/I - FST/TP - FST/TF	p 48
FLEXMAT	T - TA - TV	p 68-69



AERIALS

- **Defrosting satellite dishes** is essential to ensure continuous broadcasting on radio, TV or military channels. Cable or fabric heating elements are laid out on the back of the receiver.

FLEXELEC products:

FLEXCORD	C1S - C1S/T - C1S/I	p 23
FLEXTRACE	FST - FST/T - FST/I - FST/TP - FST/TF	p 48
	FTP - FTP/T - FTP/I - FTP/TP	p 52
	FTSH - FTSH/T - FTSH/I - FTSH/TS - FTSH/TF	p 54
FLEXMAT	T - TA - TV	p 68-69



MISCELLANEOUS APPLICATIONS



CASH DISPENSERS

- **Distributing** the right number of banknotes involves checking that condensation doesn't make them stick together. With this in view, heating cords or flexes keep the storage bay dry.

FLEXELEC products:

FLEXCORD	C1P - C1P/T - C1P/I	p 22
	C1S - C1S/T - C1S/I	p 23
	C1F - C1F/T - C1F/I	p 24



WIND GENERATORS

- **Speed up the drying process** for the resin of wind generator blades during manufacture or on-site repairs after damage such as that caused by birds, for example. Silicon Heating mats are especially recommended for the uniform heating they provide.

FLEXELEC products:

FLEXMAT	T - TA - TV	p 68-69
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VACUUM PUMPS

- **Taking vacuum to its extremes** requires the use of external means of raising the temperature of equipment using fabrics or tapes that heat the network as continuously as possible.

FLEXELEC products:

FLEXMAT	T - TA - TV	p 68-69
FLEXTAPE	RV - RV/I	p 41



BATTERIES

- **Keeping batteries from freezing**, permanently or during programmed cycles is paramount for obtaining a reliable main or emergency electrical supply. This protection can significantly extend the lifetime of this equipment.

FLEXELEC products:

FLEXTRACE	FST - FST/T - FST/I - FST/TP - FST/TF	p 48
FLEXMAT	T - TA - TV	p 68-69
	A	p 70



BILLIARD TABLES

- **Counter variations** in air humidity and temperature differences in the slate, which are detrimental to the speed and trueness of billiard balls for high-level players, by fixing heating cables to the bottom of the frame. This has the additional advantage of making the tables smoother and quieter.

FLEXELEC products:

FLEXFLOOR	KY	p 62
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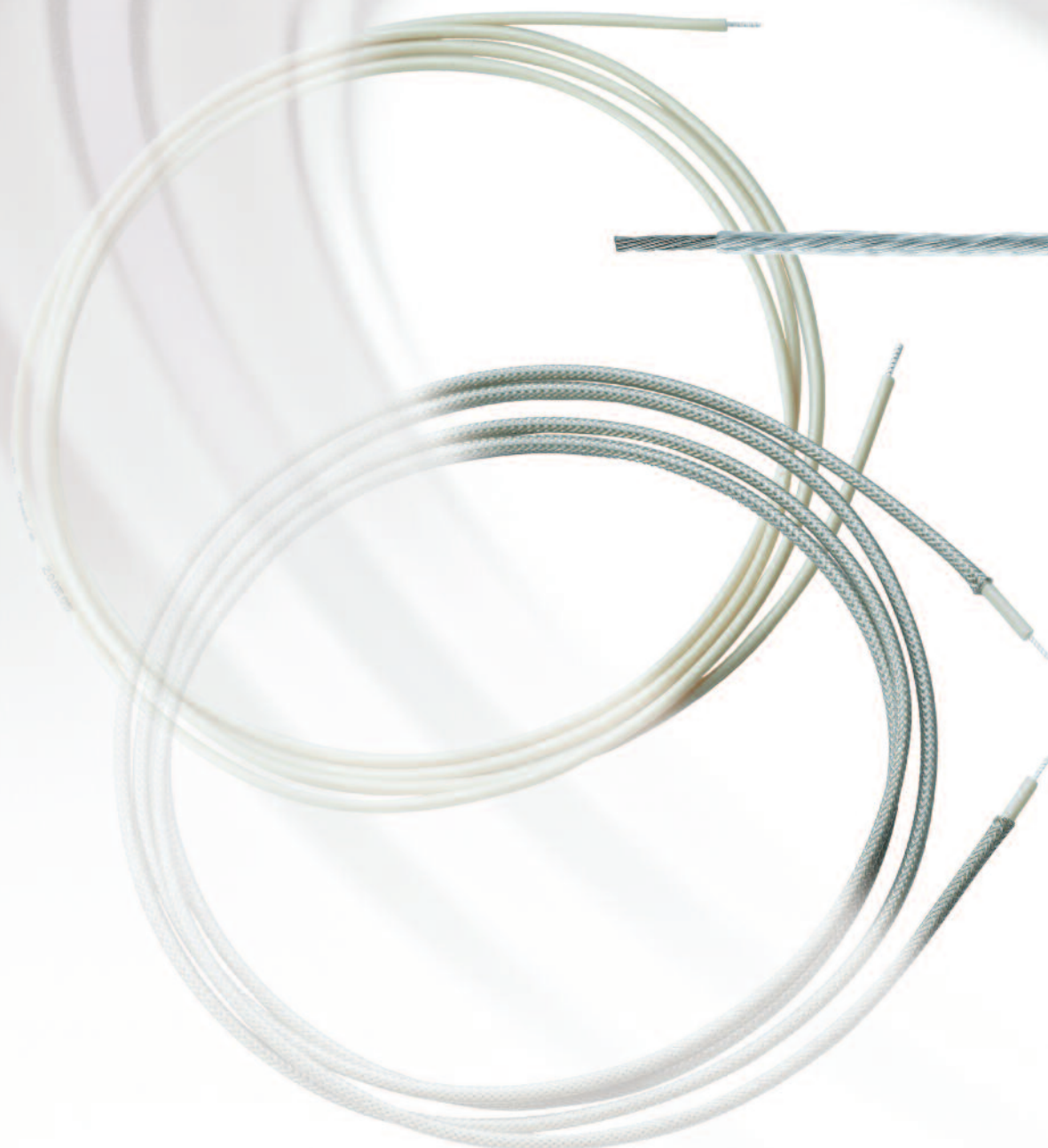
HORTICULTURE

- **Force seedlings**, or simulate the seasonal climate ahead of time to improve management of flower and vegetable production cycles, by inserting a network of heating cables in the ground to deliver heat as close as possible to the plants.

FLEXELEC products:

FLEXFLOOR	KY - KYCY	p 62
	KYCYR	p 63

Flexible heating cables and elements temperature maintenance systems



FLEXCORD®


HEATING CORDS

C1P - C1P/T - C1P/I	PVC INSULATED CORDS	22
C1S - C1S/T - C1S/I	SILICON ELASTOMER INSULATED CORDS	23
C1F - C1F/T - C1F/I	FLUOROPOLYMER INSULATED CORDS	24

C1P - C1P/T - C1P/I PVC insulated cords

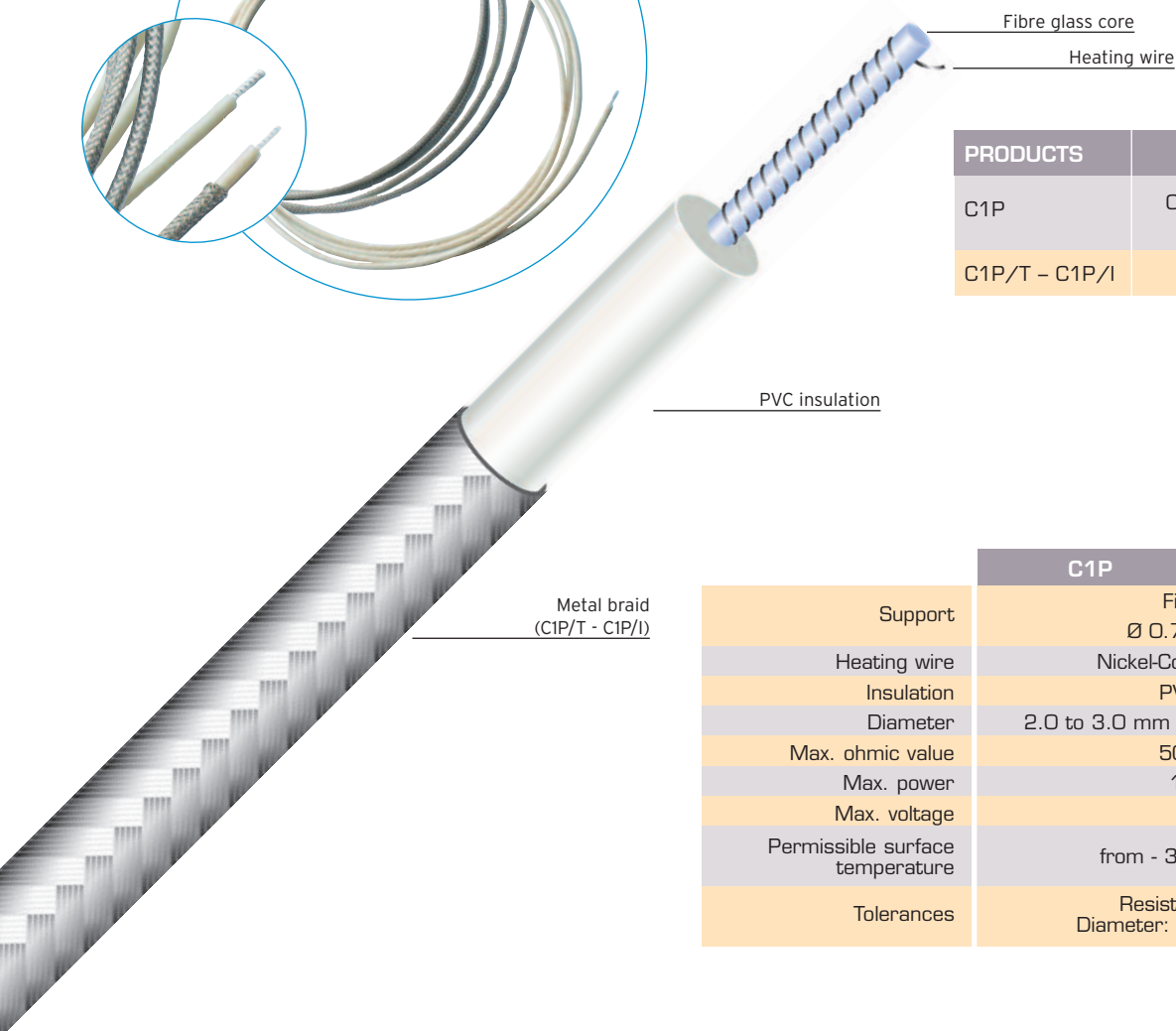
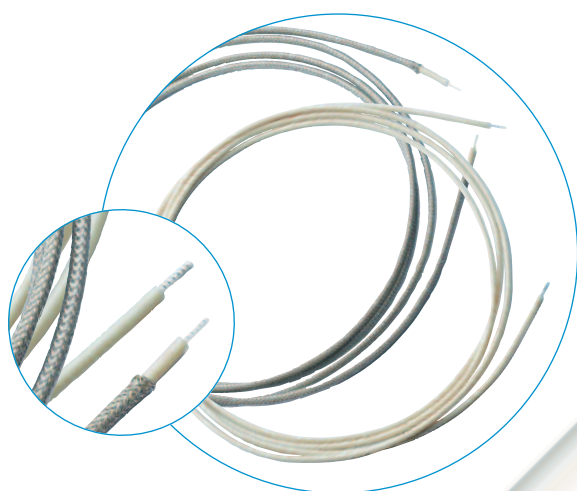


Characteristics

-  cords on request.
- C1P : PVC insulated cords.
- C1P/T : with tinned copper braid for mechanical protection and earthing.
- C1P/I : with stainless steel braid for mechanical protection and earthing.

Applications

C1P, C1P/T and C1P/I heating cables are mainly used in the household electrical or refrigeration industries, or in machines requiring protection against freezing or temperature maintenance. To ensure that these heating elements enjoy a long service life, we recommend using a control device.



PRODUCTS	INSULATION CLASS
C1P	CLASS O (single insulated) CLASS III (if low voltage)
C1P/T - C1P/I	CLASS I (earthing)

	C1P	C1P/T - C1P/I
Support	Fibre glass Ø 0.7 or Ø 1.1 mm	
Heating wire	Nickel-Copper or Nickel-Chrome	
Insulation	PVC 105°C	
Diameter	2.0 to 3.0 mm	2.3 to 3.3 mm
Max. ohmic value	5000 Ω/m	
Max. power	15 W/m	
Max. voltage	600 V	
Permissible surface temperature	from - 30°C to + 105°C	
Tolerances	Resistance: ± 10 % Diameter: + 0.2 / - 0.1 mm	

Use

Heating cords are series resistors. Consult the pages of the catalogue devoted to the corresponding general operating principles, general instructions for use and accessories

FLEXELEC S.A.S

10, rue des frères Lumière
Z.A. du Bois Rond
69720 ST BONNET DE MURE - FRANCE
Tel: + 33 (0)4.72.48.30.90
Fax: + 33 (0)4.78.40.82.81
E-mail: flexelec@omerin.com

FLEXELEC Dept

OMERIN ASIA Pte Ltd
51 Goldhill Plaza #08-12/01
SINGAPORE 308900
Tel: + 65.6255.4778
Fax: + 65.6255.4779
E-mail: sales@omerin.com.sg

FLEXELEC (UK) Ltd

Unit 11 Kings Park Industrial Estate
Primrose Hill - KINGS LANGLEY
Hertfordshire - WD4 8ST - UK
Tel: + 44 (0) 1923.274477
Fax: + 44 (0) 1923.270264
E-mail: sales@omerin.co.uk


FLEXELEC Dept

OMERIN GmbH
Buchwiese 16
D-65510 IDSTEIN - GERMANY
Tel: + 49 (0) 6126.94.31-0
Fax: + 49 (0) 6126.83.99
E-mail: omeringmbh@omerin.com

C1S - C1S/T - C1S/I Silicon elastomer cords

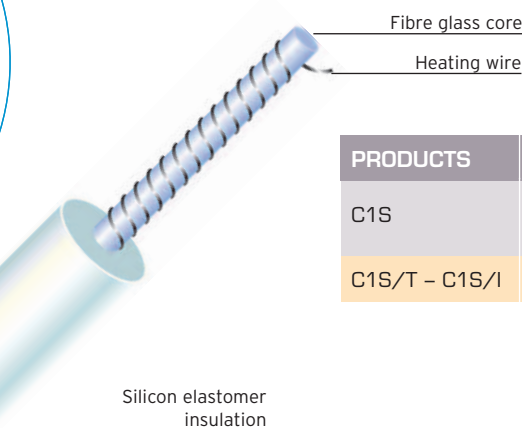
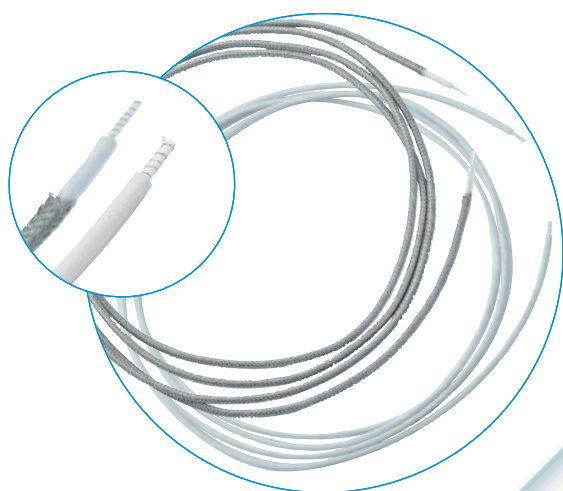


Characteristics

-  cords on request.
- **C1S** : silicon elastomer cords.
- **C1S/T** : with tinned copper braid for mechanical protection and earthing.
- **C1S/I** : with stainless steel braid for mechanical protection and earthing.

Applications

C1S, C1S/T and C1S/I heating cords are mainly used in the household electrical or refrigeration industries, or in machines requiring protection against freezing or temperature maintenance. To ensure that these heating elements enjoy a long service life, we recommend using a control device.



PRODUCTS	INSULATION CLASS
C1S	CLASS O (single insulated) CLASS III (if low voltage)
C1S/T - C1S/I	CLASS I (earthing)

	C1S	C1S/T - C1S/I
Support	Fibre glass Ø 0.7 or Ø 1.1 mm	
Heating wire	Nickel-Copper or Nickel-Chrome	
Insulation	Silicon elastomer	
Diameter	2.4 to 3.5 mm	2.7 to 3.8 mm
Max. ohmic value	5000 Ω/m	
Max. power	30 W/m	
Max. voltage	600 V	
Permissible surface temperature	from - 70°C to + 200°C	
Tolerances	Resistance: ± 10 % Diameter: + 0.2 / - 0.1 mm	

Use

Heating cords are series resistors. Consult the pages of the catalogue devoted to the corresponding general operating principles, general instructions for use and accessories.

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69720 ST BONNET DE MURE - FRANCE
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Fax: + 33 (0)4.78.40.82.81
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SINGAPORE 308900
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D-65510 IDSTEIN - GERMANY
Tel: + 49 (0) 6126.94.31-0
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E-mail: omeringmbh@omerin.com

C1F - C1F/T - C1F/I Fluoropolymer insulated cords



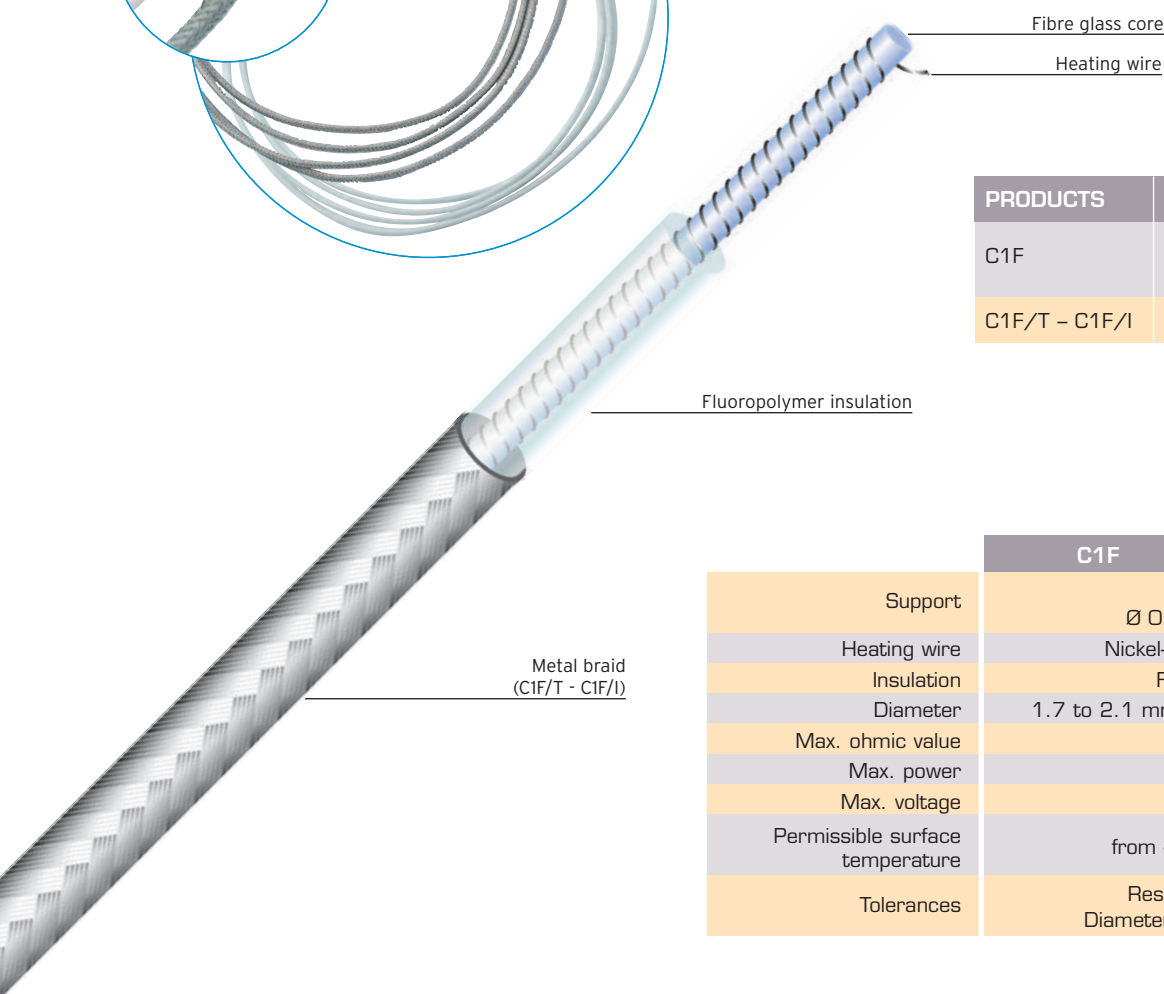
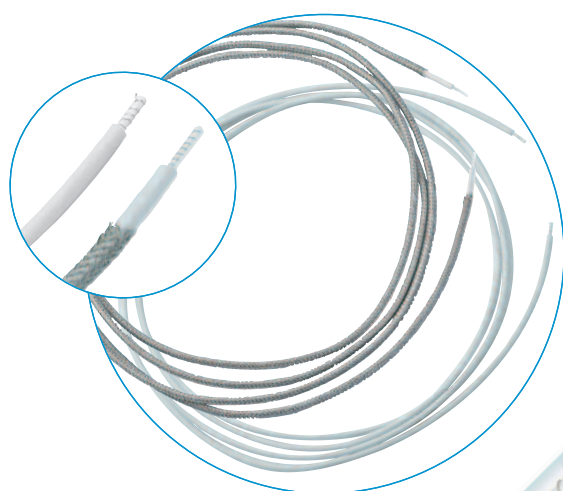
Characteristics

-  cords on request.
- **C1F** : fluoropolymer insulated cords.
- **C1F/T** : with tinned copper braid for mechanical protection and earthing.
- **C1F/I** : with stainless steel braid for mechanical protection and earthing.

Applications

C1F, C1F/T and C1F/I heating cords are mainly used in corrosive environments, or in machines requiring protection against freezing or temperature maintenance.

To ensure that these heating elements enjoy a long service life, we recommend using a control device.



PRODUCTS	INSULATION CLASS
C1F	CLASS O (single insulation) CLASS III (if low voltage)
C1F/T - C1F/I	CLASS I (earthing)

	C1F	C1F/T - C1F/I
Support	Fibre glass Ø 0.7 or Ø 1.1 mm	
Heating wire	Nickel-Copper or Nickel-Chrome	
Insulation	Fluoropolymer	
Diameter	1.7 to 2.1 mm	2.0 to 2.4 mm
Max. ohmic value	5000 Ω/m	
Max. power	30 W/m	
Max. voltage	600 V	
Permissible surface temperature	from -70°C to + 200°C	
Tolerances	Resistance: ± 10 % Diameter: + 0.2 / - 0.1 mm	

Use

Heating cords are series resistors. Consult the pages of the catalogue devoted to the corresponding general operating principles, general instructions for use and accessories

FLEXELEC S.A.S

10, rue des frères Lumière
Z.A. du Bois Rond
69720 ST BONNET DE MURE - FRANCE
Tel: + 33 (0)4.72.48.30.90
Fax: + 33 (0)4.78.40.82.81
E-mail: flexelec@omerin.com

FLEXELEC Dept

OMERIN ASIA Pte Ltd
51 Goldhill Plaza #08-12/01
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E-mail: omeringmbh@omerin.com

Flexible heating cables and elements temperature maintenance systems

FLEXUNIT®

HEATING CABLES

CP - CP/T - CP/TW - CP/I - CP/IW	PVC INSULATED CABLES	26
CS - CS/T - CS/TW - CS/I - CS/IW	SILICON ELASTOMER INSULATED CABLES	27
CP1	TERMINATED PVC INSULATED CABLES	28
CS1	TERMINATED SILICON ELASTOMER INSULATED CABLES	29
CS2 - CS2/T - CS2/TW	SILICON ELASTOMER INSULATED CABLES	30
CV - CV/I	GLASS FIBRE INSULATED CABLES	31
TUY	FLEXIBLE HEATED HOSES	32

CP - CP/T - CP/TW - CP/I - CP/IW

PVC insulated cables



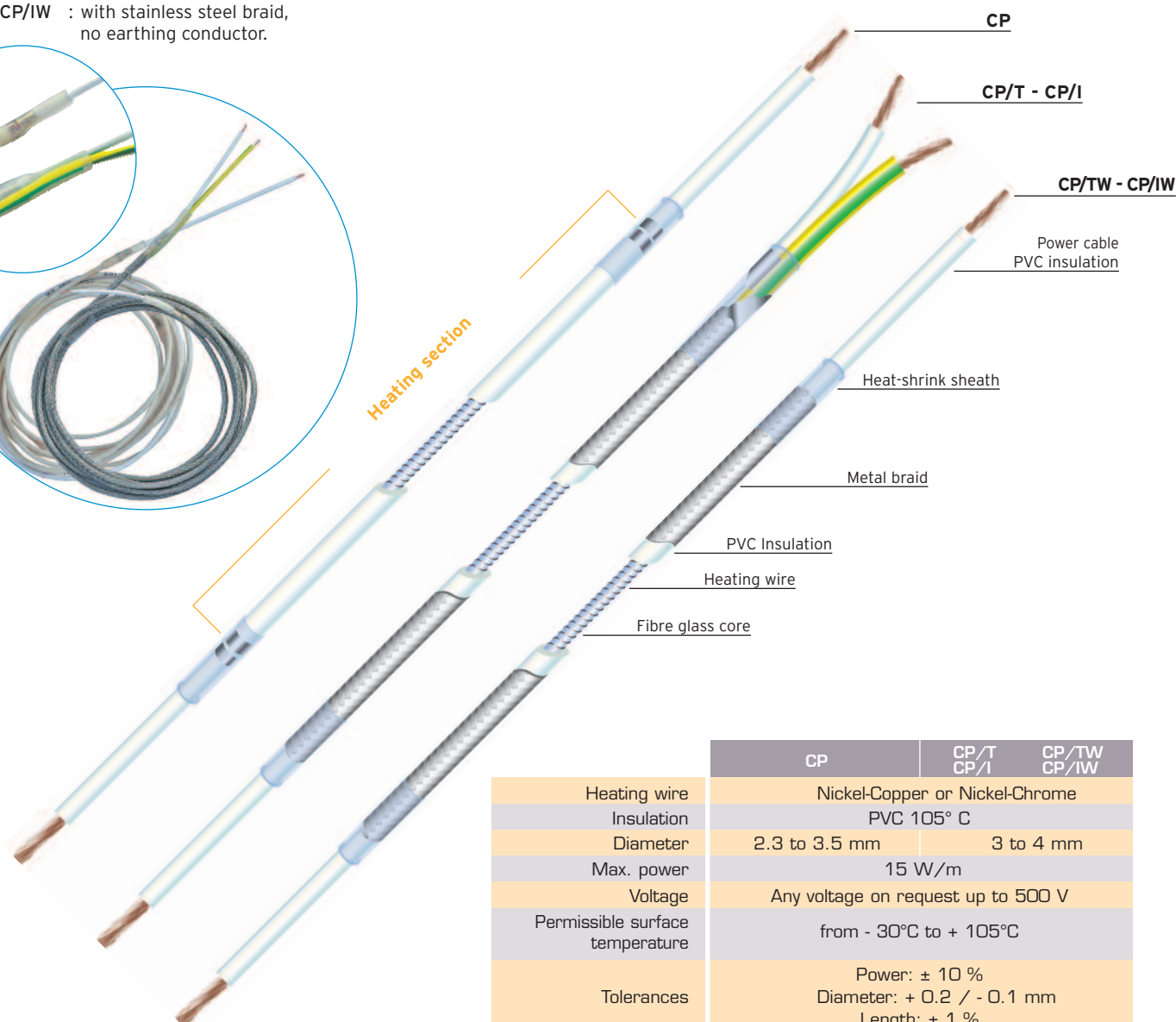
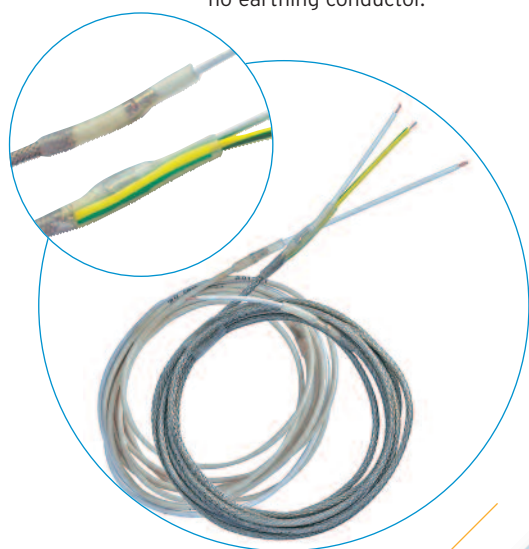
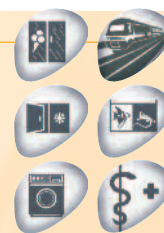
Characteristics

- Power cable: standard length: 1 m.
- CP : PVC insulated cables.
- CP/T : with tinned copper braid and earthing conductor.
- CP/TW : with tinned copper braid, no earthing conductor.
- CP/I : with stainless steel braid and earthing conductor.
- CP/IW : with stainless steel braid, no earthing conductor.

Applications

CP, CP/T, CP/TW, CP/I and CP/IW heating cables are mainly used in the household electrical and refrigeration industries and for equipment where protection against freezing or temperature maintenance is necessary.

To ensure that these heating elements enjoy a long service life, we recommend using a control device.



	CP	CP/T CP/I	CP/TW CP/IW
Heating wire	Nickel-Copper or Nickel-Chrome		
Insulation	PVC 105° C		
Diameter	2.3 to 3.5 mm	3 to 4 mm	
Max. power	15 W/m		
Voltage	Any voltage on request up to 500 V		
Permissible surface temperature	from - 30°C to + 105°C		
Tolerances	Power: ± 10 % Diameter: + 0.2 / - 0.1 mm Length: ± 1 %		
Connection insulation	Heat-shrink sheath with adhesive		

Use

Heating cables are series resistors. Consult the pages of the catalogue devoted to the corresponding general operating principles, general instructions for use and accessories.

FLEXELEC S.A.S

10, rue des frères Lumière
Z.A. du Bois Rond
69720 ST BONNET DE MURE - FRANCE
Tel: + 33 (0)4.72.48.30.90
Fax: + 33 (0)4.78.40.82.81
E-mail: flexelec@omerin.com

FLEXELEC Dept

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51 Goldhill Plaza #08-12/01
SINGAPORE 308900
Tel: + 65.6255.4778
Fax: + 65.6255.4779
E-mail: sales@omerin.com.sg

FLEXELEC (UK) Ltd

Unit 11 Kings Park Industrial Estate
Primrose Hill - KINGS LANGLEY
Hertfordshire - WD4 8ST - UK
Tel: + 44 (0) 1923.274477
Fax: + 44 (0) 1923.270264
E-mail: sales@omerin.co.uk

FLEXELEC Dept

OMERIN GmbH
Buchwiese 16
D-65510 IDSTEIN - GERMANY
Tel: + 49 (0) 6126.94.31-0
Fax: + 49 (0) 6126.83.99
E-mail: omeringmbh@omerin.com

CS - CS/T - CS/TW - CS/I - CS/IW

Silicon elastomer insulated cables



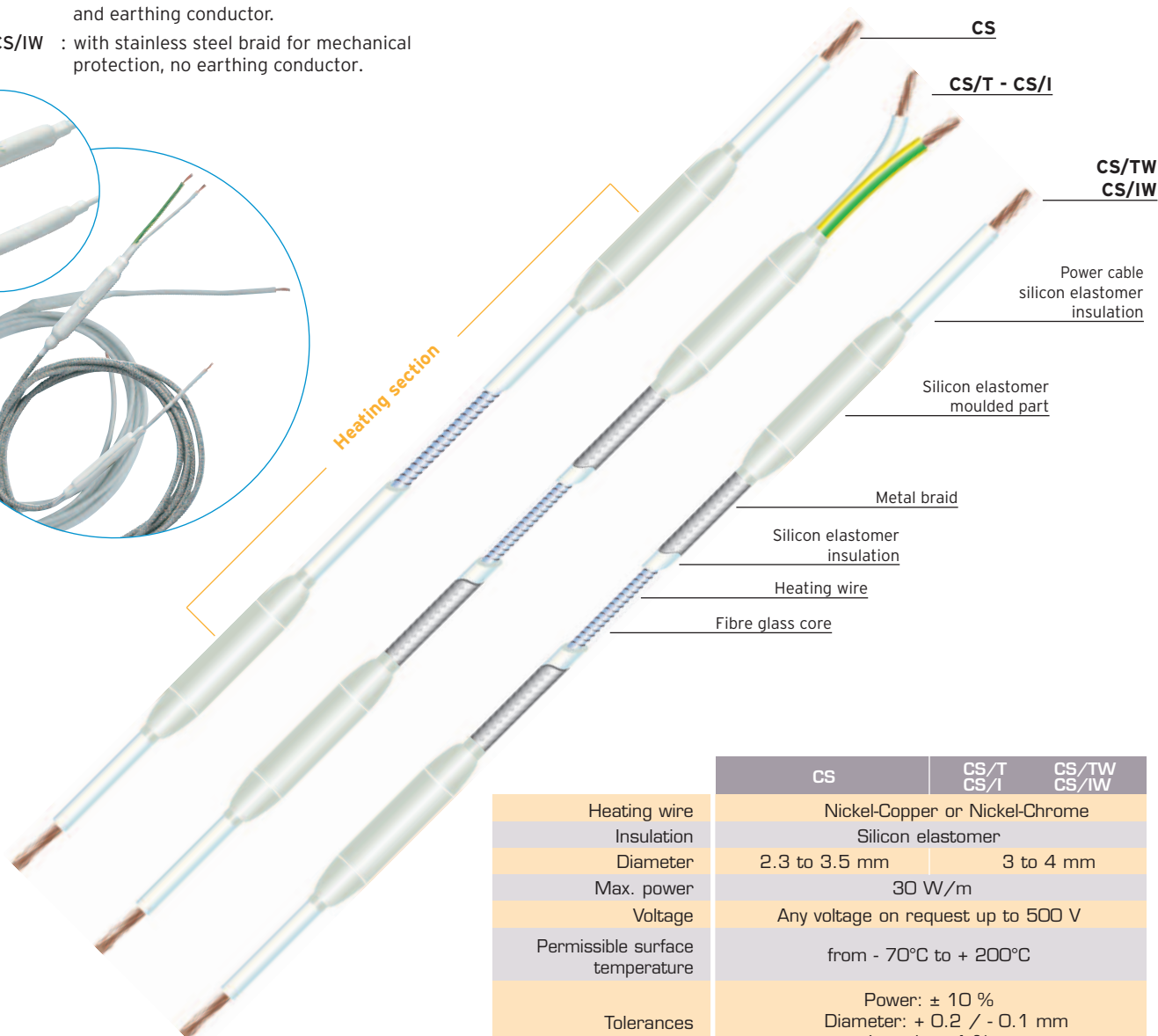
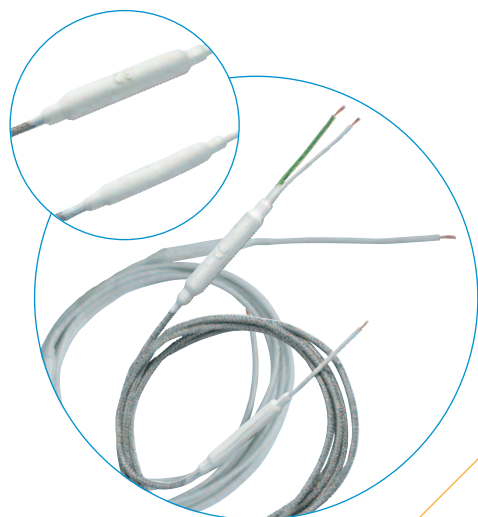
Characteristics

- Connections insulated with a silicon moulding.
- Power cable: standard length: 1 m.
- **CS** : silicon elastomer insulated cables.
- **CS/T** : with tinned copper braid and earthing conductor.
- **CS/TW** : with tinned copper braid for mechanical protection, no earthing conductor.
- **CS/I** : with stainless steel braid and earthing conductor.
- **CS/IW** : with stainless steel braid for mechanical protection, no earthing conductor.

Applications

CS, CS/T, CS/TW, CS/I and CS/IW heating cables are mainly used in the household electrical and refrigeration industries and for equipment where protection against freezing or temperature maintenance is necessary.

To ensure that these heating elements enjoy a long service life, we recommend using a control device.



	CS	CS/T CS/I	CS/TW CS/IW
Heating wire	Nickel-Copper or Nickel-Chrome		
Insulation	Silicon elastomer		
Diameter	2.3 to 3.5 mm	3 to 4 mm	
Max. power	30 W/m		
Voltage	Any voltage on request up to 500 V		
Permissible surface temperature	from - 70°C to + 200°C		
Tolerances	Power: ± 10 % Diameter: + 0.2 / - 0.1 mm Length: ± 1 %		
Connection insulation	Sealed silicon moulding		

Use

Heating cables are series resistors. Consult the pages of the catalogue devoted to the corresponding general operating principles, general instructions for use and accessories.

FLEXELEC S.A.S

10, rue des frères Lumière
Z.A. du Bois Rond
69720 ST BONNET DE MURE - FRANCE
Tel: + 33 (0)4.72.48.30.90
Fax: + 33 (0)4.78.40.82.81
E-mail: flexelec@omerin.com

FLEXELEC Dept

OMERIN ASIA Pte Ltd
51 Goldhill Plaza #08-12/01
SINGAPORE 308900
Tel: + 65.6255.4778
Fax: + 65.6255.4779
E-mail: sales@omerin.com.sg

FLEXELEC (UK) Ltd

Unit 11 Kings Park Industrial Estate
Primrose Hill - KINGS LANGLEY
Hertfordshire - WD4 8ST - UK
Tel: + 44 (0) 1923.274477
Fax: + 44 (0) 1923.270264
E-mail: sales@omerin.co.uk

FLEXELEC Dept

OMERIN GmbH
Buchwiese 16
D-65510 IDSTEIN - GERMANY
Tel: + 49 (0) 6126.94.31-0
Fax: + 49 (0) 6126.83.99
E-mail: omeringmbh@omerin.com

CP1

Terminated PVC insulated cables

Characteristics

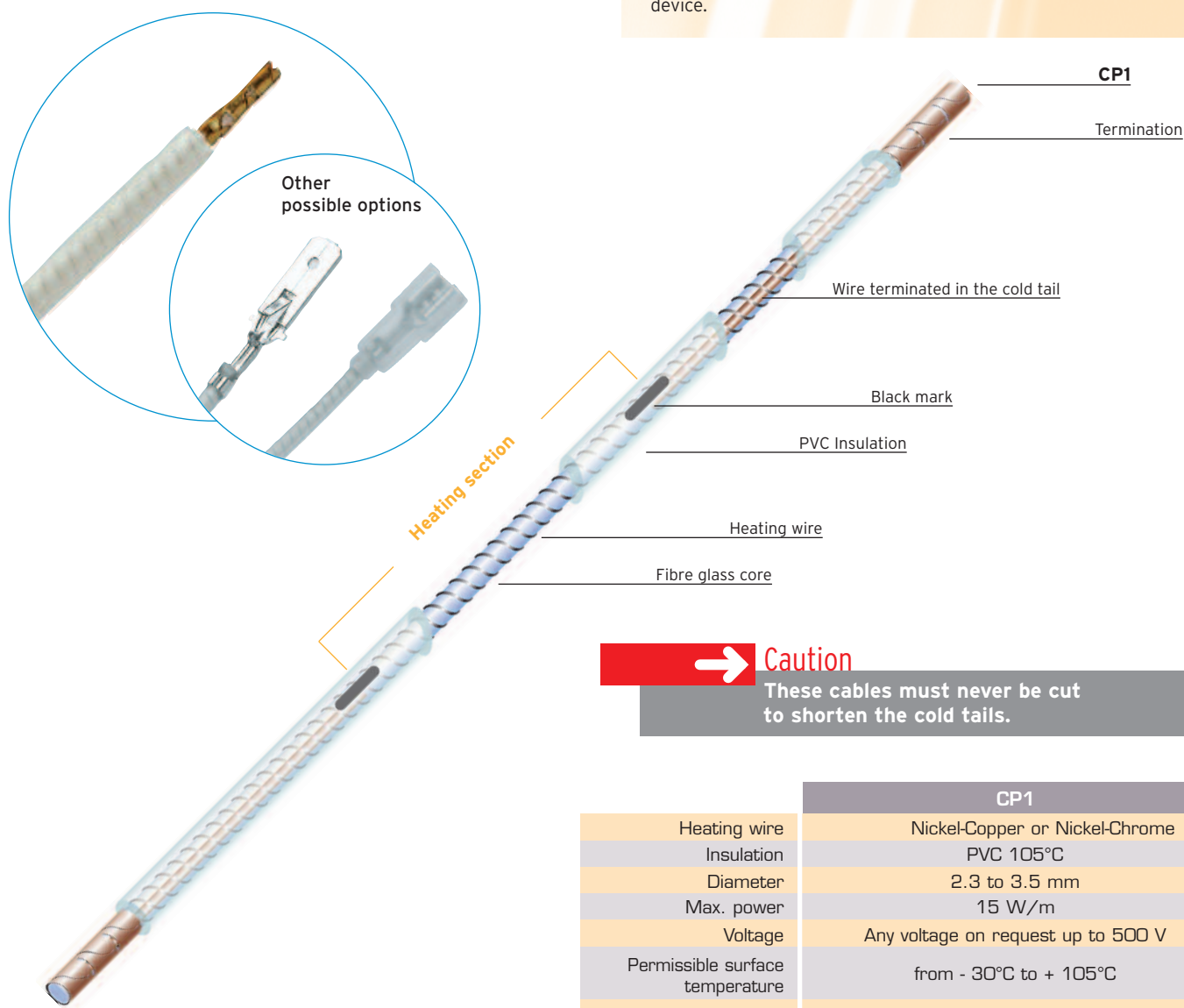
The main characteristic of this type of cable is that there is no extra thickness at the cold junction, identified with a black mark.

-  cables on request.

Applications

CP1 heating cables are mainly incorporated in household electrical or refrigeration equipment and special, mass-produced machines requiring protection against freezing or temperature maintenance.

To ensure that these heating elements enjoy a long service life, we recommend using a control device.



Caution

These cables must never be cut to shorten the cold tails.

Use

Heating cables are series resistors. Consult the pages of the catalogue devoted to the corresponding general operating principles, general instructions for use and accessories.

	CP1
Heating wire	Nickel-Copper or Nickel-Chrome
Insulation	PVC 105°C
Diameter	2.3 to 3.5 mm
Max. power	15 W/m
Voltage	Any voltage on request up to 500 V
Permissible surface temperature	from - 30°C to + 105°C
Tolerances	Power: $\pm 10\%$ Diameter: $+ 0.2 / - 0.1$ mm Length: $\pm 1\%$
Max. current	2 A

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10, rue des frères Lumière
Z.A. du Bois Rond
69720 ST BONNET DE MURE - FRANCE
Tel: + 33 (0)4.72.48.30.90
Fax: + 33 (0)4.78.40.82.81
E-mail: flexelec@omerin.com

FLEXELEC Dept

OMERIN ASIA Pte Ltd
51 Goldhill Plaza #08-12/01
SINGAPORE 308900
Tel: + 65.6255.4778
Fax: + 65.6255.4779
E-mail: sales@omerin.com.sg

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Primrose Hill - KINGS LANGLEY
Hertfordshire - WD4 8ST - UK
Tel: + 44 (0) 1923.274477
Fax: + 44 (0) 1923.270264
E-mail: sales@omerin.co.uk

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OMERIN GmbH
Buchwiese 16
D-65510 IDSTEIN - GERMANY
Tel: + 49 (0) 6126.94.31-0
Fax: + 49 (0) 6126.83.99
E-mail: omeringmbh@omerin.com

CS1

Terminated silicon elastomer insulated cables



Characteristics

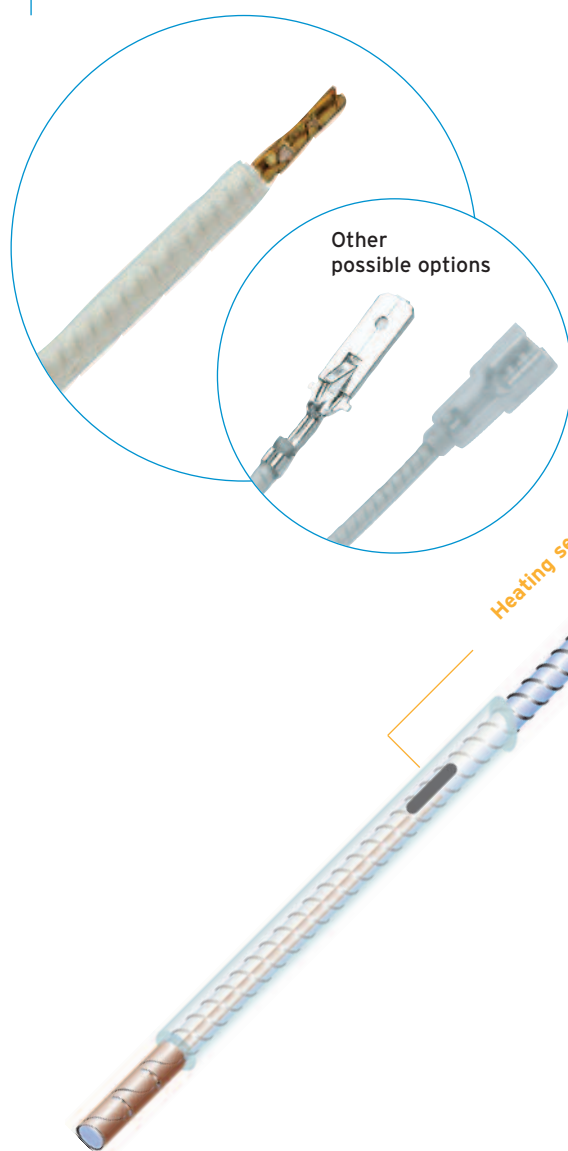
The main characteristic of this type of cable is that there is no extra thickness at the cold junction, identified with a black mark.

-  cables on request.

Applications

CS1 heating cables are mainly incorporated in household electrical or refrigeration equipment and special, mass-produced machines requiring protection against freezing or temperature maintenance.

To ensure that these heating elements enjoy a long service life, we recommend using a control device.



CS1

Termination

Wire terminated in the cold tail

Black mark

Silicon elastomer insulation

Heating wire

Fibre glass core



Caution

These cables must never be cut to shorten the cold tails.

Use

Heating cables are series resistors. Consult the pages of the catalogue devoted to the corresponding general operating principles, general instructions for use and accessories.

	CS1
Heating wire	Nickel-Copper or Nickel-Chrome
Insulation	Silicon elastomer
Diameter	2.3 to 3.5 mm
Max. power	30 W/m
Voltage	Any voltage on request up to 500 V
Permissible surface temperature	from - 70°C to + 200°C
Tolerances	Power: ± 10 % Diameter + 0.2 / - 0.1 mm Length: ± 1 %
Max. current	2 A

FLEXELEC S.A.S

10, rue des frères Lumière
Z.A. du Bois Rond
69720 ST BONNET DE MURE - FRANCE
Tel: + 33 (0)4.72.48.30.90
Fax: + 33 (0)4.78.40.82.81
E-mail: flexelec@omerin.com

FLEXELEC Dept

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Unit 11 Kings Park Industrial Estate
Primrose Hill - KINGS LANGLEY
Hertfordshire - WD4 8ST - UK
Tel: + 44 (0) 1923.274477
Fax: + 44 (0) 1923.270264
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FLEXELEC Dept

OMERIN GmbH
Buchwiese 16
D-65510 IDSTEIN - GERMANY
Tel: + 49 (0) 6126.94.31-0
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E-mail: omeringmbh@omerin.com

CS2 - CS2/T - CS2/TW

Silicon elastomer insulated cables



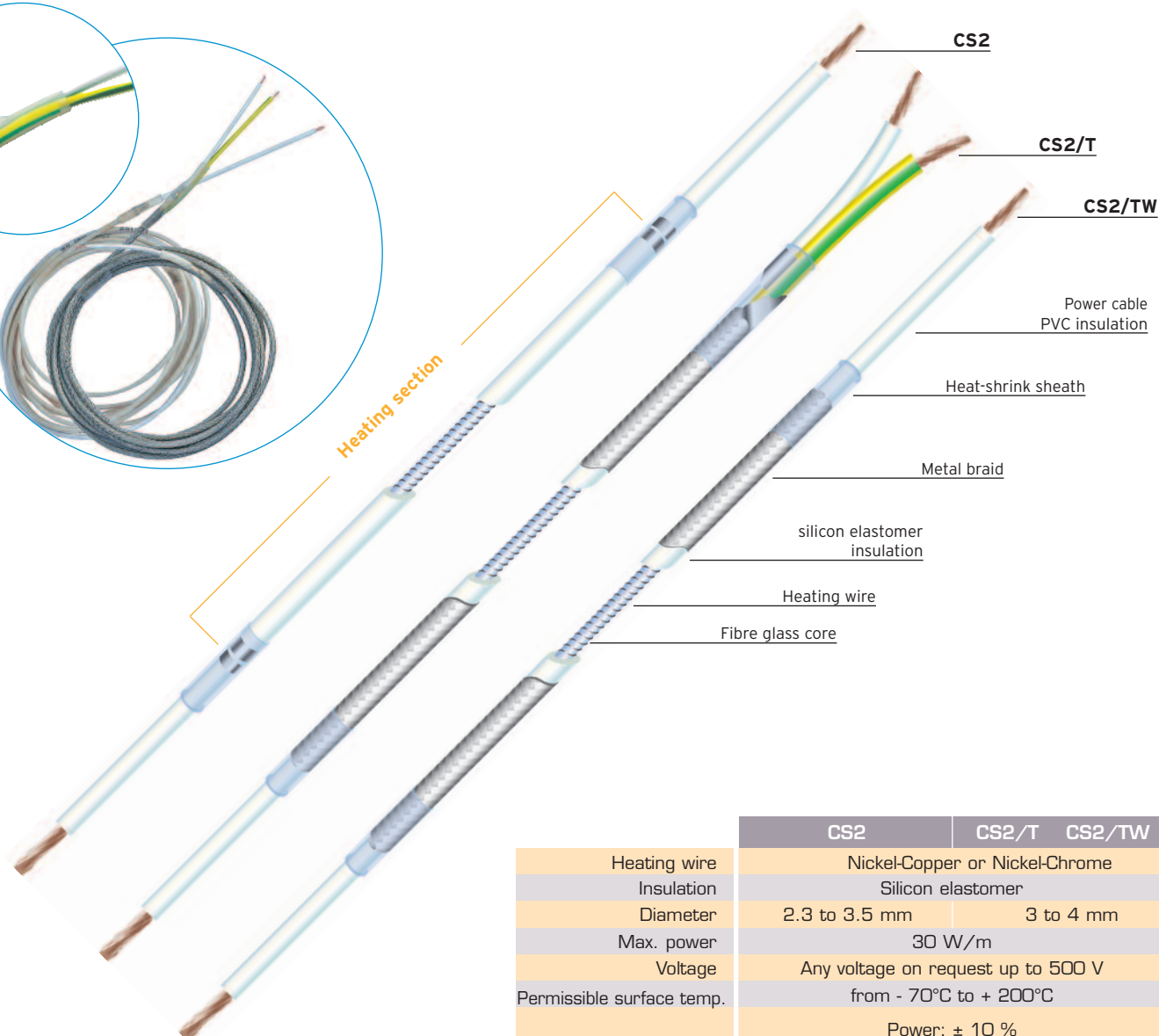
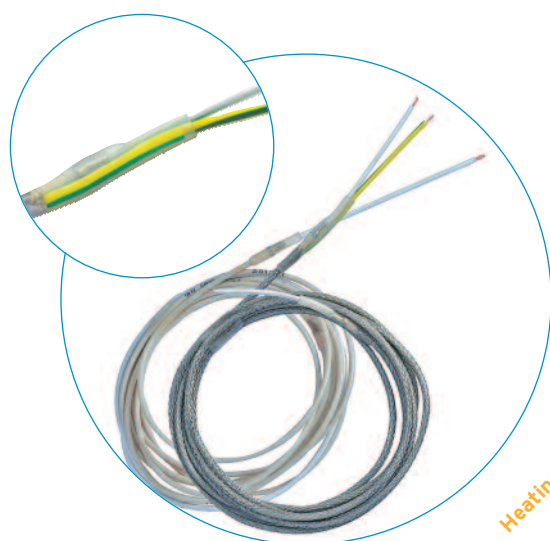
Characteristics

- Power cable: standard length: 1 m.
- **CS2** : silicon elastomer insulated cables.
- **CS2/T** : with tinned copper braid and earthing conductor.
- **CS2/TW** : with tinned copper braid for mechanical protection, no earthing conductor.

Applications

CS2, CS2/T and CS2/TW heating cables are mainly used in the household electrical and refrigeration industries and for machines where protection against freezing or temperature maintenance is necessary.

To ensure that these heating elements enjoy a long service life, we recommend using a control device.



Use

Heating cables are series resistors. Consult the pages of the catalogue devoted to the corresponding general operating principles, general instructions for use and accessories.

	CS2	CS2/T	CS2/TW
Heating wire	Nickel-Copper or Nickel-Chrome		
Insulation	Silicon elastomer		
Diameter	2.3 to 3.5 mm	3 to 4 mm	
Max. power	30 W/m		
Voltage	Any voltage on request up to 500 V		
Permissible surface temp.	from - 70°C to + 200°C		
Tolerances	Power: ± 10 % Diameter: + 0.2 / - 0.1 mm Length: ± 1 %		
Connection insulation	Heat-shrink sheath with adhesive		

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 Z.A. du Bois Rond
 69720 ST BONNET DE MURE - FRANCE
 Tel: + 33 (0)4.72.48.30.90
 Fax: + 33 (0)4.78.40.82.81
 E-mail: flexelec@omerin.com

FLEXELEC Dept

OMERIN ASIA Pte Ltd
 51 Goldhill Plaza #08-12/01
 SINGAPORE 308900
 Tel: + 65.6255.4778
 Fax: + 65.6255.4779
 E-mail: sales@omerin.com.sg

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Unit 11 Kings Park Industrial Estate
 Primrose Hill - KINGS LANGLEY
 Hertfordshire - WD4 8ST - UK
 Tel: + 44 (0) 1923.274477
 Fax: + 44 (0) 1923.270264
 E-mail: sales@omerin.co.uk

FLEXELEC Dept

OMERIN GmbH
 Buchwiese 16
 D-65510 IDSTEIN - GERMANY
 Tel: + 49 (0) 6126.94.31-0
 Fax: + 49 (0) 6126.83.99
 E-mail: omeringmbh@omerin.com

CV - CV/I

Fibre glass insulated cables



Characteristics

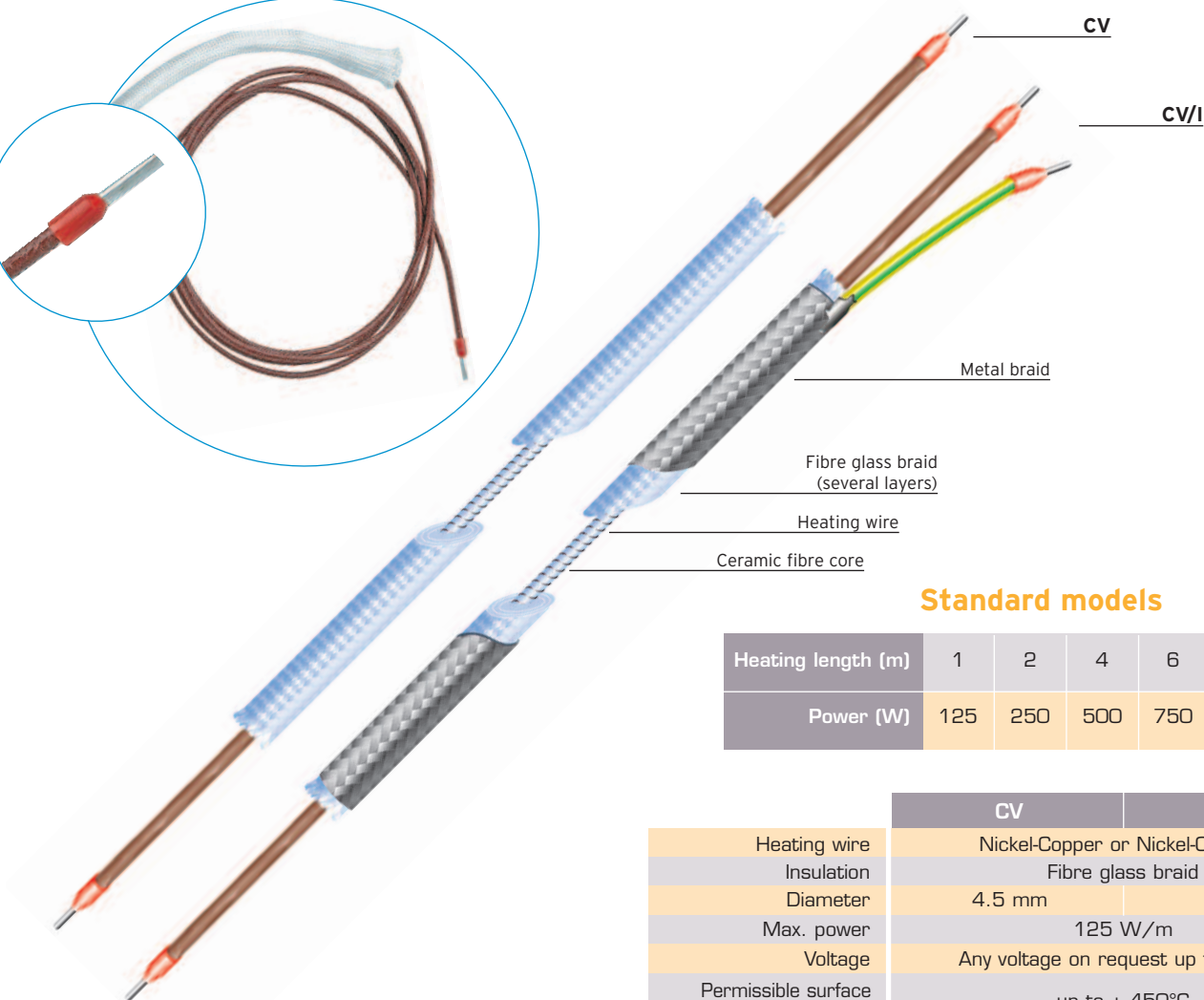
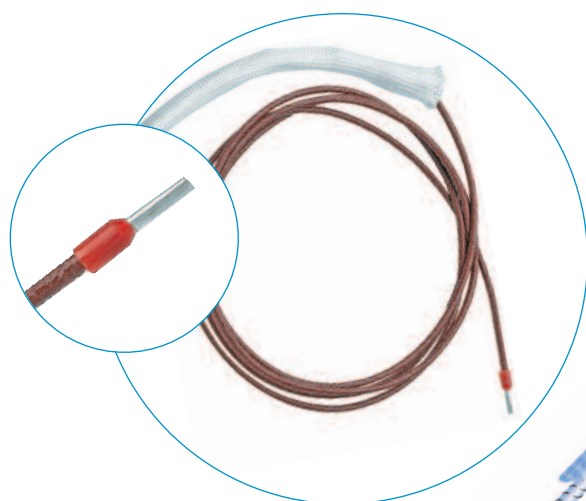
- Highly flexible.
- High power: 125 W/m.
- High temperature, up to 450°C.
- Not protected against humidity.
- Minimum bend greater than 10 mm.
- Power cable: standard length 500 mm.

- **CV** : fibre glass insulated cables.
- **CV/I** : with stainless steel braid and earthing conductor.

Applications

Fibre glass insulated CV and CV/I heating cables are mainly for use in laboratories and in industrial applications when it is required to heat quickly to a high temperature. These cables are very flexible but as they are not sealed they can be used only in a dry atmosphere, and in compliance with the electrical protection instructions in force.

To ensure that these heating elements enjoy a long service life, we recommend using a control device.



Standard models

Heating length [m]	1	2	4	6	8	10
Power [W]	125	250	500	750	1000	1250

	CV	CV/I
Heating wire	Nickel-Copper or Nickel-Chrome	
Insulation	Fibre glass braid	
Diameter	4.5 mm	5 mm
Max. power	125 W/m	
Voltage	Any voltage on request up to 230 V	
Permissible surface temperature	up to + 450°C	
Tolerances	Power: ± 10 % Diameter: ± 0.5 mm Length: ± 1 %	
Connection insulation	Fibre glass	
Protection	Without earth	With earth

Use

Heating cables are series resistors. Consult the pages of the catalogue devoted to the corresponding general operating principles, general instructions for use and accessories.

FLEXELEC S.A.S

10, rue des frères Lumière
Z.A. du Bois Rond
69720 ST BONNET DE MURE - FRANCE
Tel: + 33 (0)4.72.48.30.90
Fax: + 33 (0)4.78.40.82.81
E-mail: flexelec@omerin.com

FLEXELEC Dept

OMERIN ASIA Pte Ltd
51 Goldhill Plaza #08-12/01
SINGAPORE 308900
Tel: + 65.6255.4778
Fax: + 65.6255.4779
E-mail: sales@omerin.com.sg

FLEXELEC (UK) Ltd

Unit 11 Kings Park Industrial Estate
Primrose Hill - KINGS LANGLEY
Hertfordshire - WD4 8ST - UK
Tel: + 44 (0) 1923.274477
Fax: + 44 (0) 1923.270264
E-mail: sales@omerin.co.uk

FLEXELEC Dept

OMERIN GmbH
Buchwiese 16
D-65510 IDSTEIN - GERMANY
Tel: + 49 (0) 6126.94.31-0
Fax: + 49 (0) 6126.83.99
E-mail: omeringmbh@omerin.com

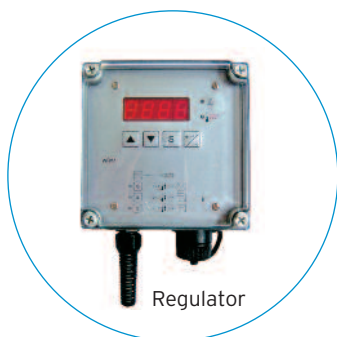
TUY

Flexible heated hoses



Characteristics

- Temperature range : 100°C, 200°C and 250°C.
- Hose : PTFE reinforced with a stainless steel braid.
- Heating cable : PTFE insulation with braid.
- Temperature sensor : PT 100 or thermocouple J or K.
- Heat insulation : Silicon foam.
- Outer sheath : Polyamide braid.
- End-pieces : Silicon caps with device to protect output cable from being ripped out.
- Voltage : 230 V, other on request.
- Connection : Revolving nuts, UNF, BSP/DKR connections, or with smooth end-pieces.



Regulator

Use

Consult the pages of the catalogue devoted to the corresponding general operating principles, general instructions for use and accessories.

Applications

Flexible heated hoses are used as connecting parts between fixed and moving machine parts when it is vital to maintain these at constant temperature.

Gluing applications, hotmelt adhesive installations, the food industry, labeling machines, polyurethane foam spraying installations, oil burner conduits, gas sampling conduits for measuring purposes, etc.

To ensure that these heating elements enjoy a long service life, we recommend using a control device.



Options

- Stainless steel connections.
- Outer stainless or galvanised steel braid.
- Pilot lines can pass through the heated hose.
- Special designs on request.

Nominal diameter (mm)	4	6	8	10	13	16	20	25
External diameter (mm)	40	40	40	40	40	40	59	59
Power (W/m)	80	90	100	150	170	200	280	300
Burst pressure (bar)	1000	900	800	600	500	400	280	220
Max. service pressure								
Up to 4°C (bar)	250	225	200	150	125	100	70	55
Up to 100°C (bar)	225	202	180	135	112	90	63	49
Up to 200°C (bar)	200	180	160	120	100	80	56	44
Minimum bend with polyamide braid (mm)	160	160	160	250	250	250	450	500
Minimum bend with metal braid (mm)	200	200	200	290	290	290	500	550

Electronic regulator option

Two-point regulator with fuse protection and ON/OFF indicator

Temperature	from 0 to + 250°C	Switch	Relay
Sensor	PT 100 or thermocouple type K or type J	Power cable	Length 1.5 m
Voltage	230 V	Power supply	Two-pin plug + earth
Nominal current	10 A	Heated hose Power supply	Multi-pole plug
Indication	Display	Dimensions	125 x 125 x 75 mm

FLEXELEC S.A.S

10, rue des frères Lumière
 Z.A. du Bois Rond
 69720 ST BONNET DE MURE - FRANCE
 Tel: + 33 (0)4.72.48.30.90
 Fax: + 33 (0)4.78.40.82.81
 E-mail: flexelec@omerin.com

FLEXELEC Dept

OMERIN ASIA Pte Ltd
 51 Goldhill Plaza #08-12/01
 SINGAPORE 308900
 Tel: + 65.6255.4778
 Fax: + 65.6255.4779
 E-mail: sales@omerin.com.sg

FLEXELEC (UK) Ltd

Unit 11 Kings Park Industrial Estate
 Primrose Hill - KINGS LANGLEY
 Hertfordshire - WD4 8ST - UK
 Tel: + 44 (0) 1923.274477
 Fax: + 44 (0) 1923.270264
 E-mail: sales@omerin.co.uk

FLEXELEC Dept

OMERIN GmbH
 Buchwiese 16
 D-65510 IDSTEIN - GERMANY
 Tel: + 49 (0) 6126.94.31-0
 Fax: + 49 (0) 6126.83.99
 E-mail: omeringmbh@omerin.com

Flexible heating cables and elements temperature maintenance systems



FLEXDRAIN®

DRAIN-LINE HEATERS

CSC - CSC/T - CSC/I	SILICON ELASTOMER INSULATED DRAIN-LINE HEATERS	34
CSC2	SILICON ELASTOMER INSULATED DRAIN-LINE HEATERS	35
CSC2K	SILICON ELASTOMER INSULATED DRAIN-LINE HEATERS WITH INTEGRATED THERMOSTAT	36

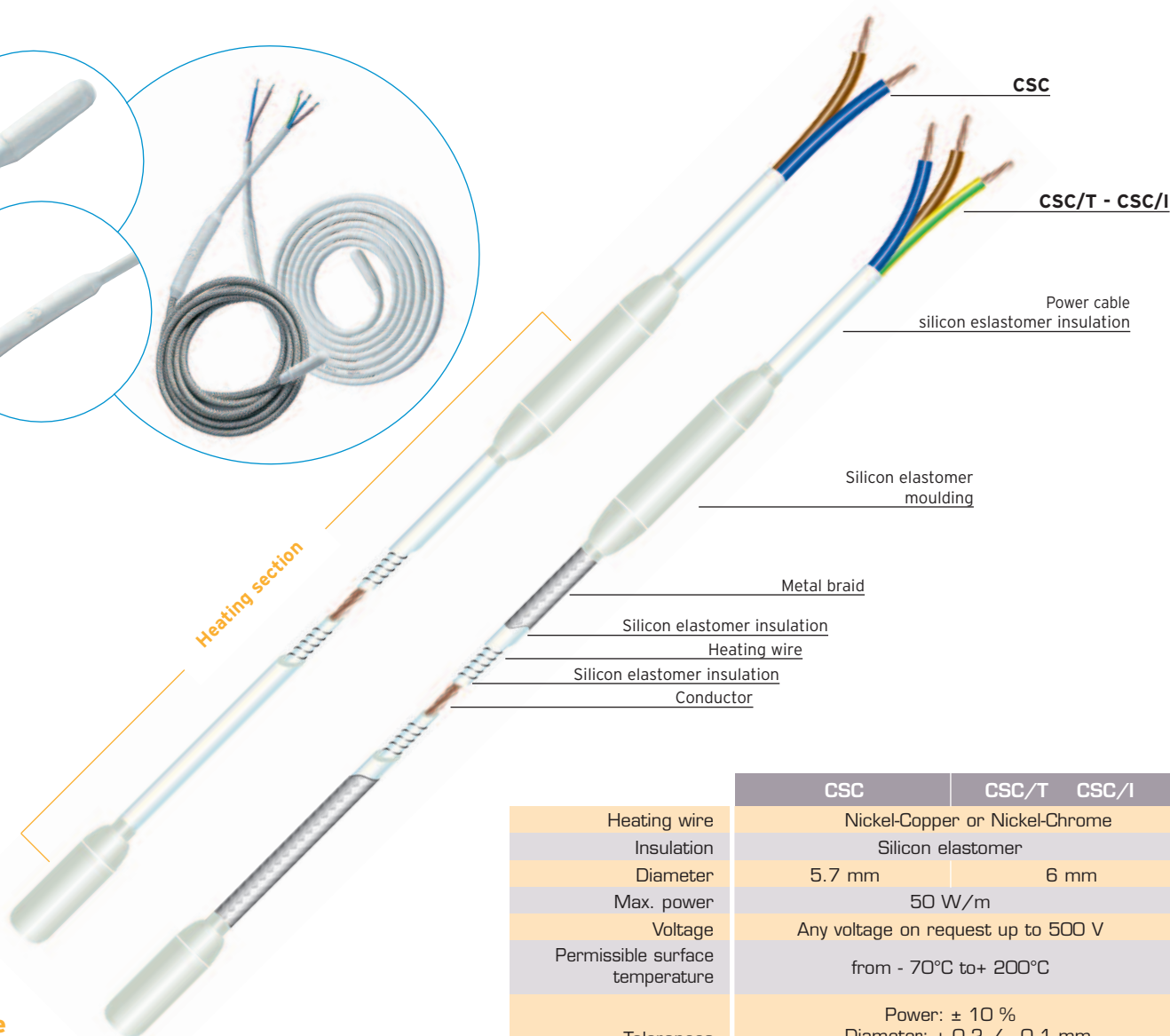
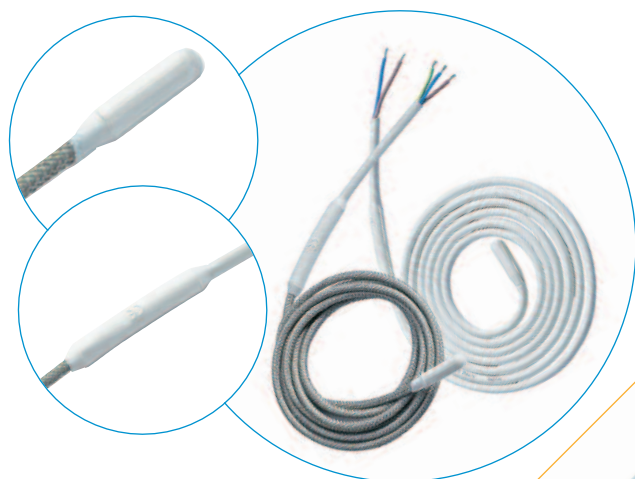
CSC - CSC/T - CSC/I**Silicon elastomer insulated drain-line heaters****Characteristics**

- Fully sealed.
- Extremely flexible.
- Any voltage on request up to 500V.
- Power cable: standard length 1 m.
- **CSC** : silicon elastomer insulated drain-line heaters.
- **CSC/T** : with tinned copper braid for earthing and mechanical protection.
- **CSC/I** : with stainless steel braid for earthing and mechanical protection.

Applications

CSC, CSC/T and CSC/I heaters are designed to be laid inside pipes for draining water from thawing refrigeration equipment installed in cold rooms. They operate only during thawing cycles.

To ensure that these heating elements enjoy a long service life, we recommend using a control device.

**Use**

Drain-line cables are series resistors. Consult the pages of the catalogue devoted to the corresponding general operating principles, general instructions for use and accessories.

	CSC	CSC/T	CSC/I
Heating wire	Nickel-Copper or Nickel-Chrome		
Insulation	Silicon elastomer		
Diameter	5.7 mm	6 mm	
Max. power	50 W/m		
Voltage	Any voltage on request up to 500 V		
Permissible surface temperature	from - 70°C to+ 200°C		
Tolerances	Power: ± 10 % Diameter: + 0.2 / - 0.1 mm Length: ± 1 %		
End insulation	Sealed silicon moulding		

FLEXELEC S.A.S

10, rue des frères Lumière
 Z.A. du Bois Rond
 69720 ST BONNET DE MURE - FRANCE
 Tel: + 33 (0)4.72.48.30.90
 Fax: + 33 (0)4.78.40.82.81
 E-mail: flexelec@omerin.com

FLEXELEC Dept

OMERIN ASIA Pte Ltd
 51 Goldhill Plaza #08-12/01
 SINGAPORE 308900
 Tel: + 65.6255.4778
 Fax: + 65.6255.4779
 E-mail: sales@omerin.com.sg

FLEXELEC (UK) Ltd

Unit 11 Kings Park Industrial Estate
 Primrose Hill - KINGS LANGLEY
 Hertfordshire - WD4 8ST - UK
 Tel: + 44 (0) 1923.274477
 Fax: + 44 (0) 1923.270264
 E-mail: sales@omerin.co.uk

FLEXELEC Dept

OMERIN GmbH
 Buchwiese 16
 D-65510 IDSTEIN - GERMANY
 Tel: + 49 (0) 6126.94.31-0
 Fax: + 49 (0) 6126.83.99
 E-mail: omeringmbh@omerin.com

CSC2

Silicon elastomer insulated drain-line heaters



Characteristics

- Fully sealed.
- Double insulation.
- Extremely flexible.
- Voltage 230 V as standard.
- Power cable: length 1 m.



Applications

CSC2 heaters are designed to be laid inside pipes for draining water from thawing refrigeration equipment installed in cold rooms.

They operate only during thawing cycles.

To ensure that these heating elements enjoy a long service life, we recommend using a control device.

Note: The most commonly used power rating is 50 W/m. However, for plastic pipes, we strongly recommend using the 40W/m range.



Wire terminated
in the cold tail

Black mark

Silicon elastomer
insulation

Silicon elastomer
insulation

Heating wire

Fibre glass core
Conductor cable

Heating section

Silicon elastomer
moulding
9 x 7 mm
Length 20 mm



Standard models

Length (m)	CSC2	
	40 W/m	50 W/m
1	40 W	50 W
1.3	52 W	65 W
1.5	60 W	75 W
2	80 W	100 W
3	120 W	150 W
4	160 W	200 W
5	200 W	250 W
6	240 W	300 W



Caution

These cables must never be cut to shorten the cold tail.

Use

Drain-line cables are series resistors. Consult the pages of the catalogue devoted to the corresponding general operating principles, general instructions for use and accessories.

	CSC2
Heating wire	Nickel-Chrome or Nickel-Cuivre
Insulation	Silicon elastomer
Section	5 x 7 mm
Power	40 or 50 W/m
Voltage	Standard 230 V
Permissible surface temperature	from - 70°C to + 200°C
Tolerances	Power: $\pm 10\%$ Section: $+ 0.2 / - 0.1$ mm Length: $\pm 1\%$

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E-mail: flexelec@omerin.com

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Tel: + 49 (0) 6126.94.31-0
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E-mail: omeringmbh@omerin.com

CSC2K - Silicon elastomer insulated drain-line heaters with integrated thermostat



Characteristics

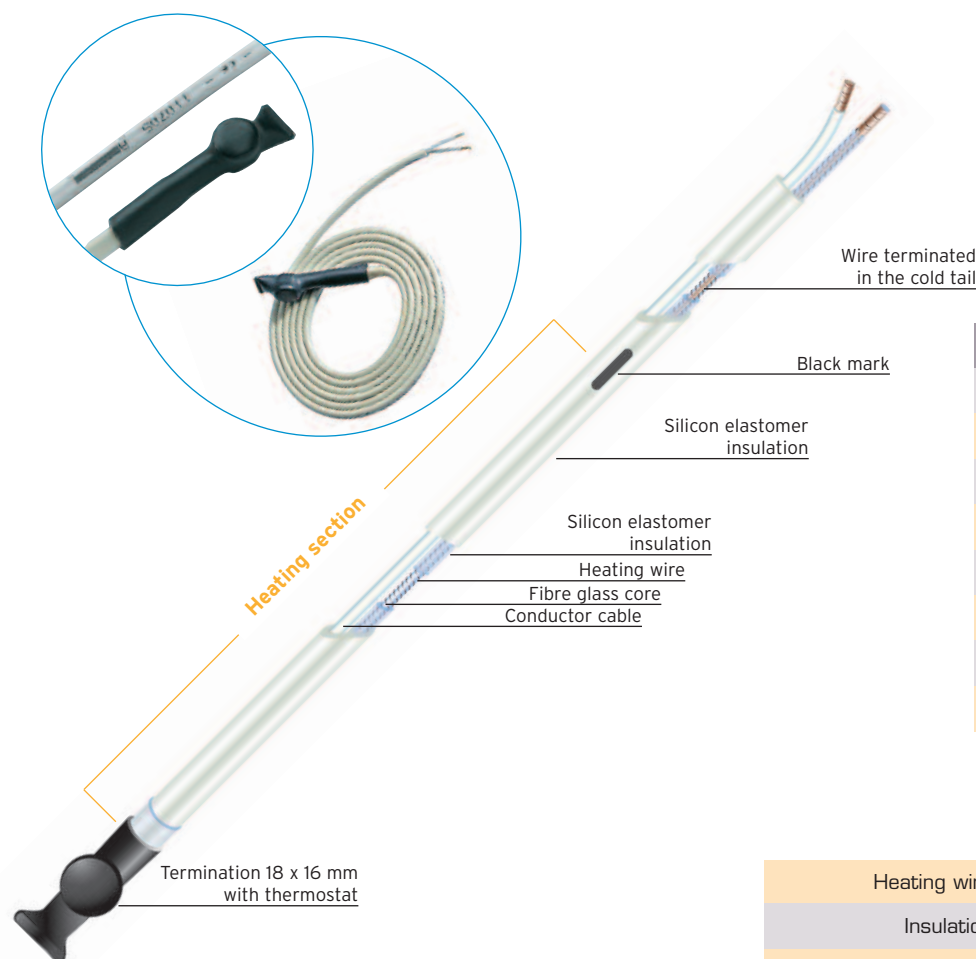
- Integrated thermostat.
- Heating section fully sealed.
- Double insulation.
- Extremely flexible.
- Voltage 230 V as standard.
- Power cable: length 1 m as standard.

Applications

CSC2K heaters are designed to be placed at the bottom of collector trays inside refrigeration equipment in cold rooms, to prevent freezing and to allow condensate water to flow freely.

The integrated thermostat makes them fully autonomous. It must not be immersed.

Note: The most commonly used power rating is 50 W/m. However, for plastic trays, we strongly recommend using the 40W/m range.



Standard models

Length (m)	CSC2K	
	40 W/m	50 W/m
1	40 W	50 W
1.3	52 W	65 W
1.5	60 W	75 W
2	80 W	100 W
3	120 W	150 W
4	160 W	200 W
5	200 W	250 W
6	240 W	300 W

	CSC2K
Heating wire	Nickel-Chrome or Nickel-Copper
Insulation	Silicon elastomer
Section	5 x 7 mm
Power	40 or 50 W/m
Voltage	230 V as standard
Permissible surface temperature	from - 40°C to + 110°C
Tolerances	Power: ± 10 % Section: + 0.2 / - 0.1 mm Length: ± 1 %
End insulation	Heat-shrink sheath with adhesive
Thermostat	Pre-set to + 5°C/+ 15°C as standard

Caution

These cables must never be cut to shorten the cold tail. The round part of the thermostat (sensor) must be placed in the best position to collect information so that the cable can operate as required.

Use

Drain-line cables are series resistors. Consult the pages of the catalogue devoted to the corresponding general operating principles, general instructions for use and accessories.

FLEXELEC S.A.S

10, rue des frères Lumière
Z.A. du Bois Rond
69720 ST BONNET DE MURE - FRANCE
Tel: + 33 (0)4.72.48.30.90
Fax: + 33 (0)4.78.40.82.81
E-mail: flexelec@omerin.com

FLEXELEC Dept

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SINGAPORE 308900
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Hertfordshire - WD4 8ST - UK
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OMERIN GmbH
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D-65510 IDSTEIN - GERMANY
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E-mail: omerin@omerin.com

Flexible heating cables and elements temperature maintenance systems



FLEXTAPE®

HEATING TAPES

RP - RP/T - RP/I	PVC INSULATED TAPES	38
RS - RS/T - RS/I	SILICON ELASTOMER INSULATED TAPES	39
RSV	ANTI-CONDENSATION TAPES FOR ELECTRIC MOTORS	40
RV - RV/I	FIBRE GLASS INSULATED TAPES	41
RVR	SILICA FIBRE INSULATED TAPES	42

RP - RP/T - RP/I PVC insulated tape



Characteristics

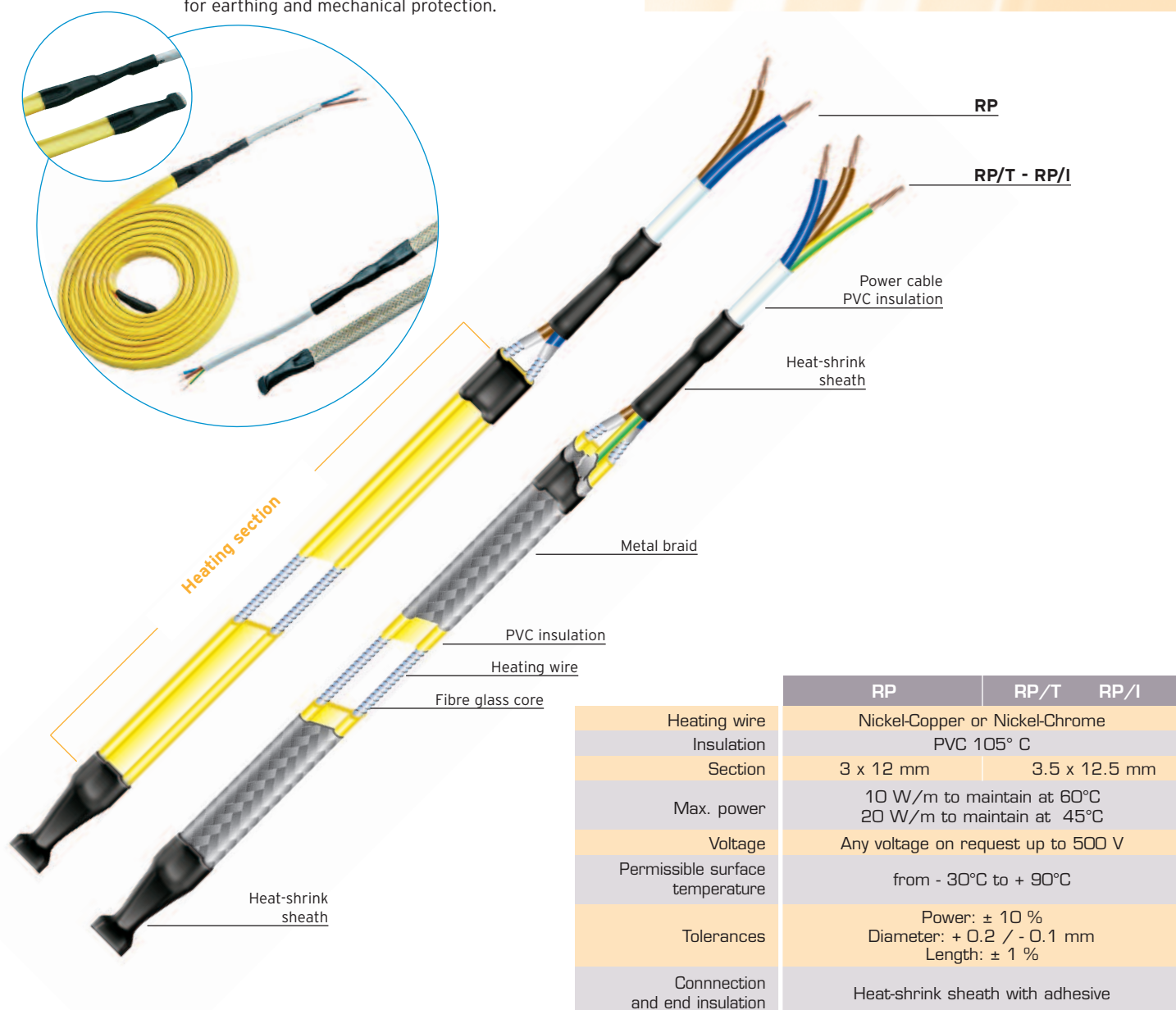
- Max. power 20 W/m.
- Power cable: length 1 m as standard.
- RP : PVC insulated heating tape.
- RP/T : with tinned copper braid for earthing and mechanical protection.
- RP/I : with stainless steel braid for earthing and mechanical protection.

Applications

RP, RP/T and RP/I heating tapes are mainly used to protect piping from freezing, but they can also be used to maintain temperatures up to 60°C.

Insulation is provided by an extremely flexible, high-temperature PVC which makes the tapes easy to use.

To ensure that these heating elements enjoy a long service life, we recommend using a control device.



	RP	RP/T	RP/I
Heating wire	Nickel-Copper or Nickel-Chrome		
Insulation	PVC 105° C		
Section	3 x 12 mm	3.5 x 12.5 mm	
Max. power	10 W/m to maintain at 60°C 20 W/m to maintain at 45°C		
Voltage	Any voltage on request up to 500 V		
Permissible surface temperature	from - 30°C to + 90°C		
Tolerances	Power: ± 10 % Diameter: + 0.2 / - 0.1 mm Length: ± 1 %		
Connnection and end insulation	Heat-shrink sheath with adhesive		

Use

Heating tapes are series resistors. Consult the pages of the catalogue devoted to the corresponding general operating principles, general instructions for use and accessories.

FLEXELEC S.A.S

10, rue des frères Lumière
Z.A. du Bois Rond
69720 ST BONNET DE MURE - FRANCE
Tel: + 33 (0)4.72.48.30.90
Fax: + 33 (0)4.78.40.82.81
E-mail: flexelec@omerin.com

FLEXELEC Dept

OMERIN ASIA Pte Ltd
51 Goldhill Plaza #08-12/01
SINGAPORE 308900
Tel: + 65.6255.4778
Fax: + 65.6255.4779
E-mail: sales@omerin.com.sg

FLEXELEC (UK) Ltd

Unit 11 Kings Park Industrial Estate
Primrose Hill - KINGS LANGLEY
Hertfordshire - WD4 8ST - UK
Tel: + 44 (0) 1923.274477
Fax: + 44 (0) 1923.270264
E-mail: sales@omerin.co.uk

FLEXELEC Dept

OMERIN GmbH
Buchwiese 16
D-65510 IDSTEIN - GERMANY
Tel: + 49 (0) 6126.94.31-0
Fax: + 49 (0) 6126.83.99
E-mail: omeringmbh@omerin.com

RS - RS/T - RS/I

Silicon elastomer insulated tapes



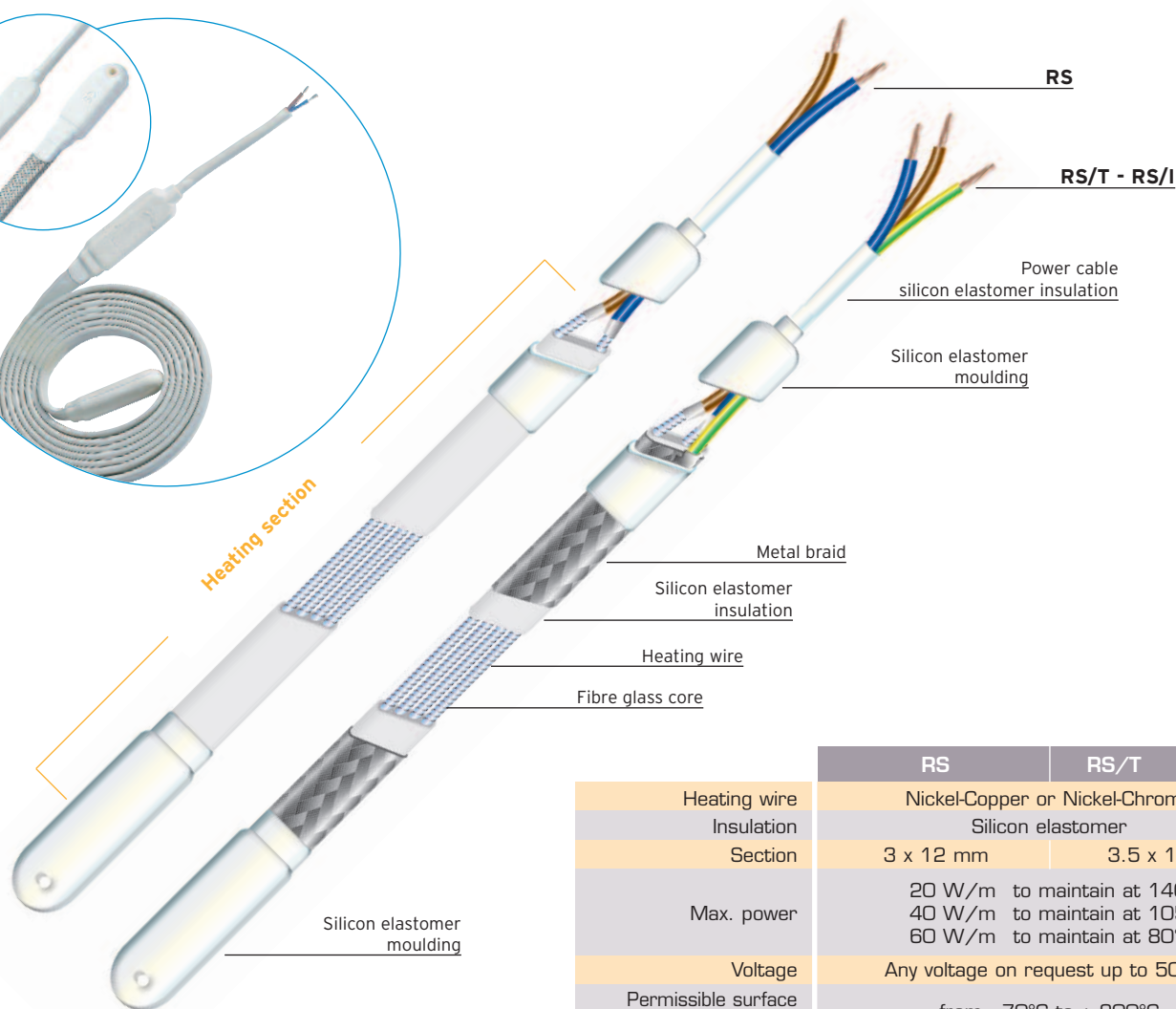
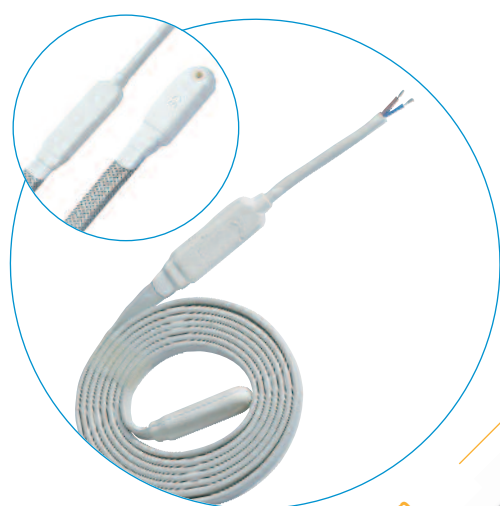
Characteristics

- Max. power 60 W/m.
- Power cable: length 1 m as standard.
- **RS** : silicon elastomer insulated tapes.
- **RS/T** : with tinned copper braid for earthing and mechanical protection.
- **RS/I** : with stainless steel braid for earthing and mechanical protection.

Applications

RS, RS/T and RS/I heating tapes are designed for maintaining temperatures of up to 140°C. They are insulated with a completely sealed silicon elastomer.

To ensure that these heating elements enjoy a long service life, we recommend using a control device.



	RS	RS/T	RS/I
Heating wire	Nickel-Copper or Nickel-Chrome		
Insulation	Silicon elastomer		
Section	3 x 12 mm	3.5 x 12.5 mm	
Max. power	20 W/m to maintain at 140°C		
	40 W/m to maintain at 105°C		
	60 W/m to maintain at 80°C		
Voltage	Any voltage on request up to 500 V		
Permissible surface temperature	from - 70°C to + 200°C		
Tolerances	Power: ± 10 %		
	Diameter: + 0.2 / - 0.1 mm		
	Length: ± 1 %		
Connection and end insulation	Sealed silicon elastomer moulding		

Use

Heating tapes are series resistors. Consult the pages of the catalogue devoted to the corresponding general operating principles, general instructions for use and accessories.

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69720 ST BONNET DE MURE - FRANCE
Tel: + 33 (0)4.72.48.30.90
Fax: + 33 (0)4.78.40.82.81
E-mail: flexelec@omerin.com

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51 Goldhill Plaza #08-12/01
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Fax: + 65.6255.4779
E-mail: sales@omerin.com.sg

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Primrose Hill - KINGS LANGLEY
Hertfordshire - WD4 8ST - UK
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Fax: + 44 (0) 1923.270264
E-mail: sales@omerin.co.uk

FLEXELEC Dept

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D-65510 IDSTEIN - GERMANY
Tel: + 49 (0) 6126.94.31-0
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E-mail: omeringmbh@omerin.com

RSV**Anti-condensation tapes for electric motors****Characteristics**

- Very flexible.
- Maximum heat transfer.
- Damp-proof.
- Extended range of lengths and power ratings.
- Power cable: length 500 mm as standard.
- Voltage 230 V as standard (115 V on request).
- Approved for use in motors running in explosive atmospheres.
- **ATEX certificate:** Sira N° 02ATEX3410U.
- **IECEx certificate:** SIR 10.0151U

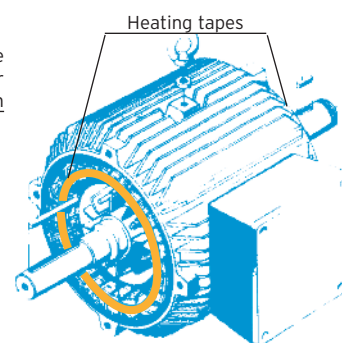
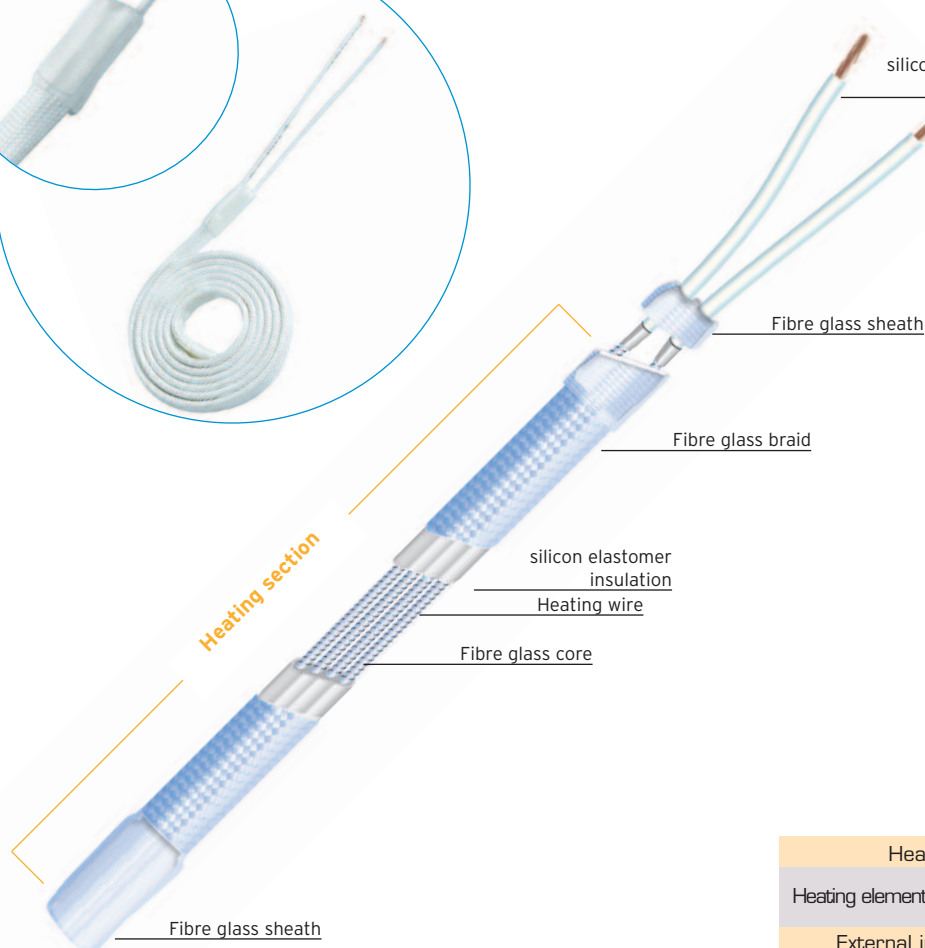
Applications

RSV heating tapes are specially designed for electric motors to prevent condensation.

These elements are ready to be incorporated into the motor coil with their fibre glass braid.

RSV tapes are practical to use and very efficient. They transfer a maximum amount of heat as they are in direct contact with the stator. RSV tapes are generally energised when the motor stops.

To ensure that these heating elements enjoy a long service life, we recommend using a control device.

**Standard models**

Length (m)	Power (W)
0.30	25
0.43	25
0.68	40
0.79	26
1.01	42
1.06	50
1.47	65
1.70	75
1.70	100
1.85	100

Use

Heating tapes are series resistors. Consult the pages of the catalogue devoted to the corresponding general operating principles, general instructions for use and accessories.

	RSV
Heating wire	Nickel-Copper or Nickel-Chrome
Heating element insulation	Silicon elastomer
External insulation	Fibre glass braid
Dimensions	3 x 11 mm
Permissible surface temperature	from - 70°C to + 200°C
Tolerances	Power: ± 10 %
Connection and end insulation	Fibre glass sheath

FLEXELEC S.A.S

10, rue des frères Lumière
 Z.A. du Bois Rond
 69720 ST BONNET DE MURE - FRANCE
 Tel: + 33 (0)4.72.48.30.90
 Fax: + 33 (0)4.78.40.82.81
 E-mail: flexelec@omerin.com

FLEXELEC Dept

OMERIN ASIA Pte Ltd
 51 Goldhill Plaza #08-12/01
 SINGAPORE 308900
 Tel: + 65.6255.4778
 Fax: + 65.6255.4779
 E-mail: sales@omerin.com.sg

FLEXELEC (UK) Ltd

Unit 11 Kings Park Industrial Estate
 Primrose Hill - KINGS LANGLEY
 Hertfordshire - WD4 8ST - UK
 Tel: + 44 (0) 1923.274477
 Fax: + 44 (0) 1923.270264
 E-mail: sales@omerin.co.uk

FLEXELEC Dept

OMERIN GmbH
 Buchwiese 16
 D-65510 IDSTEIN - GERMANY
 Tel: + 49 (0) 6126.94.31-0
 Fax: + 49 (0) 6126.83.99
 E-mail: omeringmbh@omerin.com

RV - RV/I Fibre glass insulation tapes



Characteristics

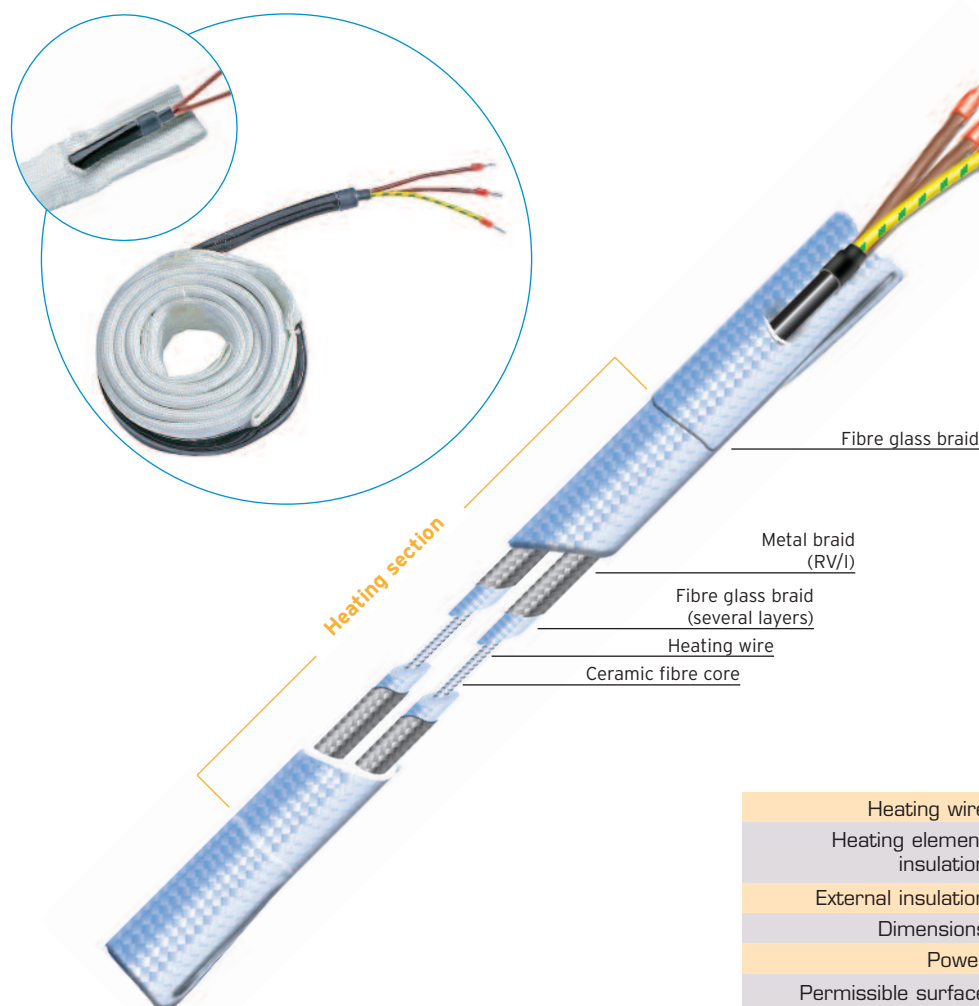
- Highly flexible.
- Minimum bend radius 15 mm.
- High power rating: 250 W/m.
- High temperature: up to + 450°C.
- Not damp-proof.
- Voltage 230 V as standard.
- Power cable: length 500 mm as standard.
- **RV** : fibre glass insulated tapes.
- **RV/I** : with stainless steel braid for earthing and mechanical protection.

Applications

RV and RV/I fibre glass tapes are mainly for use in laboratories and industry when it is required to heat quickly to a high temperature.

The tapes are very flexible but as they are not damp-proof they can only be used in a dry atmosphere, and in compliance with the electrical protection instructions in force.

To ensure that these heating elements enjoy a long service life, we recommend using a control device.



Standard models

Length (m)	Power (W)
0.5	125
1	250
2	500
3	750
4	1000
5	1250

RV - RV/I	
Heating wire	Nickel-Copper or Nickel-Chrome
Heating element insulation	Fibre glass braid
External insulation	Fibre glass braid
Dimensions	5 x 30 mm
Power	250 W/m
Permissible surface temperature	up to + 450°C
Tolerance	Power \pm 10 %

Use

Heating tapes are series resistors. Consult the pages of the catalogue devoted to the corresponding general operating principles, general instructions for use and accessories.

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10, rue des frères Lumière
Z.A. du Bois Rond
69720 ST BONNET DE MURE - FRANCE
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51 Goldhill Plaza #08-12/01
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OMERIN GmbH
Buchwiese 16
D-65510 IDSTEIN - GERMANY
Tel: + 49 (0) 6126.94.31-0
Fax: + 49 (0) 6126.83.99
E-mail: omeringmbh@omerin.com

RVR

Silica fibre insulated tapes



Characteristics

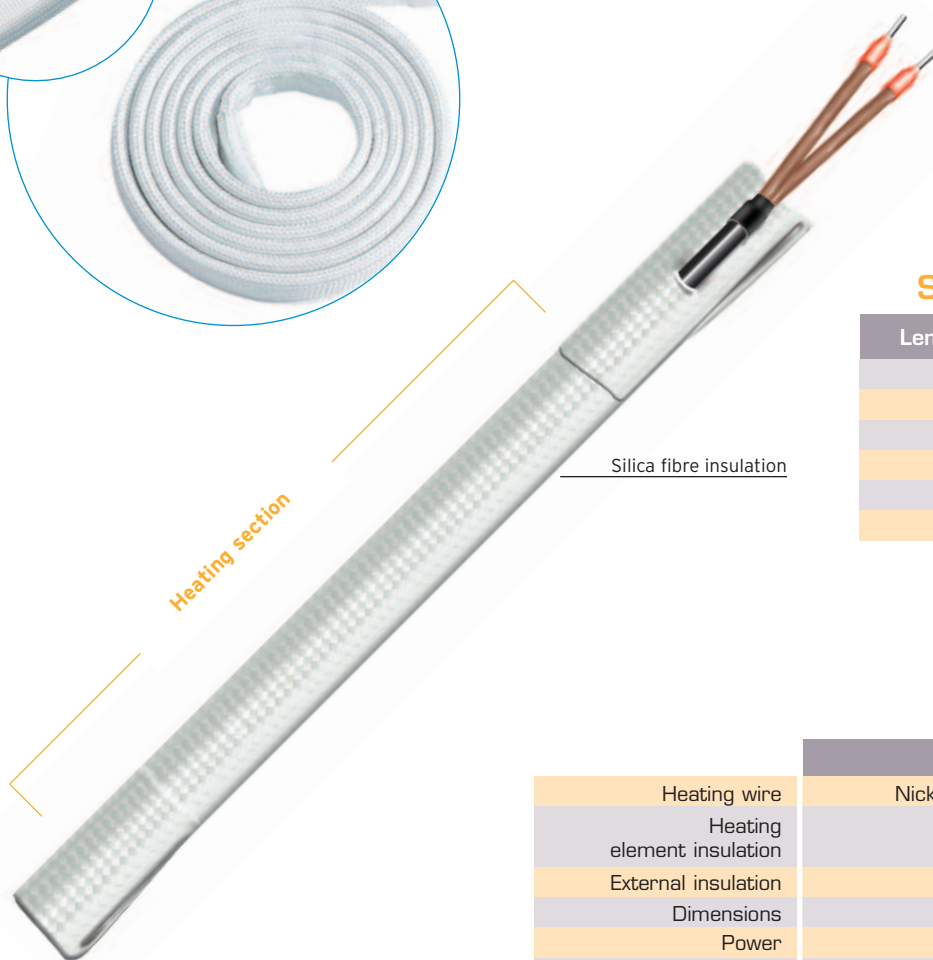
- Highly flexible.
- Very high power rating: 350 W/m.
- High temperature: up to + 900°C
- Not damp-proof.
- Voltage 230 V as standard.
- Power cable: length 400 mm as standard.

Applications

RVR silica fibre tapes are mainly for use in laboratories and in industry if a high concentration of power is necessary or if it is required to work at high temperature, as the "silica fibre" enables the heating element to withstand temperatures of up to 900°C.

These heating tapes are for use only in dry buildings, provided extra electrical protection precautions are taken.

To ensure that these heating elements enjoy a long service life, we recommend using a control device.



Standard models

Length (m)	Power (W)
0.5	175
1	350
1.5	525
2	700
2.5	875
3	1050

	RVR
Heating wire	Nickel-Copper or Nickel-Chrome
Heating element insulation	Fibre glass braid
External insulation	Silica fibre
Dimensions	8 x 30 mm
Power	350 W/m
Permissible surface temperature	up to + 900°C
Tolerance	Power \pm 10 %

Use

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 69720 ST BONNET DE MURE - FRANCE
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 E-mail: flexelec@omerin.com

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 Buchwiese 16
 D-65510 IDSTEIN - GERMANY
 Tel: + 49 (0) 6126.94.31-0
 Fax: + 49 (0) 6126.83.99
 E-mail: omeringmbh@omerin.com

Flexible heating cables and elements temperature maintenance systems



STOPGEL® - ANTIFREEZE®

STOPGEL - ANTIFREEZE

Ready-to-use cables

 VERITAS Certificate
 N° 1563016

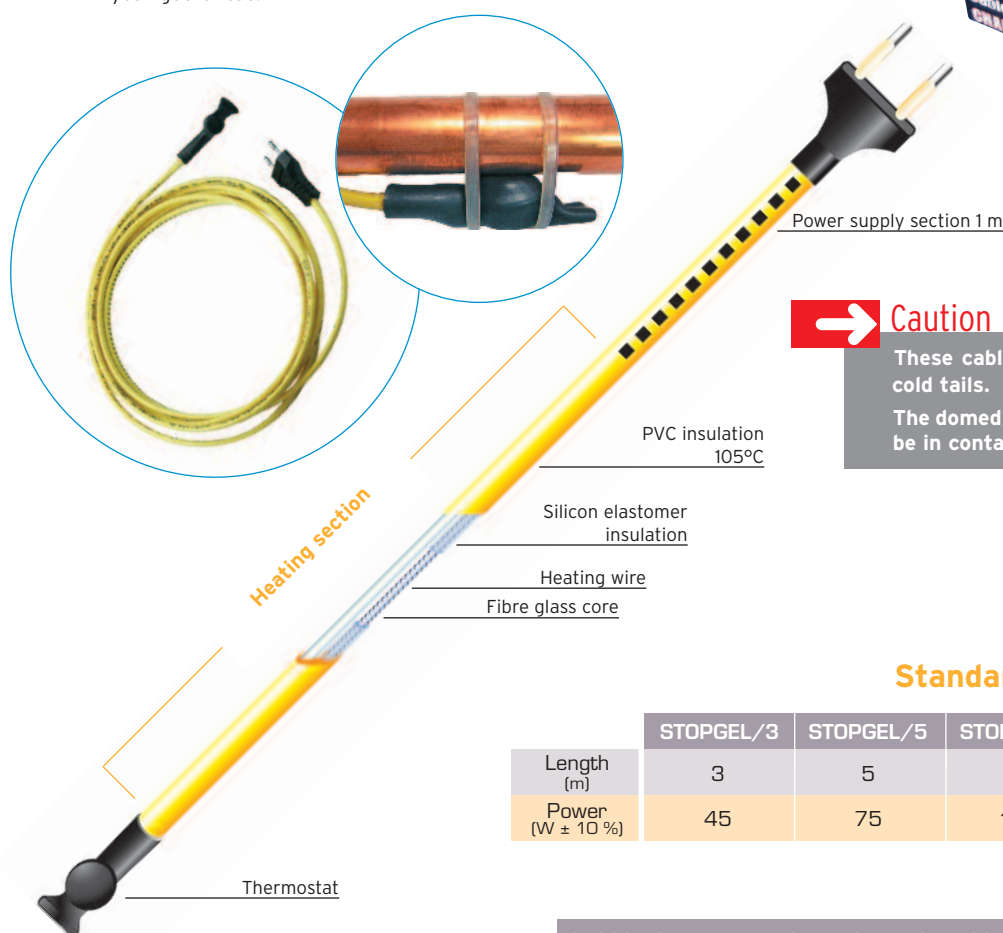

Characteristics

- Voltage 230 V - 50 Hz.
- Double insulation.
- Protection class II.
- Permissible service temperature from - 30°C to + 80°C.
- Complete kit for easy installation.
- Power rating 15 W/m.
- Flat section 5 x 7 mm for better heat transfer.
- 1 meter long power supply section at one end only.
- Electrical connection plug included.
- Thermostat incorporated at the end of the cable.
- Fitting accessories supplied.
- 2-year guarantee.

Applications

STOPGEL - ANTIFREEZE heating cables have been specially designed for protecting metal piping against freezing.

When properly fitted, the heating cables come into operation at + 5°C and will protect your installation against freezing.



Caution

These cables must never be cut to shorten the cold tails.

The domed part of the thermostat (sensor) must be in contact with the piping.

Standard models

	STOPGEL/3	STOPGEL/5	STOPGEL/7	STOPGEL/10	STOPGEL/15
Length (m)	3	5	7	10	15
Power (W ± 10 %)	45	75	105	150	225

CHOOSING THE MIN. INSULATION THICKNESS to protect against freezing down to - 25°C

External diameter of the metal piping (mm)	10	12	16	18	20	24	32	40	48
Thermal insulation thickness (mm)	9	9	9	9	9	9	13	19	19

Use

STOPGEL - ANTIFREEZE cables are series resistors. Consult the pages of the catalogue devoted to the corresponding general operating principles, general instructions for use and accessories.

FLEXELEC S.A.S

10, rue des frères Lumière
 Z.A. du Bois Rond
 69720 ST BONNET DE MURE - FRANCE
 Tel: + 33 (0)4.72.48.30.90
 Fax: + 33 (0)4.78.40.82.81
 E-mail: flexelec@omerin.com

FLEXELEC Dept

OMERIN ASIA Pte Ltd
 51 Goldhill Plaza #08-12/01
 SINGAPORE 308900
 Tel: + 65.6255.4778
 Fax: + 65.6255.4779
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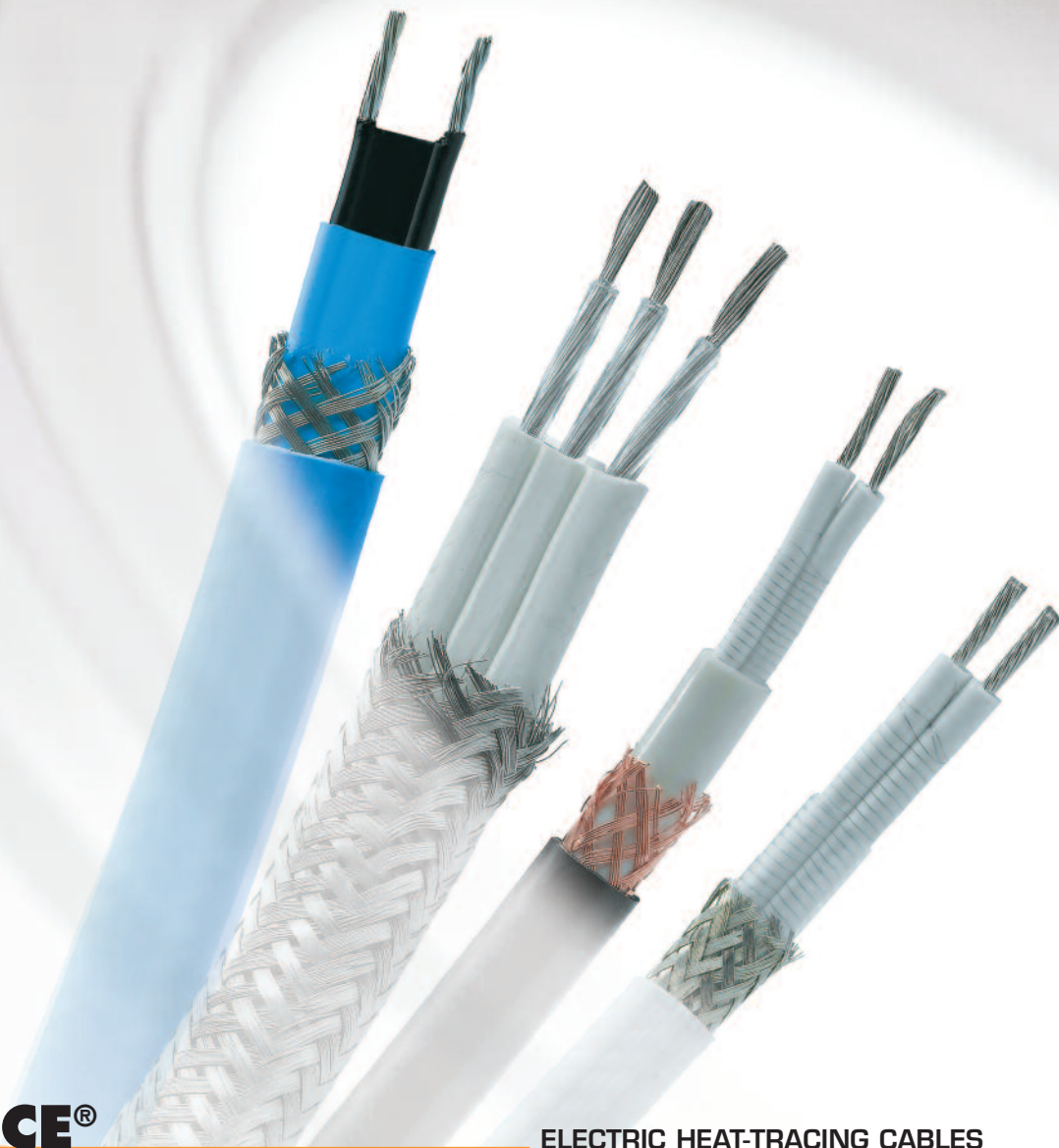
FLEXELEC (UK) Ltd

Unit 11 Kings Park Industrial Estate
 Primrose Hill - KINGS LANGLEY
 Hertfordshire - WD4 8ST - UK
 Tel: + 44 (0) 1923.274477
 Fax: + 44 (0) 1923.270264
 E-mail: sales@omerin.co.uk

FLEXELEC Dept

OMERIN GmbH
 Buchwiese 16
 D-65510 IDSTEIN - GERMANY
 Tel: + 49 (0) 6126.94.31-0
 Fax: + 49 (0) 6126.83.99
 E-mail: omeringmbh@omerin.com

Flexible heating cables and elements temperature maintenance systems



FLEXTRACE®

ELECTRIC HEAT-TRACING CABLES

FSG - FSG/T - FSG/TP - FSG/TF	SELF-REGULATING CABLES FOR REFRIGERATION	46
FSH/TP	SELF-REGULATING CABLES FOR HOT WATER	47
FST - FST/T - FST/I - FST/TP - FST/TF	SELF-REGULATING CABLES	48
FSV - FSV/T - FSV/I - FSV/TF	SELF-REGULATING CABLES	49
FSX - FSX/T - FSX/I - FSX/TF	SELF-REGULATING CABLES	50
FTC	CONSTANT POWER CABLES FOR GUTTERS	51
FTP - FTP/T - FTP/I - FTP/TP	PVC INSULATED CONSTANT POWER CABLES	52
FTPO - FTPO/T	PVC INSULATED CONSTANT POWER CABLES FOR REFRIGERATION	53
FTSH - FTSH/T - FTSH/I - FTSH/TS - FTSH/TF	SILICON ELASTOMER INSULATED CONSTANT POWER CABLES	54
FTSO - FTSO/T	SILICON ELASTOMER INSULATED CONSTANT POWER CABLES FOR REFRIGERATION	55
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ZFE/CGE/ATEX - ZFA/CGA/ATEX	ATEX FLUOROPOLYMER INSULATED CONSTANT POWER CABLES	60

FSG - FSG/T - FSG/TP - FSG/TF

Self-regulating cables for refrigeration



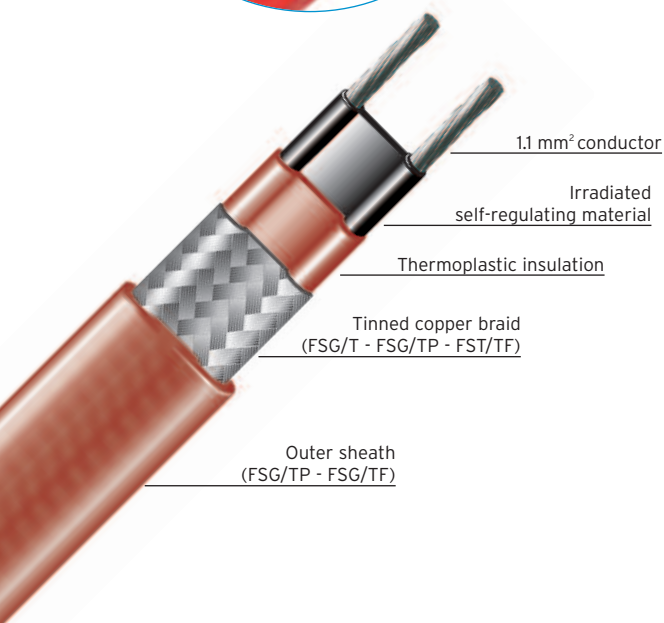
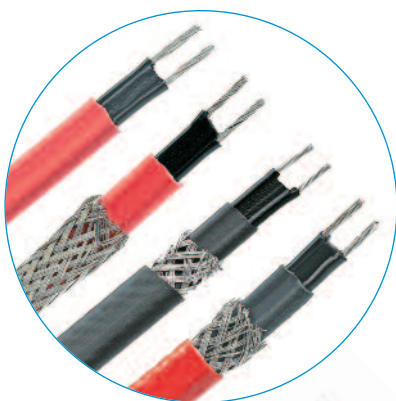
Characteristics

- Can be cut to length on site.
- Will not self-destruct by overheating.
- Power supply: 230 V.
- Available as 10, 15, 25 or 30 W/m at +10°C.
- **FSG** : self-regulating cables, thermoplastic insulation.
- **FSG/T** : with tinned copper braid for mechanical protection and earthing.
- **FSG/TP** : with tinned copper braid and outer thermoplastic anticorrosion sheath.
- **FSG/TF** : with tinned copper braid and outer fluoropolymer sheath, ideal for the chemical industry where corrosive substances may be present.

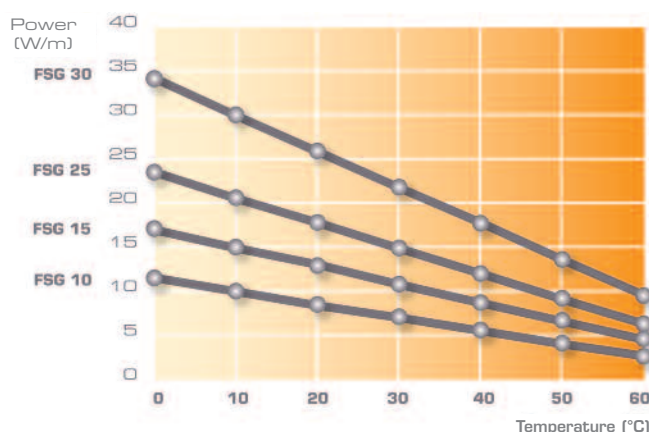
Applications

The **FSG** range of heating cables is recommended for the refrigeration industry to protect against freezing or to maintain moderate temperatures.

To ensure that these heating elements enjoy a long service life, we recommend using a control device.



Power output according to pipe temperature



	FSG 10	FSG 15	FSG 25	FSG 30
Insulation	Thermoplastic			
Dimensions				
FSG	4 x 8 mm			
FSG/T	4.5 x 8.5 mm			
FSG/TP - FSG/TF	5 x 10 mm			
Power at 10°C	10 W/m	15 W/m	21 W/m	30 W/m
Permissible surface temperature	Unenergized circuit: max. + 85°C Energized circuit: max. + 65°C			
Start-up current				
+ 10°C	0.08 A/m	0.10 A/m	0.13 A/m	0.18 A/m
0°C	0.08 A/m	0.10 A/m	0.14 A/m	0.19 A/m
- 20°C	0.11 A/m	0.12 A/m	0.18 A/m	0.24 A/m
Max. circuit length	180 m	146 m	124 m	92 m

Use

Consult the pages of the catalogue devoted to the corresponding general operating principles, general instructions for use and accessories.

FLEXELEC S.A.S

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Z.A. du Bois Rond
69720 ST BONNET DE MURE - FRANCE
Tel: + 33 (0)4.72.48.30.90
Fax: + 33 (0)4.78.40.82.81
E-mail: flexelec@omerin.com

FLEXELEC Dept

OMERIN ASIA Pte Ltd
51 Goldhill Plaza #08-12/01
SINGAPORE 308900
Tel: + 65.6255.4778
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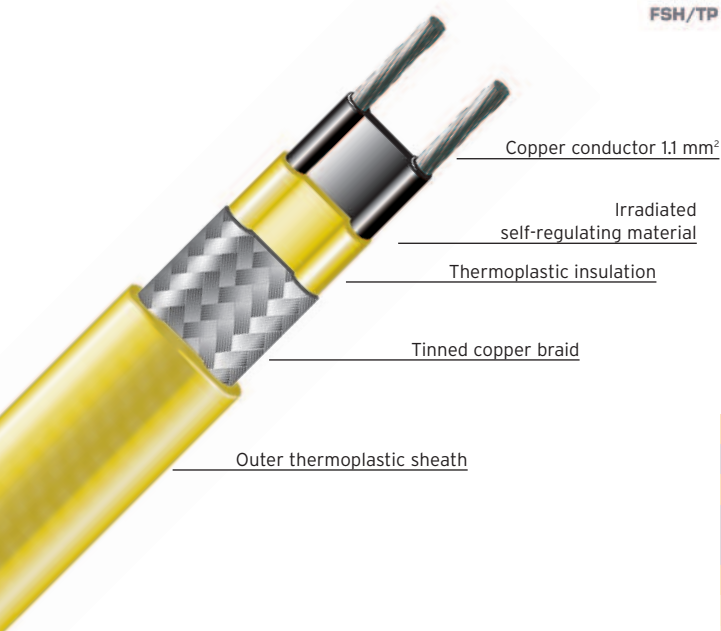
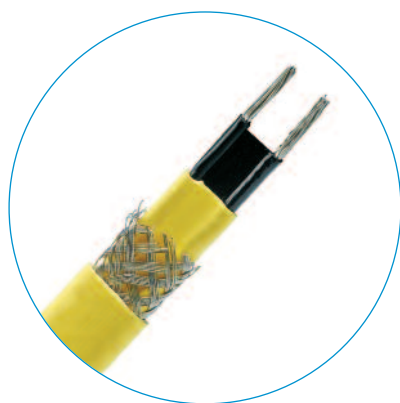
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Primrose Hill - KINGS LANGLEY
Hertfordshire - WD4 8ST - UK
Tel: + 44 (0) 1923.274477
Fax: + 44 (0) 1923.270264
E-mail: sales@omerin.co.uk

FLEXELEC Dept

OMERIN GmbH
Buchwiese 16
D-65510 IDSTEIN - GERMANY
Tel: + 49 (0) 6126.94.31-0
Fax: + 49 (0) 6126.83.99
E-mail: omeringmbh@omerin.com

**FSH/TP****Self-regulating cables for hot water****Characteristics**

- Withstands continuous hot water temperatures.
- Can be cut to length on site.
- Will not self-destruct by overheating.
- Available as 15 and 30 W/m at +10°C.
- Power supply: 230 V.
- **FSH/TP:** self-regulating cables, thermoplastic insulation with tinned copper braid and outer thermoplastic anticorrosion sheath.

**Applications**

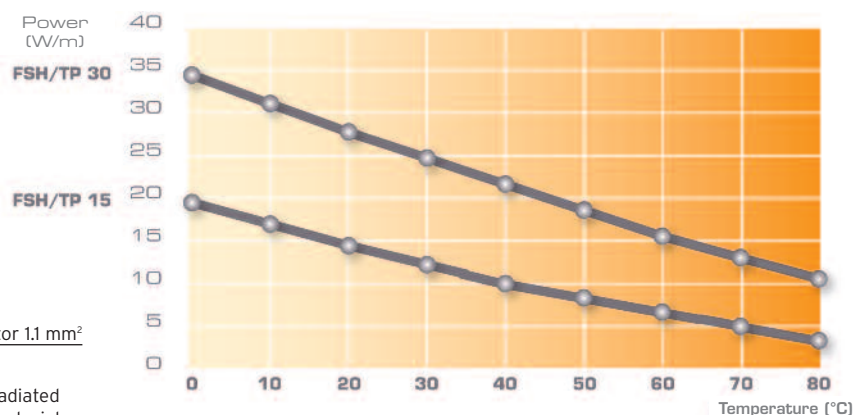
This **FSH/TP** range of self-regulating heating cables is designed for maintaining the hot water supply at a constant temperature.

When taps are not used often, the water remaining in the piping cools down and runs to waste until the hot water from the boiler arrives.

Looped circuits keep the water up to temperature only in the main piping, but this is then twice as long, and heat losses doubled, leading to a further waste of energy.

By tracing the piping network with an **FSH/TP** self-regulating heating cable under the lagging, heat losses are eliminated and the water is kept at the right temperature. Other savings are obtained by doing away with the return piping, pumps, valves, etc.

FSH/TP cables comply with the technical evaluation document issued by the CSTB.

Power output according to pipe temperature**Use**

Consult the pages of the catalogue devoted to the corresponding general operating principles, general instructions for use and accessories.

	FSH/TP 15	FSH/TP 30
Insulation	Thermoplastic	
Dimensions	6 x 13 mm	
Power at 10°C	17 W/m	31 W/m
Permissible surface temperature	Unenergized circuit: max. +100°C Energized circuit: max. +80°C	
Start-up current		
+ 18°C	0.11 A/m	0.14 A/m
0°C	0.16 A/m	0.18 A/m
Max. circuit length	138 m	110 m

FLEXELEC S.A.S

10, rue des frères Lumière
 Z.A. du Bois Rond
 69720 ST BONNET DE MURE - FRANCE
 Tel: + 33 (0)4.72.48.30.90
 Fax: + 33 (0)4.78.40.82.81
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FST - FST/T - FST/I - FST/TP - FST/TF

Self-regulating cables



Characteristics

- Can be cut to length on site.
- Will not self-destruct by overheating.
- Power supply: 230 V.
- Available as 10, 15, 25, 30 or 40 W/m at +10°C.
- **FST** : self-regulating cables, thermoplastic insulation.
- **FST/T** : with tinned copper braid for mechanical protection and earthing.
- **FST/I** : with stainless steel braid for mechanical protection and earthing.
- **FST/TP** : with tinned copper braid and outer thermoplastic anticorrosion sheath.
- **FST/TF** : with tinned copper braid and outer fluoropolymer sheath, ideal for the chemical industry where corrosive substances may be present.

Applications

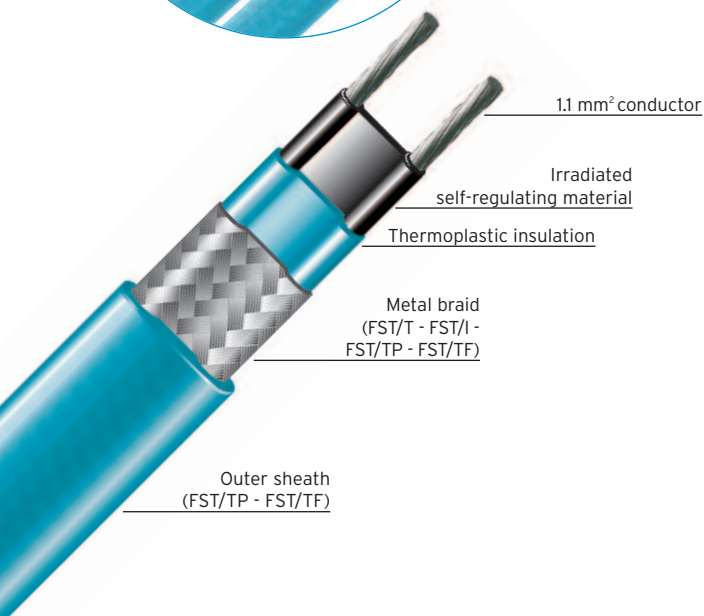
Self-regulating cables of the FST range are used to protect against freezing or to maintain moderate temperatures.

Cables of type FST/T, FST/I, FST/TP and FST/TF comply with the technical evaluation document issued by the CSTB.

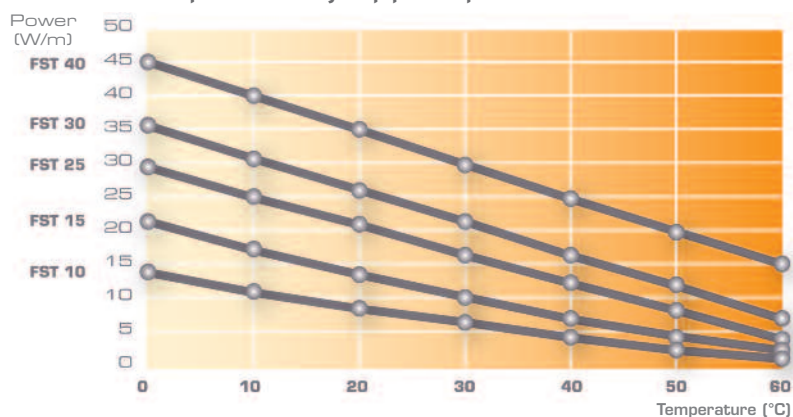
Cable FST/TP/30 is recommended for protecting against freezing in gutters.

Cables of type FST/T, FST/I, FST/TP and FST/TF can, with the appropriate accessories, be used in an explosive atmosphere.

To ensure that these heating elements enjoy a long service life, we recommend using a control device.



Power output according to pipe temperature



	FST 10	FST 15	FST 25	FST 30	FST 40
Insulation	Thermoplastic				
Dimensions					
FST	4 x 11 mm				
FST/T - FST/I	4.7 x 11.8 mm				
FST/TP - FST/TF	6 x 13 mm				
Power at 10°C	10 W/m	17 W/m	25 W/m	31 W/m	40 W/m
Permissible surface temperature	Unenergized circuit: max. + 85°C Energized circuit: max. + 65°C				
Start-up current					
+10°C	0.07 A/m	0.1 A/m	0.13 A/m	0.16 A/m	0.21 A/m
0°C	0.08 A/m	0.12 A/m	0.16 A/m	0.19 A/m	0.26 A/m
-20°C	0.12 A/m	0.15 A/m	0.21 A/m	0.24 A/m	0.32 A/m
Max. circuit length	198 m	154 m	124 m	110 m	88 m
Temperature class	T6 (85°C)				T4 (135°C)

Use

Consult the pages of the catalogue devoted to the corresponding general operating principles, general instructions for use and accessories.

ATEX certificate: SIRA N° 03ATEX3312  II 2G

FLEXELEC S.A.S

10, rue des frères Lumière
Z.A. du Bois Rond
69720 ST BONNET DE MURE - FRANCE
Tel: + 33 (0)4.72.48.30.90
Fax: + 33 (0)4.78.40.82.81
E-mail: flexelec@omerin.com

FLEXELEC Dept

OMERIN ASIA Pte Ltd
51 Goldhill Plaza #08-12/01
SINGAPORE 308900
Tel: + 65.6255.4778
Fax: + 65.6255.4779
E-mail: sales@omerin.com.sg

FLEXELEC (UK) Ltd

Unit 11 Kings Park Industrial Estate
Primrose Hill - KINGS LANGLEY
Hertfordshire - WD4 8ST - UK
Tel: + 44 (0) 1923.274477
Fax: + 44 (0) 1923.270264
E-mail: sales@omerin.co.uk

FLEXELEC Dept

OMERIN GmbH
Buchwiese 16
D-65510 IDSTEIN - GERMANY
Tel: + 49 (0) 6126.94.31-0
Fax: + 49 (0) 6126.83.99
E-mail: omeringmbh@omerin.com

FSV - FSV/T - FSV/I - FSV/TF Self-regulating cables



Characteristics

- Available as 15, 30, 45 or 60 W/m at + 10°C.
- Can be cut to length on site.
- Will not self-destruct by overheating.
- Power supply: 230 V.
- **FSV** : self-regulating cables, fluoropolymer insulation.
- **FSV/T** : with tinned copper braid for mechanical protection and earthing.
- **FSV/I** : with stainless steel braid for mechanical protection and earthing.
- **FSV/TF** : with tinned copper braid and outer fluoropolymer sheath, ideal for the chemical industry where corrosive substances may be present.

Applications

The **FSV** range of heating cables is recommended to protect against freezing or to maintain medium temperatures .

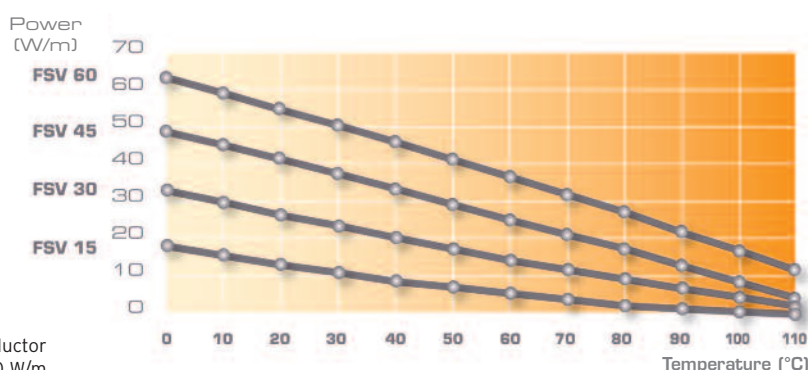
Cables of type **FSV/T**, **FSV/I** and **FSV/TF**, with power rating 15 and 30 W/m, comply with the technical evaluation document issued by the CSTB.

Cables of type **FSV/T**, **FSV/I** and **FSV/TF** can, with the appropriate accessories, be used in an explosive atmosphere.

To ensure that these heating elements enjoy a long service life, we recommend using a control device.



Power output according to pipe temperature



	FSV 15	FSV 30	FSV 45	FSV 60
Insulation	Fluoropolymer			
Dimensions				
FSV	3 x 10 mm		4 x 13 mm	
FSV/T - FSV/I	3,5 x 10,5 mm		4,5 x 13,5 mm	
FSV/TF	6 x 12 mm		7 x 15 mm	
Power at + 10°C	17 W/m	31 W/m	45 W/m	60 W/m
Permissible surface temperature	Unenergized circuit: maximum + 135°C Energized circuit: maximum + 110°C			
Start-up current				
+ 10°C	0.10 A/m	0.16 A/m	0.26 A/m	0.30 A/m
0°C	0.12 A/m	0.18 A/m	0.30 A/m	0.34 A/m
- 20°C	0.15 A/m	0.26 A/m	0.43 A/m	0.46 A/m
Max. circuit length	154 m	110 m	96 m	82 m
Temperature class	T4 (135°C)		T3 (200°C)	

Use

Consult the pages of the catalogue devoted to the corresponding general operating principles, general instructions for use and accessories.

ATEX certificate: SIRA N° 03ATEX3313  II 2G

FLEXELEC S.A.S

10, rue des frères Lumière
Z.A. du Bois Rond
69720 ST BONNET DE MURE - FRANCE
Tel: + 33 (0)4.72.48.30.90
Fax: + 33 (0)4.78.40.82.81
E-mail: flexelec@omerin.com

FLEXELEC Dept

OMERIN ASIA Pte Ltd
51 Goldhill Plaza #08-12/01
SINGAPORE 308900
Tel: + 65.6255.4778
Fax: + 65.6255.4779
E-mail: sales@omerin.com.sg

FLEXELEC (UK) Ltd

Unit 11 Kings Park Industrial Estate
Primrose Hill - KINGS LANGLEY
Hertfordshire - WD4 8ST - UK
Tel: + 44 (0) 1923.274477
Fax: + 44 (0) 1923.270264
E-mail: sales@omerin.co.uk

FLEXELEC Dept

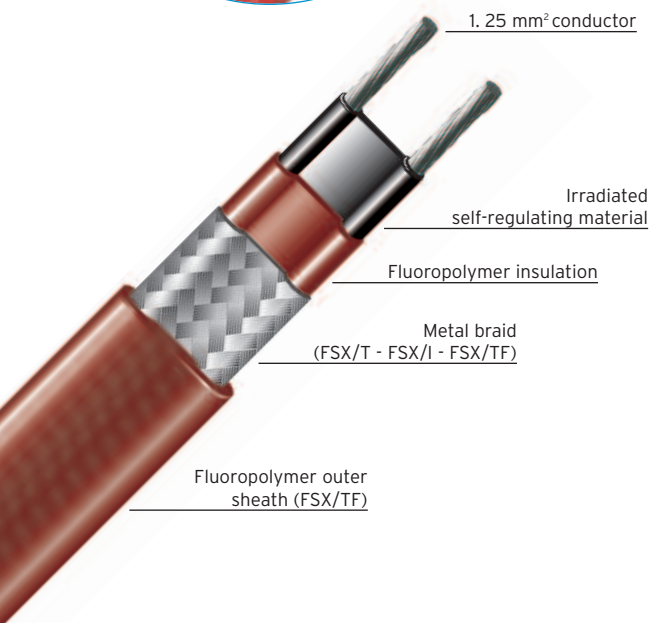
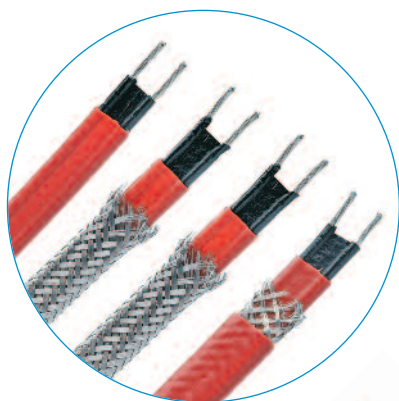
OMERIN GmbH
Buchwiese 16
D-65510 IDSTEIN - GERMANY
Tel: + 49 (0) 6126.94.31-0
Fax: + 49 (0) 6126.83.99
E-mail: omeringmbh@omerin.com

FSX - FSX/T - FSX/I - FSX/TF Self-regulating cables



Characteristics

- Available as 15, 30, 40 or 55 W/m at +10°C.
- Can be cut to length on site.
- Will not self-destruct by overheating.
- Power supply: 230 V.
- **FSX** : self-regulating cables, fluoropolymer insulation.
- **FSX/T** : with tinned copper braid for mechanical protection and earthing.
- **FSX/I** : with stainless steel braid for mechanical protection and earthing.
- **FSX/TF** : with tinned copper braid and outer fluoropolymer sheath, ideal for the chemical industry where corrosive substances may be present.



Applications

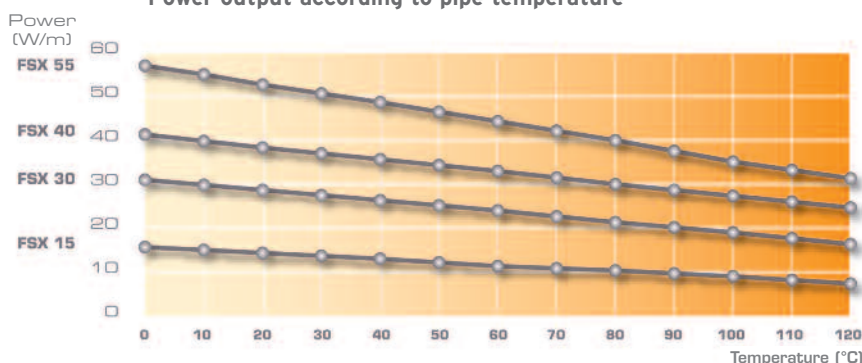
FSX self-regulating cables are recommended to protect against freezing or to maintain high temperatures.

Cables of type FSX/T, FSX/I and FSX/TF can, with the appropriate accessories, be used in an explosive atmosphere.

To ensure that these heating elements enjoy a long service life, we recommend using a control device.



Power output according to pipe temperature



	FSX 15	FSX 30	FSX 40	FSX 55
Insulation	Fluoropolymer			
Dimensions				
FSX	4 x 10 mm			
FSX/T - FSX/I	4.5 x 10.5 mm			
FSX/TF	6 x 13 mm			
Power +10°C	15 W/m	30 W/m	40 W/m	55 W/m
Permissible surface temperature	Unenergized circuit: max. + 200°C Energized circuit: max. + 120°C			
Start-up current				
+ 10°C	0.09 A/m	0.17 A/m	0.24 A/m	0.31 A/m
0°C	0.09 A/m	0.18 A/m	0.25 A/m	0.32 A/m
- 20°C	0.11 A/m	0.20 A/m	0.28 A/m	0.36 A/m
Max. circuit length	162 m	114 m	98 m	80 m
Temperature class	T2 (300°C)			

Use

Consult the pages of the catalogue devoted to the corresponding general operating principles, general instructions for use and accessories.

ATEX certificates:

SIRA N° 03ATEX3315X Ex II 2G

SIRA N° 03ATEX3314 Ex II 2G

FLEXELEC S.A.S

10, rue des frères Lumière
Z.A. du Bois Rond
69720 ST BONNET DE MURE - FRANCE
Tel: + 33 (0)472.48.30.90
Fax: + 33 (0)478.40.82.81
E-mail: flexelec@omerin.com

FLEXELEC Dept

OMERIN ASIA Pte Ltd
51 Goldhill Plaza #08-12/01
SINGAPORE 308900
Tel: + 65.6255.4778
Fax: + 65.6255.4779
E-mail: sales@omerin.com.sg

FLEXELEC (UK) Ltd

Unit 11 Kings Park Industrial Estate
Primrose Hill - KINGS LANGLEY
Hertfordshire - WD4 8ST - UK
Tel: + 44 (0) 1923.274477
Fax: + 44 (0) 1923.270264
E-mail: sales@omerin.co.uk

FLEXELEC Dept

OMERIN GmbH
Buchwiese 16
D-65510 IDSTEIN - GERMANY
Tel: + 49 (0) 6126.94.31-0
Fax: + 49 (0) 6126.83.99
E-mail: omeringmbh@omerin.com

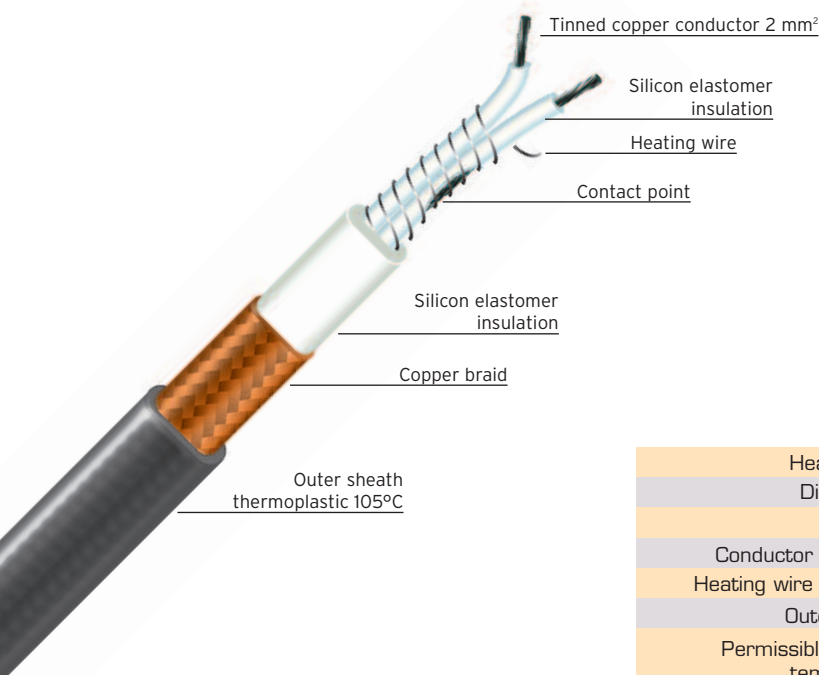
FTC

Constant power cables for gutters



Characteristics

- Hard-wearing and flexible.
- Can be cut to length on site.
- Extremely simple termination.
- Cold tail incorporated: no extra connection necessary
- Available as 30 W/m.
- Power supply: 230 V.
- Copper braid and thermoplastic outer sheath to protect against UV rays.



Applications

The FTC is a constant power cable designed to protect drainpipes and gutters against freezing.

It also guards against the consequences of two phenomena that occur in winter:

- Gutters obstructed by snowfalls: when snow on the roof melts, water cannot drain away properly and may infiltrate the facades of the building.
- Icicles hanging from gutters can be dangerous when they fall off.

Placed in the bottom of gutters and in drainpipes, the cable maintains a drainage channel for the water and prevents ice from forming.

To ensure that these heating elements enjoy a long service life, we recommend using a control device.

Installation

There are two ways of fitting the cable in the gutter or drainpipe:

- Thoroughly degrease and dry the support and lay the cable, covering it completely with **FTAL** aluminium adhesive tape.
- Glue the cable into the bottom of the gutter every meter or so using **SILT 100** silicon adhesive.

In drainpipes, hold the cable in place with an **FX/CRT** hook.

Controlling the installation with an **FX/CDM1 A** hygrothermostat will lead to significant energy savings.

FX/CRT



FX/CDM1 A

Use

Consult the pages of the catalogue devoted to the corresponding general operating principles, general instructions for use and accessories.

	FTC 30
Heating wire	Nickel-Copper or Nickel-Chrome
Dimensions	8 x 11 mm
Power	30 W/m
Conductor insulation	Silicon elastomer
Heating wire insulation	Silicon elastomer
Outer sheath	Thermoplastic 105°C
Permissible surface temperature	from - 30°C to + 90°C
Max. circuit length	100 m
Distance between 2 consecutive contact points	700 mm

FLEXELEC S.A.S

10, rue des frères Lumière
Z.A. du Bois Rond
69720 ST BONNET DE MURE - FRANCE
Tel: + 33 (0)4.72.48.30.90
Fax: + 33 (0)4.78.40.82.81
E-mail: flexelec@omerin.com

FLEXELEC Dept

OMERIN ASIA Pte Ltd
51 Goldhill Plaza #08-12/01
SINGAPORE 308900
Tel: + 65.6255.4778
Fax: + 65.6255.4779
E-mail: sales@omerin.com.sg

FLEXELEC (UK) Ltd

Unit 11 Kings Park Industrial Estate
Primrose Hill - KINGS LANGLEY
Hertfordshire - WD4 8ST - UK
Tel: + 44 (0) 1923.274477
Fax: + 44 (0) 1923.270264
E-mail: sales@omerin.co.uk

FLEXELEC Dept

OMERIN GmbH
Buchwiese 16
D-65510 IDSTEIN - GERMANY
Tel: + 49 (0) 6126.94.31-0
Fax: + 49 (0) 6126.83.99
E-mail: omeringmbh@omerin.com

FTP - FTP/T - FTP/I - FTP/TP PVC insulated constant power cables

Characteristics

- Hard-wearing and flexible.
- Can be cut to length on site.
- Extremely simple termination.
- Cold tail incorporated: no extra connection necessary.
- Available as 10, 15 and 20 W/m.
- Power supply: 230 V as standard (115 V and 400 V on request).
- **FTP** : PVC insulated constant power cables
- **FTP/T** : with tinned copper braid for mechanical protection and earthing.
- **FTP/I** : with stainless steel braid for mechanical protection and earthing.
- **FTP/TP** : with copper braid and PVC outer sheath to protect against corrosion.

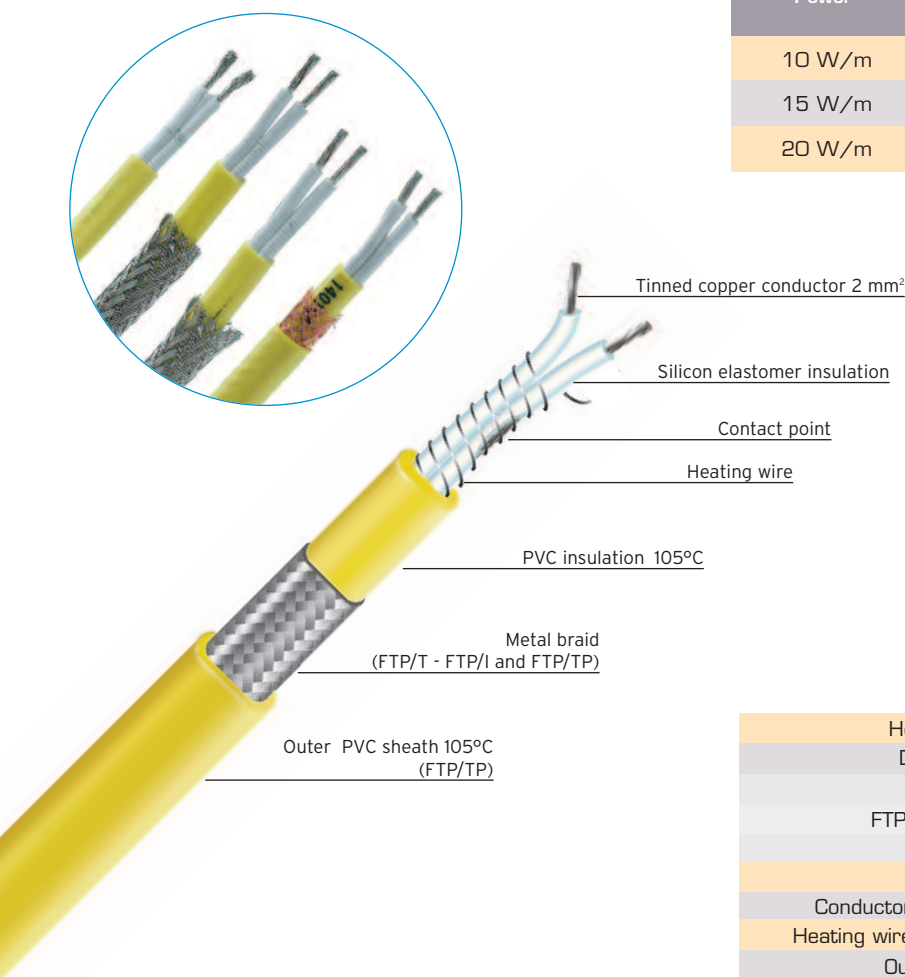
Applications

FTP cables are particularly suitable for protecting against freezing and maintaining low temperatures. Of constant power cables for industrial use, this PVC insulated version is the most economical. The **FTP 10** (10 W/m) is recommended for plastic piping.

To ensure that these heating elements enjoy a long service life, we recommend using a control device.



Power	Distance between 2 consecutive contact points	Max. circuit length	Max. maintenance temperature
10 W/m	1 m	170 m	60 °C
15 W/m	0.8 m	150 m	50 °C
20 W/m	0.7 m	140 m	40 °C



	FTP
Heating wire	Nickel-Copper or Nickel-Chrome
Dimensions	
FTP	5 x 8 mm
FTP/T - FTP/I	5.5 x 8.5 mm
FTP/TP	7 x 10 mm
Power	10, 15 or 20 W/m
Conductor insulation	Silicon elastomer
Heating wire insulation	PVC 105°C
Outer sheath	PVC 105°C
Permissible surface temperature	from - 30°C to + 90°C

Use

Consult the pages of the catalogue devoted to the corresponding general operating principles, general instructions for use and accessories.

FLEXELEC S.A.S

10, rue des frères Lumière
 Z.A. du Bois Rond
 69720 ST BONNET DE MURE - FRANCE
 Tel: + 33 (0)4.72.48.30.90
 Fax: + 33 (0)4.78.40.82.81
 E-mail: flexelec@omerin.com

FLEXELEC Dept

OMERIN ASIA Pte Ltd
 51 Goldhill Plaza #08-12/01
 SINGAPORE 308900
 Tel: + 65.6255.4778
 Fax: + 65.6255.4779
 E-mail: sales@omerin.com.sg

FLEXELEC (UK) Ltd

Unit 11 Kings Park Industrial Estate
 Primrose Hill - KINGS LANGLEY
 Hertfordshire - WD4 8ST - UK
 Tel: + 44 (0) 1923.274477
 Fax: + 44 (0) 1923.270264
 E-mail: sales@omerin.co.uk

FLEXELEC Dept

OMERIN GmbH
 Buchwiese 16
 D-65510 IDSTEIN - GERMANY
 Tel: + 49 (0) 6126.94.31-0
 Fax: + 49 (0) 6126.83.99
 E-mail: omeringmbh@omerin.com

FTPO - FTPO/T**PVC insulated constant power cables for refrigeration****Characteristics**

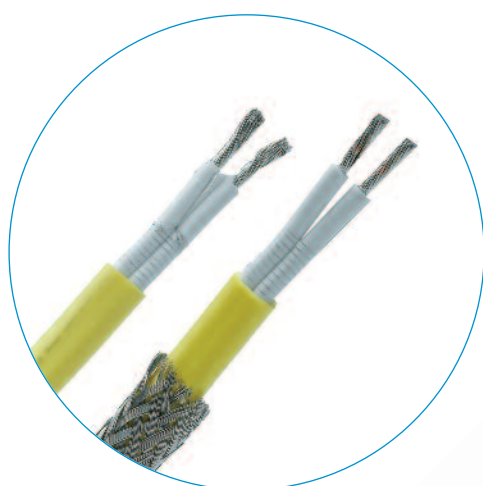
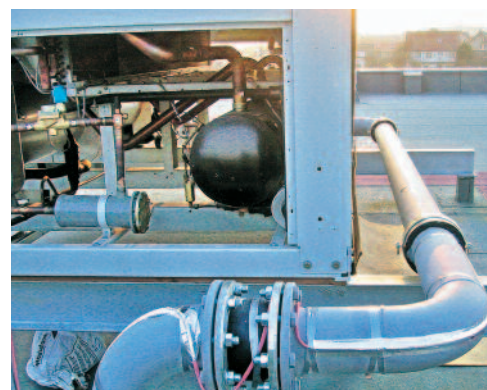
- Can be cut to length on site.
- Extremely simple termination.
- Cold tail incorporated, no extra connection necessary.
- Available as 10 and 15 W/m.
- Power supply: 230 V.
- **FTPO** : PVC insulated constant power cables.
- **FTPO/T** : with tinned copper braid for mechanical protection and earthing.

Applications

FTPO cables are the most economical constant power cables. They are extremely flexible and are designed especially for the refrigeration industry.

FTPO 10 (10 W/m) is recommended for plastic piping.

To ensure that these heating elements enjoy a long service life, we recommend using a control device.



Tinned copper
conductor 0.75 mm²

Silicon elastomer insulation

Contact point

Heating wire

PVC insulation 105°C

Tinned copper braid (FTPO/T)

Use

Consult the pages of the catalogue devoted to the corresponding general operating principles, general instructions for use and accessories.

	FTPO
Heating wire	Nickel-Copper or Nickel-Chrome
Dimensions	
FTPO	5 x 7 mm
FTPO/T	5.5 x 7.5 mm
Power	10 W/m or 15 W/m
Conductor insulation	Silicon elastomer
Heating wire insulation	PVC 105°C
Permissible surface temperature	from - 30°C to + 90°C
Max. circuit length	10 W/m : 120 m 15 W/m : 80 m
Distance between 2 consecutive contact points	10 W/m : 1 m 15 W/m : 0.9 m

FLEXELEC S.A.S

10, rue des frères Lumière
Z.A. du Bois Rond
69720 ST BONNET DE MURE - FRANCE
Tel: + 33 (0)4.72.48.30.90
Fax: + 33 (0)4.78.40.82.81
E-mail: flexelec@omerin.com

FLEXELEC Dept

OMERIN ASIA Pte Ltd
51 Goldhill Plaza #08-12/01
SINGAPORE 308900
Tel: + 65.6255.4778
Fax: + 65.6255.4779
E-mail: sales@omerin.com.sg

FLEXELEC (UK) Ltd

Unit 11 Kings Park Industrial Estate
Primrose Hill - KINGS LANGLEY
Hertfordshire - WD4 8ST - UK
Tel: + 44 (0) 1923.274477
Fax: + 44 (0) 1923.270264
E-mail: sales@omerin.co.uk

FLEXELEC Dept

OMERIN GmbH
Buchwiese 16
D-65510 IDSTEIN - GERMANY
Tel: + 49 (0) 6126.94.31-0
Fax: + 49 (0) 6126.83.99
E-mail: omeringmbh@omerin.com

FTSH - FTSH/T - FTSH/I - FTSH/TS - FTSH/TF

Silicon elastomer insulated constant power cables



Characteristics

- Welded contact points.
- Hard-wearing and flexible.
- Can be cut to length on site.
- Extremely simple termination.
- Cold tail incorporated: no extra connection necessary.
- Available as 20, 30 or 40 W/m.
- Power supply: 230 V as standard (115 V and 400 V on request).
- **FTSH** : silicon elastomer insulated constant power cables.
- **FTSH/T** : with tinned copper braid for mechanical protection and earthing.
- **FTSH/I** : with stainless steel braid for mechanical protection and earthing.
- **FTSH/TS** : with tinned copper braid and silicon elastomer outer sheath
- **FTSH/TF** : with tinned copper braid and fluoropolymer anti-corrosion outer sheath.

Applications

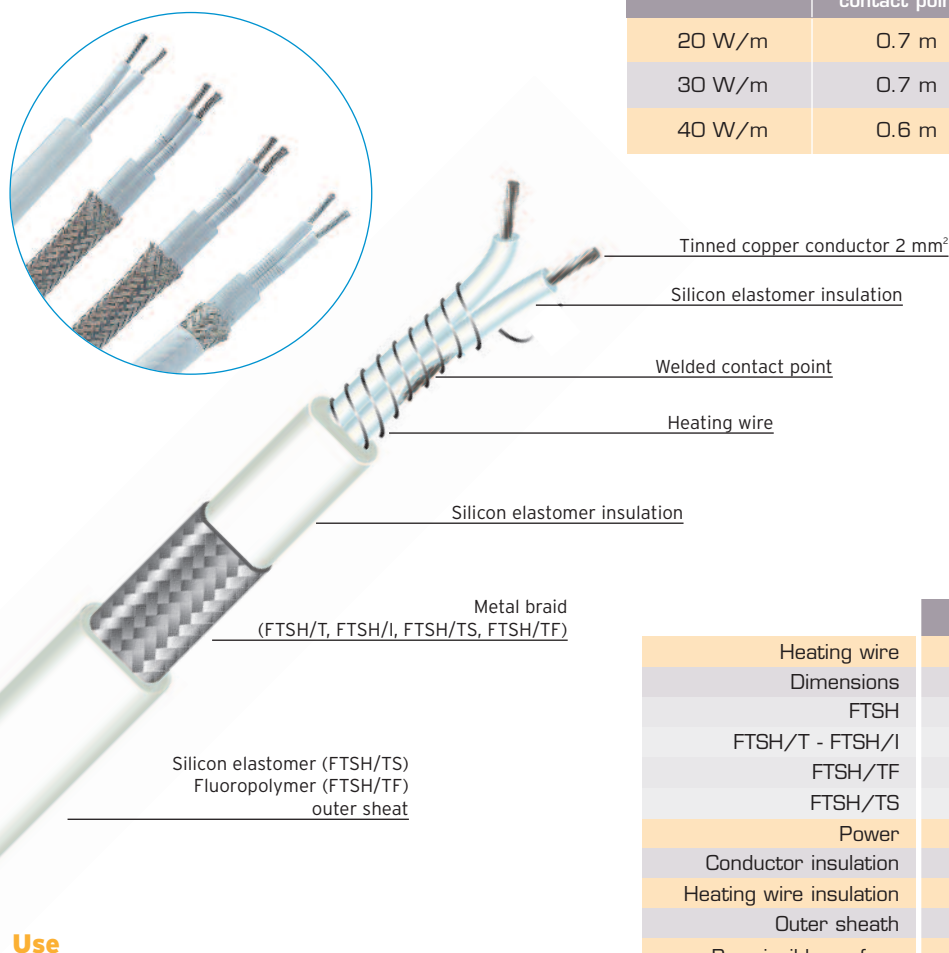
FTSH cables are particularly suitable for maintaining temperatures of up to +150°C.

Its great flexibility down to -70°C means that this version is ideal for heat tracing in industrial refrigeration or in countries with very harsh climates.

To ensure that these heating elements enjoy a long service life, we recommend using a control device.



Power	Distance between 2 consecutive contact points	Max. circuit length	Max. maintenance temperature
20 W/m	0.7 m	140 m	150°C
30 W/m	0.7 m	120 m	140°C
40 W/m	0.6 m	100 m	120°C



	FTSH
Heating wire	Nickel-Copper or Nickel-Chrome
Dimensions	
FTSH	6 x 10 mm
FTSH/T - FTSH/I	6.5 x 10.5 mm
FTSH/TF	7 x 10 mm
FTSH/TS	8 x 11 mm
Power	20, 30 or 40 W/m
Conductor insulation	Silicon elastomer
Heating wire insulation	Silicon elastomer
Outer sheath	Silicon elastomer or fluoropolymer
Permissible surface temperature	from -70°C to +200°C

Use

Consult the pages of the catalogue devoted to the corresponding general operating principles, general instructions for use and accessories.

FLEXELEC S.A.S

10, rue des frères Lumière
 Z.A. du Bois Rond
 69720 ST BONNET DE MURE - FRANCE
 Tel: + 33 (0)4.72.48.30.90
 Fax: + 33 (0)4.78.40.82.81
 E-mail: flexelec@omerin.com

FLEXELEC Dept

OMERIN ASIA Pte Ltd
 51 Goldhill Plaza #08-12/01
 SINGAPORE 308900
 Tel: + 65.6255.4778
 Fax: + 65.6255.4779
 E-mail: sales@omerin.com.sg

FLEXELEC (UK) Ltd

Unit 11 Kings Park Industrial Estate
 Primrose Hill - KINGS LANGLEY
 Hertfordshire - WD4 8ST - UK
 Tel: + 44 (0) 1923.274477
 Fax: + 44 (0) 1923.270264
 E-mail: sales@omerin.co.uk

FLEXELEC Dept

OMERIN GmbH
 Buchwiese 16
 D-65510 IDSTEIN - GERMANY
 Tel: + 49 (0) 6126.94.31-0
 Fax: + 49 (0) 6126.83.99
 E-mail: omeringmbh@omerin.com

FTSO - FTSO/T**Silicon elastomer insulated constant power cables for refrigeration****Characteristics**

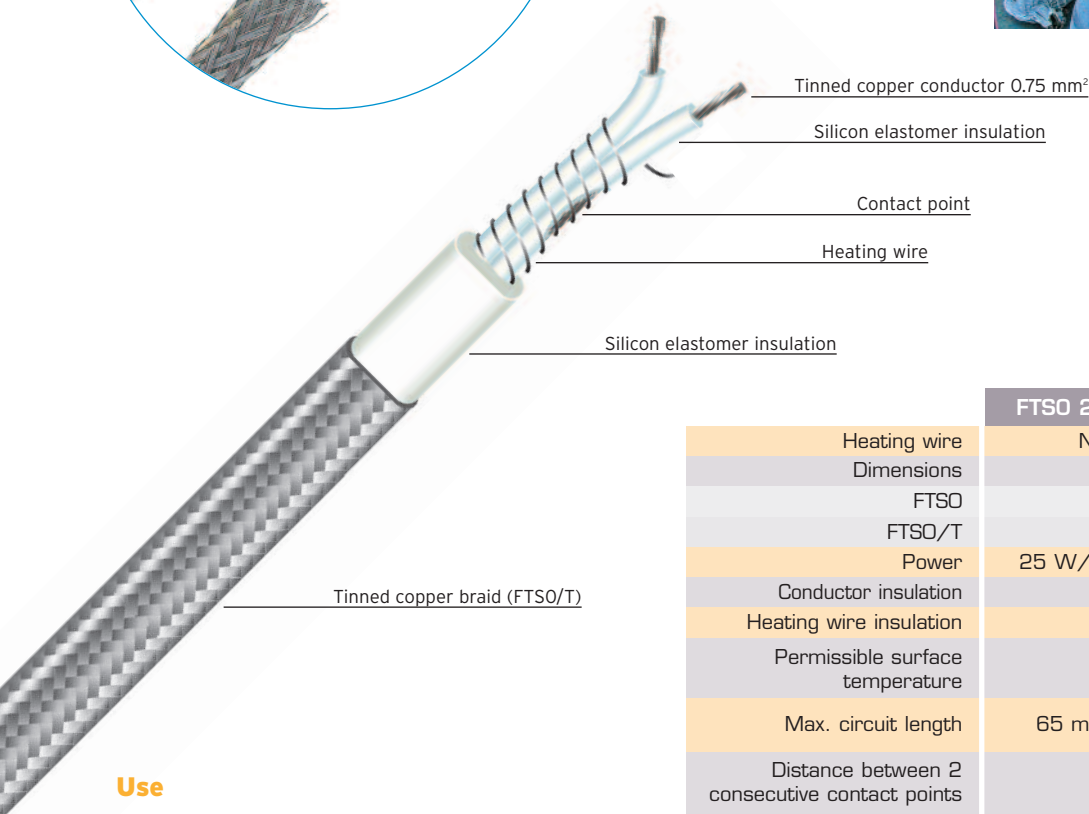
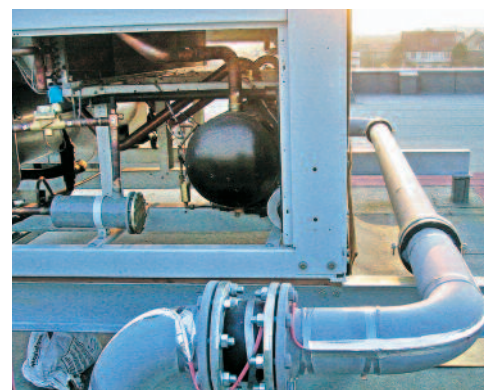
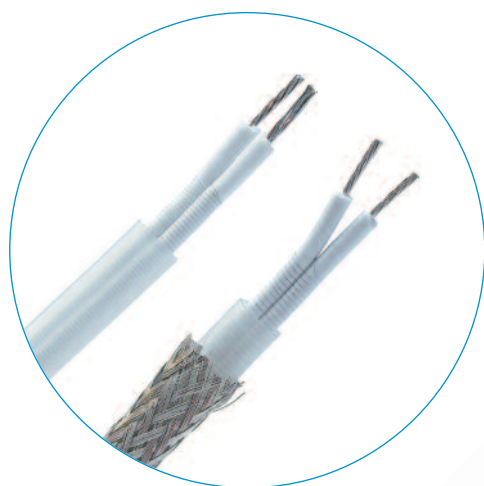
- Can be cut to length on site.
- Extremely simple termination.
- Cold tail incorporated: no extra connection necessary.
- Available as 25, 40 or 50 W/m.
- Power supply: 230 V (24 V and 115 V on request).
- **FTSO** : Silicon elastomer insulated constant power cables
- **FTSO/T** : with tinned copper braid for mechanical protection and earthing.

Applications

FTSO cables are designed for use in industrial refrigeration. Their great flexibility means that they can be incorporated into cold room doors.

They must not be used for temperature maintenance.

To ensure that these heating elements enjoy a long service life, we recommend using a control device.

**Use**

Consult the pages of the catalogue devoted to the corresponding general operating principles, general instructions for use and accessories.

	FTSO 25	FTSO 40	FTSO 50
Heating wire	Nickel-Copper or Nickel-Chrome		
Dimensions			
FTSO	5 x 7 mm		
FTSO/T	5.5 x 7.5 mm		
Power	25 W/m	40 W/m	50 W/m
Conductor insulation	Silicon elastomer		
Heating wire insulation	Silicon elastomer		
Permissible surface temperature	from - 70°C to + 200°C		
Max. circuit length	65 m	50 m	44 m
Distance between 2 consecutive contact points	0.5 m		

FLEXELEC S.A.S

10, rue des frères Lumière
 Z.A. du Bois Rond
 69720 ST BONNET DE MURE - FRANCE
 Tel: + 33 (0)4.72.48.30.90
 Fax: + 33 (0)4.78.40.82.81
 E-mail: flexelec@omerin.com

FLEXELEC Dept

OMERIN ASIA Pte Ltd
 51 Goldhill Plaza #08-12/01
 SINGAPORE 308900
 Tel: + 65.6255.4778
 Fax: + 65.6255.4779
 E-mail: sales@omerin.com.sg

FLEXELEC (UK) Ltd

Unit 11 Kings Park Industrial Estate
 Primrose Hill - KINGS LANGLEY
 Hertfordshire - WD4 8ST - UK
 Tel: + 44 (0) 1923.274477
 Fax: + 44 (0) 1923.270264
 E-mail: sales@omerin.co.uk

FLEXELEC Dept

OMERIN GmbH
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 D-65510 IDSTEIN - GERMANY
 Tel: + 49 (0) 6126.94.31-0
 Fax: + 49 (0) 6126.83.99
 E-mail: omeringmbh@omerin.com

FTS3/IS

High power constant power cables



Characteristics

- Welded contact points.
- Can be cut to length on site.
- Extremely simple termination.
- Cold tail incorporated: no extra connection necessary.
- Available as 100 W/m.
- Power supply: 230 V.
- Tinned copper braid and silicon elastomer outer sheath .

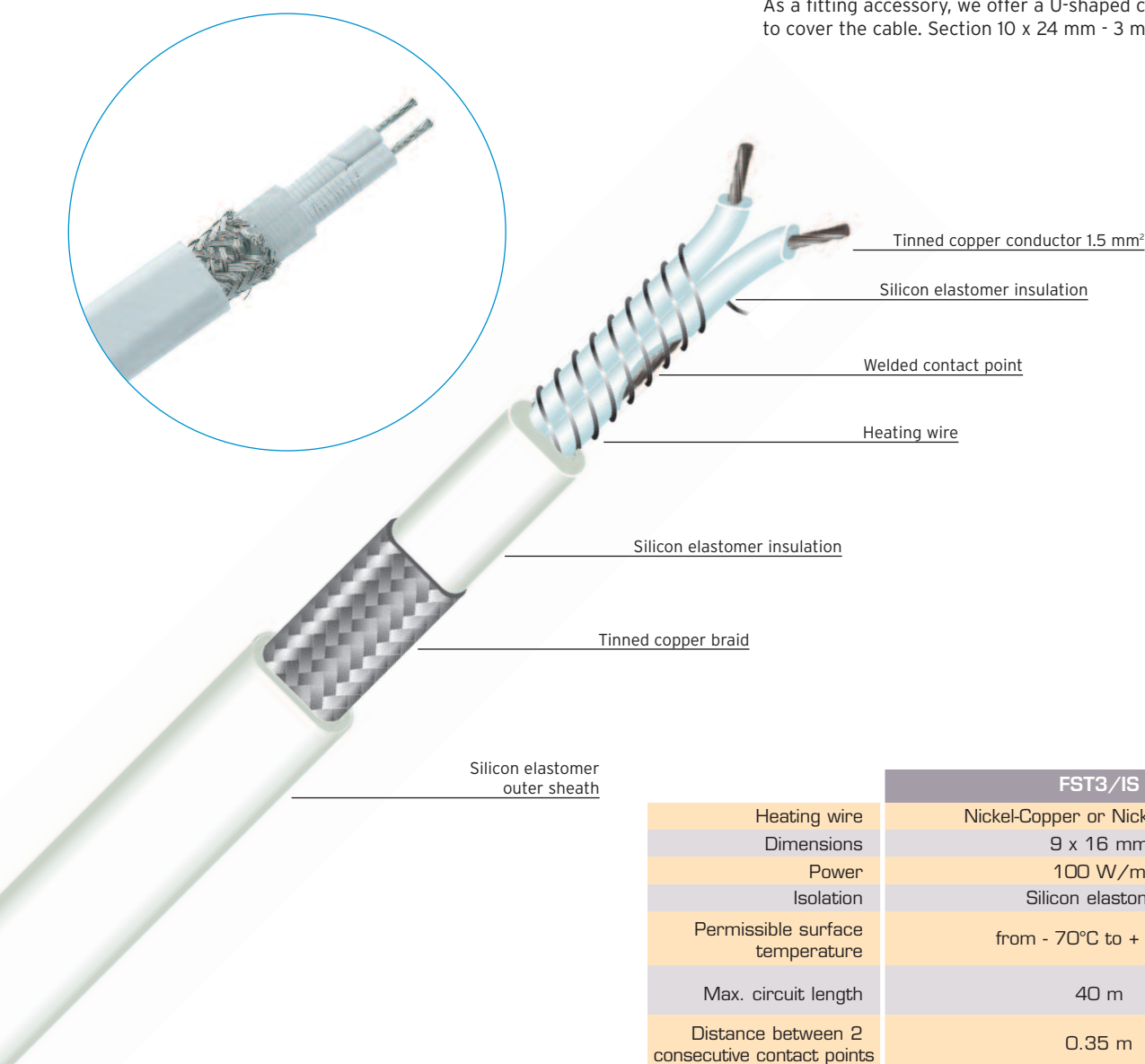
Applications

FTS3/IS cables are designed for protecting railway lines, points and power rails from freezing or for keeping them clear of snow.

To ensure that these heating elements enjoy a long service life, we recommend using a control device.

Fitting:

As a fitting accessory, we offer a U-shaped composite profile to cover the cable. Section 10 x 24 mm - 3 m long.



	FTS3/IS
Heating wire	Nickel-Copper or Nickel-Chrome
Dimensions	9 x 16 mm
Power	100 W/m
Isolation	Silicon elastomer
Permissible surface temperature	from - 70°C to + 200°C
Max. circuit length	40 m
Distance between 2 consecutive contact points	0.35 m

Use

Consult the pages of the catalogue devoted to the corresponding general operating principles, general instructions for use and accessories.

FLEXELEC S.A.S

10, rue des frères Lumière
 Z.A. du Bois Rond
 69720 ST BONNET DE MURE - FRANCE
 Tel: + 33 (0)4.72.48.30.90
 Fax: + 33 (0)4.78.40.82.81
 E-mail: flexelec@omerin.com

FLEXELEC Dept

OMERIN ASIA Pte Ltd
 51 Goldhill Plaza #08-12/01
 SINGAPORE 308900
 Tel: + 65.6255.4778
 Fax: + 65.6255.4779
 E-mail: sales@omerin.com.sg

FLEXELEC (UK) Ltd

Unit 11 Kings Park Industrial Estate
 Primrose Hill - KINGS LANGLEY
 Hertfordshire - WD4 8ST - UK
 Tel: + 44 (0) 1923.274477
 Fax: + 44 (0) 1923.270264
 E-mail: sales@omerin.co.uk

FLEXELEC Dept

OMERIN GmbH
 Buchwiese 16
 D-65510 IDSTEIN - GERMANY
 Tel: + 49 (0) 6126.94.31-0
 Fax: + 49 (0) 6126.83.99
 E-mail: omeringmbh@omerin.com

FTTH - FTTH/T - FTTH/I - FTTH/TF

Fluoropolymer insulated constant power cables



Characteristics

- Welded contact points.
- Hard-wearing and flexible.
- Can be cut to length on site.
- Extremely simple termination.
- Cold tail incorporated: no extra connection necessary.
- Available as 20, 30 or 40 W/m.
- Power supply: 230 V as standard (400 V on request).
- **FTTH** : fluoropolymer insulated constant power cables.
- **FTTH/T** : with tinned copper braid for mechanical protection and earthing.
- **FTTH/I** : with stainless steel braid for mechanical protection and earthing.
- **FTTH/TF** : with tinned copper braid and fluoropolymer anti-corrosion outer sheath.

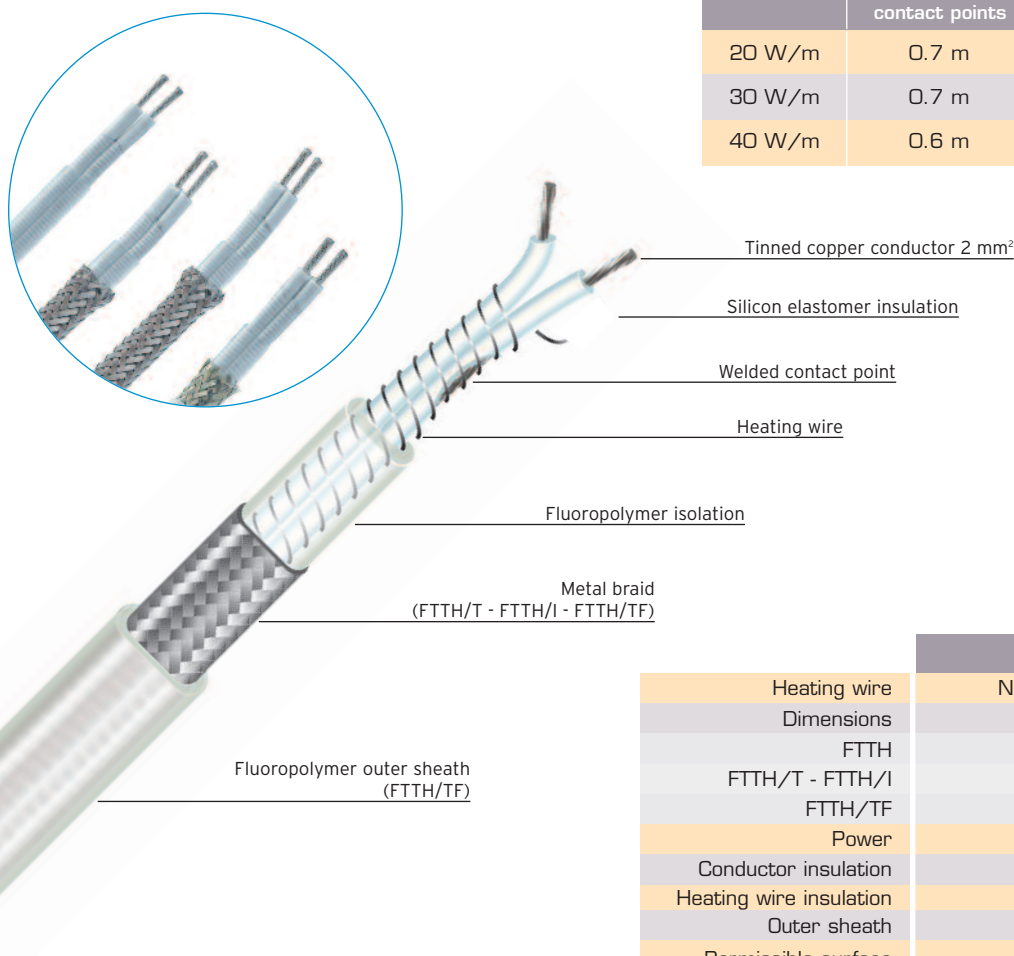
Applications

The **FTTH** range is particularly suitable for maintaining temperatures of up to +150°C. Their fluoropolymer insulation endows them with the ability to withstand corrosive substances, making **FTTH** cables particularly well-suited for use in the chemical industry.

To ensure that these heating elements enjoy a long service life, we recommend using a control device.



Power	Distance between 2 consecutive contact points	Max. circuit length	Max. maintenance temperature
20 W/m	0.7 m	140 m	150°C
30 W/m	0.7 m	120 m	140°C
40 W/m	0.6 m	100 m	120°C



	FTTH
Heating wire	Nickel-Copper or Nickel-Chrome
Dimensions	
FTTH	5 x 8 mm
FTTH/T - FTTH/I	5.5 x 8.5 mm
FTTH/TF	6 x 9 mm
Power	20, 30 or 40 W/m
Conductor insulation	Silicon elastomer
Heating wire insulation	Fluoropolymer
Outer sheath	Fluoropolymer
Permissible surface temperature	from - 70°C to + 200°C

Use

Consult the pages of the catalogue devoted to the corresponding general operating principles, general instructions for use and accessories.

FLEXELEC S.A.S

10, rue des frères Lumière
 Z.A. du Bois Rond
 69720 ST BONNET DE MURE - FRANCE
 Tel: + 33 (0)4.72.48.30.90
 Fax: + 33 (0)4.78.40.82.81
 E-mail: flexelec@omerin.com

FLEXELEC Dept

OMERIN ASIA Pte Ltd
 51 Goldhill Plaza #08-12/01
 SINGAPORE 308900
 Tel: + 65.6255.4778
 Fax: + 65.6255.4779
 E-mail: sales@omerin.com.sg

FLEXELEC (UK) Ltd

Unit 11 Kings Park Industrial Estate
 Primrose Hill - KINGS LANGLEY
 Hertfordshire - WD4 8ST - UK
 Tel: + 44 (0) 1923.274477
 Fax: + 44 (0) 1923.270264
 E-mail: sales@omerin.co.uk

FLEXELEC Dept

OMERIN GmbH
 Buchwiese 16
 D-65510 IDSTEIN - GERMANY
 Tel: + 49 (0) 6126.94.31-0
 Fax: + 49 (0) 6126.83.99
 E-mail: omeringmbh@omerin.com

FTX

Polyethylene insulated constant power cables



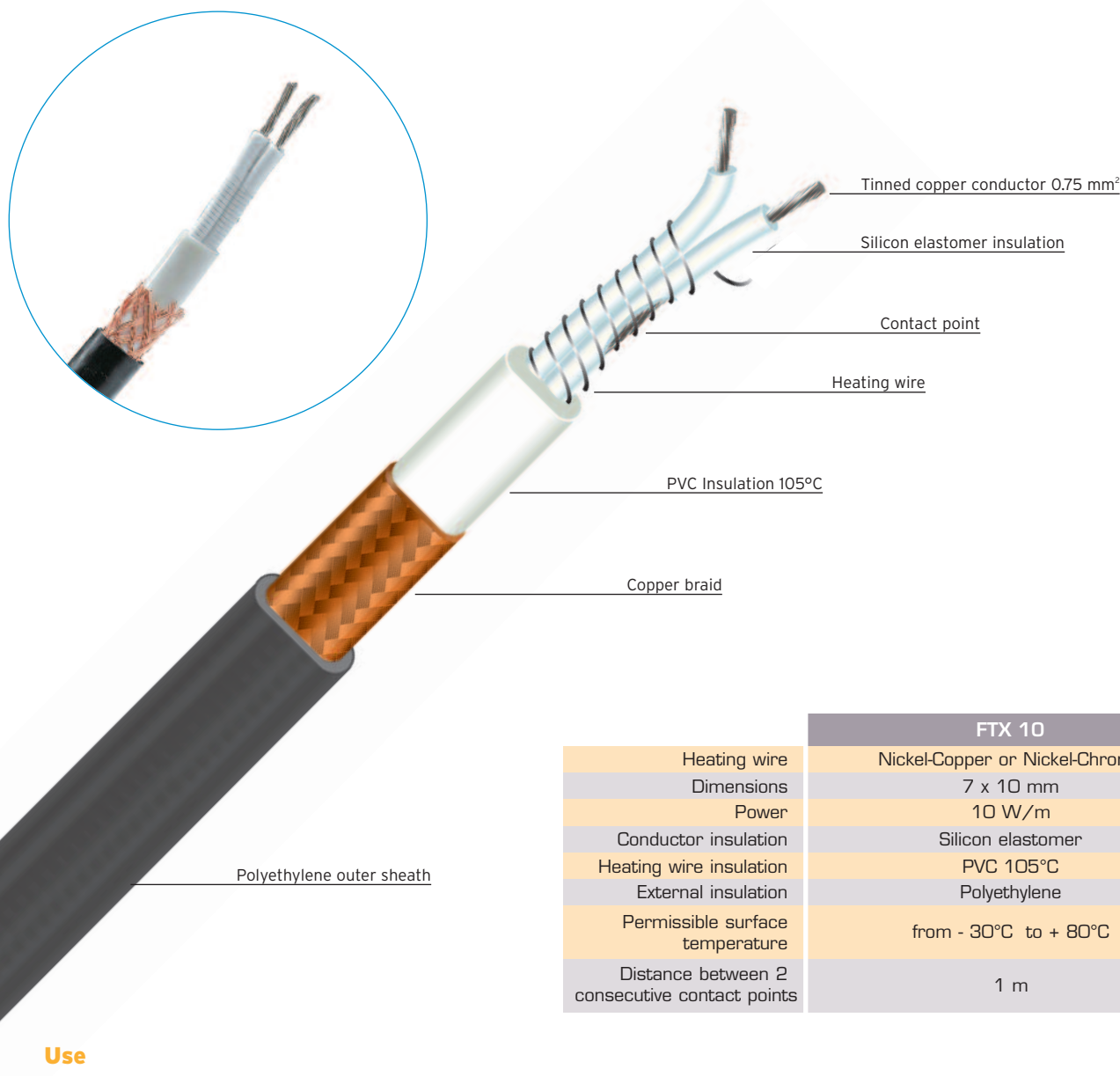
Characteristics

- Hard-wearing, flexible and sealed.
- Can be cut to length on site.
- Extremely simple termination.
- Cold tail incorporated: no extra connection necessary.
- Available as 10 W/m.
- Power supply: 230 V.
- Copper braid and polyethylene outer sheath.

Applications

The FTX cable is specially designed for protecting pipes carrying water against freezing. Its completely sealed, polyethylene outer sheath means that it can be placed inside the pipes.

To ensure that these heating elements enjoy a long service life, we recommend using a control device.



	FTX 10
Heating wire	Nickel-Copper or Nickel-Chrome
Dimensions	7 x 10 mm
Power	10 W/m
Conductor insulation	Silicon elastomer
Heating wire insulation	PVC 105°C
External insulation	Polyethylene
Permissible surface temperature	from - 30°C to + 80°C
Distance between 2 consecutive contact points	1 m

Use

Consult the pages of the catalogue devoted to the corresponding general operating principles, general instructions for use and accessories.

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 Z.A. du Bois Rond
 69720 ST BONNET DE MURE - FRANCE
 Tel: + 33 (0)4.72.48.30.90
 Fax: + 33 (0)4.78.40.82.81
 E-mail: flexelec@omerin.com

FLEXELEC Dept

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 51 Goldhill Plaza #08-12/01
 SINGAPORE 308900
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 E-mail: sales@omerin.com.sg

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 Primrose Hill - KINGS LANGLEY
 Hertfordshire - WD4 8ST - UK
 Tel: + 44 (0) 1923.274477
 Fax: + 44 (0) 1923.270264
 E-mail: sales@omerin.co.uk

FLEXELEC Dept

OMERIN GmbH
 Buchwiese 16
 D-65510 IDSTEIN - GERMANY
 Tel: + 49 (0) 6126.94.31-0
 Fax: + 49 (0) 6126.83.99
 E-mail: omeringmbh@omerin.com

C1FS/I - C2FS/I - R3FS/I

Long cables and tapes



Characteristics

- Designed according to customer requirements.
- For very long circuits.
- Highly corrosion-resistant.
- Connection via tubular connectors and Heat-shrink sheath.
- Stainless steel braid.
- Mechanical protection and earthing.
- Fluoropolymer and silicon elastomer insulation.

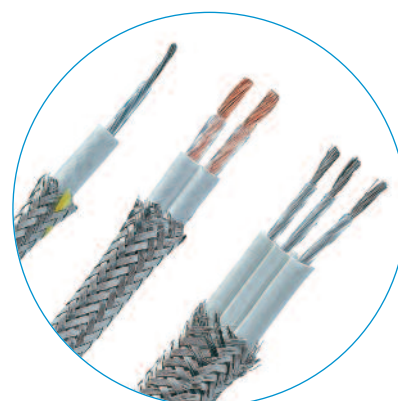
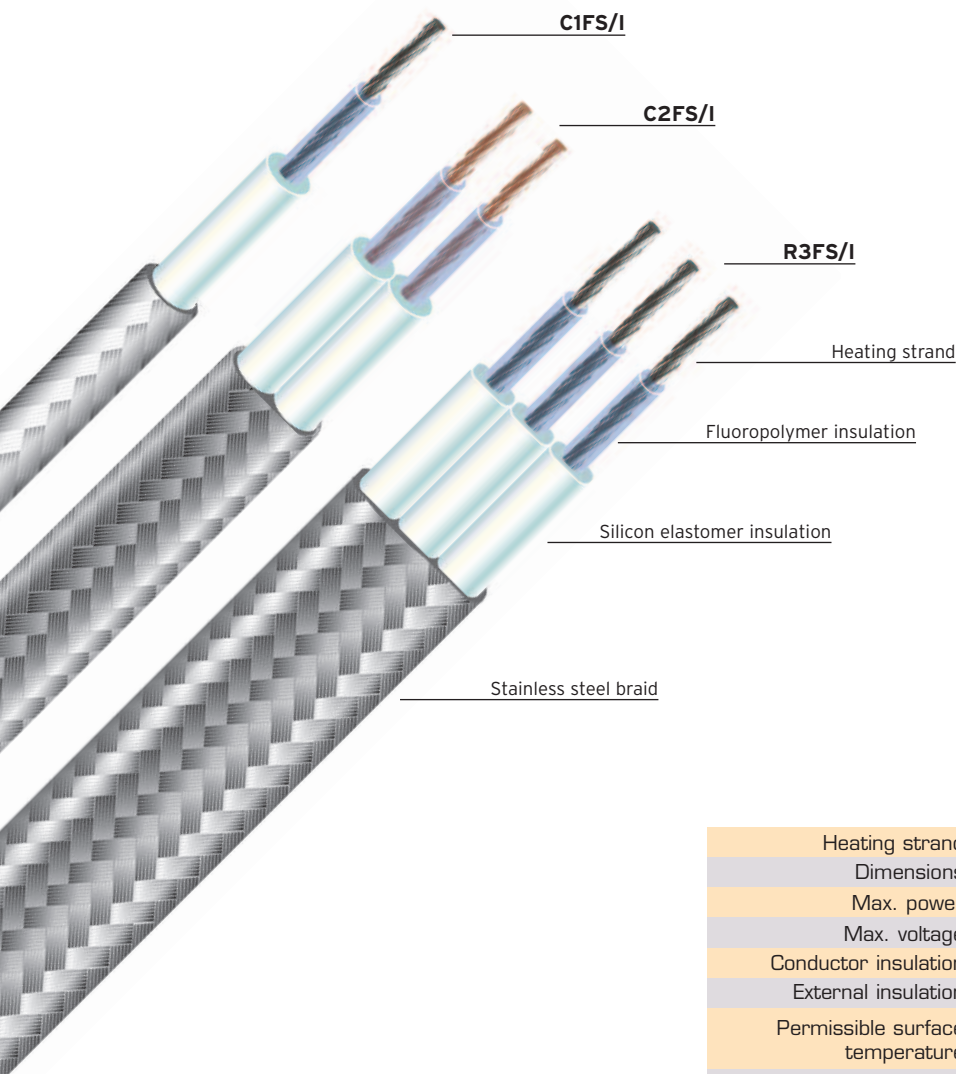
Applications

C1FS/I cables are specially designed for heating concrete tracks for VAL type metros. They can be terminated into copper tubes.

C2FS/I cables are specially designed for heating metal metro tracks and rails of the VAL type. They can be slid inside a U-shaped composite profile clamped against the rail with stainless steel clips.

R3FS/I tapes are used when it is required to trace very long stretches, where a 400V, 3-phase power supply is available, for example in pits or tunnels.

To ensure that these heating elements enjoy a long service life, we recommend using a control device.



	C1FS/I	C2FS/I	R3FS/I
Heating strand	Nickel-Copper or Nickel-Chrome		
Dimensions	Ø 6.5 mm	5 x 9 mm	7 x 16 mm
Max. power	40 W/m	60 W/m	80 W/m
Max. voltage	750 V		
Conductor insulation	Fluoropolymer		
External insulation	Silicon elastomer		
Permissible surface temperature	from - 70°C to + 200°C		
Tolerance	Resistance ± 10 %		

Use

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 Buchwiese 16
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 Fax: + 49 (0) 6126.83.99
 E-mail: omeringmbh@omerin.com

ZFE/CGE/ATEX - ZFA/CGA/ATEX

ATEX fluoropolymer insulated constant power cables



Characteristics

- Welded contact points.
- Can be cut to length on site.
- Extremely simple termination.
- Cold tail incorporated: no extra connection necessary.
- Available as 10, 20, 30 or 40 W/m.
- ZFA/CGA/ATEX also available as 50 W/m.
- Power supply: 230 V as standard.
- **ZFE/CGE/ATEX**: PFE fluoropolymer insulated constant power cables with tinned copper braid and outer sheath PFE fluoropolymer insulation.
- **ZFA/CGA/ATEX**: PFA fluoropolymer insulated constant power cables with tinned copper braid and PFA fluoropolymer outer sheath.

Applications

ZFE/CGE/ATEX and ZFA/CGA/ATEX cables are particularly suitable for maintaining temperatures of up to +150°C.

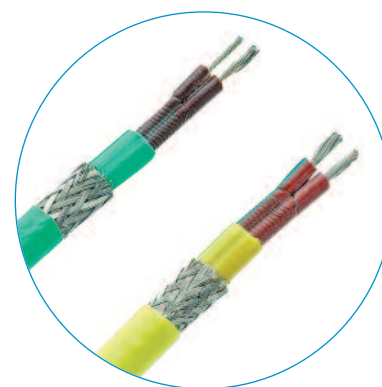
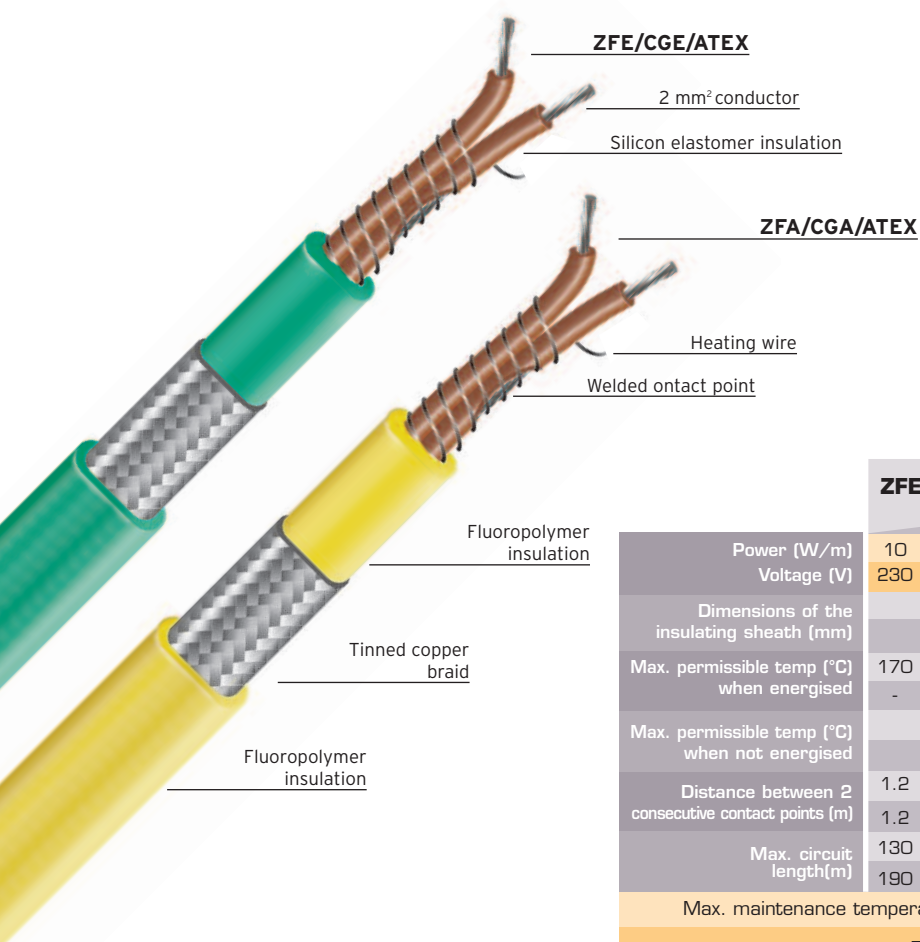
Their fluoropolymer insulation endows them with the ability to withstand corrosive substances, making these cables particularly well-suited for use in the chemical industry.

These cables can, with the appropriate accessories, be used in an explosive atmosphere.

To ensure that these heating elements enjoy a long service life, we recommend using a control device.

ATEX Certificate: LCIE N°03ATEX6302X  II 2G/D

IECEx Certificate: IECEx LCI 09.0020x



ZFE/CGE/ATEX

ZFA/CGA/ATEX

	10	10	20	20	30	30	40	40	50	50
Power (W/m)	230	400	230	400	230	400	230	400	230	400
Voltage (V)										
Dimensions of the insulating sheath (mm)	5.0 x 7.3									
	4.6 x 7.5									
Max. permissible temp (°C) when energised	170	-	145	-	115	-	75	-	-	-
	-	-	-	-	-	-	-	-	-	-
Max. permissible temp (°C) when not energised	205									
	260									
Distance between 2 consecutive contact points (m)	1.2	-	1	-	1	-	1	-	-	-
	1.2	2	1	1.5	1	1.2	1	1	1	1
Max. circuit length (m)	130	-	90	-	70	-	60	-	-	-
	190	220	120	170	100	160	90	150	75	135
Max. maintenance temperature for a given temperature class (°C)										
	T6		T5		T4		T3		T2	
10 W	45	45	60	60	95	95	160	160	160	215
20 W	X	X	30	30	70	70	135	135	135	190
30 W	X	X	X	X	40	40	115	115	115	170
40 W	X	X	X	X	X	X	90	90	90	145
50 W	-	X	-	X	-	X	-	53	-	95

Use

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FLEXELEC S.A.S

10, rue des frères Lumière
Z.A. du Bois Rond
69720 ST BONNET DE MURE - FRANCE
Tel: + 33 (0)4.72.48.30.90
Fax: + 33 (0)4.78.40.82.81
E-mail: flexelec@omerin.com

FLEXELEC Dept

OMERIN ASIA Pte Ltd
51 Goldhill Plaza #08-12/01
SINGAPORE 308900
Tel: + 65.6255.4778
Fax: + 65.6255.4779
E-mail: sales@omerin.com.sg

FLEXELEC (UK) Ltd

Unit 11 Kings Park Industrial Estate
Primrose Hill - KINGS LANGLEY
Hertfordshire - WD4 8ST - UK
Tel: + 44 (0) 1923.274477
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E-mail: sales@omerin.co.uk

FLEXELEC Dept

OMERIN GmbH
Buchwiese 16
D-65510 IDSTEIN - GERMANY
Tel: + 49 (0) 6126.94.31-0
Fax: + 49 (0) 6126.83.99
E-mail: omeringmbh@omerin.com

Flexible heating cables and elements temperature maintenance systems



FLEXFLOOR®

UNDERFLOOR HEATING CABLES

KY - KYCY	CABLES FOR UNDERFLOOR HEATING	62
KYCYR	SERIES CABLES FOR UNDERFLOOR HEATING	63
KYX	SERIES CABLES FOR ROAD HEATING	64

KY - KYCY

Underfloor heating cables

Characteristics

- Hard-wearing and flexible.
- Mechanical protection and earthing.
- KYCY sold by the metre or as a flex with 5 m of power cable at each end.
- **KY** : series cables, silicon elastomer insulated and PVC sheath.
- **KYCY** : series cables with an identical base to that of KY cables, with copper braided shielding and an extra PVC outer sheath.

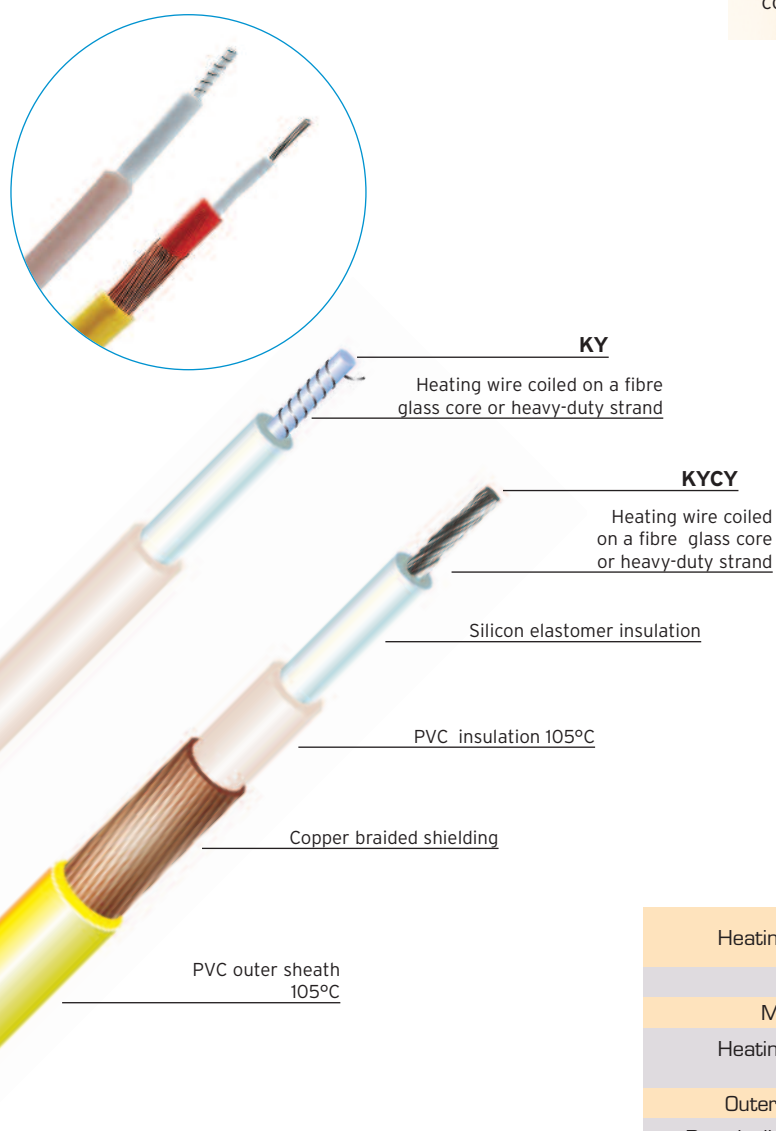
Applications

KYCY cables are particularly hard-wearing and are used for applications set in concrete slabs to protect against freezing or to maintain a temperature.

The cables must be set in accordance with the local regulations in force: in France these include DTU 65-7 published by AFNOR.

KY cables are for applications in which mechanical resistance is not so critical.

To ensure that these heating elements enjoy a long service life, we recommend using a control device.



Min. useable lengths (m)

Resistance [Ω/m]	KY		KYCY	
	230 V	400 V	230 V	400 V
0.058	214	372	191	333
0.078	185	321	165	287
0.14	138	239	123	214
0.17	125	217	112	194
0.24	105	183	94	163
0.34	89	154	79	137
0.47	75	131	67	117
0.65	64	111	57	99
1	52	90	46	80
1.47	43	74	38	66
1.9	38	65	34	58
2.9	31	53	27	47
4	26	45	23	40
8	18.5	32	16.5	28.5
18	12.5	21	11	19

	KY	KYCY
Heating element	Heavy-duty strand or Coiled heating wire Nickel-Copper or Nickel-Chrome	
Diameter	4 to 5 mm	6 to 7 mm
Max. power	20 W/m	25 W/m
Heating element insulation	Silicon elastomer	
Outer insulation	PVC 105°C	
Permissible surface temperature	up to + 80°C	
Min. bend	6 x the diameter	
Tolerance	Resistance: - 5% / + 10%	

Use

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69720 ST BONNET DE MURE - FRANCE
Tel: + 33 (0)4.72.48.30.90
Fax: + 33 (0)4.78.40.82.81
E-mail: flexelec@omerin.com

FLEXELEC Dept

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SINGAPORE 308900
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Fax: + 65.6255.4779
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Primrose Hill - KINGS LANGLEY
Hertfordshire - WD4 8ST - UK
Tel: + 44 (0) 1923.274477
Fax: + 44 (0) 1923.270264
E-mail: sales@omerin.co.uk

FLEXELEC Dept

OMERIN GmbH
Buchwiese 16
D-65510 IDSTEIN - GERMANY
Tel: + 49 (0) 6126.94.31-0
Fax: + 49 (0) 6126.83.99
E-mail: omerin@omerin.com

KYCYR

Series cables for underfloor heating



Characteristics

- Hard-wearing and flexible.
- Mechanical protection and earthing.
- 3 m power cable on one end only, integrated return conductor.
- Power supply: 230 V as standard.
- Series resistance, silicon elastomer and PVC insulation, with copper braided shielding and an extra PVC outer sheath.

Applications

KYCYR heating cables are particularly hard-wearing and are used for applications set in concrete slabs to protect against freezing or to maintain a temperature.

The cables must be set in accordance with the local regulations in force: in France these include DTU 65-7 published by AFNOR.

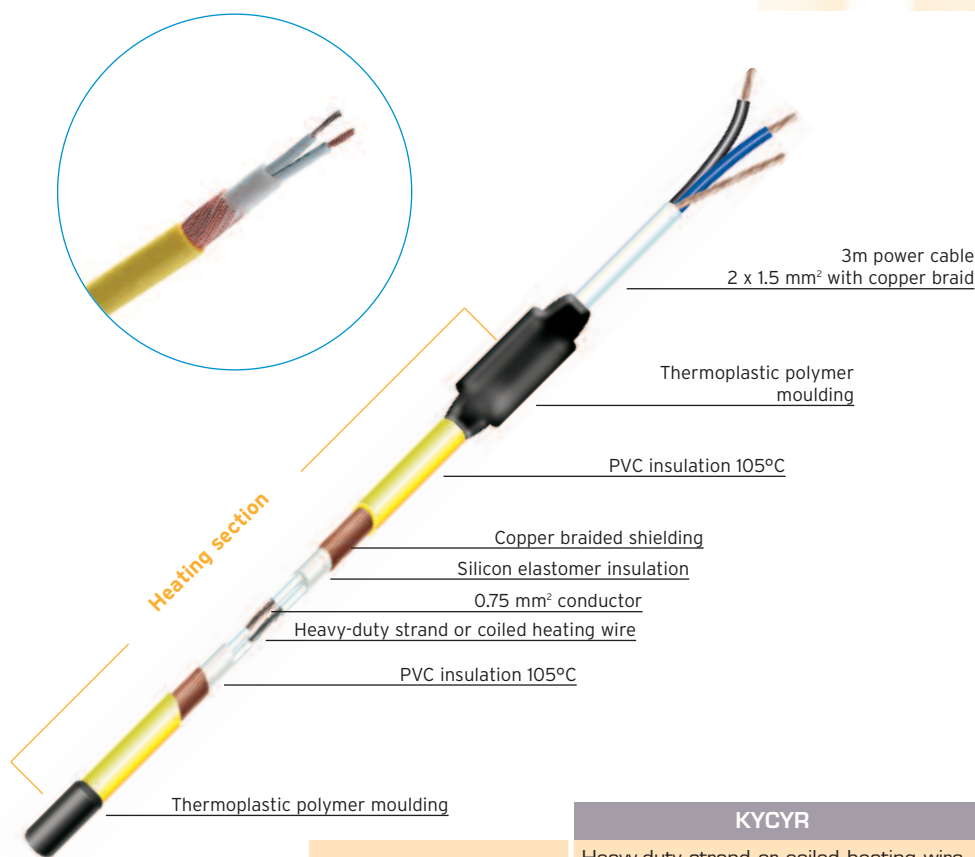
To ensure that these heating elements enjoy a long service life, we recommend a control device.



Standard 230 V models

20 W/m		
Length (m)	Power (W)	Resistance (Ω/m)
10	200	27.0
15	300	11.8
20	400	6.7
30	600	2.8
40	800	1.65
48	940	1.15
55	1100	0.87
75	1500	0.47
90	1800	0.30
113	2100	0.20

10 W/m		
Length (m)	Power en (W)	Resistance (Ω/m)
13	100	41.0
14	140	27.0
15.5	206	16.0
18	180	16.0
20	160	16.0
20	285	9.2
21	210	11.8
24	240	9.2
28	280	6.7
36	360	4.0
44	430	2.8
49	480	2.24
57	560	1.65
68	660	1.15
78	780	0.87
92	920	0.6
104	1040	0.47
128	1280	0.3
155	1550	0.2



	KYCYR
Heating element	Heavy-duty strand or coiled heating wire (Nickel-Copper or Nickel-Chrome)
Diameter	7 to 8 mm
Max. power	20 W/m
Heating element insulation	Silicon elastomer
Outer insulation	PVC 105°C
Permissible surface temperature	up to + 80°C
Min. bend	6 x the diameter
Tolerances	Resistance - 5% + 10% Length ± 1 %

Use

Consult the pages of the catalogue devoted to the corresponding general operating principles, general instructions for use and accessories.

FLEXELEC S.A.S

10, rue des frères Lumière
Z.A. du Bois Rond
69720 ST BONNET DE MURE - FRANCE
Tel: + 33 (0)4.72.48.30.90
Fax: + 33 (0)4.78.40.82.81
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FLEXELEC Dept

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51 Goldhill Plaza #08-12/01
SINGAPORE 308900
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FLEXELEC (UK) Ltd

Unit 11 Kings Park Industrial Estate
Primrose Hill - KINGS LANGLEY
Hertfordshire - WD4 8ST - UK
Tel: + 44 (0) 1923.274477
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E-mail: sales@omerin.co.uk

FLEXELEC Dept

OMERIN GmbH
Buchwiese 16
D-65510 IDSTEIN - GERMANY
Tel: + 49 (0) 6126.94.31-0
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E-mail: omeringmbh@omerin.com

KYX

Series cables for road heating



Characteristics

- Hard-wearing and flexible.
- Mechanical protection and earthing.
- Will withstand at the temperature at which asphalt is laid.
- Series resistance: 0.058 at 1 Ω /m.
- Silicon elastomer insulation, with copper braided shielding and an outer XLPE cross linked polyethylene sheath.

Applications

KYX cables are used for heating floors, roads or access ramps.

They are specially designed to be laid between 2 layers of road surface.

Cables must be set in roads in accordance with local regulations.

To ensure that these heating elements enjoy a long service life, we recommend using a control device.



	KYX
Heating strand	Nickel-Copper or Nickel-Chrome
Diameter	7 mm
Max. power	30 W/m
Heating element insulation	Silicon elastomer
Outer insulation	Cross linked polyethylene XLPE
Permissible continuous temperature	up to + 90°C
Permissible peak temperature (10 min)	up to + 250°C
Min. bend	6 x the diameter
Tolerance	Resistance - 5% + 10%

Use

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Flexible heating cables and elements temperature maintenance systems



FLEXBELT®

HEATING BELTS

FCH**Heating belts for refrigeration compressors****Characteristics**

- Quick, safe and easy to fit.
- Sealed, silicon-insulated heating element.
- Metal earthing braid.
- 230 V as standard.
-  belts on request.

Applications

FCH heating belts are fitted to refrigerating compressors to prevent the coolant from being absorbed by the oil.

The lower the temperature, the quicker and the more complete the absorption, which can seriously damage the compressor, especially when starting up, through lack of lubrication.

To ensure that these heating elements enjoy a long service life, we recommend using a control device.



	FCH
Heating wire	Nickel-Copper or Nickel-Chrome
Heating element insulation	Silicon elastomer
Length of power cable	1 m
Insulation resistance	100 MΩ min., 2500 V
Tolerance	Power ± 10%

Standard models

	FCH-10	FCH-20	FCH-30	FCH-40	FCH-50	FCH-60
Power (W)	35	40	45	55	65	75
Min. clamping Ø (mm)	120	140	150	180	220	245
Max. clamping Ø (mm)	175	175	280	280	320	370

Use

Heating belts are series resistors. Consult the pages of the catalogue devoted to the corresponding general operating principles, general instructions for use and accessories.

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Flexible heating cables and elements temperature maintenance systems



FLEXMAT®

HEATING MATS

T - TA - TV
A

SILICON ELASTOMER HEATER MATS
ALUMINIUM HEATER MATS

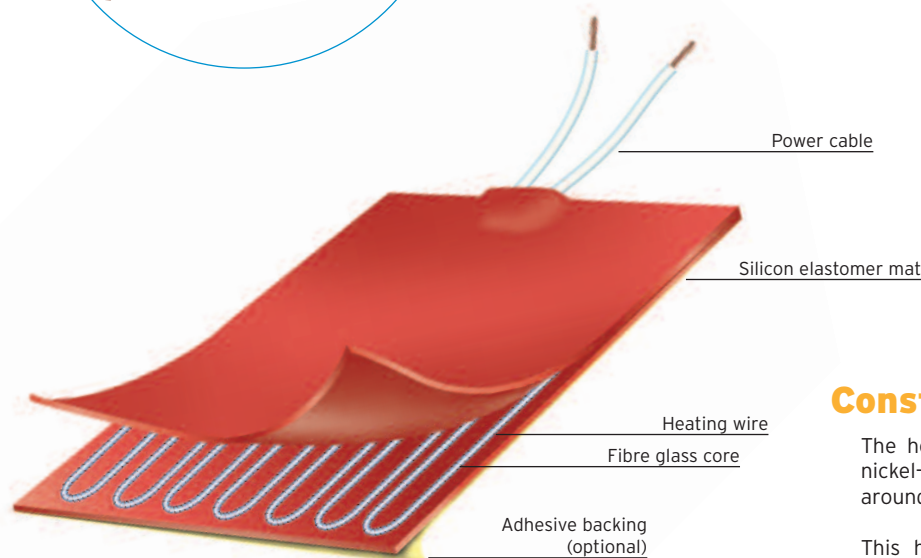
68 - 69
70

T - TA - TV

Silicon elastomer heater mats

Characteristics

- Takes up little space.
- Highly flexible.
- A variety of shapes.
- Quick and easy to fit.
- Any voltage on request.
- Length of power cable: 1 m as standard.
- T : Silicon elastomer insulated mats.
- TA : with adhesive back for permanent fitting.
- TV : factory vulcanised on metal backing.



Use

Consult the pages of the catalogue devoted to the corresponding general operating principles, general instructions for use and accessories.

Applications

Military: radars, missiles, temperature maintenance of electronic circuits or protective housings anti-condensation for aiming devices, etc.

Office equipment: photocopiers, printers.

Rolling stock: rear-view mirrors, batteries, vehicle floors, driving cabs for locomotives, locks, tank wagons, etc.

Food service industry: electric hot-plates, double boilers, trays, etc.

Photography: developing and fixing trays.

Medical: X-rays, trays for wax impressions, apparatus for bacteria cultures or blood tests, transformation of cosmetic products, etc.

Various industries: substances in drums, heating trays, distillers, boilers, ultrasound vessels, tanks for electrolysis, process tanks, storage silos and vats, hoppers, conveyor belts, control desks, presses, repair kits for composite materials, etc.

Miscellaneous: photoelectric cells, decomposition toilets, various drying devices, etc.

To ensure that these heating elements enjoy a long service life, we recommend using a control device.



Construction

The heating part is made up of a nickel-chrome or nickel-copper alloy heating wire wound in a spiral around a slender fibre glass core.

This heating element is then placed between two layers of woven fibre glass impregnated with silicon elastomer.

This material is an excellent electrical insulator (approx. 12 kV/mm), a good conductor of heat (7.10^{-4} W/cm/K) and flexible. It can withstand continuous temperatures of around 200°C. The fibre glass weave endows the assembly with good mechanical resistance, while allowing it to remain very flexible.

FLEXELEC S.A.S

10, rue des frères Lumière
 Z.A. du Bois Rond
 69720 ST BONNET DE MURE - FRANCE
 Tel: + 33 (0)4.72.48.30.90
 Fax: + 33 (0)4.78.40.82.81
 E-mail: flexelec@omerin.com

FLEXELEC Dept

OMERIN ASIA Pte Ltd
 51 Goldhill Plaza #08-12/01
 SINGAPORE 308900
 Tel: + 65.6255.4778
 Fax: + 65.6255.4779
 E-mail: sales@omerin.com.sg

FLEXELEC (UK) Ltd

Unit 11 Kings Park Industrial Estate
 Primrose Hill - KINGS LANGLEY
 Hertfordshire - WD4 8ST - UK
 Tel: + 44 (0) 1923.274477
 Fax: + 44 (0) 1923.270264
 E-mail: sales@omerin.co.uk

FLEXELEC Dept

OMERIN GmbH
 Buchwiese 16
 D-65510 IDSTEIN - GERMANY
 Tel: + 49 (0) 6126.94.31-0
 Fax: + 49 (0) 6126.83.99
 E-mail: omeringmbh@omerin.com

T - TA - TV**Silicon elastomer heater mats**

Heating mats are manufactured to order and their sizes and shapes can be adapted to each situation.

They can be fixed using eyelets or hooks incorporated into the heating mat and, in some cases, vulcanized directly by us onto your metal parts. An adhesive backing can also be provided.

Other options such as double insulation, fuses, thermal cut-out devices or temperature sensors (PT100, PT1000, thermocouple,...) are available.

	T - TA - TV
Heating wire	Nickel-Copper or Nickel-Chrome
Heating element insulation	Silicon elastomer
Max. surface	1.5 m ²
Max. length	3 m
Max. width	1 m
Thickness	~ 3 mm (thicker at connection point)
Max. power	0.5 W/cm ²
Permissible surface temperature	from - 60°C to + 200°C
Max. maintenance temperature	+ 160°C
Tolerance	Power ± 10%

Surface temperature according to power

Power W/cm ²	Surface temperature (°C)
0.05	40
0.10	70
0.15	90
0.20	105
0.25	120
0.30	135
0.35	150
0.40	165
0.45	175
0.50	190
0.55	200
0.60	210
0.70	230
0.80	250
0.90	260
1.00	270

For information, silicon elastomer will rapidly degrade beyond these values.

The above table gives surface temperatures for heating mats according to their power level in W/cm², measured in the following conditions:

Heating mats placed on a 1.5mm thick horizontal aluminium plate in a calm atmosphere at +20°C. The plate is suspended in the air. Temperatures are recorded after stabilising.

Use

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Fax: + 33 (0)4.78.40.82.81
E-mail: flexelec@omerin.com

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SINGAPORE 308900
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A Aluminium Heater Mats

Characteristics

- Takes up little space.
- Highly flexible.
- Rectangular shapes.
- Quick and easy to fit.
- Any voltage on request.
-  mats on request.
- Length of power cable: 1 m as standard.

Applications

Aluminium heater mats are used in many cases where large surfaces are to be heated and the power required is relatively low, for protecting against freezing or maintaining at temperatures up to + 80°C.

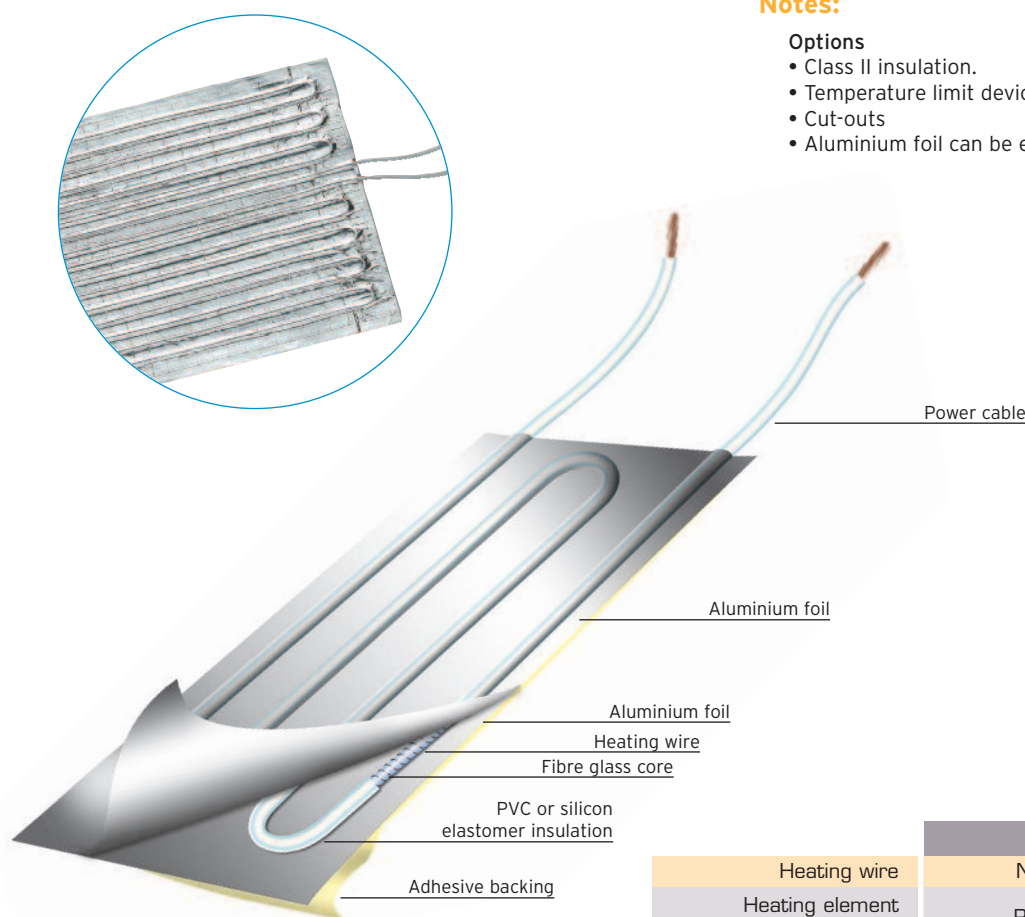
To ensure that these heating elements enjoy a long service life, we recommend using a control device.



Notes:

Options

- Class II insulation.
- Temperature limit device.
- Cut-outs
- Aluminium foil can be earthed.



	Aluminium plates
Heating wire	Nickel-Copper or Nickel-Chrome
Heating element insulation	PVC 105°C or silicon elastomer
Standard widths	50, 100, 150, 200 and 400 mm
Thickness	~ 3 mm (thicker at connection point)
Max. power	0.25 W/cm ²
Permissible surface temperature	from - 60°C to + 110°C
Max. maintenance temperature	+ 80°C
Tolerance	Power ± 10%

Use

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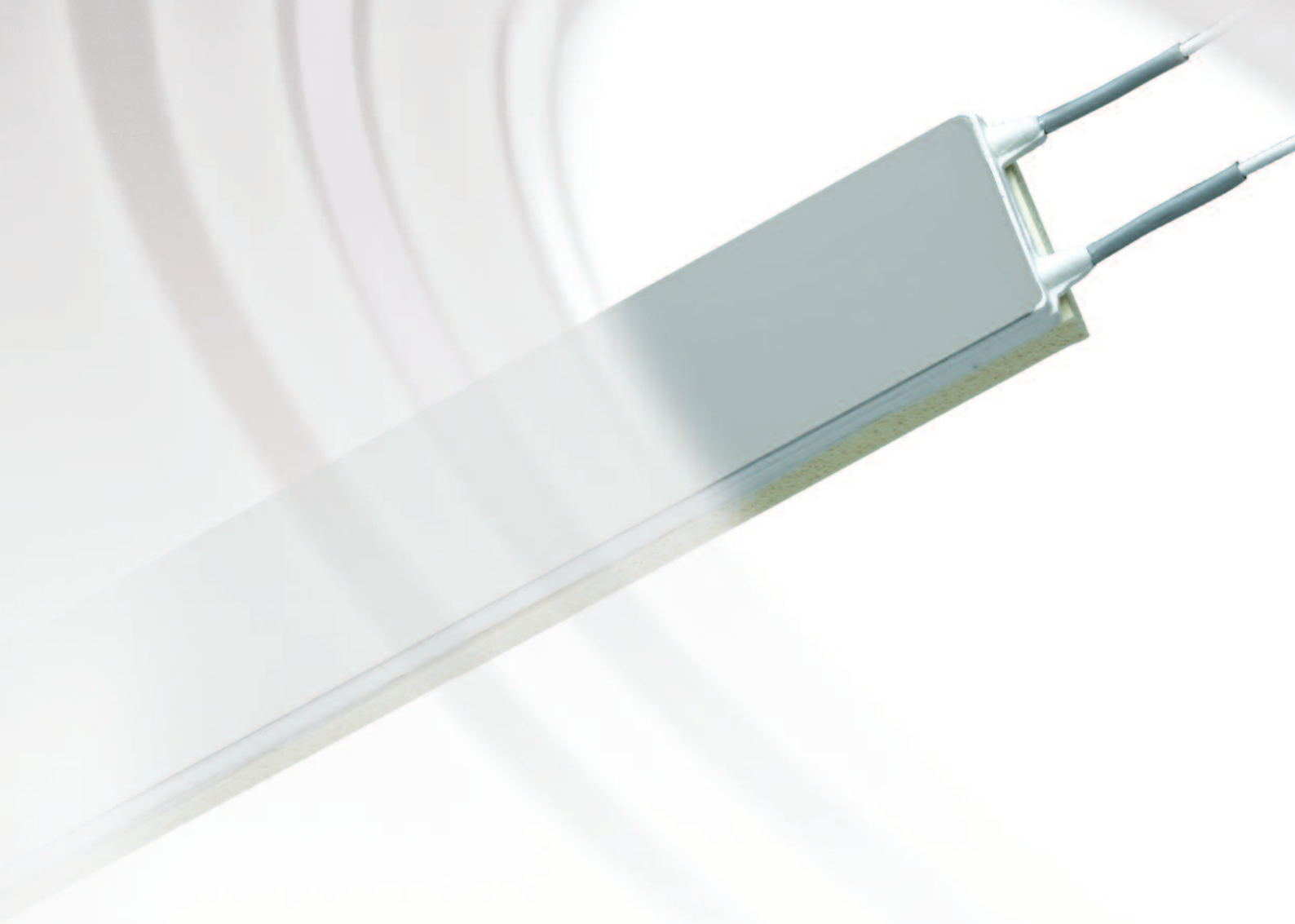
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Flexible heating cables and elements temperature maintenance systems



FLEXPLATE®

HEATING PLATES

PLA Heating plates



Characteristics

- Easy to fit.
- Stands up well to the climatic, physical and chemical conditions encountered in the railway environment.

Applications

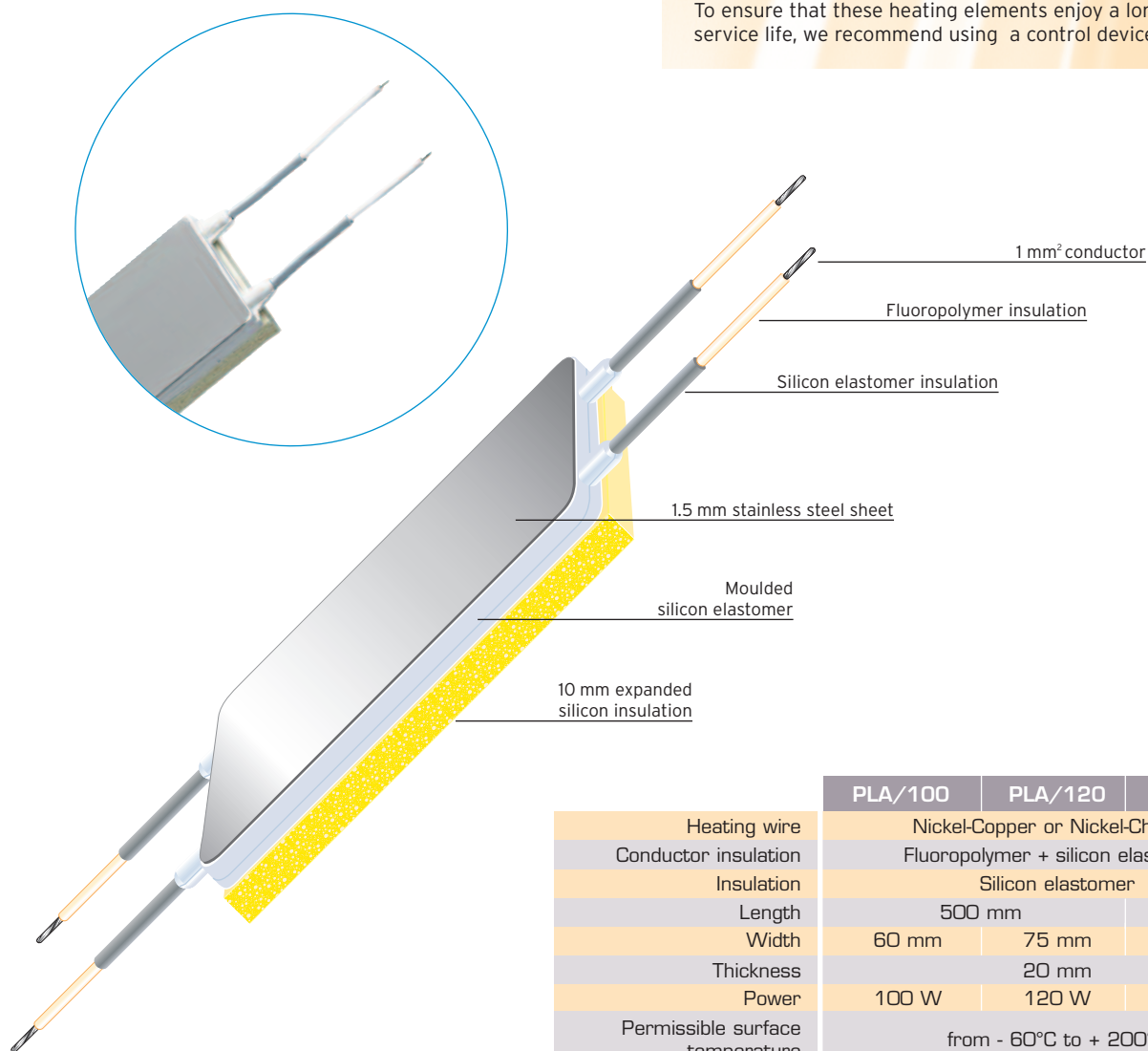
Heating plates are specially designed for protecting railway switches from freezing.

They are fixed by means of stainless steel clips.

Several plates can be connected in series (15 maximum).

Connections between plates are made by means of tubular connectors and heat-shrink sheaths.

To ensure that these heating elements enjoy a long service life, we recommend using a control device.



	PLA/100	PLA/120	PLA/200
Heating wire	Nickel-Copper or Nickel-Chrome		
Conductor insulation	Fluoropolymer + silicon elastomer		
Insulation	Silicon elastomer		
Length	500 mm		450 mm
Width	60 mm	75 mm	110 mm
Thickness	20 mm		
Power	100 W	120 W	200 W
Permissible surface temperature	from - 60°C to + 200°C		
Insulation	Class II		
Protection class	IP 66		
Dielectric strength	2500 V min.		
Insulation resistance	100 MΩ min.		
Weight	approx. 1 kg		

Use

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Flexible heating cables and elements temperature maintenance systems



FLEXDRUM®

DRUM HEATERS

TCF - TCF/TV	SILICON ELASTOMER INSULATED DRUM HEATERS	74
CF/B - CF/BP - CF/BC - CF/BCH	BASE DRUM HEATERS	75
CF/JL	JACKET DRUM HEATERS	76

TCF - TCF/TV**Silicon elastomer insulated drum heaters****Characteristics**

- Silicon elastomer insulated heating mats.
- Damp-proof and splash-proof.
- Double insulation.
- Power supply: 230 V as standard.
- Fixed by means of hooks and a stainless steel spring.
- If an accurate temperature is necessary, use either a thermometer or a thermostat immersed in the liquid.
- **TCF** : Silicon elastomer insulated drum heater without thermostat.
- **TCF/TV** : with adjustable thermostat graduated from 0 to 11 (approx + 20°C to + 150°C).

Applications

TCF and TCF/TV drum heaters are specially designed to heat the contents of drums of 30, 60, 120 and 200 litre capacity from around the outside.

They are recommended for obtaining relatively low temperatures with a fairly long heating time, or for maintaining medium temperatures.

A typical example is heating fluids to reduce their viscosity ready for pumping or transfer operations: glucose, honey, fat, wax and oil.

To reach the required temperature more quickly, drums can be heated or maintained at temperature with 1, 2 or 3 drum-heaters.

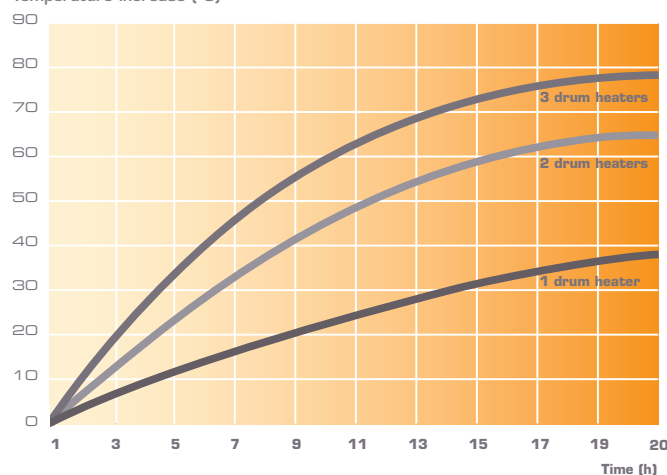
To ensure that these heating elements enjoy a long service life, we recommend using a control device, especially for TCF drum-heaters.

**TCF**

The graphs show the increase in temperature of a 200 litre drum filled with a liquid of density 1 and specific heat 1 Kcal/kg.°C

TCF/TV**Temperature increase with time**

Temperature increase (°C)



	TCF/300 TCF/TV/300	TCF/500 TCF/TV/500	TCF/750 TCF/TV/750	TCF/1000 TCF/TV/1000
Heating element	Nickel-Copper or Nickel-Chrome heating wire			
Heating wire insulation	Silicon elastomer			
Second insulation	Fibre glass mat impregnated with silicon elastomer			
Length of the heating section	770 mm	935 mm	1280 mm	1660 mm
Width	150 mm			
Drum diameter (± 10 mm)	296 mm	350 mm	460 mm	580 mm
Standard capacity (as a guide)	30 L	60 L	120 L	200 L
Power	300 W	500 W	750 W	1000 W
Voltage	230 V			
Permissible surface temperature	up to + 200°C			
Length of power cable	2 m			

Use

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10, rue des frères Lumière
 Z.A. du Bois Rond
 69720 ST BONNET DE MURE - FRANCE
 Tel: + 33 (0)4.72.48.30.90
 Fax: + 33 (0)4.78.40.82.81
 E-mail: flexelec@omerin.com

FLEXELEC Dept

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 51 Goldhill Plaza #08-12/01
 SINGAPORE 308900
 Tel: + 65.6255.4778
 Fax: + 65.6255.4779
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Unit 11 Kings Park Industrial Estate
 Primrose Hill - KINGS LANGLEY
 Hertfordshire - WD4 8ST - UK
 Tel: + 44 (0) 1923.274477
 Fax: + 44 (0) 1923.270264
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 D-65510 IDSTEIN - GERMANY
 Tel: + 49 (0) 6126.94.31-0
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 E-mail: omeringmbh@omerin.com

CF/B - CF/BP - CF/BC - CF/BCH

Base drum heaters



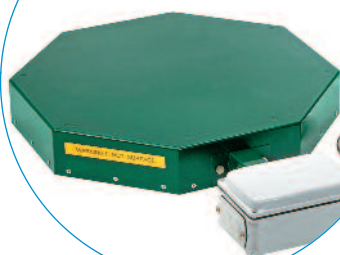
Characteristics

- Sturdy, octagonal metal base.
- Uniform temperature surface.
- Surface covered with special paint to ensure good heat transfer.
- **CF/B** : Drum heater without thermostat.
- **CF/BP** : Drum heater without thermostat, low power, for plastic drums.
- **CF/BC** : Drum heater with thermostat.
- **CF/BCH** : High power drum heater with thermostat.

CF/B - CF/BP



CF/BC - CF/BCH



Applications

Base drum heaters are specially designed to heat the contents of 200 litre capacity plastic or metal drums from the base.

They are recommended for obtaining relatively low temperatures with a fairly long heating time, or for maintaining medium temperatures.

When the base drum heaters are used in conjunction with one or more **TCF/TV** silicon insulated drum-heaters fitted around the drum, it is then possible to obtain rapid increases in temperature.

A typical example is heating fluids to reduce their viscosity ready for pumping or transfer operations: glucose, honey, fat, wax and oil.



Control

If a metal drum heater without thermostat is used, it is recommended to place a thermometer inside the drum so as to be able to control the temperature of the contents.

The other metal drum heaters are provided with a bulb and capillary, with a temperature range of from + 20°C to + 220°C and an indicator lamp to show when the heater is switched on.

The thermostat makes it possible to more accurately control the surface of the drum heater and thereby the drum contents.

	CF/B	CF/BC	CF/BCH	CF/BP
Dimensions	Diameter 550 mm - Height 80 mm			
Power (230 V)	1000 W	1000 W	1840 W	300 W
Power (110 V)	1000 W	1000 W	-	-
Voltage [V]	110/230	110/230	230	230
Heating element	Mineral heating element with Incolloy sheath			Silicon elastomer heater mat
Insulation	50 mm of mineral wool			
Length of power cable	2 m			
Cable in	Brass cable gland			
Weight (kg)	11	12.4	17	14
Temperature range	+ 20°C to + 220°C			
Max. temperature of drum contents	+ 130°C	+ 130°C	+ 130°C	+ 50°C
Thermostat dimensions (mm)	-	240 x 225 x 90 approx.	240 x 225 x 90 approx.	-

Use

Consult the pages of the catalogue devoted to the corresponding general operating principles, general instructions for use and accessories.

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10, rue des frères Lumière
 Z.A. du Bois Rond
 69720 ST BONNET DE MURE - FRANCE
 Tel: + 33 (0)4.72.48.30.90
 Fax: + 33 (0)4.78.40.82.81
 E-mail: flexelec@omerin.com

FLEXELEC Dept

OMERIN ASIA Pte Ltd
 51 Goldhill Plaza #08-12/01
 SINGAPORE 308900
 Tel: + 65.6255.4778
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 Primrose Hill - KINGS LANGLEY
 Hertfordshire - WD4 8ST - UK
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 Fax: + 44 (0) 1923.270264
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 Buchwiese 16
 D-65510 IDSTEIN - GERMANY
 Tel: + 49 (0) 6126.94.31-0
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 E-mail: omeringmbh@omerin.com

CF/JL Jacket drum heaters



Characteristics

- Two hinged parts.
- Rollers for easy fitting.
- Heating uniformly divided up between the two halves.
- Fully insulated lid.
- Steel casing and lid.
- Power 4.65 kW.
- 400 V 3-phase.



Use

Consult the pages of the catalogue devoted to the corresponding general operating principles, general instructions for use and accessories.

Applications

CF/JL drum heaters are ideal for heating materials such as bitumen, tar, grease, paint, varnish and wax.

A thermostat allows the temperature to be adjusted to prevent overheating the contents.



Control

A thermostat that can be set between + 50 and + 300°C controls the temperature of the inner wall of the heater and does not necessarily reflect the temperature inside the drum.

Heating time is variable. It depends on the type of substance being heated, the ambient temperature and the temperature to be obtained.

For substances that could be damaged by too high a temperature it is recommended to proceed in stages, progressively increasing the thermostat setting.

Connection and fitting

The drum heater has a power rating of 4.65 kW at 400 V and must be connected to a three-phase power supply. It is made up of two parts and is provided with rollers to make it easy to fit around the drum.

To use it, simply place it round the drum, close it with the clips and fit the lid. When the thermostat is set to the required temperature, connect it up to the mains. The CF/JL is then ready to use. If rapid heating is required, a CF/B type drum heater can be added under the drum.

	CF/JL
Heating element	Shielded resistors
Height with lid	1080 mm
Diameter with thermostat box	870 mm
Power	4650 W
Voltage	400 V 3-phase
Insulation	50 mm rock wool
Thermostat	from + 50°C to + 300°C
Weight	72 kg

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10, rue des frères Lumière
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Flexible heating cables and elements temperature maintenance systems



FLEXKIT®

ACCESSORIES

INSTALLATION	CONNECTION KITS	78
MOUNTING	FITTING ACCESSORIES	79
FX/AT1 - FX/AT - FX/ST	THERMOSTATS	80
FX/TM1	ELECTRONIC THERMOSTATS	81
FX/CDM1 A	HYGROTHERMOSTATS	82
FX/DC1P	POWER MODULATORS	83

Connection kits

ITEM	KIT	SAFE AREAS														HAZARDOUS AREAS				
		FS/KIT FS/KIT5	FS/KIT/T FS/KIT5/T	FS/KIT/TP FS/KIT5/TP	FS/KIT/V	FS/KIT/VF	FS/KIT/X	FS/KIT/XF	FS/KIT/C	FT/KIT/C	FT/KIT1 FT/KIT5	FT/KIT0.1 FT/KIT0.5	FT/KIT1/G FT/KIT5/G	FT/KITX-1 FT/KITX-5	on request	FS/KIT/EX1	FS/KIT/EX2	FS/KIT/EX3	FS/KIT/EX4	Z01 12012
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FTTH/TF																				
FTX 10																				
C1FS/I																				
C2FS/I																				
R3FS/I																				
ZFE CGE																				
ZFA CGA																				

For use in gutters

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Fitting accessories



FX/JB	Junction box 85 x 85 x 45mm – IP 55 (IP 65 fitted with FX/G) - 7 entries 20 mm - For the connection or derivation of heating cables. Use the junction box FLEXKIT FX/JBG for following cables : FSTTP, FSV, FSVT, FSVI, FSVTF, FSX, FSXT, FSXI, FSXTF.
FX/JBG	Junction box 98 x 98 x 61mm – IP 55 (IP 65 if equipped with the FLEXKIT FS/KIT/...) - 7 entries 25 mm - For the connection or derivation of heating cables : FSTTP, FSV, FSVT, FSVI, FSVTF, FSX, FSXT, FSXI, FSXTF.
FX/PBA	Pipe bracket for FLEXKIT FX/AT, FX/AT1, FX/BOITIER, FX/JB, FX/JBG, FX/JBE2, FX/ST.
SILT 25 SILT 100	Tube of silicon sealant 25 g Tube of silicon sealant 100 g
Caps P Caps G	Silicon end-piece for FTP/FTTH Silicon end-piece for FTSH
FTAL	Aluminium adhesive tape. 50 mm wide, 50 m long
FX/G FX/GX	Cable gland 20 mm Cable gland for FTX cable
FX/ETIQ	Self-adhesive "WARNING" label
FX/BJE2	ATEX EEx "e" IIC – T6 junction box with 4 M20 outputs and 2 caps
FX/CRT	Hook to hold cable in place for drain pipe
KYCY FIXATION	Box of 25 m metal fixing strip

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FX/AT1 - FX/AT - FX/ST Thermostats



FX/AT1 thermostat



FX/AT thermostat



FX/ST thermostat



Applications

In order to maintain the right temperature, a control device will provide the following advantages:

- the heating element is energised only when necessary.
- the heating element lifetime is increased.
- the heating element will not overheat.
- the energy consumed is kept to a minimum.

FX/AT1 ambient thermostat

To protect vessels and piping from freezing, this thermostat is preset at + 4°C.

FX/AT ambient thermostat

To protect vessels and piping from freezing, this thermostat can be set from - 5°C to + 40°C.

FX/ST bulb thermostat and capillary tube

The stainless steel bulb and capillary tube allow the temperature at the surface of the vessel or the piping to be read. Three temperature ranges from - 5°C to + 220°C (see below).

	FX/AT1 ambient thermostat	FX/AT ambient thermostat
Temperature range	Preset to + 4°C	- 5°C to + 40°C
Current rating	5 A	16 A
Box protection level	IP 55	IP 65
Box dimensions	85 x 85 x 45 mm	125 x 125 x 75 mm
Accuracy	± 2°C	± 2.5°C
Differential	4°C	2.5°C
Connection	2 inputs with cable gland	

	FX/ST - 40	FX/ST - 120	FX/ST - 220
Temperature range	- 5°C to + 40°C	+ 20°C to + 120°C	+ 20°C to + 220°C
Accuracy	+ 4°C at + 40°C	+ 5°C at + 120°C	+ 10°C at + 220°C
Differential	2.5°C	5°C	7°C
Capillary tube length	1.2 m		
Bulb dimensions	155 mm x 0.6 mm	86 mm x 0.6 mm	211 mm x 0.3 mm
Max. bulb temperature	+ 77°C	+ 202°C	+ 262°C
Bulb & capillary tube material	Stainless steel		
Current rating	16 A		
Box material	Polycarbonate		
Protection level	IP 65		
Box dimensions	175 x 125 x 75 mm		
Max. box temperature	+ 50°C		

Use

Consult the pages of the catalogue devoted to the corresponding general operating principles, general instructions for use and accessories.

FLEXELEC S.A.S

10, rue des frères Lumière
Z.A. du Bois Rond
69720 ST BONNET DE MURE - FRANCE
Tel: + 33 (0)4.72.48.30.90
Fax: + 33 (0)4.78.40.82.81
E-mail: flexelec@omerin.com

FLEXELEC Dept

OMERIN ASIA Pte Ltd
51 Goldhill Plaza #08-12/01
SINGAPORE 308900
Tel: + 65.6255.4778
Fax: + 65.6255.4779
E-mail: sales@omerin.com.sg

FLEXELEC (UK) Ltd

Unit 11 Kings Park Industrial Estate
Primrose Hill - KINGS LANGLEY
Hertfordshire - WD4 8ST - UK
Tel: + 44 (0) 1923.274477
Fax: + 44 (0) 1923.270264
E-mail: sales@omerin.co.uk

FLEXELEC Dept

OMERIN GmbH
Buchwiese 16
D-65510 IDSTEIN - GERMANY
Tel: + 49 (0) 6126.94.31-0
Fax: + 49 (0) 6126.83.99
E-mail: omerinmbh@omerin.com

FX/TM1 Electronic thermostats



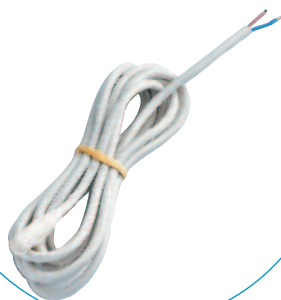
Characteristics

- Current rating 20 A.
- 230 V.
- Accuracy 0.2°C.
- Dimensions 85 x 53 x 65 mm.
- FX/TM1/SONDE: CTN sensor 1000 Ω at + 25°C.
- Sensor length: 3 m.
- FX/TM1/35 : from - 5°C to + 35°C.
- FX/TM1/90 : from + 30°C to + 90°C.
- FX/TM1/140 : from + 80°C to + 140°C.

FX/TM1 thermostat



FX/TM1/SONDE



FX/BOITIER



Use

Consult the pages of the catalogue devoted to the corresponding general operating principles, general instructions for use and accessories.

Applications

The FX/TM1 range of electronic thermostats is used for accurate temperature control.

To keep piping and its contents at the right temperature, a control device provides the following advantages:

- the heating element is energised only when necessary.
- the heating element lifetime is increased.
- the heating element will not overheat.
- the energy consumed is kept to a minimum.

The sensor can be extended and positioned 50m away from the thermostat, making it extremely flexible to use.

The FX/TM1 thermostat is fitted to a DIN rail in an electrical cabinet.

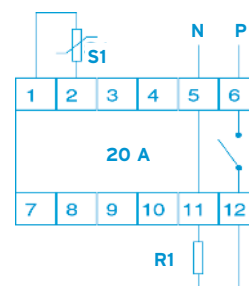
FX/BOITIER option

The thermostat can be fitted in an IP 54 box (195 x 115 x 110 mm).

Electrical connection diagram

R1 = Heating cable

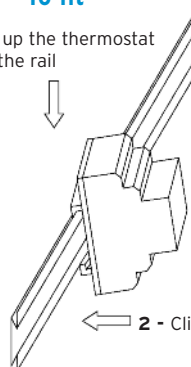
S1 = Sensor



Fitting / removing the thermostat

To fit

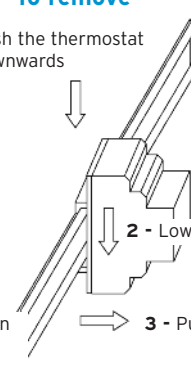
- 1 - Offer up the thermostat onto the rail



2 - Clip in position

To remove

- 1 - Push the thermostat downwards



2 - Lower the tongue

3 - Pull

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10, rue des frères Lumière
Z.A. du Bois Rond
69720 ST BONNET DE MURE - FRANCE
Tel: + 33 (0)4.72.48.30.90
Fax: + 33 (0)4.78.40.82.81
E-mail: flexelec@omerin.com

FLEXELEC Dept

OMERIN ASIA Pte Ltd
51 Goldhill Plaza #08-12/01
SINGAPORE 308900
Tel: + 65.6255.4778
Fax: + 65.6255.4779
E-mail: sales@omerin.com.sg

FLEXELEC (UK) Ltd

Unit 11 Kings Park Industrial Estate
Primrose Hill - KINGS LANGLEY
Hertfordshire - WD4 8ST - UK
Tel: + 44 (0) 1923.274477
Fax: + 44 (0) 1923.270264
E-mail: sales@omerin.co.uk

FLEXELEC Dept

OMERIN GmbH
Buchweise 16
D-65510 IDSTEIN - GERMANY
Tel: + 49 (0) 6126.94.31-0
Fax: + 49 (0) 6126.83.99
E-mail: omeringmbh@omerin.com

FX/CDM1 A Hygrothermostats



Characteristics

Electronic regulator alone: FX/CDM1 A

- Power supply: 230 V.
- Current rating: 6 A.
- Fits to DIN rail.
- Dimensions: 85 x 53 x 65 mm (3 modules).

External temperature sensor FX/CDM/SENSOR

- Type : CTN 1000 Ohms at 25°C.
- Dimensions : Box 50 x 50 x 35 mm.
- Power supply : By standard 2 conductor cable, (not supplied) from the electronic box to the sensor terminals (50 m maximum).

External humidity sensor

- Capacitive type.
- Power supply: by 4 conductor cable from the electronic box to the sensor (5 m long, can be extended up to 50 m).
- Heating: When it freezes, the sensor is automatically heated to melt the snow on the electrodes.
- **FX/CDM/SONDENEIGE**: Box 60 x 15 x 15 mm + 2 electrodes 150 mm length in the extension.
- **FX/CDM/SONDEPARKING** dimensions 60 x 60 x 35 mm.

FX/BOITIER option

- IP 54 box (195 x 115 x 110 mm) for hygrothermostat.

Applications

The FX/CDM1 A hygrothermostat permanently checks for the presence of snow or black ice in gutters or access ramps. The heating cables are powered according to the outside temperature and the presence of humidity.

The energy required is calculated by an interval timer switch.

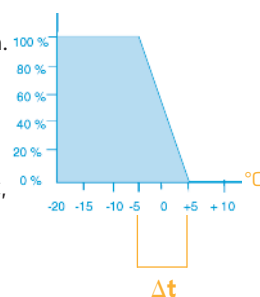
Operation/Settings

°C → Temperature below which the regulator comes into operation.

Δt → Zone in which the regulator operates as an energy dispenser proportional to needs.

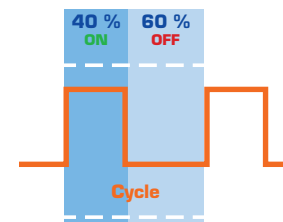
Example:

with "°C" = + 5°C and "Δt" = 10°C,
if outside temperature:
+ 5°C : 0 % of energy
0°C : 50 % of energy
- 5°C : 100 % of energy



"T min" Time Base → This is the period of a cycle energised and de-energised in the operation sequence. Time can be set from 30s to 10 min.

Example with 40 % of energy:

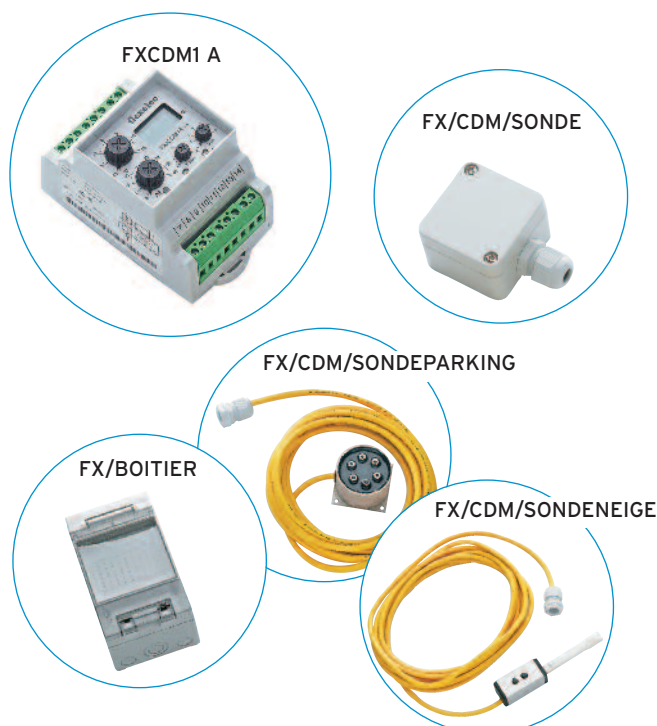
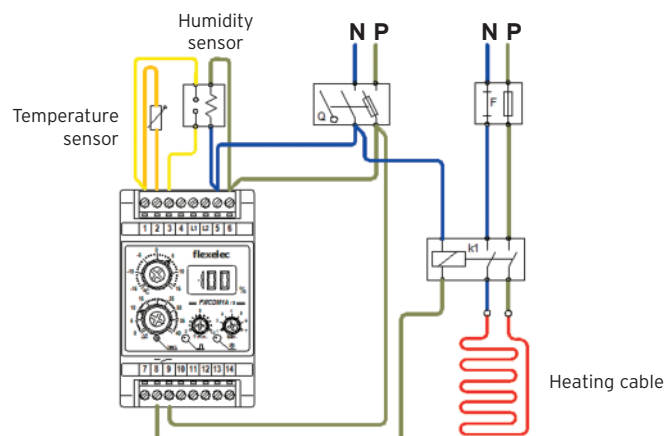


"SEN" Sensitivity of the humidity sensor →

This setting makes it possible to vary the sensitivity of the snow detection circuit.

Value "1" corresponds to the greatest sensitivity to humidity.

Connection diagram



FLEXELEC S.A.S

10, rue des frères Lumière
Z.A. du Bois Rond
69720 ST BONNET DE MURE - FRANCE
Tel: + 33 (0)4.72.48.30.90
Fax: + 33 (0)4.78.40.82.81
E-mail: flexelec@omerin.com

FLEXELEC Dept

OMERIN ASIA Pte Ltd
51 Goldhill Plaza #08-12/01
SINGAPORE 308900
Tel: + 65.6255.4778
Fax: + 65.6255.4779
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FLEXELEC (UK) Ltd

Unit 11 Kings Park Industrial Estate
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Hertfordshire - WD4 8ST - UK
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FLEXELEC Dept

OMERIN GmbH
Buchwiese 16
D-65510 IDSTEIN - GERMANY
Tel: + 49 (0) 6126.94.31-0
Fax: + 49 (0) 6126.83.99
E-mail: omeringmbh@omerin.com

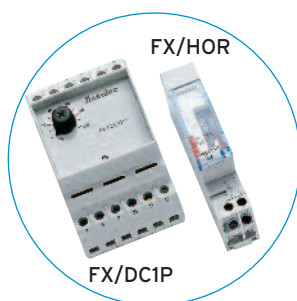
FX/DC1P

Power modulators

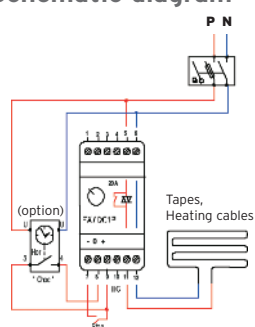


Characteristics

- Principle: Analogue chrono-proportional.
- Setting: Percentage 0 to 100 %.
- Time base: 30 seconds fixed.
- Power supply: 230 V \pm 10 %.
- Output: 230 V, 20 A maximum.
- Dimensions: 87 x 55 x 55 mm.
- Fits to DIN rail.



Schematic diagram



Applications

The FX/DC1P power modulator is used to adjust the power of an installation to the real need.

It is particularly suited for heating cables used in hot water networks.

Operation

The power can be set from 0 to 100 %.

Power is modified by limiting the power supply time to the cable in a 30 second cycle.

Two controls are used to force the cycle to 100 % (impulse) or to 0 % (stop). For hot water, the sterilise function can be obtained with an external timer (option).

FX/BOITIER option

The power modulator can be fitted in an IP 54 box (195 x 115 x 110 mm).

External timer option FX/HOR

- Weekly programme
- Programming in 2 h segments
- Output: 16 A rated contact
- Vertical analogue face
- Power reserve 100 h
- Dimensions: 1 x 17.5 mm module

Setting the modulator according to the power required

Use the FSH/TP 30 self-adjusting heating tape. The tables below give heat losses in W/m, and the modulator setting (the figure in brackets) for straight heat tracing along the piping. This setting is given as a guide only and must be adjusted according to the results obtained. For the sterilise function, please consult us.

Vertical risers Ambient temperature: 15°C Insulation 0.042 W/m.°C								
Nominal diameter Ext. diameter (mm)	1/2" 21	3/4" 27	1" 34	1 1/4" 42	1 1/2" 48	2" 60	2 1/2" 76	3" 89
Thermal lagging th. mm	Maintenance temperature 45°C							
9	14.07 (70)	17.05 (85)	15.33 (80)	18.07 (90)				
13	10.81 (55)	12.91 (65)	11.61 (60)	13.52 (70)	14.93 (75)	17.75 (90)		
19	8.43 (45)	9.91 (50)	8.23 (40)	9.41 (50)	10.28 (50)	12.00 (60)	14.25 (70)	16.07 (80)
32	6.23 (30)	7.17 (35)						
	Maintenance temperature 50°C							
9	16.41 (90)	15.06 (80)						
13	12.61 (70)	11.56 (65)	13.54 (75)	15.77 (85)				
19	9.84 (55)	8.36 (45)	9.60 (50)	10.97 (60)	11.99 (65)	14.00 (75)	16.63 (90)	
32	7.27 (40)							
	Maintenance temperature 55°C							
9	14.41 (85)							
13	11.24 (65)	13.22 (80)	15.48 (90)					
19	8.30 (50)	9.56 (55)	10.97 (65)	12.54 (75)	13.70 (80)	15.99 (95)		
32								
Basement Area Ambient temperature: 5°C Insulation 0.036 W/mK								
Nominal diameter Ext. diameter (mm)	1/2" 21	3/4" 27	1" 34	1 1/4" 42	1 1/2" 48	2" 60	2 1/2" 76	3" 89
Thermal lagging th. mm	Maintenance temperature 45°C							
25	8.17 (40)	9.50 (50)	11.00 (55)	12.69 (65)	13.94 (70)	16.42 (80)		
30	7.37 (35)	8.51 (45)	9.79 (50)	11.22 (55)	12.27 (60)	14.36 (70)	17.10 (85)	
40	6.34 (30)	7.23 (35)	8.23 (40)	9.33 (45)	10.15 (50)	11.75 (60)	13.84 (70)	15.52 (80)
50	5.68 (30)	6.43 (35)	7.26 (35)	8.17 (40)	8.84 (45)	10.15 (50)	11.85 (60)	13.22 (65)
	Maintenance temperature 50°C							
25	9.19 (50)	10.68 (60)	12.38 (70)	14.28 (80)	15.69 (85)			
30	8.29 (45)	9.57 (50)	11.01 (60)	12.62 (70)	13.81 (75)	16.15 (90)		
40	7.13 (40)	8.13 (45)	9.25 (50)	10.50 (60)	11.42 (60)	13.21 (70)	15.57 (85)	
50	6.39 (35)	7.23 (40)	8.16 (45)	9.19 (50)	9.94 (55)	11.42 (60)	13.33 (75)	14.87 (80)

FLEXELEC S.A.S

10, rue des frères Lumière
Z.A. du Bois Rond
69720 ST BONNET DE MURE - FRANCE
Tel: + 33 (0)4.72.48.30.90
Fax: + 33 (0)4.78.40.82.81
E-mail: flexelec@omerin.com

FLEXELEC Dept

OMERIN ASIA Pte Ltd
51 Goldhill Plaza #08-12/01
SINGAPORE 308900
Tel: + 65.6255.4778
Fax: + 65.6255.4779
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FLEXELEC (UK) Ltd

Unit 11 Kings Park Industrial Estate
Primrose Hill - KINGS LANGLEY
Hertfordshire - WD4 8ST - UK
Tel: + 44 (0) 1923.274477
Fax: + 44 (0) 1923.270264
E-mail: sales@omerin.co.uk

FLEXELEC Dept

OMERIN GmbH
Buchwiese 16
D-65510 IDSTEIN - GERMANY
Tel: + 49 (0) 6126.94.31-0
Fax: + 49 (0) 6126.83.99
E-mail: omeringmbh@omerin.com

TECHNICAL GUIDE

GENERAL INSTALLATION

AND INSTRUCTIONS FOR USE OF ALL FLEXELEC PRODUCTS



BASIC RULES

Your temperature maintenance system will give trouble-free operation provided it is fitted in accordance with good engineering practice. You should fit and connect up the cables and flexible heating elements as indicated below. Read the instructions carefully: it will be more costly to have to carry out repair work afterwards than to "waste" time reading these instructions to the end and installing your system in keeping with the recommendations given. (BS 6351 Part3)

It is prohibited to use the system in any way that does not respect the precautions for use.

Before beginning to fit the heating element, make sure that thermal insulation is fitted immediately afterwards: our products could be damaged by tools or solder, etc. falling on them if too much time elapses between these two operations.

→ Warning:

In no event should the heating element be held in the air or enclosed within insulating material while it is operating.
Do not energise the heating element before fitting it.
Do not immerse the heating element.
Do not fit the heating element if it is damaged.
Do not touch the heating element when it is energised.

Assembly and commissioning are subject to standards (BS 6351 Part3), safety instructions and accident prevention rules in force in each country.

It is prohibited to modify the devices in any way.

Clean and wipe the outside of the part to be heated.

Also check that no sharp parts such as welds, welding flash, metal parts, etc. could damage the heating element.

The whole of the heating element must be in contact with the part to be heated.

In no circumstances should the heating element cross over or overlap itself.

Cover the whole of the heating element and the part to be heated with thermal insulation of recommended thickness.

Stick the warning label on the thermal insulation.

The heating element should be energised only when fitting operations are finished.

Connect up to a suitable, properly protected electric power supply.

The electrical protection systems (fuses, circuit-breakers, etc.) must be provided on the site as per the applicable standards in force.

SPECIAL INSTRUCTIONS

Ensure that the flexible heating element chosen is fully appropriate for the requirements of the installation. For this purpose, consult the FLEXELEC technical documents.

Check whether the project requires straight or spiral heat tracing and if extra lengths need to be provided for valves, flanges, pumps, etc.

Heat loss calculations for flanges, valves, piping supports or other elements may turn out to be complex because of difficulty in measuring the exact heat transfer surfaces. Many accessories such as flanges and valves are manufactured according to standards, while others, such as filters or pumps differ from one manufacturer or application to another. To determine heat losses, follow the recommendations below:

Type	Diameter	Equivalent cable length
Flanges	≤ DN 200	0.3 m
	> DN 200	1.0 m
Valves	≤ DN 200	1.0 m
	> DN 200	3.0 m

Note: The extra length of cable calculated in these 4 cases may not be used in full for practical reasons. All constant power cables or self-regulating heating tapes have maximum circuit lengths depending on their power rating and voltage. Consult the FLEXELEC technical documentation.

When fitting heating elements, do not:

- allow them to come into contact with sharp edges,
- apply excessive pulling force to them,
- allow them to be crushed in any way.

The cables must be terminated as soon as possible after fitting to prevent damp entering by non-sealed ends.

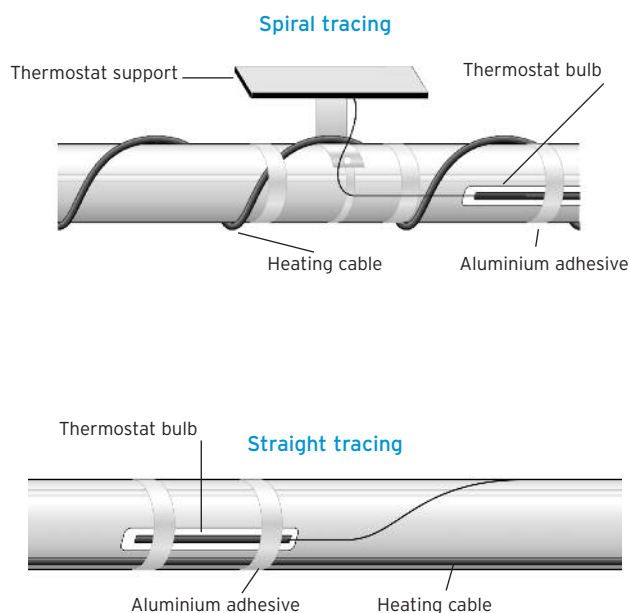
- Inspect the heating elements and accessories as soon as you receive them to check that they have not been damaged during transit. It is recommended to carry out measurement of insulation resistance at this stage.
- For constant power cables, check that sufficient length has been provided to allow for the incorporated cold tails.
- Allow an extra 0.5 m of self-regulating heating cable to connect to another cable or for a branch joint.
- Always begin heat tracing at the power supply end.

FITTING THERMOSTATS AND JUNCTION BOXES

To protect against freezing, air thermostats are generally used. These must be fitted in the area most exposed to freezing and can be fixed to the piping or any other support. If they are fitted to piping the heating cable can be connected directly into the thermostat. Self-regulating heating cables can be connected directly to a junction box (a thermostat is not strictly necessary, but strongly recommended). Supports exist for fixing the junction box or thermostat onto the piping.

Bulb and capillary or temperature probe thermostats are normally used for production lines to control the surface temperature and must be fitted immediately adjacent to the power point. Supports exist for fixing the thermostat onto the piping.

First fix the thermostats and junction boxes in the planned locations. For bulb thermostats, the bulb must always be fixed as shown below:



INSTRUCTIONS

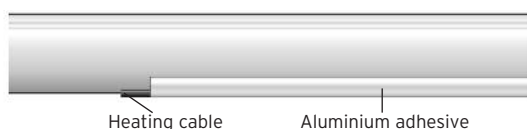
FITTING HEATING CABLES

(the term "cables" also refers to other flexible heating elements). The first rule is never to cross heating cables or lay one on top of another.

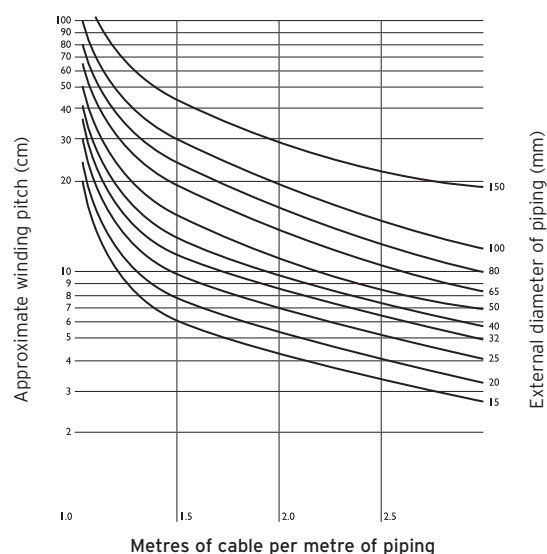
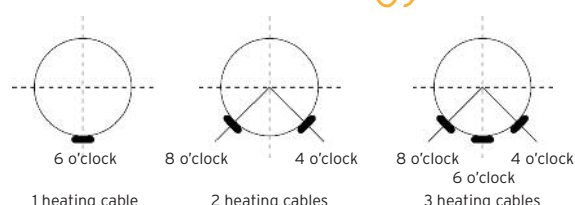
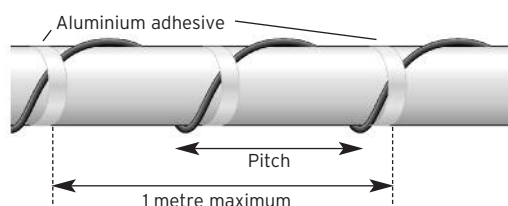
It is not essential to completely cover the heating element with aluminium adhesive, but this is recommended for the following reasons:

- The heating cable will not be trapped in the thermal insulation.
- Thermal efficiency will be improved through better contact between the heating cable and the piping.
- This eliminates the risk of hot spots on the heating cable.
- This type of fitting is strongly recommended on flanges, valves, taps, etc.

Straight tracing



Spiral tracing



TRACING PIPING EQUIPMENT: ELBOWS, FLANGES, VALVES AND PIPING SUPPORTS

- Notes:**
- Inverting the screw pitch either side of the equipment makes it easier to remove.
 - Ensure that the heating cable is properly in contact with the equipment.
 - Smooth over any sharp edges as necessary (with an aluminium tape, for example).

Type	Straight tracing	Spiral tracing
Elbows	 Trace on the outside of the elbow	 Regular pitch, adjacent turns must not touch on the inside
Flanges		
Small diameter valves		
Large diameter valves		

GENERAL INSTALLATION

AND INSTRUCTIONS FOR USE OF ALL FLEXELEC PRODUCTS



PIPING SUPPORTS

Type	Straight tracing	Spiral tracing
Screwed collars		
Welded flat iron bars		
Welded columns		

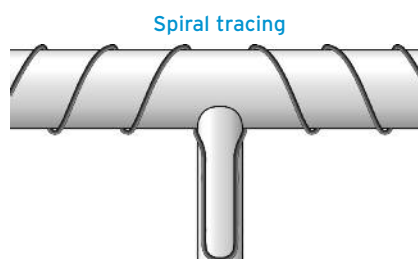
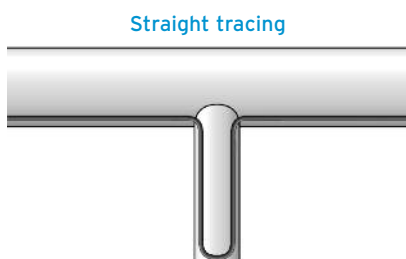
TRACING A BRANCH JOINT

Branch joints or nozzles are often of a smaller diameter than the main pipe. Return tracing must therefore be avoided on long nozzles as these would increase the installed power to the point of multiplying it by two (straight tracing) and causing local overheating.

Short nozzles: 1.5 m maximum.

Long nozzles: greater than 1.5 m.

For long nozzles, break the circuit and fit a junction box to allow the heating circuit to branch off.

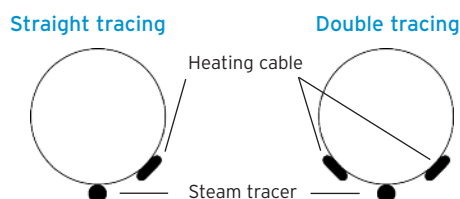


FITTING A HEATING CABLE TO PIPING WITH A STEAM TRACER

Check that the cable sheath will withstand the temperature of the steam.

Never use spiral tracing, which would cause the cable to come into contact with the steam tracer.

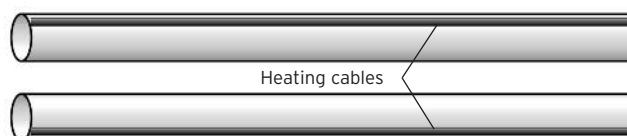
Use single or double straight tracing.



TRACING TWO PIPES SIDE BY SIDE

Never spiral the heating cable over the piping.

Use double straight tracing.



INSTRUCTIONS

INSPECTION

Before fitting the thermal insulation, perform the following inspections:

- Throughout the cable installation process.
- As soon as possible once the installation is finished and before connecting up to the electric power supply.

Installation inspection

The following inspections must be made:

- The heating cables and temperature probes (if any) are in close contact with the piping; there is no air gap between these devices and the piping.
- No cable loops are hanging in mid air.
- No heating cable is trapped under piping supports, thermostat supports or junction boxes, etc.
- No heating cable is crossed over or laid on top of another, or twisted about itself.
- All the heating cables are fixed to the piping with appropriate fixing materials.

Circuit continuity and insulation resistance inspection

The following procedure is designed to check that the various heating cables are operating properly.

• Constant power cables

- 1 Check the resistance and continuity of the circuits using a multimeter.
- 2 Check the insulation resistance between the conductors and the earth using a 2500 V DC (500V DC min) megohmmeter.

Whatever the length of the cable, the minimum insulation resistance must be 10 megohms.
- 3 The results of the above tests must be recorded and stored.

• Self-regulating heating cables

Check the insulation resistance using a 2500 V DC (500V DC min) megohmmeter.

Whatever the length of the cable, the minimum insulation resistance must be 10 megohms.

- 1 Between conductors and piping if the cable is not braided.
- 2 Between conductors and braid if any.
- 3 For cables with braid and sheath, **perform 2 tests:**
 - **Test 1:** between conductor and braid,
 - **Test 2:** between braid and metal piping
- 4 As before, record and store the test results.

MAINTENANCE

Visual inspection

Visually inspect the piping with tracers to check that neither the insulation nor the cable have been damaged.

Tracer inspection

The following inspection procedures must be carried out at least once a year (before winter) for installations protecting against freezing or twice a year for production installations.

Thermal insulation

- The heating cables must always be protected by thermal insulation.
- During inspection operations, be very careful not to damage the heating cables.
- The thermal insulation must always have the same temperature limit as the heating cables.
- The heating cables must never be trapped within the thermal insulation.
- The thermal insulation must be appropriate for the environmental conditions prevailing.
- Apply labels warning that electrical heat tracing is in use on the outside of the thermal insulation at intervals which make it possible for them to be seen clearly, wherever the person working on the piping may be. Do not forget to place them on both sides of the thermal insulation.

Before any inspection work, switch off the electric power supply.

- Remove the lid from junction boxes and thermostats.
- Disconnect the heating cable from the electric power supply.
- Check, as described above, the insulation resistance rating and, for constant power cables, the resistance rating. Make a note of these figures and store them.
- Compare these figures with those from the previous inspection. If they are the same, reconnect the heating cable and replace the junction box lids.
- With the thermostat still electrically insulated, carry out the inspection as above. Check that the power cables are properly connected to the right terminal block. Using a multimeter, check that the thermostat cuts off power to the heating cables by lowering and raising the temperature setpoint to minimum and then to maximum.
- If the thermostat operates, do not forget to put the setpoint back to the initial temperature.
- Replace the thermostat lid.
- Visually inspect the installation in order to detect any damage to piping or insulation.
- Connect the electric power supply back up.

THESE QUESTIONNAIRES ARE INTENDED TO HELP YOU
TO CHOOSE THE RIGHT PRODUCT



A

Temperature maintenance

Temperature maintenance is the operation which aims to keep the temperature of a device constant.

This implies that the products and their containments must already be at this same temperature.

If this is not the case, then the application comprises a heating dimension, and part B of the questionnaire must also be completed.

Temperature to be maintained		°C
Min. ambient temperature		°C
Nominal Diameter	<input type="text"/> mm	OR outside diameter of the piping <input type="text"/> mm
Length of piping		m
Piping material	<input type="text"/>	
<small>The material that the piping is made of is important information since it will influence the choice of power rating of the cable or braid.</small>		
Max. surface temperature of the piping		°C
<small>The max. temperature of the piping is sometimes a decisive criterion, for example if there are high temperature steam cleaning cycles.</small>		
Type of substance being conveyed	<input type="text"/>	
<small>This is important, as it must be ensured that, in the event of leakage the insulation of the heating cable will not be chemically attacked.</small>		
Thickness of the insulation		mm
Type of insulation	<input type="text"/>	
Thermal conductivity of the insulation		W/m.K
Max. temperature acceptable for the insulation		°C
Available voltage		V
Safe area	<input type="text"/>	OR ATEX hazardous area (indicate the temperature class) <input type="text"/>
Network geometry: nozzles, "T", any diagram		
Other <small>flanges, pumps, valves, max. or min. temperature acceptable by the fluid, etc.</small>		

PHOTOCOPY - FILL IN - FAX with your name, address, phone n°, email

B

Heating

Heating may be static or involve a flow.

Fluid density		kg/dm ³
Specific heat of the fluid		kJ/kg.K
Initial temperature		°C
Temperature to be reached		°C
Min. ambient temperature		°C
Time allowed for heating		h
Fluid flow rate		kg/h
Inside diameter	<input type="text"/> mm	OR Piping thickness <input type="text"/> mm
Specific heat of the piping material		kJ/kg.K

FLEXELEC S.A.S

10, rue des frères Lumière
Z.A. du Bois Rond
69720 ST BONNET DE MURE - FRANCE
Tel: + 33 (0)4.72.48.30.90
Fax: + 33 (0)4.78.40.82.81
E-mail: flexelec@omerin.com

FLEXELEC Dept

OMERIN ASIA Pte Ltd
51 Goldhill Plaza #08-12/01
SINGAPORE 308900
Tel: + 65.6255.4778
Fax: + 65.6255.4779
E-mail: sales@omerin.com.sg

FLEXELEC (UK) Ltd

Unit 11 Kings Park Industrial Estate
Primrose Hill - KINGS LANGLEY
Hertfordshire - WD4 8ST - UK
Tel: + 44 (0) 1923.274477
Fax: + 44 (0) 1923.270264
E-mail: sales@omerin.co.uk

FLEXELEC Dept

OMERIN GmbH
Buchwiese 16
D-65510 IDSTEIN - GERMANY
Tel: + 49 (0) 6126.94.31-0
Fax: + 49 (0) 6126.83.99
E-mail: omeringmbh@omerin.com

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A

Temperature maintenance

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This implies that the products and their containments must already be at this same temperature.

If this is not the case, then the application comprises a heating dimension, and part B of the questionnaire must also be completed.

Temperature to be maintained		°C
Min. ambient temperature		°C
Outside diameter of the vessel or dimension of the edges if rectangular		mm
Height or length of the vessel		mm
Cylindrical height available for tracing		mm
Bottom: flat, rounded, etc.		
Feet: number, insulation, etc.		
Vessel material <i>The material that the vessel is made of is important information since it will influence the choice of power rating of the cable or braid.</i>		
Max. surface temperature of the vessel <i>The max. temperature of the vessel can be a decisive criterion, for example if there are steam cleaning cycles.</i>		°C
Type of substance contained <i>This is important, as it must be ensured that, in the event of leakage the insulation of the heating cable will not be chemically attacked.</i>		
Thickness of the insulating lagging		mm
Type of insulating lagging		
Thermal conductivity of the insulation		W/m.K
Max. temperature acceptable for the insulation		°C
Available voltage		V
Safe area	OR	ATEX hazardous area <i>(indicate the temperature class)</i>
Obstacle on the surface of the vessel: nozzles, feet, ... any diagrams		
Other <i>flanges, pumps, valves, max. or min. temperature acceptable by the fluid, etc.</i>		

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B

Heating

Heating may be static or involve a flow.

Fluid density	kg/dm³
Specific heat of the fluid	kJ/kg.K
Initial temperature	°C
Temperature to be reached	°C
Min. ambient temperature	°C
Time allowed for heating	h
Fluid flow rate	kg/h
Max. vessel capacity	kg or m³
Max. fill rate	%
Vessel thickness	mm
Specific heat of the vessel material	kJ/kg.K

FLEXELEC S.A.S

10, rue des frères Lumière
Z.A. du Bois Rond
69720 ST BONNET DE MURE - FRANCE
Tel: + 33 (0)4.72.48.30.90
Fax: + 33 (0)4.78.40.82.81
E-mail: flexelec@omerin.com

FLEXELEC Dept

OMERIN ASIA Pte Ltd
51 Goldhill Plaza #08-12/01
SINGAPORE 308900
Tel: + 65.6255.4778
Fax: + 65.6255.4779
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D-65510 IDSTEIN - GERMANY
Tel: + 49 (0) 6126.94.31-0
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IN ORDER TO DETERMINE A SPECIAL PRODUCT MADE TO THE MEASUREMENTS YOU REQUIRE, ANSWERS TO THE FOLLOWING QUESTIONS ARE NECESSARY. THESE WILL BE USED TO DEFINE THE BEST PRODUCT FOR YOUR NEEDS.



A Cords

Linear ohmic value	<input type="text"/>	ohm/m
Type of insulation <i>PVC/Silicon elastomer/Fluoropolymer</i>	<input type="text"/>	
Outside diameter	<input type="text"/>	mm
OR		
Final circuit length	<input type="text"/>	m
Power	<input type="text"/>	W
Voltage	<input type="text"/>	V
Type of insulation <i>PVC/Silicon elastomer/Fluoropolymer</i>	<input type="text"/>	

B Cables - Tapes

Total length	<input type="text"/>	mm
Heating length	<input type="text"/>	mm
Power	<input type="text"/>	W
Voltage	<input type="text"/>	V
Type of insulation	<input type="text"/>	
Braid	<input type="text"/>	
Braid material <i>tinned copper; stainless steel, glass silk</i>	<input type="text"/>	
Outside diameter	<input type="text"/>	mm
Number of power cables	<input type="text"/>	1 or 2
Length of power cables	<input type="text"/>	mm
Type of insulation for the connection between heating and cold part(s) <i>(sleeving, moulding, etc.)</i>	<input type="text"/>	
Other	<input type="text"/>	

C Mats

Length	<input type="text"/>	mm
Width	<input type="text"/>	mm
Other geometry details <i>diagram and dimensions</i>	<input type="text"/>	
Power	<input type="text"/>	W
Voltage	<input type="text"/>	V
Power cable length	<input type="text"/>	mm
Location of power cable <i>diagram and dimensions</i>	<input type="text"/>	
OPTIONS		
Adhesive surface for permanent fitting (YES / NO)	<input type="text"/>	
Type of removable fitting <i>Hook + spring / Velcro / Eyelets + silicon tape</i>	<input type="text"/>	
Location for thermostat probe <i>(YES: state diameter / NO)</i>	<input type="text"/>	
Temperature limiter <i>(60°C / 80°C / 150°C / NO)</i>	<input type="text"/>	
PT 100, J Thermocouple <i>(YES / NO)</i>	<input type="text"/>	
Location of options <i>diagram and dimensions</i>	<input type="text"/>	

D Hoses

There are so many different types of pipe that these questions are only a basis to help us define the product. Please contact us to provide us with more complete information.

Nominal inside diameter <i>standard: maximum = 25 mm</i>	<input type="text"/>	mm
Total hose length	<input type="text"/>	m
Operating temperature	<input type="text"/>	°C
Max. operating temperature	<input type="text"/>	°C
Voltage	<input type="text"/>	V
Power	<input type="text"/>	W
Type of probe <i>(P = PT 100, N = NiCr-Ni or F = Fe-CuNi)</i>	<input type="text"/>	
Max. pressure	<input type="text"/>	bar
Type of connections	<input type="text"/>	
Other	<input type="text"/>	

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TECHNICAL GUIDE

OPERATING PRINCIPLES

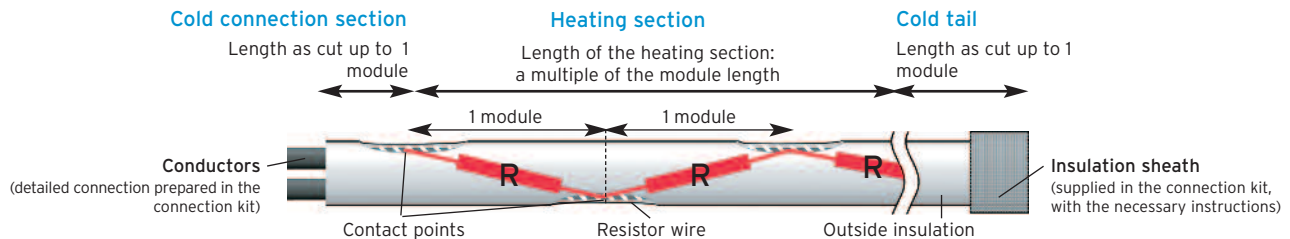


CONSTANT POWER CABLES

A constant power cable is a succession of identical resistors R connected in parallel, which makes it possible to have the same power dissipation on each of these sections.

These resistors are made up of a heating wire coiled around insulated conductor cables, with which it comes into contact at each contact point. These sections, between 2 consecutive contact points, are known as modules.

This is why the cable can only heat between 2 contact points, as shown in the following diagram:

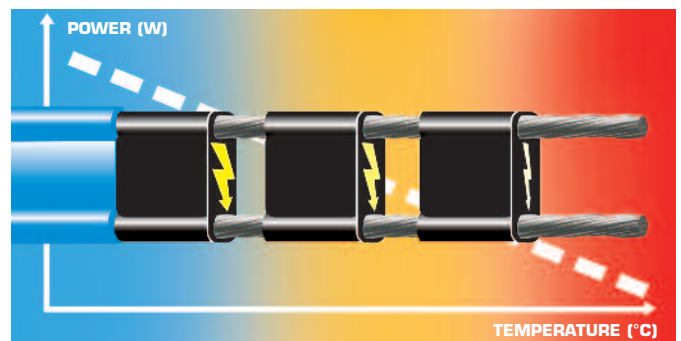


SELF-REGULATING CABLES

Between the conductors, the dark material which makes up the heating element is a polymer enriched with carbon as a conductor. The resistivity of this material varies with temperature because of the dilation of the internal structures which reduce the space available for the current to pass.

Consequently, when the temperature rises, the power dissipated by the cable decreases. This is the phenomenon referred to as **self-regulation**. This prevents overheating which could damage the cable and allows the part of the cable placed in a colder environment to produce more energy in that zone.

When in operation, the cable will therefore always reach a balance between the power it dissipates and the losses due to the outside environment. However, it is impossible to accurately determine at what temperature the surface of the cable will stabilise, because of the complexity and variability of its environment. Similarly, in order to keep control over the installation and to make significant energy savings, it is always recommended to adjust these cables by means of a thermostat.



NB: unlike the other heating elements, it is impossible to check that a self-regulating cable is operating correctly by measuring resistance with an ohmmeter. This can be done instead by measuring the voltage/current.

SERIES RESISTORS

A series resistor is an element with an electric current running between its two ends. It dissipates an amount of power governed by Ohm's law (cf. formula). As a result, any change in length, voltage or current is extremely tricky and means that we have to perform a new, in-depth study.

For series resistors sold by their Ohm/m rating (semi-finished products ordered by the metre or kilometre), a prior study is absolutely essential to at least be sure that the final cut length will produce a maximum power level that is in keeping with the recommendations of our technical documentation.

For finished products sold by their wattage (ordered individually), the power supply voltage must be strictly respected and the length never modified.

TECHNICAL FORMULAE

OHM'S LAW:

The formulae linking the electrical variables of a purely resistive element are as follows:

$$U = R \times I = P/I = \sqrt{P \times R}$$

$$I = U/R = \sqrt{P/R} = P/U$$

$$R = U/I = P/I^2 = U^2/P$$

$$P = U \times I = I^2 \times R = U^2/R$$

where:

U: voltage in Volts (V)

I: current in Amps (A)

R: resistance in Ohms (Ω)

P: power in Watts (W)

WINDING PITCH:

The winding pitch is the distance between two successive turns of a cable wound round a cylindrical support. This winding should be used when the linear power obtained by straight tracing is insufficient or when very uniform heating is required.

$$P = \frac{\pi \times D \times L}{\sqrt{T^2 - L^2}}$$

$$T = \frac{(\pi \times D \times L)^2}{P^2} + L^2$$

where:

P: winding pitch in mm

D: outside diameter of the support

L: total length of the piping

T: total length of the cable

USUAL METAL PIPE DIAMETERS

Nominal diameter DN (inches)	1/4	3/8	1/2	3/4	1	1 ^{1/4}	1 ^{1/2}	2	2 ^{1/2}	3	3 ^{1/2}	4	5	6	8	10	12
Outside diameter D (mm)	13.71	17.14	21.34	26.67	33.4	42.16	48.26	60.32	73.02	88.9	101.6	114.3	141.3	168.27	219.07	273.05	323.85

LOSSES PER m OF PIPING: HEAT LOSSES TO BE COMPENSATED FOR IN ORDER TO MAINTAIN A TEMPERATURE

$$Q = \frac{\pi \times (T_m - T_a)}{2 \times \lambda \times \ln\left(\frac{D + 2 \times e}{D}\right)}$$

where:

Ambient temperature	Ta	°C
Maintenance temperature	Tm	°C
Outside dia. of piping	D	mm
Thickness of heat lagging	e	mm
Heat lagging lambda	λ	W/m.K
Theoretical losses	Q	W/m

IMPORTANT: this is a theoretical calculation and must be weighted using a safety coefficient which depends on how the installation will be used. Please consult us to evaluate this coefficient.

LOSSES in W/m FOR INSULATED PIPING

Thermal insulation thickness (mm)	dT in degC	Dimension of the piping																			
		ND (mm)	8	15	20	25	32	40	50	65	80	100	150	200	250	300	350	400	450	500	600
		Ext. D (mm)	14	21	27	34	42	48	60	76	89	114	168	219	273	324	356	406	457	508	610
10	20		6.2	7.2	8.5	10	12	14	16	19	23	28.8	41.1	52.6	64.7	76.1	83.3	94.6	106	117	140
	30		9.4	11	13	15	19	21	25	29	35	43.8	62.5	80	98.5	116	127	144	161	178	213
	40		13	15	18	21	25	28	34	40	47.3	59.2	84.5	108	133	157	171	195	218	241	287
20	20		4	4.6	5.3	6.2	7.3	8	9.5	11	13	16	22.5	28.5	34.9	40.9	44.7	50.7	56.7	62.6	74.6
	30		6.2	7	8.1	9.4	11	12	15	17	19.8	24.4	34.2	43.4	53.2	62.3	68	77.1	86.2	95.3	113
	40		8.3	9.5	11	13	15	17	20	23	26.7	33	46.3	58.7	71.9	84.2	92	104	117	129	153
	60		13	15	17	20	23	26	30	35	41.2	50.9	71.4	90.5	111	130	142	161	180	199	237
25	20		3.6	4.1	4.6	5.3	6.2	6.9	8.1	9.3	10.9	13.4	18.6	23.5	28.7	33.5	36.5	41.4	46.2	51.1	60.7
	30		5.4	6.2	7.1	8.1	9.5	10	12	14	16.6	20.3	28.3	35.7	43.6	51	55.6	63	70.3	77.7	92.4
	40		7.4	8.4	9.5	11	13	14	17	19	22.4	27.5	38.2	48.3	59	69	75.2	85.2	95.1	105	125
	60		11	13	15	17	20	22	26	30	34.5	42.4	59	74.5	90.9	106	116	131	147	162	193
	80		16	18	20	23	27	30	35	41	47.4	58.2	81	102	125	146	159	180	201	222	265
	100		20	23	26	32	30	39	45	53	61.2	75.2	105	132	161	189	206	233	260	287	342
30	20		3.3	3.7	4.2	4.8	5.5	6.1	7.1	8.1	9.5	11.6	15.9	20.1	24.4	28.5	31	35.1	39.2	43.2	51.3
	30		5	5.6	6.3	7.3	8.4	9.2	11	12	14.4	17.6	24.3	30.5	37.1	43.3	47.2	53.4	59.6	65.8	78.1
	40		6.7	7.6	8.6	9.8	11	13	15	17	19.5	23.8	32.8	41.3	50.2	58.6	63.8	72.2	80.6	88.9	106
	60		10	12	13	15	18	19	23	26	30	36.6	50.6	63.6	77.4	90.4	98.4	111	124	137	163
	80		14	16	18	21	24	26	31	36	41.2	50.3	69.4	87.3	106	124	135	153	171	188	224
	100		18	21	23	27	31	34	40	46	53.2	65	89.7	113	137	160	175	197	220	243	289
	120		23	26	29	33	39	42	49	57	65.9	80.4	111	140	170	198	216	244	273	301	358
	140		27	31	35	40	46	51	59	68	79.3	96.8	134	168	204	239	260	294	328	362	430
	160		32	36	41	47	55	60	70	80	93.3	114	157	198	241	281	306	346	386	426	506
	180		37	42	48	55	63	69	81	93	108	132	182	229	279	325	354	401	447	494	586
40	20		2.8	3.2	3.6	4	4.6	5	5.8	6.6	7.6	9.2	12.6	15.7	19	22.1	24	27.1	30.2	33.3	39.4
	30		4.3	4.8	5.4	6.1	7	7.7	8.9	10	11.6	14.1	19.1	23.9	28.9	33.6	36.6	41.3	45.9	50.6	60
	40		5.8	6.5	7.3	8.3	9.5	10	12	14	15.7	19	25.9	32.3	39.1	45.5	49.4	55.8	62.1	68.5	81.1
	60		9	10	11	13	15	16	19	21	24.3	29.3	39.9	49.8	60.3	70.1	76.2	86	95.8	106	125
	80		12	14	16	18	20	22	25	29	33.3	40.2	54.8	68.4	82.7	96.2	105	118	132	145	172
	100		16	18	20	23	26	28	33	37	43	52	70.8	88.3	107	124	135	152	170	187	222
	120		20	22	25	28	32	35	41	46	53.3	64.4	87.6	109	132	154	167	189	210	232	275
	140		24	27	30	34	39	42	49	56	64.1	77.4	105	132	159	185	201	227	253	279	330
	160		28	31	35	40	46	50	57	66	75.4	91.1	124	155	187	218	237	267	298	328	339
	180		32	36	41	46	53	58	67	76	87.3	106	144	179	217	252	274	310	345	380	450
50	20		2.6	2.8	3.2	3.6	4.1	4.4	5	5.7	6.5	7.8	10.5	13.1	15.7	18.2	19.8	22.3	24.7	27.2	32.2
	30		3.9	4.3	4.8	5.4	6.2	6.7	7.7	8.7	9.9	11.9	16	19.9	23.9	27.7	30.1	33.9	37.6	41.4	48.9
	40		5.3	5.9	6.5	7.3	8.4	9.1	10	12	13.4	16.1	21.7	26.9	32.3	37.5	40.7	45.8	50.9	56	66.2
	60		8.1	9	10	11	13	14	16	18	20.7	24.8	33.4	41.4	49.9	57.8	62.7	70.6	78.5	86.3	102
	80		11	12	14	16	18	19	22	25	28.5	34.1	45.9	56.8	68.4	79.3	86.1	96.9	108	119	140
	100		14	16	18	20	23	25	28	32	36.7	44	59.2	73.4	88.3	102	111	125	139	153	181
	120		18	20	22	25	28	31	35	40	45.5	54.5	73.3	90.9	109	127	138	155	172	190	224
	140		22	24	27	30	34	37	42	48	54.7	65.6	88.2	109	132	153	166	186	207	228	269
	160		25	28	31	35	40	43	50	56	64.4	77.2	104	129	155	180	195	220	244	268	317
	180		29	33	36	41	46	50	58	65	74.6	89.4	120	149	179	208	226	254	282	311	367
80	20		2.1	2.3	2.6	2.8	3.2	3.4	3.8	4.3	4.8	5.7	7.4	9	10.7	12.3	13.3	14.9	16.4	18	21.1
	30		3.2	3.5	3.9	4.3	4.8	5.2	5.8	6.5	7.3	8.6	11.3	13.7	16.3	18.7	20.2	22.6	25	27.4	32.1
	40		4.4	4.8	5.2	5.8	6.5	7	7.9	8.8	9.9	11.6	15.2	18.5	22	25.3	27.3	30.6	33.8	37	43.5
	60		6.7	7.4	8.1	9	10	11	12	14	15.3	17.9	23.5	28.6	34	39	42.1	47.1	52.1	57.1	67
	80		9.2	10	11	12	14	15	17	19	20.9	24.6	32.2	39.2	46.6	53.5	57.8	64.7	71.5	78.3	92
	100		12	13	14	16	18	19	22	24	27	31.8	41.6	50.6	60.2	69.1	74.6	83.5	92.3	101	119
	120		15	16	18	20	22	24	27	30	33.5	39.3	51.5	62.7	74.5	85.5	92.4	103	114	125	147
	140		18	19	21	24	27	28	32	36	40.3	47.3	61.9	75.4	89.6	103	111	124	138	151	177
	160		21	23	25	28	31	33	38	42	47.4	55.7	72.9	88.8	106	121	131	146	162	177	208
	180		24	27	29	32	36	39	44	49	54.9	64.5	84.4	103	122	140	152	170	188	205	241

CONVERTING BETWEEN THE METRIC SYSTEM AND THE IMPERIAL SYSTEM

Multiply				by				to obtain			
Unit	x	Coefficient	=	Unit	Unit	x	Coefficient	=	Unit	Unit	x
millimetres	x	0.03937	=	inches	Ω / km	x	0.3048	=	Ω / 1000 feet	Ω / km	x
millimetres	x	39.37	=	mils	Ω / 1000 feet	x	3.281	=	Ω / km	Ω / km	x
metres	x	39.37	=	inches	pounds / 1000 feet	x	1.488	=	kilograms/km	kilograms/km	x
metres	x	3.28	=	feet	square inches	x	645.2	=	square millimetres	square millimetres	x
inches	x	25.4	=	millimetres	square millimetres	x	1.273	=	circular mms	circular mms	x
feet	x	0.3048	=	metres	square millimetres	x	1973.5	=	circular mils	circular mils	x
mils	x	0.0254	=	millimetres	square mils	x	1.273	=	circular mils	circular mils	x
kilograms	x	2.205	=	pounds	circular mms	x	1550	=	circular mils	circular mils	x
pounds	x	0.4536	=	kilograms	circular mils	x	0.7854	=	square millimetres	square millimetres	x

Variables		Unit	Customary units	
Names	Symbols	Names and symbols	Names and symbols	SI value
GEOMETRY	Length	ℓ	metre (m)	
	Wavelength	λ	metre (m)	
	Wavenumber	σ	metre to the power minus one (m ⁻¹)	
	Surface area	A	square metre (m ²)	are (a) 10 ²
	Cross section	σ	square metre (m ²)	hectare (ha) 10 ⁴
	Volume	V	cubic metre (m ³)	barn (b) 10 ⁻²⁸
	Plane angle	α	radian (rad)	litre (L ou l) 10 ⁻³
	Solid angle	Ω	steradian (sr)	
MASS	Mass	m	kilogram (kg)	tonne (t) 10 ³
	Atomic mass	m _a	kilogram (kg)	
	Mass per unit length	ρ_ℓ	kilograms per metre (kg/m)	tex (tex) 10 ⁻⁶
	Surface density	ρ_A	kilograms per square metre (kg/m ²)	
	Density	ρ	kilograms per cubic metre (kg/m ³)	
	Volume per unit mass	ν	cubic metres per kilogram (m ³ /kg)	
	Concentration	ρ_B	kilograms per cubic metre (kg/m ³)	
TIME	Time	t	second (s)	
	Frequency	f	hertz (Hz)	
MECHANICS	Velocity	v	metres per second (m/s)	
	Angular velocity	ω	radians per second (rad/s)	
	Acceleration	a	metres per second squared (m/s ²)	gal (Gal) 10 ⁻²
	Angular acceleration	α	radians per second squared (rad/s ²)	
	Force	F	newton (N)	
	Moment of force	M	newton-metre (N.m)	
	Surface voltage	γ	newtons per metre (N/m)	
	Work, energy, quantity of heat	W	joule (J)	
	Radiant intensity	I	watts per steradian (W/sr)	
	Power, radiant flux	P	watt (W)	
	thermal flux	Φ		
	Strain	σ	pascal (Pa)	bar (bar) 10 ⁵
	Pressure	ρ		
	Dynamic viscosity	η	pascal-second (p.s) or poiseuille	poise (P) 10 ⁻¹
	Kinetic viscosity	ν	square metres per second (m ² /s)	stockes (St) 10 ⁻⁴

Variables		Unit	Customary units	
Names	Symbols	Names and symbols	Names and symbols	SI value
ELECTRICITY	Electric current	I	ampere (A)	biot (bi) 10
	Electromotive force	E	volt (V)	
	Potential difference voltage	U		
	Electrical resistance	R	ohm (Ω)	
	Electric field strength	E	volts per metre (V/m)	
	Electrical conductance	G	siemens (S)	mho 1
	Amount of electricity, electrical charge	Q	coulomb (C)	
	Electrical capacity	C	farad (F)	
	Self-induction	L	henry (H)	
	Magnetic flux induction	Φ	weber (Wb)	maxwell (Mx,M) 10 ⁻⁴
	Magnetic induction	B	tesla (T)	Gamma (γ) 10 ⁻⁹ Gauss (Gs, G) 10 ⁻⁴
	Magnetic field strength	H	amperes per metre (A/m)	
	Magnetomotive force	F	ampere (A)	
HEAT	Temperature	T	kelvin (K) degree Celsius ($^{\circ}$ C)	
	Heat capacity, entropy	C	joules per kelvin (J/K)	
	Specific heat capacity, specific entropy	c	joules per kilogram kelvin (J/(kg.K))	
	Thermal conductivity	λ	watts per metre-kelvin (W/(m.K))	
IONISING RADIATION	Activity	A	becquerel (Bq)	
	Exposure	X	coulomb par kilogram (C/kg)	
	Absorbed dose	D	gray (Gy)	rad (rd) 10 ⁻²
	Dose equivalent	H	sievert (Sv)	rem (rem) 10 ⁻²
PHYSICAL CHEMISTRY	Quantity of matter	n	mole (mol)	
OPTICS	Light intensity	I	candela (cd)	
	Luminous flux	Φ	lumen (lm)	
	Illuminance	E	lux (lx)	
	Luminance	L	candelas per square metre (cd/m ²)	
	Optical system vergence		metres to the power minus one (m ⁻¹)	

MAIN CONVERSION FACTORS

Unit	Conversion factor	Unit	Conversion factor
Length (conversion into metres)			
angstrom (Å)	1 x 10 ⁻¹⁰	mile	1.609344 x 10 ³
fermi (fm)	1 x 10 ⁻¹⁵	mile (nautical mile)	1.852 x 10 ³
foot (ft)	3.048 x 10 ⁻¹	pica	4.2175 x 10 ⁻³
inch (in)	2.54 x 10 ⁻²	point (US)	3.515 x 10 ⁻⁴
light year	9.46073 x 10 ¹⁵	rod	5.029 2
micron (μ)	1 x 10 ⁻⁶	sigma(σ)	1 x 10 ⁻¹²
mil	2.54 x 10 ⁻⁵	yard (yd)	9.144 x 10 ⁻¹
Area (conversions into square metres)			
acre	4.04686 x 10 ³	circular mil	5.067075 x 10 ⁻¹⁰
are (a)	1 x 10 ²	rood	1.01171 x 10 ³
Volume (conversion into cubic metres)			
barrel (US)	1.58987 x 10 ⁻¹	gill (UK)	1.42065 x 10 ⁻⁴
board foot	2.36 x 10 ⁻³	gill [US](gi)	1.18294 x 10 ⁻⁴
bushel (UK)	3.63687 x 10 ⁻²	liquid pint [US](liq pt)	4.73176 x 10 ⁻⁴
bushel [US](bu)	3.52391 x 10 ⁻²	liquid quart [US](liq qt)	9.46352 x 10 ⁻⁴
dry barrel [US](bbl)	1.15627 x 10 ⁻¹	litre (L, l)	1 x 10 ⁻³
dry pint [US](dry pt)	5.50610 x 10 ⁻⁴	minim [UK](min)	5.91939 x 10 ⁻⁸
dry quart [US](dry qt)	1.10122 x 10 ⁻³	minim [US](min)	6.16115 x 10 ⁻⁸
fluid ounce [UK](fl oz)	2.84130 x 10 ⁻⁵	peck (UK)	9.0922 x 10 ⁻³
fluid ounce [US](fl oz)	2.95735 x 10 ⁻⁵	peck (US)	8.809768 x 10 ⁻³
gallon [UK](gal)	4.54609 x 10 ⁻³	quart [UK](qt)	1.13652 x 10 ⁻³
gallon [US](gal)	3.78541 x 10 ⁻³		
plane angle (conversion into radians)			
degree ($^{\circ}$)	1.745329 x 10 ⁻²	minute (')	2.908882 x 10 ⁻⁴
grade (gr)	1.570796 x 10 ⁻²	second (")	4.848137 x 10 ⁻⁶
Time (conversion into seconds)			
day	8.64 x 10 ⁴	minute (min)	60
hour	3.6 x 10 ³		
Mass (conversion into kilograms)			
atomic mass		quintal (q)	1 x 10 ²
unit (u)	1.66054 x 10 ⁻²⁷	short ton (sh tn)	9.07185 x 10 ²
cental	4.53592 x 10 ²	ton (ton)	1.016047 x 10 ³
long ton (US)	1.016047 x 10 ³	tonne (t)	1 x 10 ³
ounce (oz)	2.834952 x 10 ⁻²	troy ounce	3.11035 x 10 ⁻²
pound (lb)	4.535924 x 10 ⁻¹	troy pound	3. 73242 x 10 ⁻¹
Velocity (conversion into metres per second)			
international knot,			
knot	5.144 44 x 10 ⁻¹		

Unit	Conversion factor	Unit	Conversion factor
Force (conversion into newtons)			
dyne (dyn)	1 x 10 ⁻⁵	pound-force (lbf)	4.44822
kilogram-force (kgf)	9.80665	poundal (pdl)	1.38255 x 10 ⁻¹
pound (p)	9.80665 x 10 ⁻³		
Work, energy (conversion into joules)			
British thermal unit (Btu) (Intern Table)	1.055056 x 10 ³	kilogramtre (kgm)	9.80665
calorie I.T. (cal I.T)	4.186 8	therm	1.055056 x 10 ⁶
calorie 15 $^{\circ}$ C (cal15)	4.185 5	thermie (th)	4.1855 x 10 ⁶
electronvolt (eV)	1.60218 x 10 ⁻¹⁹	thermochemical calorie (calth)	4.184
frigorie (fg)	- 4.1855 x 10 ³	watthour (Wh)	3.6 x 10 ³
Power (conversion into watts)			
mechanical horsepower [UK]	7.457 0 x 10 ²	var (var)	
metric horsepower	7.354 99 x 10 ²		
Strain and pressure (conversion into pascals)			
bar (bar)	1 x 10 ⁵	millimetre of water (mmH ₂ O)	9.806 65
foot of water (ftH ₂ O)	2.989 07 x 10 ³	normal atmosphere	1.013 25 x 10 ⁵
inch of mercury (inHg)	3.386 39 x 10 ³	pound-force per square inch (psi)	6.894 757 x 10 ³
inch of water (inH ₂ O)	2.490 89 x 10 ²	technical atmosphere	9.806 65 x 10 ⁴
millimetre of mercury (mmHg)	1.333224 x 10 ²	torr (Torr)	1.333 224 x 10 ²
Magnetomotive force (conversion into amperes)			
gilbert (Gb)	7.957 7 x 10 ⁻¹		
Quantity of electricity, electrical charge (conversion into coulombs)			
ampere-hour (Ah)	3.6 x 10 ³	franklin (Fr)	3.335 64 x 10 ⁻¹⁰
faraday (F)	9.648 70 x 10 ⁴		
Activity (conversion into becquerels)			
curie (Ci)	3.7 x 10 ¹⁰		
Exposure (conversion into coulombs per kilogram)			
röntgen (R)	2.58 x 10 ⁻⁴		

LIQUIDS HEATING (NOTES AND FORMULAE)

PHYSICAL CHARACTERISTICS OF THE MAIN LIQUIDS

LIQUIDS	DENSITY	Solidific. TEMP.	Boiling TEMP.	Cp	Heat of vaporis.
Acetone	0,814	- 95	57	0,53	124,5
Acetic acid	1,07	17	118	0,51	117
Ammonia	0,82	-78	-33,4	1,1	327
Beer	1	2		1	
Benzene	0,87	5	80	0,45	-94
Bromine	3	-7	58,8	0,11	43,7
Carbon disulphide	1,27	-108	46	0,23	90
Carbon tetrachloride	1,63	-23	76,8	0,21	45
Castor oil	0,96			0,43	68
Chloroform	1,48	-63	61	0,23	60
Ether	0,74	-117	35	0,54	90
Ethyl alcohol	0,80	-130	78	0,68	210
Formic acid	1,23	8,4	100,7	0,39	120
Freon 12	1,33		-30	0,20	40
Glycerine	1,27	17	290	0,58	
Hydrochloric acid	1,2	-114	83	0,60	97,5
Mercury	13,6	-39	358	0,033	73
Methacrylate	0,9			0,25	
Methyl alcohol	0,80	-97,8	65	0,60	269
Methyl chloride	1,33	-96	40	0,60	95
Mineral oil	0,84			0,50	
Milk	1,03			0,94	
Nitric acid	1,52	-42	86	0,66	115
Paraffin	0,8			0,45	
Paraffin oil	0,88			0,52	
Petroleum	0,89			0,50	
Phenol	1,08	41	182	0,56	
Sulphuric acid at 66° B	1,80	10	330	0,33	123
Tetrachlorethylene	1,6	-20	120	0,22	52
Toluene	0,87	-95	110,6	0,39	
Trichlorethylene	1,49	-73	87	0,23	57,3
Turpentine	0,86			0,42	
Vinegar	1,02			0,92	
Water	1	0	100	1	539
Wine	0,99			0,90	
Honey	1,395 to 1,445			0,6 to 0,65 (liquid) 0,65 to 0,70 (solid)	
UNITS	kg/dm ³	Degrees C	Degrees C	K.Cal/kg /°C	Kg.cal/kg

Notes

Aqueous solutions have a specific heat that varies between that of water for very weak concentrations and the specific heat of the substance for strong concentrations.

All oils have a specific heat of approximately 0.5.

Boiling temperature and solidification temperature vary with pressure.

Heat of vaporisation varies with temperature.

For water, Régnault's formula is applied:

$L = 606,5 - 0,695 T$, which gives for $T = 100^\circ$: 537 Kcal/kg.

THERMAL CONDUCTIVITY AND SPECIFIC HEAT

Metals, liquids, air

	TEMP. °C	Thermal conductivity coefficient λ		Average specific heat	
		Kcal.h m°C	W m°C	Kcal./Kg °C	J/Kg°C
Metals					
Pure aluminium	20°	197	228	0,22	921
Steel(c ≈ 1,5)	20°	45	52	0,115	481
Pure copper	20°	332	385	0,094	393
Brass	20°	63	73	0,092	385
Zinc					
Various materials					
Asbestos	20°	0,13	0,15	0,20	837
Asphalt	20°	0,80	0,93	0,22	921
Concrete (2000 Kg/m³)	20°	0,80	0,93	0,22	921
Bitumen	20°	0,14	0,16	0,15	628
Solid bricks	20°	0,42 at0,60	0,49 at0,70	0,215	900
Cement mortar	20°	0,44	0,51	0,22	921
Plaster rendering (1200 Kg/m³)	20°	0,37	0,43	0,273	1143
Liquids					
Alcohol	20°	0,15 at0,20	0,17 at0,23	0,56	2344
Benzol	20°	0,12	0,14	0,42	1758
Heavy fuel oil	20°	0,116	0,135	0,48	2010
Petroleum	20°	0,13	0,15	0,50	2093
Water	0°	0,477	0,553	1,005	4207
	20°	0,505	0,586	0,999	4182
	60°	0,562	0,652	0,998	4177
Light fuel oil (domestic) d = 0,846	20°			0,48	
Steam					
Saturated water at 100 constant pressure	to 270° 100	-	-	0,4639	1942
	to 440°	-	-	0,4713	1973
	110 to 620°	-	-	0,4717	1975
Superheated steam					
1 bar	150°	-	-	0,16	1925
1 bar	250°	-	-	0,468	1959
1 bar	350°	-	-	0,477	1997
1 bar	450°	-	-	0,486	2034
1 bar	550°	-	-	0,495	2072
4 bar	150°	-	-	0,524	2193
4 bar	350°	-	-	0,490	2051
4 bar	550°	-	-	0,518	2168
Air					
Air at	20°	0,0216	0,025	0,240	1005
	50°	0,0232	0,027	0,241	1008
	100°	0,0259	0,030	0,242	1013
	200°	0,0314	0,036	0,244	1021
	250°	0,0336	0,039	0,245	1026
Polyol d = 1,1				0,525	2200
Isocyanate d = 1,1				0,332	1390

SPECIFIC WEIGHTS AND DENSITIES OF GASES

in g/dm³, AS COMPARED WITH AIR AT 0°C and 760 mm Hg

GAS	Specific weight	Density	GAS	Specific weight	Density	GAS	Specific weight	Density
Acetylene	1,173	0,906	Ethyl chloride	2,87	2,219	n-Butane	2,5985	2,01
Air*	1,2928	1	Ethylzine	1,264	0,975	Neon	0,8713	0,674
Allylene	1,786	1,381	Fluorine	1,635	1,264	Nitric oxide	1,34	1,036
Ammonia	0,7718	0,597	Helium	0,1768	0,1368	Nitrogen	1,2515	0,968
Argon	1,7828	1,38	Hydrobromic acid	3,5035	2,71	Nitrogen dioxide	1,3402	1,0367
Arsine	3,484	2,695	Hydrochloric acid	1,6393	1,268	Nitrogen protoxide	1,9779	1,53
Bromine	7,5887	5,87	Hydrofluoric acid	0,922	0,713	Nitrosyl chloride	2,9863	2,31
Carbon dioxide*	1,9779	1,53	Hydrogen	0,08982	0,06948	Nitrous oxide	1,9781	1,53
Carbon disulphide	3,4	2,63	Hydrogen phosphide	1,529	1,18	Oxygen	1,4289	1,1053
Carbon monoxide	1,2514	0,968	Hydride-silicon	1,44	1,11	Ozone	2,1434	1,658
Carbon oxygen sulphide	2,71	2,1	Hydrogen sulphide	1,5378	1,1895	Phosgene	4,5313	3,505
Carbonyl chloride	4,47	3,46	Hydriodic acid	5,688	4,4	Producer gas	1,141	0,893
Chlorine	3,219	2,49	Hydroselenic acid	3,67	2,84	Propane	1,966	1,52
Chlorine dioxide	3,01	2,33	Krypton	3,6431	2,818	Silicon tetrafluoride	4,684	3,62
Cyanogen	2,3348	1,806	Methane	0,7168	0,554	Sulphur dioxide	2,9269	2,264
Dimethylamine	0,6804	0,526	Methyl chloride	0,991	0,766	Xenon	5,8564	4,53
Ethane	1,3566	1,057	Natural gas (processed)	0,74	0,57			

GENERAL CONDITIONS OF SALE

1. APPLICATION OF THE GENERAL CONDITIONS OF SALE - CONTESTABILITY

In accordance with the provisions of the Law of 2 August 2005, these FLEXELEC Conditions of Sale are integral together with the current price list and relevant regulations or recommendations, as circulated periodically and available to every customer in conjunction with his order requirements. These General Conditions of Sale shall be forwarded or presented to each purchaser to enable that party to place an order.

Consequently, the act of placing an order implies the purchaser's full, unreserved adherence to these General Conditions of Sale to the exclusion of all other documents such as brochures and catalogues issued by the vendor, which are only of an indicative nature.

Unless formally accepted in writing by the vendor, no special condition may prevail over the General Conditions of Sale. In the absence of express acceptance, no contrary condition may be raised in objection by the purchaser, regardless of the time when it may have been brought to its knowledge.

Should the vendor not avail itself of any one of these General Conditions of Sale at a given time, this may not be interpreted as constituting renunciation of availing itself of any of the aforementioned conditions whatsoever at a later date.

2. ORDERS

Orders are final only when they have been confirmed in writing by the vendor in the form of an acknowledgement of receipt, unless otherwise stipulated.

The vendor is only bound by orders taken by its representatives or employees subject to signed, written confirmation.

Benefit from the order is personal to the purchaser and may not be transferred without the vendor's agreement.

3. CHANGING AN ORDER

Any change or cancellation of an order requested by the purchaser may be taken into consideration only if it is received in writing prior to shipment of the products.

At the vendor's discretion, amendments or cancellations shall give rise to additional invoicing or the payment of penalties equal to 25 % of the amount of the initial order.

If the vendor does not accept the change or cancellation, any advance payments made will not be returned.

4. DELIVERY - GOODS DELIVERED

The vendor reserves the right to make any modifications that he deems appropriate for his goods at any time, and reserves the right to modify the models defined in his brochures or catalogues without providing prior notice and without any obligation to modify products either delivered previously or for which an order is pending.

5. DELIVERY

5.1. TERMS

Delivery is carried out either by directly delivering the product to the purchaser, or by delivering it to a forwarding agent or carrier at the vendor's warehouses.

The purchaser undertakes to take delivery within 8 days of notice of the goods' availability being provided. Once this period has elapsed, the vendor may either consider the order to be cancelled and the sale to be unilaterally terminated by the purchaser, or storage costs will be taken into account.

5.2. DELIVERY TIMES

Deliveries are made only depending on availability and following the sequence in which orders arrive. The vendor is allowed to make either full or partial deliveries.

The delivery times are indicated as precisely as possible, but depend on what options the vendor has in terms of procurement and transport.

Should deliveries take longer than the delivery time stated, this shall not give rise to damages, deductions or the cancellation of orders in progress. Nevertheless if, one month after the indicative delivery date, the goods have not been delivered for any reason other than force majeure, the sale may then be cancelled at the request of either party; the purchaser shall have his advance payment returned, but shall not be eligible for any other compensation or damages.

The following are considered to be cases of force majeure which release the vendor from his obligation to deliver: war, riots, fires, strikes, accidents, or it being impossible for the vendor to obtain procure supplies.

The vendor shall, within an appropriate time, keep the purchaser abreast of the cases and events listed above. In any case, delivery within the delivery times may be made only if the purchaser has fulfilled his obligations towards the vendor, for whatever reason.

5.3. COSTS

For all deliveries in metropolitan France, the goods are deliverable carriage-paid for any shipment over the value of 750 € before tax.

For shipments under the value of 750 € H.T., before tax, the goods shall be delivered carriage paid in advance.

International sales shall be subject to the Incoterm selected and specified by the parties. Should no Incoterm have been selected, the sales are deemed to be EX WORKS.

5.4. RISKS

Goods travel at the recipient's risk, that party being responsible for making any observations required in the event of damage or short shipment as well as for confirming reservations stated via a deed prepared out of court or via a registered letter with acknowledgement of receipt from the carrier within three days of receipt of the merchandise.

6. RECEPTION

Without prejudice to the provisions to be made in relation to the carrier, complaints regarding conspicuous defects, or non-compliance of the goods delivered with the goods ordered or the dispatch note, must be made in writing within 48 hours of the arrival of the goods.

It will be the purchaser's responsibility to provide any supporting documentation regarding the real nature of the

defects or anomalies noted. That party shall grant the vendor every leeway for the purpose of assessing these defects and setting them right, and shall refrain from intervening himself, or from asking any third party to intervene for this purpose. For goods sold in packaging, the weights and measurements upon departure shall be valid for ascertaining the quantities delivered.

The lengths invoiced shall be the ones actually delivered. When they are subject to special manufacturing, they may differ from the quantities ordered by 10% without this providing grounds for being contested by the purchaser.

7. REPLACEMENT

7.1. TERMS

Non-compliant or spoilt goods can be replaced.

Returns shall be subject to formal prior agreement between the vendor and the purchaser.

Any goods returned without this agreement would be held for the purchaser and would not lead to a credit being drawn up. The costs and risks involved in such a return shall always be borne by the purchaser.

Merchandise that is returned shall be accompanied by a return slip attached to the package and such merchandise must be in the condition it was in when delivered.

7.2. CONSEQUENCES

In the event of a conspicuous defect or non-compliance of the goods delivered, duly noted by the vendor under the conditions set out hereinabove, the purchaser may obtain a free replacement, or a refund for the goods at the vendor's discretion, to the exclusion of any compensation or damages.

8. WARRANTY FOR CONCEALED DEFECTS

8.1. SCOPE

Goods are guaranteed against concealed defects in pursuance of Article 1641 and subsequent articles in the Civil Code for a period of one month counting from the delivery date.

The vendor's warranty is limited to defects that are inherent to the goods sold and which existed on the day on which they were sold. The vendor's liability cannot be invoked in the event of abnormal use of the goods or failure to follow safety rules, and notably responsibility transfers to the end user in the case of orders where installation and end use do not follow the FLEXELEC recommendations for installation and use.

Under this warranty, the only obligation incumbent on the vendor shall be free replacement or repair (vendor's choice) of a product or component recognised as being defective by his departments.

To benefit from the warranty, all products must be submitted to the vendor's after-sales service beforehand, which must provide its approval for any replacement to be provided. Any carriage costs shall be borne by the purchaser.

8.2. EXCLUSIONS

The warranty shall not apply to conspicuous defects.

Faults and deterioration due to normal wear and tear or an external accident (incorrect assembly or installation, poor storage conditions, abnormal use, etc.), or due to a modification of the goods which was neither foreseen or specified by the vendor shall also be excluded.

9. PRICES

With the exception of orders with particular specifications where the prices are determined by quotation, FLEXELEC products are subject to the list price currently in force as confirmed by simple notification. Prices are net, before tax. Unless otherwise agreed, any request for the provision of additional services such as studies, engineering, test reports, factory acceptance, approval procedures or miscellaneous certificates shall be subject to additional invoicing by the vendor which is separate from the cost of the products sold. The payment currency shall be the Euro unless otherwise stipulated.

Any tax, duty or other provision of service to be paid for in pursuance of French regulations or the regulations of an importing country or a transit country shall be borne by the purchaser.

Unless the vendor provides written agreement, carriage costs shall always be borne by the purchaser.

10. INVOICING

An invoice shall be drawn up for each delivery and issued when it is made, unless a summary invoice which refers to several delivery slips that have been issued is drawn up.

11. PAYMENT

11.1. TERMS

Unless otherwise agreed, payments shall be made within 30 days of the invoice date.

In the event of deferred payment, for the purposes of this article, a payment does not constitute the mere presentation of a commercial paper or cheque implying an obligation to pay, but settlement thereof by the agreed deadline.

11.2. ADVANCE PAYMENT

The vendor reserves the option of making the order subject to an advance payment.

11.3. LATE PAYMENT OR NON-PAYMENT

In the event of late payment, the vendor may suspend all orders in progress without prejudice to any other course of action.

Any sum not paid by the due date featured on the invoice shall lead to the application of penalties to a sum equal to one and a half times the legal interest rate.

These penalties shall be payable when the vendor so requests.

In the event of non-payment, if forty-eight hours elapse after notice has been provided without any result, the sale shall automatically be cancelled should the vendor deem fit to do so. The vendor may institute summary proceedings to request the return of the goods, without prejudice to any other damages. Cancellation shall apply not only to the

order in question but also to any prior orders that are unpaid, whether or not deliveries have been made or are being delivered, and whether or not payment for them is due.

In the event of payment using a commercial paper, failure to return the paper shall be considered to constitute refusal of acceptance comparable to failure to pay. Likewise, when payment is staggered, non-payment of a single instalment shall lead to all of the debt becoming immediately payable without need to provide notice of this.

In all the above cases, the sums that may be due for other deliveries, or for any other reason, shall become payable immediately if the vendor does not opt to cancel the relevant orders.

The purchaser shall provide compensation for all expenses incurred due to the disputed recovery of sums owed, including the professional fees for legal officials.

Under no circumstances may payments be suspended or be subject to any compensation whatsoever without the vendor's prior agreement in writing. Any partial payment shall be attributed firstly to the non-preferential part of the debt, and then to the sums that have been outstanding for the longest.

11.4. REQUIREMENT OF GUARANTEES OR PAYMENT

The vendor reserves the option of requiring guarantees, a cash payment, or payment via a bill payable on sight before executing the orders received, notably for international sales.

12. TRANSFER OF RISKS

The transfer of risks for products, even for a sale that is agreed to on a carriage-paid basis, shall occur as of shipment from the vendor's warehouse.

In particular, this means that merchandise shall travel at the purchaser's risk, with that party being responsible for stating any reservations or instituting any proceedings against the carriers responsible in the event of damage, losses or short shipment.

13. RETENTION OF OWNERSHIP

The goods covered by this contract are sold subject to retention of ownership: transfer of ownership is conditional on the purchaser providing full payment of the price by the agreed deadline.

In the event of failure to pay by the deadline, the vendor shall take the merchandise of which he remains the owner back into his possession and may, at his discretion, choose to terminate the contract via a registered letter sent to the purchaser.

The purchaser shall refrain from any conversion, incorporation or assembly of the merchandise before paying for it.

The purchaser must retain the merchandise sold subject to retention of ownership in such a manner that it cannot get mixed up with merchandise of the same nature from other vendors.

14. PACKAGING

Unless otherwise agreed, consignment of the cable drums is invoiced for at the same time as the cables (based on the professional rate in force). A refund is provided for this subject to deduction of a fixed fee if the cable drums are returned carriage-paid and in good condition within a maximum period of 3 months. Beyond this period, the vendor may apply a rental fee of 2.5 % of the price per month.

Packaging and cable drums bearing the vendor's trademark may only be used for his products and may not be used for anyone else's products under any circumstances. Any breach of this rule shall render the party responsible subject to prosecution and the payment of damages.

15. INDUSTRIAL PROPERTY

All equipment, models, plans, specifications, technical documents, assembly instructions, user manuals and other items of information provided by the vendor shall remain his property at all times.

The purchaser may not claim any ownership whatsoever over the equipment, models, plans and specifications and other items of information and may not use them outside the context of the sales contract under any circumstances.

The purchaser shall refrain from reproducing the Vendor's products.

All the industrial property rights relating to results stemming from the execution of the order shall remain the vendor's property without any time limits or geographical limits.

16. CONFIDENTIALITY

The Purchaser shall consider any information given, technical formula, or concept it may obtain knowledge of through this contract to be strictly confidential and shall refrain from divulging it.

For the purposes of applying this clause, the purchaser shall be responsible both for himself and his employees. However the purchaser shall not be held responsible for any disclosure if the items divulged were in the public domain or if he had knowledge or them or obtained them from a third party by legitimate means.

Likewise, the vendor undertakes to keep any information he may have had available in the course of executing this contract strictly confidential and not to divulge it to anyone whatsoever, either during execution of the agreement or following its completion.

17. COMPETENCE - APPLICABLE LAW

In the event of litigation of any sort or a dispute regarding the formation or execution of the order, the courts at Thiers - France alone shall be competent, unless the vendor prefers to submit his case to any other competent jurisdiction.

This clause applies even in the case of summary proceedings, incidental claims, or in the event of there being several defendants or the introduction of third parties, regardless of the method and terms of payment, no clauses assigning jurisdiction which may exist in purchasers' documents being able stand in the way of the application of this clause.

The applicable law is French law.

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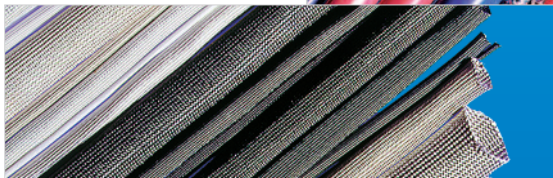


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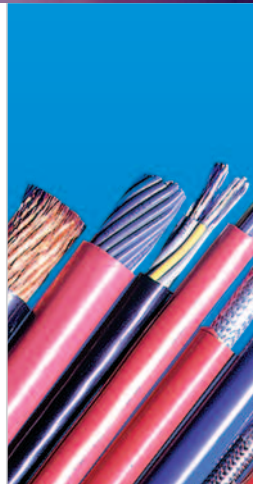
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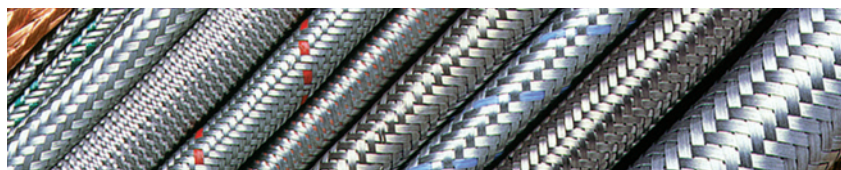
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omerin
division principale

Omerin division principale
F - 63600 Ambert
Tél.: +33 (0)4 73 82 50 00

omerin
division principale

Omerin division principale
F - 63880 Olliergues

omerin
division silisol

Omerin division silisol
F - 42010 Saint-Etienne
Tél.: +33 (0)4 77 81 36 00

omerin
division principale

Omerin division tunisienne
T - 5042 Mesjed Aïssa
Tél.: 00 216 73 422 200

omerin
division polycable

Profiplast groupe omerin
F - 42161 Andrézieux-Bouthéon
Tél.: +33 (0)4 77 36 07 00

IFT
Industrie du Flexible Technique

IFT groupe omerin
F - 63600 Ambert
Tél.: +33 (0)4 73 82 32 33

flexelec
groupe omerin

Flexelec groupe omerin
F - 69720 Saint Bonnet de Mure
Tél.: +33 (0)4 72 48 30 90

TEXPOL
AISLANTES

Texpol Aislantes
SP - 17244 CASSA DE LA SELVA
Tél.: +34 972 46 05 74

DECOVISION

Décovision
F - 63600 AMBERT
Tél.: +33 (0)4 73 82 50 00

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