











For more than 50 years, FLEXELEC has specialized 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 longlasting solutions.

teamwork



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.



innovation

quality































A REFERENCE GUIDE

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

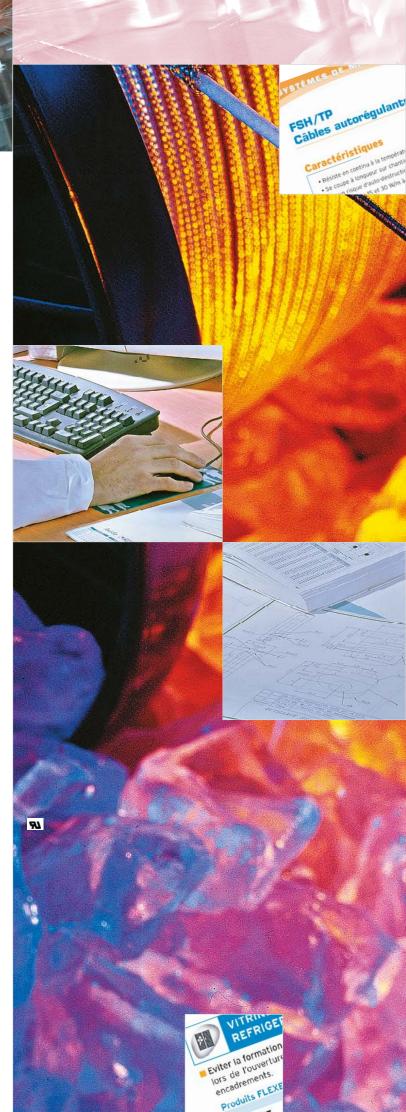
You'll find our complete range of cables and flexible heating elements for temperature maintenance systems.

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
- $\,\blacksquare\,$ an illustration of the product and the way it is built
- the characteristics and options available as standard
- $\,\blacksquare\,$ 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.



Icons used

REFRIGERATION



windows, cabinets and wine storage units



Refrigerating compressors



Cold rooms doors



Refrigerating units and air conditioning





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



Plastic and composite materials



Chemical



Adhesives



Agro-food



Electric motors



Military



Household electrical



Aeronautics



Medical, pharmaceutical and cosmetics

TRANSPORT





Metros



MISCELLANEOUS APPLICATIONS



Aquariums and terrariums



Aerials



Special machines and instrumentation



Cash dispensers



Laboratories



Wind generators



Drinking troughs



Vacuum pumps

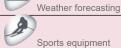


Printing industry



Billiard tables

Batteries





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®

FLEXTRACE®: ELECTRIC HEAT TRACING CABLES

FLEXFLOOR®: UNDERFLOOR HEATING

: READY-TO-USE CABLES

FLEXBELT®

: HEATING BELTS

FLEXMAT®

: HEATING MATS FLEXPLATE®: HEATING PLATES

FLEXDRUM®

FLEXKIT®

: DRUM HEATERS

: ACCESSORIES



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GUIDE BY TYPE OF APPLICATION

REFAIGERATION



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 CS - CS/T - CS/TW - CS/I - CS/IW CP1 CS1 CS2 - CS2/T - CS2/TW | р р р | 27 28 29 |
|-----------|--|-------------|----------------|
| FLEXTRACE | FTS0 - FTS0/T - FTS0/TS | р | 56 |

Allow water from defrost cycles to flow freely or help it to evaporate by internal or external tracing of piping, collector spouts or trays.

FTSM - FTSM/T

FLEXELEC products:

| FLEXDRAIN | CSC - CSC/T - CSC/I - CSC/TS | p 34 |
|-----------|------------------------------|------|
| | CSC2 | p 35 |
| | CSC2M | p 37 |



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 CS - CS/T - CS/TW - CS/I - CS/IW CP1 CS1 CS2 - CS2/T - CS2/TW | p 27 p 28 p 29 |
|-----------|--|----------------------|
| FLEXTRACE | FSJ - FSJ/T - FSJ/TP FTS0 - FTS0/T - FTS0/TS FTSM - FTSM/T | p 48 |



p 58

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 - CS | C/T - CSC/I | p 34 |
|------------------|----------|-------------|------|
| | CSC2 | 180 | p 35 |
| | CSC2M | | p 37 |
| | | | |

FLEXMAT A ...

675

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 | р | 68 |
|-----------|-------|---|----|
| | KYCYR | р | 69 |



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 | FCHK | • |
|----------|------|------|
| FLEXMAT | A | p 75 |



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:

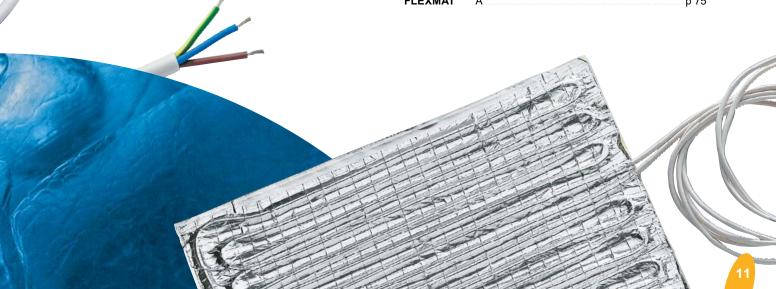
| FLEXDRAIN | CSC2 CSC2K CSC2M | |
|-----------|---|--------------|
| FLEXTRACE | FSJ - FSJ/T - FSJ/TP FTP0 - FTP0/T - FTP0/TP FTS0 - FTS0/T - FTS0/TS FTSM - FTSM/T | p 54 p 56 |
| FLEXBELT | FCH FCHK | p 72 p 73 |
| FLEXMAT | Α | p 75 |



HEAT PUMPS

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

| FLEXDRAIN | CSC2 | p 35 |
|-----------|-------------------------|------|
| | CSC2K | p 36 |
| | CSC2M | p 37 |
| FLEXTRACE | FSJ - FSJ/T - FSJ/TP | |
| | FTP0 - FTP0/T - FTP0/TP | p 54 |
| | FTS0 - FTS0/T - FTS0/TS | |
| ELEYMAT | ۸ | n 75 |



GUIDE BY TYPE OF APPLICATION

CONSTRUCTION



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 RS - RS/T - RS/I | | |
|-------------|--|------------|----------------|
| STOPGEL - A | ANTIFREEZE | p 4 | 45 |
| FLEXTRACE | FSO - FSO/T - FSO/TP FST - FST/T - FST/I - FST/TP - FST/TF FTP - FTP/T - FTP/I - FTP/TP FTSH - FTSH/T - FTSH/I - FTSH/TS - FTSH/T FTX1 | р <u>{</u> | 50 53 55 |



HOT WATER SUPPLY

Reduce water consumption when the tap-off point is distant from the boiler. In hotels, schools, leisure centers, offices and shopping centers, 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 | FSH2/TP | p 47 |
|-----------|--|-------------------|
| | FTP - FTP/T - FTP/I - FTP/TP | p 53 |
| | FTSH - FTSH/T - FTSH/I - FTSH/TS - FTSH/TF | ⁻ p 55 |



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 62 |
|-----------|--------------------------|---------|
| | C4FS/IS | p 63 |
| | SR - SRHT | p 64-65 |



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 RS - RS/T - RS/I | |
|-----------|---|--------------|
| FLEXTRACE | FSO - FSO/T - FSO/TP FST - FST/T - FST/I - FST/TP - FST/TF FTP - FTP/T - FTP/I - FTP/TP ETSH - FTSH/T - FTSH/I - FTSH/TS - FTSH/T | р 50 р 53 |



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 70

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

FLEXELEC products:

FTSL/TF - FTSL/TS p 60 FTSL/TF - FTSL/TS



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.

| FLEXFLOOR | KYCY | p 68 |
|------------------|------|------|
| | | p 69 |

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 FST/TP/30 | |
|-----------|------------------|--|
| FLEXFLOOR | KYCY KYCYR | |



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 | р | 68 |
|------------------|-------|---|----|
| | KYCYR | p | 69 |



ACCESS RAMPS

Keep accesses to shopping centers, 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 68 |
|------------------|-------|------|
| | KYCYR | p 69 |
| | KYX | p 70 |



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 | KYX | p 70 |
|-----------|-----|------|
|-----------|-----|------|



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 | р | 68 |
|-----------|-------|---|----|
| | KYCYR | р | 69 |

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...

| FLEXTRACE | FTC | p 52 |
|-----------|-----------|------|
| | FST/TP/30 | p 50 |



GUIDE BY TYPE OF APPLICATION INDUSTRIE



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 | FSO - FSO/T - FSO/TP | p 49 |
|------------------|---|-----------|
| | FST - FST/T - FST/I - FST/TP - FST/TF | р 50 |
| | FSX - FSX/T - FSX/I - FSX/TF | p 51 |
| | FTSH - FTSH/T - FTSH/I - FTSH/TS - FTSH | 1/TF p 55 |
| | FTSL/TF - FTSL/TS | p 57 |
| | FTTH - FTTH/T - FTTH/I - FTTH/TF | р 59 |
| | C1FS/I - C2FS/I - C3FS/I | p 61 |
| | C4FS/IS | р 63 |
| | SR - SRHT | p 64-65 |
| | ZFE/CGE/ATEX - ZFA/CGA/ATEX | p 66 |



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:

FLEXDRUM TCF - TCF/TV

| FLEXTRACE | FSO - FSO/T - FSO/TP | p 49 |
|-----------|---|-----------|
| | FST - FST/T - FST/I - FST/TP - FST/TF | р 50 |
| | FSX - FSX/T - FSX/I - FSX/TF | p 51 |
| | FTSH - FTSH/T - FTSH/I - FTSH/TS - FTSH | I/TF p 55 |
| | FTSL/TF - FTSL/TS | р 57 |
| | FTTH - FTTH/T - FTTH/I - FTTH/TF | р 60 |
| | C1FS/I - C2FS/I - C3FS/I | p 62 |
| | C4FS/IS | р 63 |
| | SR - SRHT | p 64-65 |
| | ZFE/CGE/ATEX - ZFA/CGA/ATEX | р 66 |
| | | |



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 | FSO - FSO/T - FSO/TP p 49 FST - FST/T - FST/I - FST/TP - FST/TF p 50 FSX - FSX/T - FSX/I - FSX/TF p 51 FTSH - FTSH/T - FTSH/I - FTSH/TS - FTSH/TF p 55 FTTH - FTTH/T - FTTH/I - FTTH/TF p 60 |
| FLEXDRUM | TCF - TCF/TV p 81 |



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:

| FIFXMAT | T - TA - TV - TP | n 76-77 |
|---------|------------------|---------|



p 81

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 - TP p 76-77

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 C1F - C1F/T - C1F/I | |
|----------|--|---------|
| FLEXUNIT | CS - CS/T - CS/TW - CS/I - CS/IW CS2 - CS2/T - CS2/TW | • |
| FLEXMAT | T - TA - TV - TP | р 76-77 |



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 |
|----------|-----|------|
|----------|-----|------|



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 R | SV | n 41 |
|-------------------|----|------|



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 C1S - C1S/T - C1S/I C1F - C1F/T - C1F/I | p 23 |
|----------|--|------|
| FLEXUNIT | CP - CP/T - CP/TW - CP/I - CP/IW CS - CS/T - CS/TW - CS/I - CS/IW CP1 CS1 CS2 - CS2/T - CS2/TW | p 27 |



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.

| FLEXUNIT | CP - CP/T - CP/TW - CP/I - CP/IW CS - CS/T - CS/TW - CS/I - CS/IW CP1 CS1 CS2 - CS2/T - CS2/TW | p 27 p 28 p 29 |
|----------|--|----------------------|
| FLEXMAT | T - TA - TV - TP | р 76-77 |
| FLEXDRUM | TCF - TCF/TV | p 81 |





RAILWAY SWITCHES

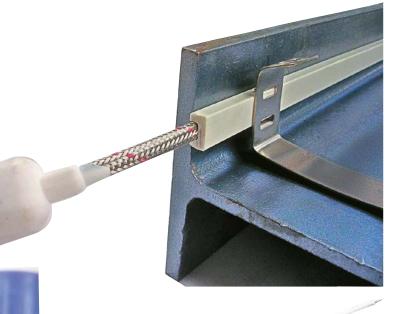
Prevent snow and ice from building up on railway switches to allow them to operate properly. The switches are heated by means of a heating cable held in place by a composite strip.

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 | р | 79 |
|-----------|-------------------|---|----|
| FLEXTRACE | FTS3/IS - FTS3/IF | р | 59 |







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 30 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 - FTS3/IF | p 59 |
|-----------|--------------------------|---------|
| | C1FS/I - C2FS/I - C3FS/I | |
| | C4FS/IS | p 63 |
| | SR - SRHT | p 64-65 |

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

| FLEXTRACE | FTS3/IS - FTS3/IF | p 59 |
|-----------|--------------------------|---------|
| | C1FS/I - C2FS/I - C3FS/I | p 62 |
| | C4FS/IS | p 63 |
| | SR - SRHT | n 64-65 |



Rail transport is one of FLEXELEC's key areas of expertise. Innovatory 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 - TP | n | 76-77 |
|---------|----------------------|---|-------|
| | 1 = 1/A = 1 V = 11 . | | 10-11 |

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 CS - CS/T - CS/TW - CS/I - CS/IW CP1 CS1 CS2 - CS2/T - CS2/TW | p 27 p 28 p 29 |
|-----------|--|----------------------|
| FLEXPLATE | PLA | p 79 |

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 - TP | p 76-77 |
|---------|------------------|---------|
| | | |

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 - TP | p 76-77 |
|---------|------------------|---------|

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.

| FLEXMAT | T - TA - TV - TP | p 76-77 |
|---------|------------------|---------|
|---------|------------------|---------|



GUIDE BY TYPE OF APPLICATION APPLICATIONS DIVERSES



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 | • |
|-----------|----------------------------------|------|
| FLEXDRAIN | CSC - CSC/T - CSC/I - CSC/TS | 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 | р 32 |
|-----------|------------------------------|------|
| FLEXDRAIN | CSC - CSC/T - CSC/I - CSC/TS | р 34 |
| FLEXTAPE | RS - RS/T - RS/I | p 40 |
| FLEXMAT | T - TA - TV - TP | |



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/I | p 31 |
|----------|---------------------------------|---------|
| FLEXTAPE | RS - RS/T - RS/I RV/I RVR | p 42 |
| FLEXMAT | T - TA - TV - TP | p 76-77 |



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.

| FLEXTAPE | RP - RP/T - RP/I RS - RS/T - RS/I | |
|-----------|--|--------------|
| STOPGEL - | ANTIFREEZE | p 45 |
| FLEXTRACE | FSO - FSO/T - FSO/TP FST - FST/T - FST/I - FST/TP - FST/TF FTP - FTP/T - FTP/I - FTP/TP FTSH - FTSH/T - FTSH/I - FTSH/TS - FTSH/T | р 50 р 53 |





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 - TP | p 76-77 |
|---------|------------------|---------|
| | Α | p 75 |



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 | - TP | p 76-77 |
|----------------------------|------|---------|
|----------------------------|------|---------|



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 | FSO - FSO/T - FSO/TP FST - FST/T - FST/I - FST/TP - FST/TF | |
|-----------|---|-------|
| FLEXMAT | T - TA - TV - TP p 7 | 76-77 |



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 |
|----------|---|--------------|
| | FSO - FSO/T - FSO/TP FST - FST/T - FST/I - FST/TP - FST/TF FTP - FTP/T - FTP/I - FTP/TP FTSH - FTSH/T - FTSH/I - FTSH/TS - FTSH/TI | p 50 p 53 |
| | | |

T - TA - TV - TP

p 76-77



GUIDE BY TYPE OF APPLICATION

APPLICATIONS DIVERSES



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 - TP p 76-77



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 - TP | p 76-77 |
|----------|------------------|---------|
| FLEXTAPE | RV/I | p 42 |



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 | FSO - FSO/T - FSO/TP FST - FST/T - FST/I - FST/TP - FST/TF | |
|-----------|---|---------|
| FLEXMAT | T - TA - TV - TP | p 76-77 |



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 68



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.

| FLEXFLOOR | KY - KYCY | р 6 | 86 |
|-----------|-----------|-----|----|
| | KYCYR | p 6 | 39 |





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 |

FLEXCORD®

TEMPERATURE MAINTENANCE SYSTEMS

www.flexelec.com

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.

· Special production on request.



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.



Standards

CEI 62395-1 CEI 62395-2 UL758 (UL) on request C22.2 N° 210 (cUL) on request

Fiber glass core Heating wire

| PRODUCTS | INSULATION CLASS |
|---------------|--|
| C1P | CLASS 0 (single insulated) CLASS III (if low voltage) |
| C1P/T - C1P/I | CLASS I (earthing) |

PVC insulation 105°C (C1P)

Metal braid (C1P/T - C1P/I)

Fibre class Ø 0.7 or Ø 1.1 mm Support Heating wire Nickel-Copper or Nickel-Chrome Diameter 2.0 to 3.0 mm 2.3 to 3.3 mm 5000 Ω/m Max. ohmic value Max. power 15 W/m Max. voltage 600 V Permissible surface From - 30°C to + 105°C temperature Resistance : ± 10 % Diameter : + 0.2 / - 0.1 mm 6 x the diameter Minimum bending radius

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 Tél : + 33 (0)4.72.48.30.90

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FLEXCORD®



TEMPERATURE MAINTENANCE SYSTEMS

www.flexelec.com

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

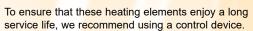


Characteristics

- **91** 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.
- Special production on request.



C1S, C1S/T and C1S/I heating cords are mainly usedin the household electrical or refrigeration industries, or in machines requiring protection against freezing or temperature maintenance.



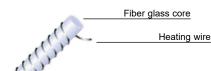




Standards

CEI 62395-1

CEI 62395-2 UL758 (UL) on request C22.2 N° 210 (cUL) on request



| PRODUCTS | INSULATION CLASS |
|---------------|--|
| C1S | CLASS 0 (single insulated) CLASS III (if low voltage) |
| C1S/T - C1S/I | CLASS I (earthing) |

Silicon elastomer Insulation (C1S)

Metal braid (C1S/T - C1S/I)

Support
Heating wire
Diameter
Max. ohmic value
Max. power
Max. voltage
Permissible surface
temperature

Minimum bending radius

C1S C1S/T - C1S/I

Fibre class Ø 0.7 or Ø 1.1 mm

Nickel-Copper or Nickel-Chrome

2.4 to 3.5 mm 2.7 to 3.8 mm

5000 Ω/m

30 W/m

600 V

from - 70°C to + 200°C

Resistance : ± 10 %
Diameter : + 0.2 / - 0.1 mm
6 x the diameter

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

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FLEXCORD®



TEMPERATURE MAINTENANCE SYSTEMS

www.flexelec.com

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

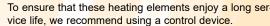


Characteristics

- 91 cords on request.
- : Fluoropolymer insulated cords.
- C1F/T : with tinned copper braid for mechanical protection and earthing.
- : with stainless steel braid for mechanical C1F/I
 - protection and earthing.
- · Special production on request.

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.





Standards

CEI 62395-1 CEI 62395-2

Fiber glass core Heating wire

| PRODUCTS | INSULATION CLASS |
|---------------|--|
| C1F | CLASS 0 (single insulated) CLASS III (if low voltage) |
| C1F/T – C1F/I | CLASS I (earthing) |

Fluoropolymer insulation (C1F)

Metal braid (C1F/T - C1F/I)

Support Heating wire Diameter Max. ohmic value Max. power Max. voltage Permissible surface

temperature Tolerances

Minimum bending radius

Fibre class Ø 0.7 or Ø 1.1 mm Nickel-Copper or Nickel-Chrome 1.7 to 2.1 mm 2.0 to 2.4 mm 5000 Ω/m 30 W/m 600 V from - 70°C to + 200°C Resistance : ± 10 % Diameter : + 0.2 / - 0.1 mm

6 x the diameter

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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Flexible heating cables and elements temperature maintenance systems



| 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 - CS2/I - CS2/IW | SILICON ELASTOMER INSULATED CABLES | 30 |
| CV/I | GLASS FIBRE INSULATED CABLES | 31 |
| TUY | FLEXIBLE HEATED HOSES | 32 |

TEMPERATURE MAINTENANCE SYSTEMS

www.flexelec.com

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. : with stainless steel braid CP/IW

no earthing conductor. · Special production on request.

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.

Standards

CEI 62395-1 СР CEI 62395-2 CP/T • CP/I

> CP/TW • CP/IW Power cable **PVC** insulation

> > Heat-shrink sheath

Metal braid

PVC insulation 105°C

Heating wire

Fiber glass core

| PRODUCTS | INSULATION CLASS |
|---------------------|--|
| CP - CP/TW CP/IW | CLASS 0 (single insulated) CLASS III (if low voltage) |
| CP/T – CP/I | CLASS I (earthing) |

Nickel-Copper or Nickel-Chrome 2.3 to 3.5 mm 3 to 4 mm 15 W/m Any voltage on request up to 500 V from - 30°C to + 105°C Power : ± 10 % Diameter : + 0.2 / - 0.1 mm Length: ± 1 % Heat-shrink sheath with adhesive IP 55

6 x the diameter

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.

Max. power Voltage Permissible surface temperature

Tolerances

Heating wire

Diameter

Connection insulation Ingress protection code Minimum bending radius

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TEMPERATURE MAINTENANCE SYSTEMS

www.flexelec.com

CS - CS/T - CS/TW - CS/I - CS/IW Silicon elastomer insulated cables



Characteristics

- · Connection 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. · Special production on request.

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.



Standards

CEI 62395-1 CS CEI 62395-2 CS/T · CS/I

> CS/TW CS/IW

Power cable silicon elastomer insulation

Silicon elastomer moulded part

Metal braid

Silicon elastomer insulation

Heating wire

Fiber glass core

| PRODUCTS | INSULATION CLASS |
|-----------------------|--|
| CS - CS/TW - CS/IW | CLASS 0 (single insulated) CLASS III (if low Voltage) |
| CP/T - CP/I | CLASS I (earthing) |

Nickel-Copper or Nickel-Chrome 2.3 to 3.5 mm 3 to 4 mm 30 W/m Any voltage on request up to 500 V from - 70°C to + 200°C

> Power : ± 10 % Diameter : + 0.2 / - 0.1 mm Length: ± 1 % Sealed silicon moulding IP 66

> > 6 x the diameter

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.

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Heating wire

Max. power Voltage

temperature

Tolerances

Permissible surface

Connection insulation

Ingress protection code

Minimum bending radius

Diameter

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TEMPERATURE MAINTENANCE SYSTEMS

www.flexelec.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

- n cables on request.
- · Special production 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.

Other possible options

Standards CEI 62395-1

CEI 62395-2 UL758 (UL) on request C22.2 N° 210 (cUL) on request CP1

Termination

Wire terminated in the cold tail

Black mark

PVC insulation 105°C

Heating wire

Fiber glass core



Caution

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

| PRODUCTS | INSULATION CLASS |
|----------|--|
| CP1 | CLASS 0 (single insulated) CLASS III (if low voltage) |

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. Heating wiret Diameter Max. power Voltage

Permissible surface temperature

Tolerances

Max. current Ingress protection code Minimum bending radius

Nickel-Copper or Nickel-Chrome

2.3 to 3.5 mm

15 W/m

Any voltage on request up to 500 V

from - 30°C to + 105°C

Power : ± 10 % Diameter : + 0.2 / - 0.1 mm Length: ± 1 %

IP 66 6 x the diameter

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TEMPERATURE MAINTENANCE SYSTEMS

www.flexelec.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.

Other

possible options

- su cables on request.
- · Special production 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.

Standards

CEI 62395-1 CEI 62395-2 UL758 (UL) on request C22.2 N° 210 (cUL) on request

CS1

Termination

Wire terminated in the cold tail

Black mark

Silicon elastomer insulation

Heating wire

Fiber glass core

Heating wiret

Max. power

temperature

Tolerances

Max.current

Permissible surface

Ingress protection code

Minimum bending radius

Diameter

Voltage



Caution

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

| PRODUCTS | INSULATION CLASS |
|----------|--|
| CS1 | CLASS 0 (single insulated) CLASS III (if low Voltage) |

Nickel-Copper or Nickel-Chrome

2.3 to 3.5 mm 30 W/m

Any voltage on request up to 500 V

from - 70°C to + 200°C

Power : ± 10 % Diameter: + 0.2 / - 0.1 mm

Length: ± 1 % 2 A

IP 66

6 x the diameter

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.

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TEMPERATURE MAINTENANCE SYSTEMS

www.flexelec.com

CS2 - CS2/T - CS2/TW - CS2/I - CS2/IW 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/I: : with stainless steel braid

and earthing conductor.

• CS2/TW: with tinned copper braid for mechanical protection, no earthing conductor.

• CS2/IW: with stainless steel braid for mechanical protection, no earthing conductor.

· Special production on request.

Applications

CS2, CS2/T, CS2/I, CS2/TW and CS2/IW 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.

Standards

CEI 62395-1 CS2 CEI 62395-2 CS2/T -CS2/I CS2/TW-CS2/IW

Heat-shrink sheath

Power cable PVC insulation

Metal braid

Silicon elastomer insulation

Heating wire

Fiber glass core

| PRODUCTS | INSULATION CLASS |
|--------------------------|--|
| CS2 - CS2/TW - CS2/IW | CLASS 0 (single insulated) CLASS III (if low Voltage) |
| CS2/T - CS2/I | CLASS I (earthing) |

Nickel-Copper or Nickel-Chrome 2.3 to 3.5 mm 3 to 4 mm 30 W/m Any voltage on request up to 500 V from - 70°C to + 200°C Power: ± 10 % Diameter: + 0.2 / - 0.1 mm

Length: ± 1 %

Heat-shrink sheath with adhesive

IP 54 6 x the diameter

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.

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Heating wire Diameter

Max. power

temperature

Tolerances

Permissible surface

Connection insulation

Ingress protection code

Minimum bending radius

Voltage

FLEXELEC Dept OMERIN GmbH

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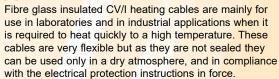
CV/I Fibre glass insulated cables



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.
- · Fibre glass insulated cables with stainless steel braid and earthing conductor.
- · Special production on request.

Applications



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

Standards

CEI 62395-1 CEI 62395-2

Metal braid

Fibre glass braid (several layers)

Heating wire

Ceramic fibre core

Standard models

| Heating length (m) | 1 | 2 | 4 | 6 | 8 | 10 |
|--------------------|-----|-----|-----|-----|------|------|
| Power (W) | 125 | 250 | 500 | 750 | 1000 | 1250 |

| PRODUCTS | INSULATION CLASS | | | |
|----------|--------------------|--|--|--|
| CVI | CLASS I (earthing) | | | |

Heating wire Nickel-Copper or Nickel-Chrome Diameter 5 mm 125 W/m Max. power Voltage Any voltage on request up to 230 V Permissible surface up to + 450°C temperature Power : ± 10 % Tolerances Diameter: ± 0.5 mm Length: ± 1 % Connection insulation Fibre class With earth Protection IP 40 Ingress protection code

Use

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TEMPERATURE MAINTENANCE SYSTEMS

www.flexelec.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. : Polyamid braid.

 Outer sheath · End pieces

: Silicon caps with device to protect output cable from being ripped out.

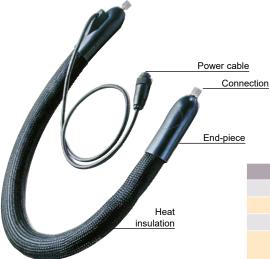
Voltage

: 230 V, other on request.

Connection

: Revolving nuts, UNF, BSP/DKR connections, or with smooth end-

: IP 40. · Ingress protection code



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 connection.
- · Outer stainless or galvanised steel braid.
- Pilot lines can pass through the heated hose.
- · Special designs on request.
- · Electronic regulator.

| Nominal diameter (mm) | | 6 | | 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 24°C (bar) Up to 100°C (bar) Up to 200°C (bar) | 250 225 200 | 225 202 180 | 200 180 160 | 150 135 120 | 125 112 100 | 100 90 80 | 70 63 56 | 55 49 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 |

Use

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



FLEXDRAIN®

DRAIN-LINE HEATERS

| CSC - CSC/T - CSC/I - CSC/TS | 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 |
| CSC2M | SILICON ELASTOMER INSULATED DRAIN-LINE HEATERS MICRO SIZE FOR REFRIGERATION | 37 |

FLEXDRAIN®



TEMPERATURE MAINTENANCE SYSTEMS

www.flexelec.com

CSC - CSC/T - CSC/I - CSC/TS Silicon elastomer insulated drain-line heaters



Characteristics

- · Fully sealed.
- · Extremely flexible.
- · Any voltage on request.
- Power cable: standard length: 1m.
- · 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.
- CSC/TS: with tinned copper braid and silicon elastomer insulated
- · Special production on request.



CSC, CSC/T, CSC/I and CSC/TS 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.

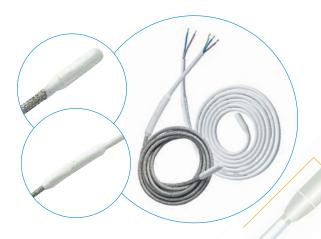


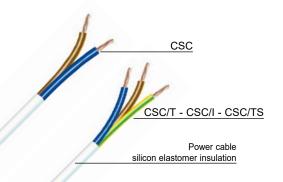
To ensure that these heating elements enjoy a long service life, we recommend using a control device.



Standards

CEI 62395-1 CFI 62395-2





Silicon elastomer moulding

Silicon elastomer Insulation (CSC)

Heating wire

Heating wire

Max. power Voltage

temperature

Tolerances

End insulation

Minimum bending

Ingress protection code

Permissible surface

Diameter

Conductor

Metal braid (CSC/T - CSC/I)

Silicon elastomer Insulation (CSC/TS)

INSULATION CLASS PRODUCTS CSC CLASS 0 (single insulated) CLASS III (if low Voltage)

CSC/T - CSC/I CSC/TS

CLASS I (earthing)

Nickel-Copper or Nickel-Chrome 6 mm 50 W/m Any voltage on request up to 500 V

from - 70°C to + 200°C

Power : ± 10 % Diameter : + 0.2 / - 0.1 mm Length: ± 1 % Sealed silicon moulding IP66

6 x the diameter

Use

Drain-line heaters are serie resistors. Consult the pages of

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

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CSC₂ Silicon elastomer insulated drain-line heaters

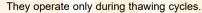


Characteristics

- · Fully sealed.
- · Double insulation.
- · Extremely flexible.
- · Voltage 230 V as standard.
- Power cable : Length 1m.
- Special production on request.



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



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.





Standards

CEL 62395-1 CEI 62395-2





Wire terminated in the cold tail

Heating wire

Permissible surface

Ingress protection code

Minimum bending radius

Section

Power

Voltage

temperature

Tolerances

Black mark

Silicon elastomer insulation

insulation

Silicon elastomer Heating wire Fiber glass core Conductor cable

Standard models

| | CSC2 | | | |
|------------|--------|--------|--|--|
| Length (m) | 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 | | |

Nickel-Copper or Nickel-Chrome

5 x 7 mm 40 or 50 W/m

Standard 230 V

from - 70°C to + 200°C

Power: ± 10 % Diameter: + 0.2 / - 0.1 mm

Length: ± 1 %

IP67

6 x the thickness

Silicon elastomer moulding 9 x 7 mm Length 20 mm



These cables must never be cut to shorten

Use

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

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FLEXELEC Dept

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TEMPERATURE MAINTENANCE SYSTEMS

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CSC2K Silicon elastomer insulated drain-line heaters with integrated thermostat

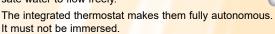


Characteristics

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

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.



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

Standards

CEI 62395-1

CEI 62395-2

1

Wire terminated in the cold tail

Black mark

Silicon elastomer insulation

Silicon elastomer insulation Heating wire

Fiber glass core Conductor cable

Standard models

| | CSC2K | | | | | |
|------------|--------|--------|--|--|--|--|
| Length (m) | 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. 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.

Heating wiret
Section
Power
Voltage
Permissible surface
temperature

Tolerances

End insulation Thermostat

Ingress protection code
Minimum bending radius

CSC2K

Nickel-Copper or Nickel-Chrome 5 x 7 mm 40 or 50 W/m 230 V as standard

from - 40°C to + 110°C

Power : ± 10 %
Diameter : + 0.2 / - 0.1 mm
Length : ± 1 %

Heat-shrink sheath with adhesive

Pre-set to + 5°C/+ 15°C as standard

Cable IP67 - Thermostat IP54

6 x the thickness

Use

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

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TEMPERATURE MAINTENANCE SYSTEMS

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CSC₂M Silicon elastomer insulated drain-line heaters "micro" size for refrigeration

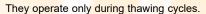


Characteristics

- · Fully sealed.
- · Double insulation.
- · Extremely flexible.
- Voltage 230 V as standard.
- · Power cable : length 1m.
- · Very small size.
- · Round shape.
- · Special production on request.

Applications

CSC2M heaters are designed to be laid inside pipes for draining water from thawing refrigeration equipment installed in cold rooms.



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





Standards

CEI 62395-1 CEI 62395-2





Wire terminated in the cold tail

> Support Diameter

> > Power Voltage

Permissible surface

Ingress protection code

Minimum bending radius

temperature

Tolerances

Black mark

Silicon elastomer insulation

Silicon elastomer insulation Heating wire Fiber glass core Conductor cable

Standard models

| | CSC2M |
|------------|--------|
| Length (m) | 40 W/m |
| 1 | 40 W |
| 1.3 | 52 W |
| 1.5 | 60 W |
| 2 | 80 W |
| 3 | 120 W |
| 4 | 160 W |
| 5 | 200 W |
| 6 | 240 W |

Nickel-Copper or Nickel-Chrome

4.8mm

40 W/m

Standard 230 V

From - 70°C to + 200°C

Power: ± 10 % Diameter: + 0.2 / - 0.1 mm

Length: ± 1 %

IP67

6 x the diameter

Silicon elastomer moulding Diameter 7.2 mm Length 33 mm

Caution

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

Use

Drain-line heaters are serie 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



FLEXTAPE®

HEATING TAPES

| RP - RP/T - RP/I | PVC INSULATED TAPES | 39 |
|------------------|---|----|
| RS - RS/T - RS/I | SILICON ELASTOMER INSULATED TAPES | 40 |
| RSV | ANTI-CONDENSATION TAPES FOR ELECTRIC MOTORS | 41 |
| RV/I | FIBRE GLASS INSULATED TAPES | 42 |
| RVR | SILICA FIBRE INSULATED TAPES | 43 |



TEMPERATURE MAINTENANCE SYSTEMS

www.flexelec.com

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



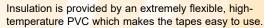
RP/T - RP/I

Characteristics

- · Max. power 20 W/m.
- · Power cable: length 1m 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.
- · Special production on request.

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.



sheath

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

Standards

CEI 62395-1 CEI 62395-2



Metal braid

Heating wire

PVC insulation 105°C

Fiber glass core

| PRODUCTS | INSULATION CLASS |
|-----------|--|
| RP | CLASS 0 (single insulated) CLASS III (if low Voltage) |
| DD/T DD/I | CLASS L (earthing) |

Heating wiret Diameter

Max. power

Voltage Permissible surface temperature

Tolerances

Connection and end insulation Ingress protection code Minimum bending radius

Nickel-Copper or Nickel-Chrome 3 x 12 mm 3.5 x 12.5 mm 10 W/m to maintain at 60°C 20 W/m to maintain at 45°C Any voltage on request up to 500 V from - 30°C to + 90°C Power : ± 10 % Diameter : + 0.2 / - 0.1 mm Length: ± 1 % Heat-shrink sheath with adhesive IP55

6 x the thickness

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.

Heat-shrink

sheath

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TEMPERATURE MAINTENANCE SYSTEMS

www.flexelec.com

RS - RS/T - RS/I Silicon elastomer insulated tape



Characteristics

- · Max. power 60 W/m.
- · Power cable : Length 1m 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.
- · Special production on request.

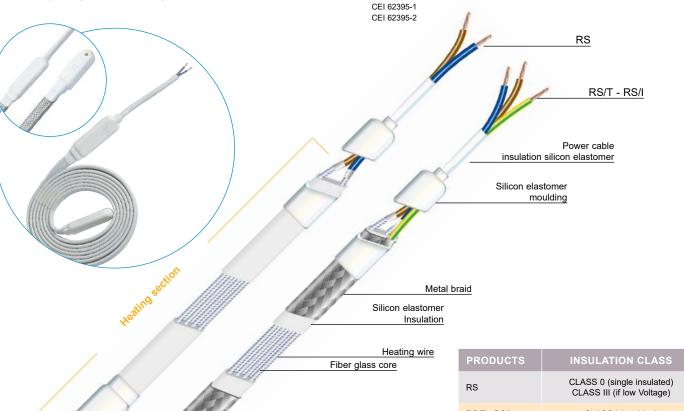
Applications

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.

Standards



| PRODUCIS | INSULATION CLASS |
|-------------|--|
| RS | CLASS 0 (single insulated) CLASS III (if low Voltage) |
| RS/T - RS/I | CLASS I (earthing) |

Silicon elastomer moulding Heating wire Diameter

Max. power

Voltage Permissible surface temperature

Tolerances

Connection and end insulation Ingress protection code Minimum bending radius

Nickel-Copper or Nickel-Chrome 3 x 12 mm 3.5 x 12.5 mm 20 W/m to maintain at 140°C 40 W/m to maintain at 105°C 60 W/m to maintain at 80°C Any voltage on request up to 500 V from - 70°C to + 200°C Power : ± 10 % Diameter : + 0.2 / - 0.1 mm Length: ± 1 % Sealed silicon elastomer moulding

IP66

6 x the thickness

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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TEMPERATURE MAINTENANCE SYSTEMS

Anti-condensation tapes for electric motors

www.flexelec.com

RSV











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.
- · Special production on request.
- Production 🔊 on request.

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.

Standards

CEI 62395-1 NE EN 60079-30-1 CEI 62395-2 NF EN 60079-7 CAN/CSA-C22.2 n°130-03 NF EN IEC 60079-0



Power cable silicon elastomer insulation

Heating tapes

Fibre glass sheath

Heating wire

Dimensions

temperature Tolerances

Connection

External insulation

Permissible surface

and end insulation

Ingress protection code

Minimum bending radius

Fibre glass braid

Insulation

Heating wire

Fiber glass core

INSULATION CLASS RSV CLASS 0 (single insulated)

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 |
| | |

Nickel-Copper or Nickel-Chrome

Fibre glass braid

3 x 11 mm

from - 70°C to + 200°C

Power: ± 10 %

Fibre glass sheath

IP53

6 x the thickness

sheat

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.

Fibre class

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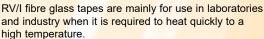
RV/I Fibre glass insulation tapes

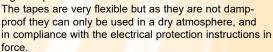


Characteristics

- · Highly flexible.
- · Minimum bending radius up to 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.
- · Fibre glass insulation tapes with stainless steel braid.for mechanical protection earthing
- · Special production on request.

Applications

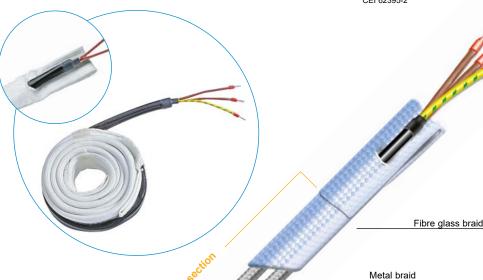




To ensure that these heating elements enjoy a long service life, we recommend using a control device.

Standards

CEI 62395-1 CEI 62395-2



Standard models

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

| PRODUCTS | INSULATION CLASS |
|----------|--------------------|
| RV/I | CLASS I (earthing) |

Heating wire Dimensions Power Permissible surface temperature Tolerances

Ingress protection code

Fibre glass braid (several layers) Heating wire

Ceramic fibre core

Nickel-Copper or Nickel-Chrome 5 x 30 mm 250 W/m up to + 450°C Power: ± 10 %

IP40

Use

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

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TEMPERATURE MAINTENANCE SYSTEMS

www.flexelec.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.
- · Special production on request.



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.

Standards

CEI 62395-1 CEI 62395-2





Silica fibre insulation

Heating wire

Dimensions

temperature

Tolerances

Permissible surface

Ingress protection code

Power

Heating element insulation External insulation

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

| PRODUCTS | INSULATION CLASS |
|----------|----------------------------|
| RVR | CLASS 0 (single insulated) |

Nickel-Copper or Nickel-Chrome Fibre glass braid

Silica fibre

8 x 30 mm

350 W/m

up to + 900°C

Power: ± 10 %

IP40

Use

Heating resistors. tapes are series 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



STOPGEL® - ANTIFREEZE®

STOPGEL - ANTIFREEZE

READY-TO-USE CABLES

STOPGEL® ANTIFREEZE®



TEMPERATURE MAINTENANCE SYSTEMS

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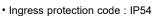
STOPGEL - ANTIFREEZE Ready-to-use cables

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 at one end only.
- · Electrical connection plug included.
- Thermostat incorporated at the end of the cable.
- · Fitting accessories supplied.
- 2 years guarantee.
- · Special production on request.



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.

Standards



Power supply section 1 m



PVC insulation 105°C

Silicon elastomer insulation Heating wire

Fiber glass core

Caution

These cables must never be cut to shorten

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.

Thermostat

FLEXELEC S.A.S

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Flexible heating cables and elements temperature maintenance systems



FLEXTRACE®

FSH2/TP

| 1 0112,11 | CEEF RECOEMING OF BEEG FOR TELL ENGINEERS WITH THE WITH | 71 |
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| | | |



TEMPERATURE MAINTENANCE SYSTEMS

www.flexelec.com

FSH2/TP

Self-regulating cables for temperature maintenance

Characteristics

- Withstands continuous at + 80°C.
- · Can be cut to length on site.
- · Will not self-destruct by overheating.
- Available as 40 W/m to + 10°C.
- Power supply 230 V.
- · Self-regulating cables, thermoplastic insulation with tinned copper braid and outer thermoplastic anticorrosion sheath.
- · Special production on request.





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

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Applications

to +80°C.

By tracing the piping network with an FSH2/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,

This FSH2/TP range of self-regulating heating cables is designed

for maintaining the hot water supply at a constant temperature up

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

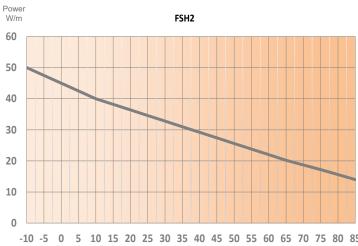
Standards

CEI 62395-1 CEI 62395-2

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Power output according to pipe temperature



-10 -5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 Temperature °C

| | FSH2/TP 40 |
|---------------------------------|---|
| Insulation | Thermoplastic |
| Dimensions (Tol. +/-0.5mm) | 6.8 x 13 mm |
| Power at 10°C | 40 W/m |
| Permissible surface temperature | Unenergized circuit : max. + 100°C Energized circuit : max. + 80°C |
| Max. circuit length | |
| 16 A -10°C | 75 m |
| 0°C | 80 m |
| 20 A -10°C | 100 m |
| 0°C | 110 m |
| Ingress protection code | IP54 with our kits |
| Min. bending radius | 6 x the thickness of cable |

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TEMPERATURE MAINTENANCE SYSTEMS

www.flexelec.com

FSJ - FSJ/T - FSJ/TP Self-regulating cables



Characteristics

- · Can be cut to length on site.
- · Will not self-destruct by overheating.
- Power supply 230 V.
- Available as 15, 25 or 35 W/m at + 10°C.
- FSJ : self-regulating cables thermoplastic insulation.
- FSJ/T : with tinned copper braid
 - for mechanical protection and hearting.
- FSJ/TP : with tinned copper braid and outer thermoplastic anticorrosion sheath.
- · Special production on request.

Applications

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

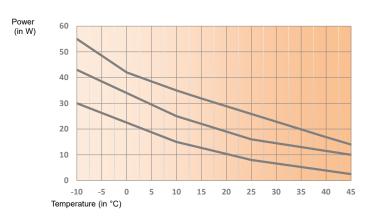
To ensure that these heating elements enjoy a long service life, we recommend using a control device.

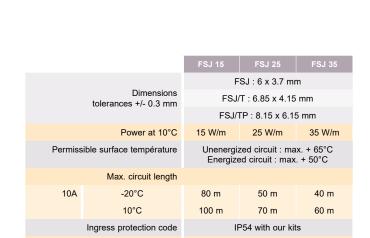


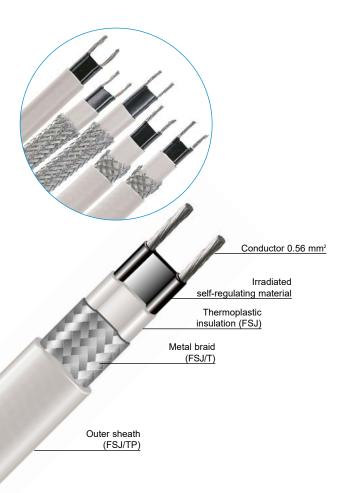
Standards

CEI 62395-1 CEI 62395-2

Power output according to pipe temperature







Use

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

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FLEXELEC (UK) Ltd Unit 11 Kings Park Industrial Estate Primrose Hill - KINGS LANGLEY Hertfordshire – WD4 85T - UK Tel : + 44 (0) 1923.274477 Fax : + 44 (0) 1923.270264 E-mail : sales@omerin.co.uk

Min. bending radius

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6 x the thickness of cable



TEMPERATURE MAINTENANCE SYSTEMS

www.flexelec.com

FSO - FSO/T - FSO/TP **Self-regulating cables**



Characteristics

- · Can be cut to length on site.
- · Will not self-destruct by overheating.
- Power supply 230 V.
- Available as 10, 20, 30 or 40 W/m at + 10°C.
- : self-regulating cables • FSO thermoplastic insulation.
- FSO/T : with tinned copper braid
 - for mechanical protection and hearting.
- FSO/TP: with tinned copper braid and outer thermoplastic anticorrosion sheath.
- · Special production on request.

Conductor 1.23 mm² Irradiated self-regulating material Thermoplastic insulation (FSO) Metal braid (FSO/T) Outer sheath (FSO/TP)

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

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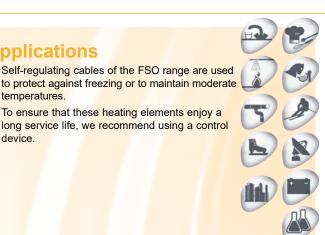
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Standards

Applications

temperatures.

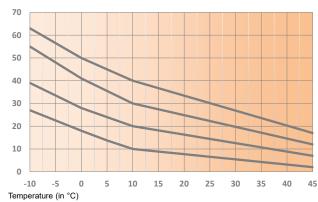
device.

CEI 62395-1

CEI 62395-2

(in W)

Power output according to pipe temperature Power



| | | FSO 10 | FSO 20 | FSO 30 | FSO 40 | | | |
|------------|-----------------------------|--|-------------------------|--------|--------|--|--|--|
| | | FSO : 9.7 x 3.8 mm | | | | | | |
| tolerance | Dimensions es +/- 0.3 mm | FSO/T : 10.65 x 4.35 mm | | | | | | |
| | | | FSO/TP: 12.25 x 6.35 mm | | | | | |
| Р | ower at 10°C | 10 W/m | 20 W/m | 30 W/m | 40W/m | | | |
| surface | Permissible température | Unenergized circuit : max. + 65°C Energized circuit : max. + 50°C | | | | | | |
| Max. | circuit length | | | | | | | |
| 16A | -20°C | 180 m | 90 m | 70 m | 50 m | | | |
| IOA | 10°C | 200 m | 120 m | 80 m | 70 m | | | |
| 20A | -20°C | 230 m | 120 m | 90 m | 65 m | | | |
| ZUA | 10°C | 230 m | 140 m | 110 m | 80 m | | | |
| Ingress pr | otection code | IP 54 with our kits | | | | | | |
| Min. be | ending radius | 6 x the thickness of cable | | | | | | |



TEMPERATURE MAINTENANCE SYSTEMS

www.flexelec.com

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.
- : self-regulating cables FST 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

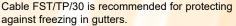
fluoropolymer sheath, ideal for the chemical industry

where corrosive products may be present.

· Special production on request.

Applications

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



Cables of type 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.

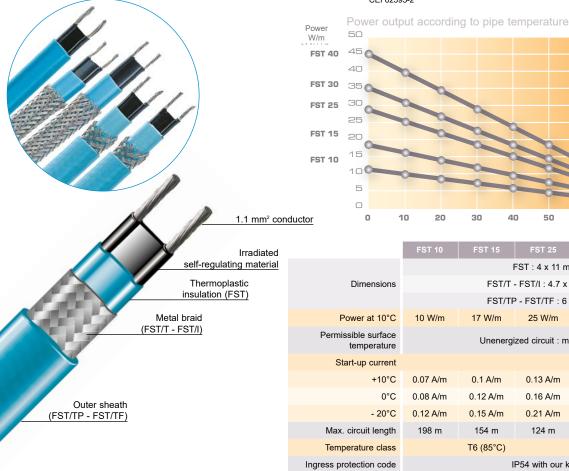






Standards

CEI 62395-1 CEI 62395-2



0 10 20 30 40 50 70 80 90 Temperature °C FST · 4 x 11 mm FST/T - FST/I : 4.7 x 11.8 mm Dimensions FST/TP - FST/TF : 6 x 13 mm Power at 10°C 10 W/m 25 W/m 40W/m Permissible surface Unenergized circuit: max. + 85°C temperature Start-up current 0.13 A/m +10°C 0.07 A/m 0.16 A/m 0.21 A/m 0.1 A/m 0°C 0.08 A/m 0.12 A/m 0.16 A/m 0.19 A/m 0.26 A/m 0.21 A/m - 20°C 0.12 A/m 0.15 A/m 0.24 A/m 0.32 A/m 198 m 154 m 124 m 88 m Max. circuit length Temperature class T6 (85°C) T4 (135°C) Ingress protection code IP54 with our kits Min. bending radiusi 6 x the thickness of cable

> Certificat ATEX: CML 20ATEX3204 pour FST/TP et FST/TF Certificat IECEx: CML 20.0130 pour FST/TP et FST/TF

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Consult the pages of the catalogue devoted to the corre-

sponding general operating principles, general instructions

for use and accessories.

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TEMPERATURE MAINTENANCE SYSTEMS

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

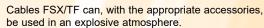


Characteristics

- Available as 15, 30, 45, 60 or 75 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 can be present
- Special production on request.

Applications

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



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





Standards

CEI 62395-1 NF EN 60079-30-1 CEI 62395-2 NF EN 60079-7 NF EN IEC 60079-0 CAN/CSA-C22.2 n°130-03

Power W/m FSX 75 FSX 60

FSX 45

FSX 30

FSX 15

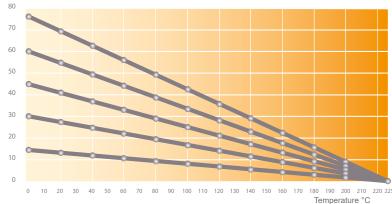
1.25 mm² conductor

self-regulating material

Fluoropolymer insulation (FSX)

Metal braid (FSX/T - FSX/I) Irradiated

Power output according to pipe temperature



| | | | Powe | ar at | 10°C | | 15 V | M/m | | 30 |) W/r | | | - : c | | | m 60 \ | M/m | | 71 | 5 W/ | m |
|----|---|----|-------|-------|-------|----|---|------|----|-----|-------|-----|-------|-------|-------|-----|-----------|-----------|------------|--------------------------|-------------------------|---------|
| | | | Di | mens | sions | | FSX/T - FSX/I : 5 x 11,5 mm FSX/TF : 6 x 13 mm | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | FS | X : 4 | 1,5 > | c 10, | 5 m | m | | | | | |
| | | | | | | | FSX | (15 | | F | SX 3 | 0 | | SX | 45 | | FS | (60 | | F | SX 7 | '5 |
| | 0 | 10 | 20 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 | 130 | 140 | 150 | 160 | 170 | 180 Te | 190 mpe | ²⁰⁰ eratur | ²¹⁰ re °C | 220 225 |
| 0 | | | | | | | | | | | | | | | | | | | | Î | | |
| 10 | | | | - | | 0 | | | | | | | | | | | | | | | | |

| | | FS | X : 4,5 x 10,5 | mm | |
|---------------------------------|-------------------------------|--------|-----------------|---------|------------|
| Dimensions | | FSX/T | - FSX/I : 5 x 1 | 11,5 mm | |
| | FSX/TF : 6 x 13 mm | | | | |
| Power at 10°C | 15 W/m | 30 W/m | 45 W/m | 60 W/m | 75 W/m |
| Permissible surface temperature | Unenergized circuit : + 225°C | | | | |
| Max. circuit Length | 154 m | 108 m | 88 m | 76 m | 52 m |
| Temperature class | T3 (200°C) T2 (300°C) | | | | T2 (300°C) |
| Ingress protection code | IP54 with our kits | | | | |
| Min. bending radius | | 6 x th | e thickness o | f cable | |
| | | | | | |



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

Fluoropolymer outer sheath (FSX/TF)

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ATEX certificate: CML 20ATEX3203 pour FSX/TF

IECEx certificate: CML 20.0129 pour FSX/TF

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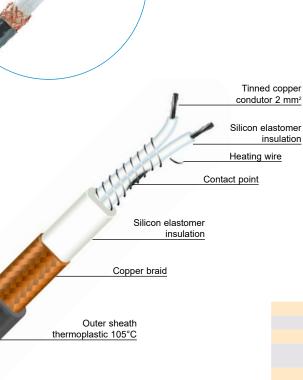
FTC **Constant power cables for gutters**



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 and 40 W/m.
- Power supply 230 V.
- · Copper braid and thermoplastic outer sheath to protect against
- · Special production on request.





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

Standards

CEI 62395-1 CEI 62395-2

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/CDM2 or FX/CDM3 hygrothermostat will lead to significant energy savings.

Heating wire Dimensions

Permissible surface temperature

Max. circuit length

Distance between 2 consecutive contact points

> Ingress protection code Min. bending radius

FTC

Nickel-Copper or Nickel-Chrome 8 x 11 mm

> 30 or 40 W/m From - 30°C to + 90°C

120 m in 30 W/m - 100 m in 40 W/m

700 mm

IP54 with our kits 6 x the thickness of the cable

Use

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

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TEMPERATURE MAINTENANCE SYSTEMS

www.flexelec.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).
- : PVC insulated constant power cables.
- FTP/T : with tinned copper braid.
 - for mechanical protection and earthing.
- : with stainless steel braid . FTP/I
 - for mechanical protection and earthing.
- FTP/TP : with copper braid and PVC outer sheath to protect

against corrosion.

Special production on request.

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

1 m 0.8 m

0.7 m

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

170 m

150 m

140 m





60°C

50°C

40°C

Standards

CEI 62395-1

CEI 62395-2

| Special production on request. | Power |
|--------------------------------|----------------------------------|
| | 10 W/m |
| | 15 W/m |
| | 20 W/m |
| | Tinned copper conductor 2 mm² |
| | Silicon elastomer insulation |
| | Contact point |
| He | ating wire |
| PVC insulation 105°C (FTP) | |
| Metal braid (FTP/T - FTP/I) | |
| Outer PVC sheath 105°C | |
| (FTP/TP) | Heatir |
| | Dime |

| | FTP |
|---------------------------------|--------------------------------|
| Heating wire | Nickel-Copper or Nickel-Chrome |
| | FTP : 5 x 8 mm |
| Dimensions | FTP/T - FTP/I : 5.5 x 8.5 mm |
| | FTP/TP: 7 x 10 mm |
| Power | 10, 15 or 20 W/m |
| Permissible surface temperature | de - 30°C to + 90°C |
| Ingress protection code | IP54 with our kits |
| Min. bending radius | 6 x the thickness of cable |

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

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TEMPERATURE MAINTENANCE SYSTEMS

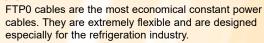
www.flexelec.com

CE FTP0 - FTP0/T - FTP0/TP **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.
- FTP0 : PVC insulated constant power cables.
- FTP0/T : with tinned copper braid.
 - for mechanical protection and earthing.
- FTP0/TP: with copper braid and PVC outer sheath
 - to protect against corrosion.
- · Special production on request.

Applications



FTP0 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

Standards

CEI 62395-1 CEI 62395-2



Tinned copper conductor 0.75 mm² Silicon elastomer Insulation Contact point Heating wire

PVC insulation 105°C (FTP0)

Metal braid (FTP0/T)

Outer sheath PVC insulation 105°C (FTP0/TP) Heating wire

Dimensions

Power Permissible surface temperature

Max. circuit length

Distance between 2 consecutive contact points Ingress protection code Min. bending radius

FTPO Nickel-Copper or Nickel-Chrome

> FTP0:5x7mm FTP0/T: 5.5 x 7.5 mm FTP0/TP: 7 x 9 mm 10 W/m or 15 W/m

from -30°C to +90°C

10 W/m : 120 m 15 W/m: 80 m 10 W/m : 1 m 15 W/m : 0.9 m IP54 with our kits 6 x the thickness of cable

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

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TEMPERATURE MAINTENANCE SYSTEMS

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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, 40 or 50 W/m.
- Power supply: 230 V as standard (115 V and 400 V on request).
- : silicon elastomer insulated constant power cables.
- FTSH/T : with tinned copper braid.

for mechanical protection and earthing.

: with stainless steel braid . FTSH/I

for mechanical protection and earthing.

• FTSH/TS : with tinned copper braid and silicon elastomer

outer sheat

• FTSH/TF : with tinned copper braid and fluoropolymer

anti-corrosion outer sheat.

· Special production on request.

Applications

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

Its great flexiblity 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



Standards

CEI 62395-1 CEI 62395-2

| 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 |
| 50 W/m | 0.6 m | 80 m | 90°C |

Tinned copper condutor 2 mm² Silicon elastomer insulation Welded contact point Heating wire

> Metal braid (FTSH/T, FTSH/I)

Silicon elastomer insulation (FTSH)

Silicon elastomer (FTSH/TS Fluoropolymer (FTSH/TF) outer sheat

| FTSH |
|---------------------------------|
| Nickel-Copper or Nickel-Chrome |
| 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 |
| 20, 30, 40 or 50 W/m |
| from - 70°C to + 200°C |
| IP54 with our kits |
| 6 x the thickness of cable |
| |

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

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TEMPERATURE MAINTENANCE SYSTEMS

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FTS0 - FTS0/T - FTS0/TS Silicon elastomer insulated constant power cables for refrigeration

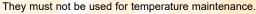


Characteristics

- · 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).
- FTS0 : silicon elastomer insulated constant power cables.
- FTS0/T : with tinned copper braid.
 - for mechanical protection and earthing.
- FTS0/TS: with tinned copper braid and
 - silicon elastomer insulated outer sheat.
- · Special production on request.

Applications

FTS0 cables are designed for use in industrial refrigeration. Their great flexibility means that they can be incorporated into cold room doors.



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



Standards

CEI 62395-1 CEI 62395-2

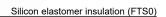


Tinned copper conductor 0.75 mm²

Silicon elastomer insulation

Contact Point

Heating wire



Tinned copper braid (FTS0/T)

Silicon elastomer insulated

outer sheat (FTS0/TS)

Power
Permissible surface temperature
Max. circuit length
Distance between 2 consecutive contact points
Ingress protection code
Min. bending radius

| FTS0 25 | FTS0 40 | FTS0 50 | | | | | | |
|--------------------------------|------------------------|---------|--|--|--|--|--|--|
| Nickel-Copper or Nickel-Chrome | | | | | | | | |
| | FTS0 : 5 x 7 mm | | | | | | | |
| F | TS0/T : 5.5 x 7.5 mn | n | | | | | | |
| F | TS0/TS: 7.5 x 9.5 m | m | | | | | | |
| 25 W/m | 40 W/m | 50 W/m | | | | | | |
| fı | rom - 70°C to + 200°0 | | | | | | | |
| 65 m | 50 m | 44 m | | | | | | |
| | 0.5 m | | | | | | | |
| | IP54 with our kits | | | | | | | |
| 6: | x the thickness of cal | ole | | | | | | |

HeΔ

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

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TEMPERATURE MAINTENANCE SYSTEMS

www.flexelec.com

FTSL/TF - FTSL/TS

Constant power cable with self-limiting effect

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 55, 75, 95 or 115 W/m at +20°C.
- Power supply 230 V and 400 V as standard.
- FTSL/TS : with tinned copper braid and silicon elastomer outer sheat.
- FTSL/TF : with tinned copper braid and
 - fluoropolymer anti-corrosion outer sheat.
- · Special production on request.

Applications

FTSL cables are particularly suitable for maintaining temperatures of up to + 135°C.

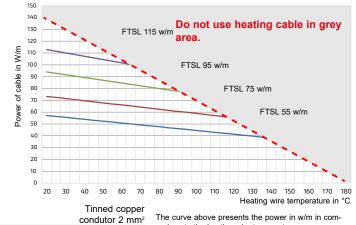
Its great flexiblity up to - 70°C means that this version is ideal for heat tracing.

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



Standards

CEI 62395-1 CEI 62395-2



Silicon elastomer insulated

Welded contact point

parison to the heating wire temperature.

The heating cable must be covered 100% with an adhesive aluminium and installed on a metalic support. Consult our technical department for any informations.

Heating wire with autolimited effect

Silicon elastomer insulated

Metal braid

55 W/m 2.0 m 2.75 m 135°C 54 m 75 W/m 1.6 m 2.75 m 115°C 46 m 95 W/m 1.4 m 2.0 m 90°C 41 m 115 W/m 60°C 1.0 m 1.5 m 37 m

Silicon elastomer (FTSL/TS Fluoropolymer (FTSL/TF) Outer sheat

| п | ı | _ | | |
|---|---|---|-----|--|
| | | S | ∢ ^ | |

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

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Heating wire

Dimensions

temperature Ingress protection code

Permissible surface

Min. bending radius

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Nickel FTSL/TF: 8.4 x 11.9 mm

FTSL/TS: 8.6 x 12.2 mm

from - 70°C to + 200°C

IP54 with our kits

6 x the thickness of cable



TEMPERATURE MAINTENANCE SYSTEMS

www.flexelec.com

FTSM - FTSM/T Silicon elastomer insulated constant power cable "micro"size for refrigeration

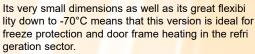


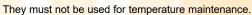
Characteristics

- · Very small diameter.
- · Round shape.
- · High flexibility
- · Can be cut to length on site..
- · Extremely simple termination.
- · Cold tail incorporated: no extra connection necessary.
- Available as 10, 20, 30 et 40 W/m (others on request).
- Power supply: 230 V as standard (others on request).
- FTSM : silicon elastomer insulated constant power cable
- FTSM/T : with tinned copper braid
 - for mechanical protection and earthing.

Applications

FTSM cables are particularly suitable for applications in the refrigeration industry.



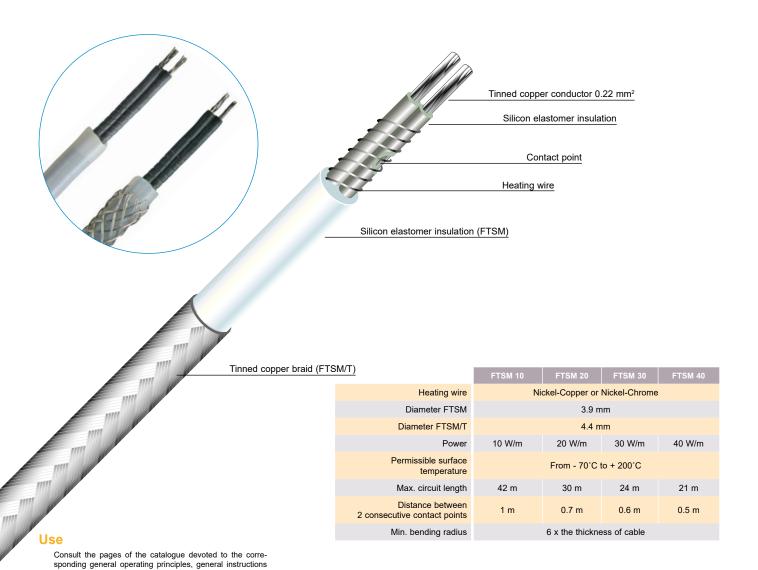


To ensure that these heating elements enjoy a long service life, we recommend using a control device.



Standards

CEI 62395-1 CFI 62395-2



FLEXELEC S.A.S

for use and accessories.

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TEMPERATURE MAINTENANCE SYSTEMS

www.flexelec.com

FTS3/IS - FTS3/IF **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 or 400 V (option 750 V)
- FTS3/IS : Stainless steel braid and silicon elastomer outer sheath.
- FTS3/IF : Stainless steel braid and fluoropolymer outer sheath.
- · Special production on request.

Applications

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

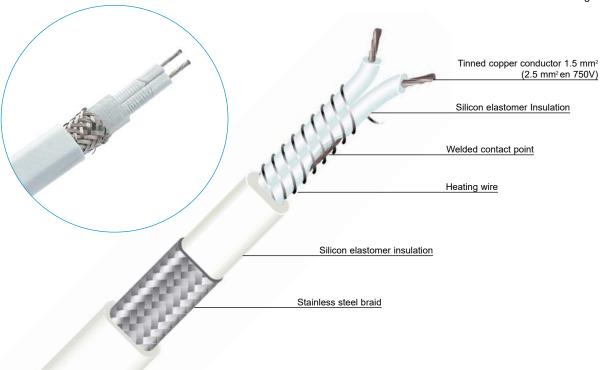
To ensure that these heating elements enjoy a long service life, we recommend using a control device.

Standards

CEI 62395-1 NF EN 60077-1 CEI 62395-2 NF EN 60077-2

Fitting:

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



Silicon elastomer (FTS3/IS) Fluoropolymer (FTS3/IF) outer sheath

Heating wire Dimensions Power

Permissible surface temperature Max. circuit length

Distance between 2 consecutive contact points

Ingress protection code Min. bending radius

Nickel-Copper or Nickel-Chrome FTS3/IS: 9 x 16 mm - FTS3/IF: 7.6 x 13.6 mm 100 W/m (up to 150W/m in 750v)

from - 70°C to + 200°C

40 m

0.35 m in 230 or 750v 0.50 m in 400v

IP54 with our kits

6 x the thickness of cable

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

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TEMPERATURE MAINTENANCE SYSTEMS

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FTTH - FTTH/T - FTTH/I - FTTH/TF - FTTH/IS Fluoropolymer insulated constant power cables

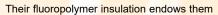


Characteristics

- · 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, 40 or 50 W/m.
- Power supply 230 V as standard (400 V on request).
- : 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.
- FTTH/IS : with stainless steel braid and silicon elastomer outer sheath.
- · Special production on request.

Applications

The FTTH range is particularly suitable for maintaining temperatures up to + 150°C.



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.



Standards

CEI 62395-1 CEI 62395-2

| 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 |
| 50 W/m | 0.6 m | 90 m | 90°C |

Tinned copper condutor 2 mm²

Silicon elastomer insulation

Welded contact point

Heating wire

Fluoropolymer insulation (FTTH)

Metal braid (FTTH/T - FTTH/I)

| Silicon elastomer (FTTH/IS) |
|-----------------------------|
| Fluoropolymer (FTTH/TF) |
| outer sheath |

| | FITH |
|---------------------------------|--------------------------------|
| Heating wire | Nickel-Copper or Nickel-Chrome |
| | FTTH: 5 x 8 mm |
| D: . | FTTH/T - FTTH/I : 5.5 x 8.5 mm |
| Dimensions | FTTH/TF: 6 x 9 mm |
| | FTTH/IS: 7 x 10 mm |
| Power | 20, 30, 40 or 50 W/m |
| Permissible surface temperature | from - 70°C to + 200°C |
| Ingress protection code | IP54 with our kits |
| Min. bending radius | 6 x the thickness of cable |

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

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TEMPERATURE MAINTENANCE SYSTEMS

www.flexelec.com

FTX1

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.
- · Cable halogene free.
- · Special production on request.

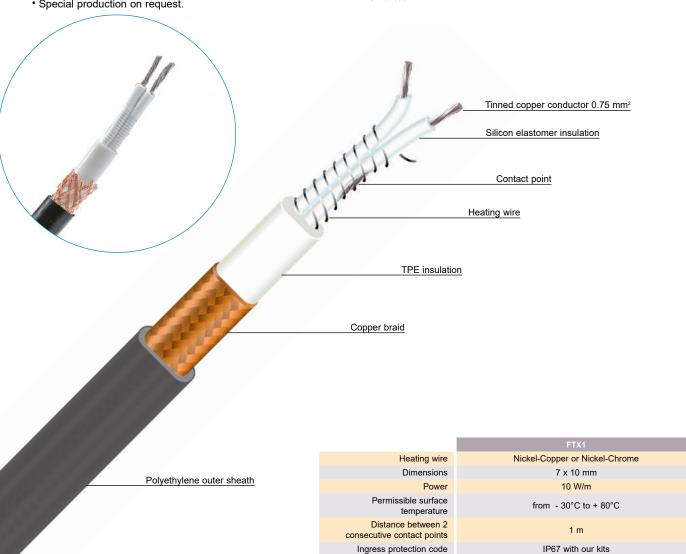
Applications

The FTX1 cable is specially designed for protecting pipes carrying water against freezing. Its completely sealed, polyethylene outer sheath means that it can be placed

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

Standards

CEI 62395-1 CEI 62395-2



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

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Min. bending radius

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6 x the thickness of cable



TEMPERATURE MAINTENANCE SYSTEMS

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C1FS/I - C2FS/I - C3FS/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.
- · Special production on request.

Applications

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



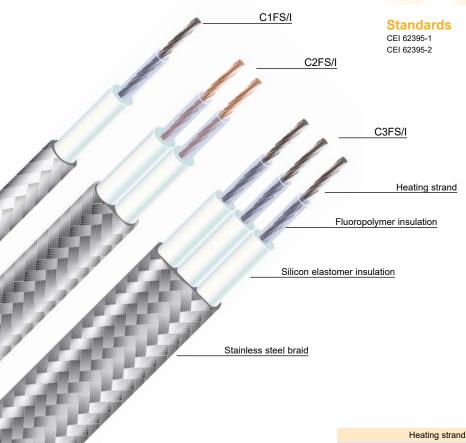
C2FS/I cables are specially designed for heating metal metro tracks and rails of the VAL type. They can be slid inside a U-shaped composite profile clamped against the rail with stainless steel clips.



C3FS/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.

NF EN 60077-1 NF EN 60077-2





Dimensions

Max. power

Max. voltage

Permissible surface
temperature

Tolerance
Ingress protection code

Min. bending radius

Use

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

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TEMPERATURE MAINTENANCE SYSTEMS

www.flexelec.com

C4FS/IS Long cables and tapes

CE

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.
- · Special production on request.

Applications

C4FS/IS cables are used when it is required to trace very long stretches, where electrical supply is available only at one end, for example in case of pits,tunnels, heating tracks, pipes,...

Through their building, these heating cables allow a power modulation from single to double thanks to an adequat electrical coupling.

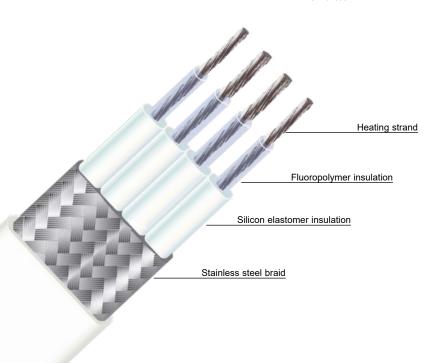


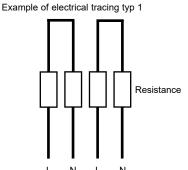
To ensure that these heating elements enjoy a long service life, we recommend using a control device.

Standards

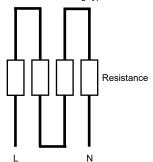
CEI 62395-1 CEI 62395-2

NF EN 60077-1 NF EN 60077-2





Example of electrical tracing typ 2



Silicon elastomer insulation

Heating strand Dimensions Max. power Max. voltage Permissible surface temperature

Tolerance Ingress protection code Min. bending radius

Nickel-Copper or Nickel-Chrome 6 x 16.8 mm 120 W/m 1000 V according to IEC 62395-1

From - 70°C to + 200°C

Resistance ± 10 % IP54 with our kits 6 x the thickness of cable

Use

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

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TEMPERATURE MAINTENANCE SYSTEMS

www.flexelec.com

SR - SRHT Long cables and tapes

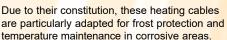
CE

Characteristics

- · Designed according to customer requirements.
- · For very long circuits.
- · Highly corrosion-resistant.
- · Very good resistance to mechanical stress.
- · Connection with specific accessories.
- Nickel-copper braid, for mechanical protection and earthing.
- Fluoropolymer insulation.
- · Special production on request.

Applications

SR and SRHT cables are used when it is required to trace very long stretches, where power supply is available only at one end for example in pits, tunnels, heating tracks, pipes,...



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





Standards

CEI 62395-1 NF EN 60077-1 CEI 62395-2 NF EN 60077-2 CAN/CSA-C22.2 n°130-03 NF EN 60079-30-1 C22.2 N° 210 (cUL) NF EN IEC 60079-0 NF EN 60079-7

Resistance characteristics

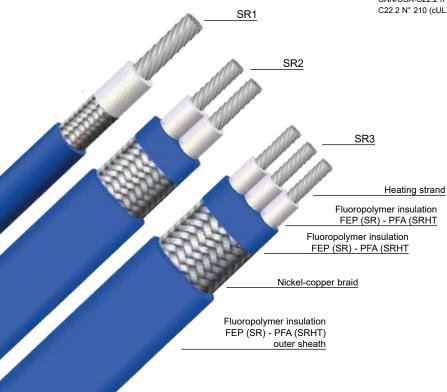
The table below gives the resistance values in Ohm / m at the nominal voltage and for an ambient temperature of 20 ° C.

These values indicate the linear resistance for each conductor. Power supply variations and temperature coefficients may affect the given values.

The connection and use of these products are aimed to electrical professionals.

Contact our technical service for more informa-

| Тур | Max. linear resistance per conductor at +20°C in Ohms/m |
|--|---|
| | 0,01939 |
| SR1 : 1 conductor | 0,01512 |
| | 0,00955 |
| SR2 : 2 conductors SR3 : 3 conductors | 0,00600 |
| | 0,00348 |
| | 0,00243 |



| Тур | per conductor at +20°C in Ohms/m |
|---|-------------------------------------|
| | 0,01939 |
| | 0,01512 |
| SR1 : 1 conductor SR2 : 2 conductors | 0,00955 |
| SR3 : 3 conductors | 0,00600 |
| | 0,00348 |
| | 0,00243 |

Nickel-Copper or Nickel-Chrome

SR1: Diameter 5 to 8 mm SR2: 6x9 to 10x15 mm SR3: 6x12 to 10x19 mm 40 W/m of cable (UL version) Max. power others contact us Max. voltage 600 V 1200 V Permissible surface From - 60°C From - 60°C temperature to + 200°C to + 260°C Resistance + 10 % Tolerance Min. bending radius 6 x the diameter or the thickness Ingress protection code IP54 to IP67 with our kits

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

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Heating strand

FLEXELEC (UK) Ltd

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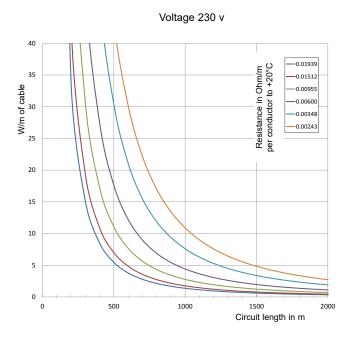
TEMPERATURE MAINTENANCE SYSTEMS

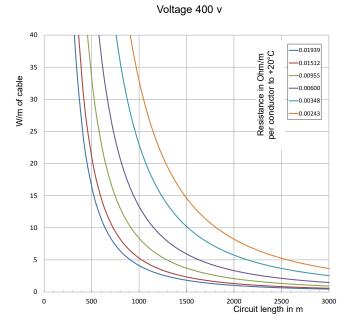
www.flexelec.com

SR - SRHT Long cables and tapes

Circuit lengths for 2 conductors serie coupling

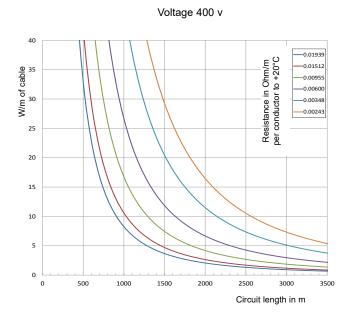
The graphs below indicate the nominal power at +20°C in function of the total length of cable installed at a rated voltage The lengths represent the totality of installed cables, in serie coupling under a single phase voltage, for SR1 and SR2 version.

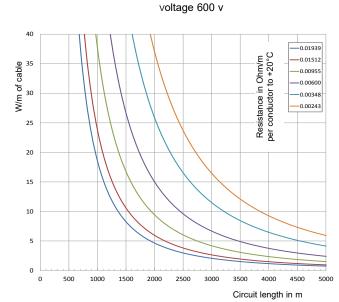




Circuit lengths for 3 conductors star coupling

The graphs below indicate the nominal power at +20°C in function of the total length of cable installed at a rated voltage The lengths represent the totality of installed cables, in star coupling at the end of the circuit with a 3-phase power-supply, for SR3 versions.





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TEMPERATURE MAINTENANCE SYSTEMS

www.flexelec.com

ZFE/CGE/ATEX - ZFA/CGA/ATEX ATEX fluoropolymer insulated constant power cables

ZFE/CGE/ATEX

Welde

Fluoropolymer insulation

Tinned copper braid

2 mm² conductor Silicon elastomer insulation

Heating wire

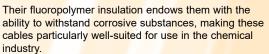
ZFA/CGA/ATEX

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 PFE fluoropolymer outer sheath.
- ZFA/CGA/ATEX: PFA fluoropolymer insulated constant power cables with tinned copper braid and PFA fluoropolymer outer sheath.
- · Special production on request.
- Ingress protection code: IP54 with our kits

Applications

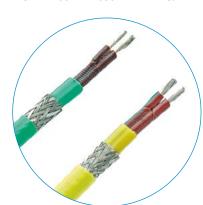
ZFE/CGE/ATEX and ZFA/CGA/ATEX cables are particularly suitable for maintaining temperatures of up to + 150°C.



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

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



| ed contact point | ZFE/C | GE/ATE | K | | | | | | | |
|---|-----------|--------|-----|-----|-------|-------|-----|-----|-----|-----|
| Power (W/m) | 10 | 10 | 20 | 20 | 30 | 30 | 40 | 40 | 50 | 50 |
| Voltage (V) | 230 | 400 | 230 | 400 | 230 | 400 | 230 | 400 | 230 | 400 |
| Dimensions of the | 5.0 x 7.3 | | | | | | | | | |
| insulating sheath (mm) | | | | | 4.6 > | ¢ 7.5 | | | | |
| Max. permissible temp (°C) | 170 | - | 145 | - | 115 | - | 75 | - | - | - |
| when energised | - | - | - | - | - | - | - | - | - | - |
| Max. permissible temp (°C) | 205 | | | | | | | | | |
| when not energised | 260 | | | | | | | | | |
| Distance between 2 | 1.2 | - | 1 | - | 1 | - | 1 | - | - | - |
| consecutive contact points (m) | 1.2 | 2 | 1 | 1.5 | 1 | 1.2 | 1 | 1 | 1 | 1 |
| Max. circuit | 130 | - | 90 | - | 70 | - | 60 | - | - | - |
| length (m) | 190 | 220 | 120 | 170 | 100 | 160 | 90 | 150 | 75 | 135 |
| Max. maintenance temperature for a given temperature class (°C) | | | | | | | | | | |
| | Т | 6 | Т | 5 | Т | 4 | Т | 3 | Т | 2 |
| 10 W | 45 | 45 | 60 | 60 | 95 | 95 | 160 | 160 | 160 | 215 |

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

Fluoropolymer Insulation

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190

170

145

135

115

90

135

115

90

135

115

90

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OMERIN GmbH

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TEMPERATURE MAINTENANCE SYSTEMS

www.flexelec.com

C2SSTS Long line heating cable



Characteristics

- · Designed according to customer requirements.
- · For very long circuits.
- · Possible connection via tubular connectors and heat-shrink sheath.
- · Tinned copper braid for earthing.
- · Silicon elastomer insulation.
- · Ohmic value on request.

Applications

C2SSTS cables are used when it is required to trace very long stretches, where electrical supply is available only at one end, for example in case of pits,tunnels, heating tracks, pipes,...



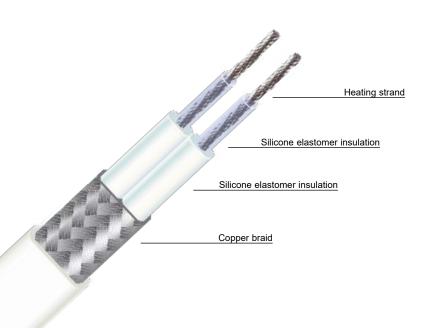
To ensure that these heating elements enjoy a long service life, we recommend using a control device.



Standards

CEI 62395-1 CEI 62395-2 NF EN 60077-1

NF EN 60077-2



Heating strand Dimensions Max. power Max. voltage Permissible surface temperature Tolerance Ingress protection code Min. bending radius

Nickel-Copper or Nickel-Chrome 7 x 11 mm ± 1 mm 15 W/m 1000 V according to IEC 62395-1

From - 70°C to + 200°C

Resistance ± 10 % IP54 with our kits 6 x the thickness of cable

Use

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

Silicon elastomer insulation

FLEXELEC S.A.S

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câbles et éléments chauffants souples systèmes de maintien en température



FLEXFLOOR®

UNDERFLOOR HEATING CABLES

| KY - KYCY | CABLES FOR UNDERFLOOR HEATING | 68 |
|-----------|-------------------------------------|----|
| KYCYR | SERIE CABLES FOR UNDERFLOOR HEATING | 69 |
| KYX | SERIE CABLES FOR ROAD HEATING | 70 |

FLEXFLOOR®



TEMPERATURE MAINTENANCE SYSTEMS

www.flexelec.com

KY - KYCY Underfloor heating cables

Characteristics

- · Hard-wearing and flexible.
- · Mechanical protection and earthing.
- KYCY sold by the meter or as a flex with 5 m of power cable at each end.
- · KY : series cables, silicon elastomer insulated and PVC
- KYCY : series cables with an identical base to that of KY cables, with copper braided shielding and an extra PVC outer sheath.
- Special production on request.
- Ingress protection code: IP54 terminated cable by ourself, KY cable IK07, KYCY cable IK08.

Applications

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

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



Standards

CEI 62395-1 NF P 52-302-1 + annex A1 CEI 62395-2 NF P 52-302-2 (DTU 65.7)

Minimum useable lengths (m)

| | K | Υ | KY | CY |
|---------------------|-------|-------|-------|-------|
| Resistance (Ω/m) | 230 V | 400 V | 230 V | 400 V |
| 0.03 | 297 | 516 | 265 | 462 |
| 0.058 | 214 | 372 | 191 | 333 |
| 0.078 | 185 | 321 | 165 | 287 |
| 0.11 | 151 | 270 | 139 | 241 |
| 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 |

ΚY Heating wire coiled on a fibre glass core or heavy-duty strand **KYCY** Heating wire coiled on a fibre glass core or heavy-duty strand Silicon elastomer insulation PVC insulation 105°C Copper braided shielding PVC outer sheath 105°C

Heavy-duty strand or coiled heating wire Heating element Nickel-Copper or Nickel-Chrome Diameter 6 to 7 mm 4 to 5 mm Max. power Permissible surface up to + 80°C temperature Min. bending radius 6 x the diameter Resistance : - 5% / + 10%

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

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FLEXFLOOR®



TEMPERATURE MAINTENANCE SYSTEMS

www.flexelec.com

KYCYR

Series cables for underfloor heating

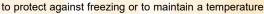


Characteristics

- · Hard-wearing and flexible.
- · For 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.
- · Special production on request.
- Ingress protection code: IP65 terminated cable by ourself, -IK08.

Applications

KYCYR heating cables are particularly hard-wearing and are used for applications set in concrete slabs



The cables must be set in accordance with the local regulations in force: in France these include DTU65-7 published by AFNOR.

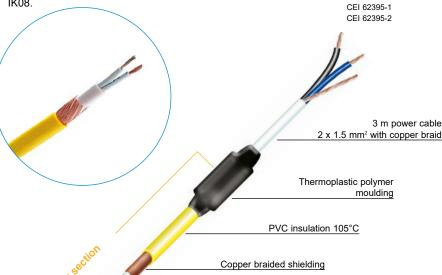
To ensure that these heating elements enjoy a long service life, we recommend using a control device





Standards

NF P 52-302-1 + annex A1 NF P 52-302-2 (DTU 65.7)



Silicon elastomer insulation

0.75 mm² conductor Heavy-duty strand or coiled heating wire

PVC insulation 105°C

Thermoplastic polymer moulding

Standard 230 V models

| 20 W/m | | | | | | |
|--------|-------|------------|--|--|--|--|
| Length | Power | Resistance | | | | |
| (m) | (W) | (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 | Power | Resistance | | | | | |
| (m) | (W) | (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 | | | | | |
| | | | | | | | |

Heating element

Diameter

Max. power Permissible surface temperature

Min. bending radius

Tolerance

Heavy-duty strand or coiled heating wire (Nickel-Copper or Nickel-Chrome)

7 to 8 mm

27 W/m

up to + 80°C

6 x the diameter Resistance : - 5% / + 10% Length ± 1 %

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

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FLEXFLOOR®



TEMPERATURE MAINTENANCE SYSTEMS

www.flexelec.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 $\,\Omega$ /m.
- Silicon elastomer insulation, with copper braided shielding and an outer XLPE cross linked polyethylene sheath.
- Special production on request.
- Ingress protection code: IP67 terminated cable by ourself -IK09.

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

Standards

CEI 62395-1 CEI 62395-2 NF P 52-302-1 + annex A1 NF P 52-302-2 (DTU 65.7)



Heating strand

Silicon elastomer

Copper braid

XLPE cross linked polyethylene

Diameter Max. power

Max. power

Permissible

continuous temperature

Permissible peak temperature (10 min) Min. bending radius

Tolerance

KYX

Nickel-Copper or Nickel-Chrome

7 mm 30 W/m

up to + 90°C

up to + 250°C

6 x the diameter

Resistance - 5% + 10%

Use

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

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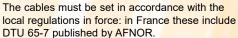
KYR Underfloor heating cables

Characteristics

- · Hard-wearing and flexible.
- · Mechanical protection and earthing.
- KYR : series cable with PVC insulation, Twisted coper wire, and PVC jacketing.

Applications

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



KYR 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



Standards

CEI 62395-1 NF P 52-302-1 + annex A1 CEI 62395-2 NF P 52-302-2 (DTU 65.7)

Heating strand Insulation Copper wire PVC insulation +105°C

Minimum useable lengths (m)

| Oh | mic value | 230 V | 400 V | |
|-------------------------|--------------------------------------|-------|----------------------|--|
| Per resistive conductor | Per meter the 2 conductors in series | | n) minimum length | |
| 0.015 | 0.03 | 297 | 516 | |
| 0.029 | 0.058 | 214 | 371 | |
| 0.039 | 0.078 | 184 | 320 | |
| 0.055 | 0.11 | 155 | 270 | |
| 0.07 | 0.14 | 137 | 239 | |
| 0.085 | 0.17 | 125 | 217 | |
| 0.12 | 0.24 | 105 | 183 | |
| 0.17 | 0.34 | 88 | 153 | |
| 0.235 | 0.47 | 75 | 130 | |
| 0.325 | 0.65 | 64 | 111 | |
| 0.5 | 1 | 51 | 89 | |
| 0.735 | 1.47 | 42 | 74 | |
| 0.98 | 1.96 | 37 | 64 | |
| 1.45 | 2.9 | 30 | 53 | |
| 2 | 4 | 26 | 45 | |
| 4 | 8 | 18 | 32 | |

Heating strand **Dimensions** Max. power Permissible surface temperature Tolerance Min. bending radius Resistive alloy of Copper - Nickel - Chrome 8.5 mm x 5.5 mm 20 W/m Up to + 80°C Resistance: -5% / +10% 6 x the thickness

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



FLEXBELT®

HEATING BELTS

| TOTIK | WITH INTEGRATED THERMOSTAT | 72 |
|-------|---|----|
| FCHK | HEATING BELTS FOR REFRIGERATION COMPRESSORS | |
| FCH | HEATING BELTS FOR REFRIGERATION COMPRESSORS | 72 |

FLEXBELT®

TEMPERATURE MAINTENANCE SYSTEMS

www.flexelec.com

FCH Heating belts for refrigeration compressors

FL (6

Characteristics

- · Quick, safe and easy to fit.
- · Sealed silicon insulated heating element.
- · Metal braid for earthing.
- · Voltage 230 V as standard.
- 91 belts on request.
- · Special production on request.
- Ingress protection code : IP54

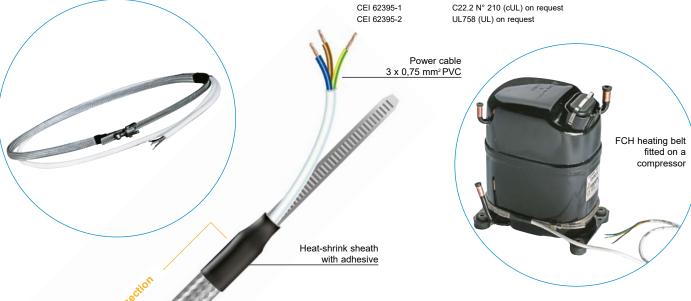
Applications

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

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

Standards



Metal braid

Stainless steel cable clamp

Heating wire Heating element insulation Length of Insulation resistance

Tolerance

Nickel-Copper or Nickel-Chrome Silicon elastomer

1 m

100 MΩ min., 2500 V 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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FLEXBELT®



TEMPERATURE MAINTENANCE SYSTEMS

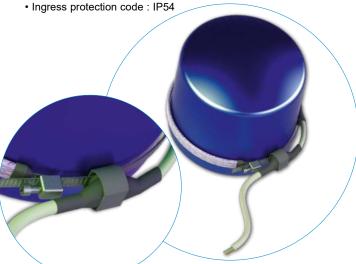
www.flexelec.com

FCHK Heating belts for refrigeration compressors with integrated thermostat



Characteristics

- · Quick, safe and easy to fit.
- · Sealed silicon insulated heating element.
- · Metal braid for earthing.
- Voltage 230 V as standard.
- · Integrated thermostat.
- · Patented product.
- · Special production on request.





Applications

FCHK 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

The integrated thermostat on the crankcase heater makes it completely autonomous.

Standards

CEI 62395-1 CEI 62395-2



FCHK heating belt fitted on a compressor

Heating wire Heating element insulation Length of power cable Insulation resistance Tolerance

Nickel-Copper or Nickel-Chrome Silicon elastomer 1 m 100 MΩ min., 2500 V Power ± 10% Temperature on request

Standard models

| | FCHK-10 | FCHK-20 | FCHK-30 | FCHK-40 | FCHK-50 | FCHK-60 |
|----------------------|---------|---------|---------|---------|---------|---------|
| Power (W) | 35 | 40 | 45 | 55 | 65 | 75 |
| Min. clamping Ø (mm) | 145 | 165 | 175 | 205 | 245 | 270 |
| 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





HEATING MATS

| A | ALUMINIUM HEATER MATS | 75 |
|------------------|-------------------------------|---------|
| T - TA - TV - TP | SILICON ELASTOMER HEATER MATS | 76 - 77 |

FLEXMAT®





www.flexelec.com

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.
- · Special production on request.
- Ingress protection code: IP54

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.





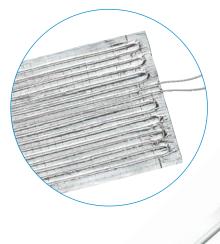
Standards

CEI 62395-1 C22.2 N° 210 (cUL) on request CEI 62395-2 UL758 (UL) on request

Notes:

Options

- CLASS II insulation
- · Temperatur limit device.
- · Cut-outs.
- · Aluminium foil can be earthed.



Power cable

Aluminium foil

Aluminium foil

Heating wire

PVC 105°C or silicon

elastomer insulation

Adhesive backing

Fiber glass core

Nickel-Copper or Nickel-Chrome

 1.5 m^2

3 m 1 m

~ 3 mm (thicker at connection point)

0.25 W/cm²

from - 60°C to + 110°C

+ 80°C

Power ± 10%

Use

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

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FLEXELEC (UK) Ltd

Heating wire

Max.surface

Max.length

Max. width

Thickness

Max. power

température Max. maintenance

temperature Tolerance

Permissible surface

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FLEXMAT®



TEMPERATURE MAINTENANCE SYSTEMS

www.flexelec.com

T - TA - TV - TP Silicon elastomer heater mats

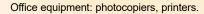


Characteristics

- · 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.
- TP : factory preformed version.
- · Special production on request.
- EN 45545 certification on request.
- Ingress protection code: IP53 (others on request).

Applications

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



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.



CEI 62395-1 CEI 62395-2

NF EN 45545-2 on request NF EN 60077-1 on request NF EN 60077-2 on request



Heating wire

Fiber glass core

Adhesive backing (optional)

Constitution

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

This heating element is then placed between two layers of woven fiber 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 fiber glass weave endows the assembly with good mechanical resistance, while allowing it to remain very flexible.

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

MUUUM

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FLEXMAT®



TEMPERATURE MAINTENANCE SYSTEMS

www.flexelec.com

T-TA-TV-TP 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 - TP |
|---------------------------------|--------------------------------------|
| 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. temperature maintenance | + 160°C |
| Tolerance | Power ± 10% |

Surface temperature according to power

| Power W/cm² | Surface temperature (°C) |
|----------------|-----------------------------|
| 0.05 | 50 |
| 0.10 | 70 |
| 0.15 | 90 |
| 0.20 | 110 |
| 0.25 | 130 |
| 0.30 | 145 |
| 0.35 | 160 |
| 0.40 | 175 |
| 0.45 | 190 |
| 0.50 | 205 |
| 0.55 | 215 |
| 0.60 | 230 |
| 0.70 | 250 |
| 0.80 | 265 |
| 0.90 | 280 |
| 1.00 | 290 |
| | |

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.

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





HEATING PLATES

PLA HEATING PLATES 79

FLEXPLATE®



TEMPERATURE MAINTENANCE SYSTEMS

www.flexelec.com

PLA **Heating plates**

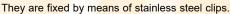


Characteristics

- Easy to fit.
- · Stands up well to the climatic, physical and chemical conditions encountered in the railway environment.
- · Special production on request.

Applications

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



Several plates can be connected in series (15 maximum). Connections between plates are made by meansof tubular connectors and heat-shrink sheaths.

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

Standards

CEI 62395-1 NF EN 60077-1 CEI 62395-2 NF EN 60077-2

1 mm² conductor

Fluoropolymer insulation

Silicon elastomer insulation

1.5 mm stainless steel sheet

Moulded silicon elastomer

10 mm expansed silicon insulation

| Heating wire |
|---------------------------------|
| Length |
| Width |
| Thickness |
| Power |
| Permissible surface temperature |
| Insulation |
| Protection CLASS |
| Dielectric strength |
| Insulation resistance |
| Weight |

| PLA/100 | PLA/120 | PLA/200 | | | | |
|--------------------------------|---------|---------|--|--|--|--|
| Nickel-Copper or Nickel-Chrome | | | | | | |
| 500 | mm | 450 mm | | | | |
| 60 mm | 75 mm | 110 mm | | | | |
| | 20 mm | | | | | |
| 100 W | 120 W | 200 W | | | | |
| de - 60°C to + 200°C | | | | | | |
| CLASS II | | | | | | |
| IP 66 | | | | | | |
| 2500 V min. | | | | | | |
| 100 MΩ min. | | | | | | |

Approx. 1 kg

Use

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





DRUM HEATERS

FLEXDRUM®



TEMPERATURE MAINTENANCE SYSTEMS

www.flexelec.com

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.
- : with adjustable thermostat graduated from 0 to 11 (approx + 20°C to + 150°C).
- Ingress protection code: TCF IP55, TCF/TV IP54.



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

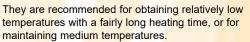


Use

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

Applications

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



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

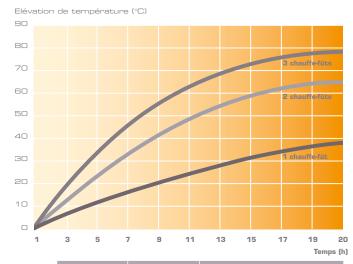
To reach the required temperature more quickly, drums can be heated or maintained at temperature with 1, 2 or 3 drum-heaters.

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

Standards

CEI 62395-1 CEI 62395-2

Temperature increase with time



| Heating element |
|---------------------------------|
| Heating wire insulationt |
| Second insulation |
| Length of heating section |
| Width |
| Drum diameter (± 10 mm) |
| Standard capacity (as a guide) |
| Power |
| Voltage |
| Permissible surface temperature |
| Length of power cable |
| |

| TCF/300 TCF/TV/300 | TCF/500 TCF/TV/500 | TCF/750 TCF/TV/750 | TCF/1000 TCF/TV/1000 | | | |
|---|-----------------------|-----------------------|-------------------------|--|--|--|
| Nickel-Copper or Nickel-Chrome heating wire | | | | | | |
| | Silicon e | lastomer | | | | |
| Fiber g | lass mat impregna | ited with silicon ela | stomer | | | |
| 770 mm | 935 mm | 1280 mm | 1660 mm | | | |
| | 150 | mm | | | | |
| 296 mm | 350 mm | 460 mm | 580 mm | | | |
| 30 L | 60 L | 120 L | 200 L | | | |
| 300 W | 500 W | 750 W | 1000 W | | | |
| 230 V | | | | | | |
| up to + 200°C | | | | | | |
| 2 m | | | | | | |
| | | | | | | |

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Flexible heating cables and elements temperature maintenance systems





FLEXKIT®

ACCESSORIES

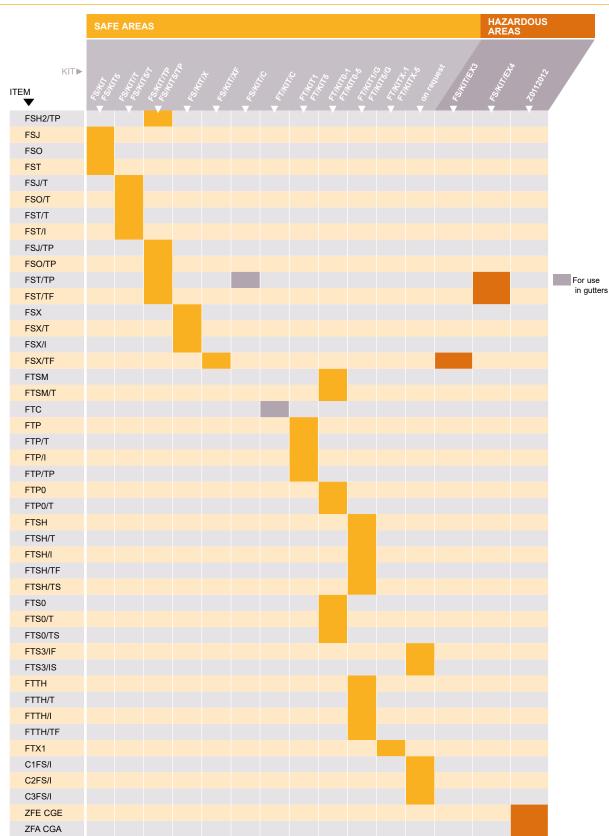
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Connection kits



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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.



FX/JBG

Junction box 98 x 98 x 61mm – IP 55 (IP65 if equipped with the FLEXKIT FS/KIT/...) - 7 entries 5 mm. For the connection or derivation of heating cables: FSTTP, FSX, FSXT, FSXI, FSXTF.



FX/BOITIER/2

Junction box IP 65 (195 x 195 x 110 mm) for FX/CDM2, FX/CDM3 hygrothermostat, FX/DC1P power modulator, FX/TM3 thermostat.



FX/PBY

Pipe bracket with bending strip and screws for FLEXKIT FX/JB junction box or FLEXKIT FX/AT2 thermostat.



FX/PBA

Pipe bracket for FLEXKIT FX/AT, FX/BOITIER/2, FX/JB,FX/JBG, FX/JBE2, FX/ST.



SILT 25

Tube of silicon sealant 25 g



SILT 100

Tube of silicon sealant 100 g



Caps P

Silicon end-piece for FTP/FTTH



Caps G

Silicon end-piece for FTSH



Aluminium adhesive tape. 50 mm wide, 50 m long



FX/G

Cable gland 20 mm



FX/GX

Cable gland for FTX1 cable



FX/ETIQ

Self-adhesive "ELECTRICAL HEAT TRACING" label



FX/JBE2

ATEX EEx "e" IIC - T6 junction box with 4 M20 outputs and 2 caps



FX/CRT

Hook to hold cable in place for drain



KYCY/FIXATION

Box of 25 m metal fixing strip



FIXATION/INOX

Box of 25 m stainless steel fixing

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flexelec

TEMPERATURE MAINTENANCE SYSTEMS

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FX/AT2 - FX/AT - FX/ST Thermostats







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/AT2 ambient thermostat

To protect vessels and piping from freezing, this thermostat is preset at + 3°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).

Standards

CEI 62395-2



| | ambient thermostat | ambient thermostat |
|----------------------|---------------------------|--------------------|
| Temperature range | preset to + 3°C | - 5°C to + 40°C |
| Current rating | 5 A | 16 A |
| Box protection level | IP 65 | IP 65 |
| Box dimensions | 80 x 80 x 45 mm | 125 x 125 x 75 mm |
| Accuracy | ± 3°C | ± 2.5°C |
| Differential | 5°C | 2.5°C |
| Connection | 2 inputs with cable gland | |
| Voltage | 220 V / 240 V | |
| | | |

| | FX/S1 - 40 | FX/ST - 120 | FX/S1 - 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 and 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 | | |
| Voltage | 220 V / 240 V | | |
| | | | |

Use

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

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TEMPERATURE MAINTENANCE SYSTEMS



www.flexelec.com

FX/TM3

CE

Electronic thermostats with double digital display

Characteristics

- Current rating 8 A (resistive) by changeover contact.
- Power supply from 100 to 240 V 50/60 Hz.
- Accuracy +/- 1% of temperature range.
- Dimensions 70 x 87 x 61 mm, 4 DIN modules.
- Double temperature display (value and setup) at +/- 1°C.
- Adjustable differential from 1 to 30°C.
- Thermostat is fitted to a DIN rail (omega 3)
- The sensor can be extended and positioned 50m away from the thermostat (cable not included)
- Alarm up and down via free contact, current rating 8 A (resistive)
- Exposure temperature -5 to +55°C.
- Screw terminals for conductors up to 2,5mm².

Thermostat FX/TM3/140

- Temperature range: from 5°C to + 140°C.
- PTC sensor.
- Sensor length: 3 m (can be extended up to 50m with 2x1.5mm² cable).

Thermostat FX/TM3/200

- Temperature range: from 5°C to + 200°C.
- PT100 sensor.
- Sensor length: 3 m(can be extended up to 50m with 3x1.5mm²



Applications

The range of FX/TM3 electronic thermostats allow precise control of temperatures.

To maintain a desired temperature of the pipes, tank or other container and their contents, 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.

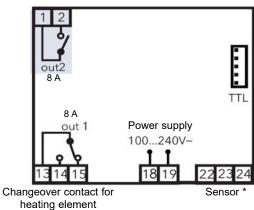
The FX/TM3 thermostat is fitted to a DIN rail (omega3) in an electrical cabinet or waterproof electrical junction box.

Standards

CEI 62395-2

Electrical connection diagram

Alarm







Use

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

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TEMPERATURE MAINTENANCE SYSTEMS

www.flexelec.com

FX/CDM2 Hygrothermostat



Characteristics

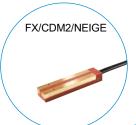
Electronic regulator FX/CDM2:

- Power supply 230 V +/- 10%, 50/60 Hz.
- Current rating 16 A.
- · Fit on DIN rail.
- Dimensions: 86 x 52 x 59 mm (3 modules).
- Ingress protection code IP20.
- Temperature range preset from 0 to +10°C.
- Heating time preset from 1 to 5 hours.
- Ambient temperature : -10 to +50°C.

For others characteristics, refer to instructions given with the product.











Option FX/BOITIER/2

• Box IP 65 (195 x 195 x 110 mm) for hygrothermostat

Applications

The FX/CDM2 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.

This regulator is particularly adapted for small installations and ensure an energy saving.

Usefull for gutter ice protection:

FX/CDM2 + FX/CDM2/TEMP + FX/CDM2/NEIGE

Usefull for access ramps ice protection:

FX/CDM2 + FX/CDM2/TEMP + FX/CDM2/PARK

Standards

CEI 62395-2 N

NF P 52-302-1 + annex A1 NF P 52-302-2 (DTU 65.7)

External temperature sensor FX/CDM2/TEMP:

- Dimensions: box 86X45X35 mm, wall fixation.
- Power supply: By standard 2x1.5mm² conductor cable,(not supplied) from the electronic box to the sensor terminals (50 m maximum).

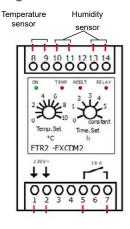
Humidity sensor FX/CDM2/NEIGE:

- Use in case of ice protection of roof or gutter
- Dimensions of the box: 105 x 30 x 13 mm.
- Ingress protection code IP68.
- Power supply by conductor cable (10m long, can be extended up to 50 m with 6x1.5mm² conductor).
- The sensor is automatically heated to transform snow into humidity.

Humidity sensor FX/CDM2/PARK:

- Use in case of ice protection of access ramps.
- Dimensions Diam. 60 mm high 32mm.
- Ingress protection code IP68.
- Power supply by conductor cable (10m long, can be extended up to 50 m with 6x1.5mm² conductor).
- The sensor is automatically heated to transform snow into humidity.

Connection diagram



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www.flexelec.com

FX/CDM3

Hygrothermostat



Characteristics

Electronic regulator with digital display FX/CDM3

TEMPERATURE MAINTENANCE SYSTEMS

- Power supply 230 V +/- 10%, 50/60 Hz.
- · Current rating 16 A.
- · Fit on DIN rail.
- Dimensions: 106 x 90 x 58 mm (6 modules).
- · Ingress protection code IP20.
- · LCD display 2 lines of 16 characters.
- 3 adjustment buttons: MENU / VALUE / ENTER.
- Temperature range preset from 0 to +6°C.
- After run time preset from 10 min to 24 hours.
- Temperature unit in °C or °F.
- · Operating time counter.
- Switching contact for alarm messages 230v 2A.
- Ambient temperature: -20 to +50°C.
- · Alarm messages on display.
- Program menu available in following languages: Deutsch, English, Français, Suomi, Svenska, Cesky, Dutch, Magyar, Italiano, Turkce and Polski.

For others characteristics, refer to instructions given with the product.



Option FX/BOITIER2

• Box IP 65 (195 x 195 x 110 mm) for hygrothermostat.

Applications

The **FX/CDM3** hygrothermostat is used to control permanently the presence of snow or black ice in gutters or access ramps, parking...

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.

This regulator is particularly adapted for installations which need a precise management of energy.

Equiped with a switching contact for alarm messages, it allows a permanent control of your installations.

Use for freeze protection of gutter:

FX/CDM3 + FX/CDM3/TEMP + FX/CDM3/NEIGE

Use for freeze protection of access ramps:

FX/CDM3 + FX/CDM3/TEMP + FX/CDM3/PARK

Standards

CEI 62395-2 NF P 52-302-1 + annex A1

NF P 52-302-2 (DTU 65.7)

External temperature sensor FX/CDM3/TEMP:

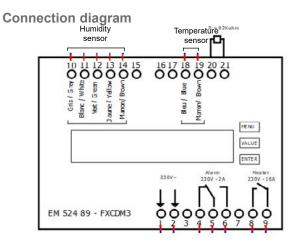
- · Dimensions: Dia. 9 mm, length 35 mm, wall fixation
- Power cable of 4m (can be extended up to 50 m with 2x1.5mm² cable).

Humidity sensor FX/CDM3/NEIGE:

- Use for freeze protection for roof and gutter.
- Dimensions: box 225 x 108 x 13 mm.
- Ingress protection code IP68.
- Length of conductor cable 4 m (can be extended up to 50 m with 5x1.5mm² cable).
- The sensor is automatically heated to transform snow into humidity.

Humidity sensor FX/CDM3/PARK:

- Use for freeze protection for of access ramps.
- Dimensions: Dia. 70 mm / high 40mm.
- Ingress protection code IP68.
- Power supply by 15m long cable (can be extended up to 50 m with 5x1.5mm² cable)
- The sensor is automatically heated to transform snow into humidity.



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FX/DC1P Power modulators



Characteristics

• Principle: Analogue chrono-proportional.

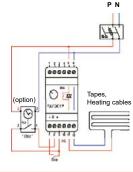
Setting: Percentage 0 to 100 %.Time base: 30 seconds fixed.

Power supply: 230 V ± 10 %.
Output: 230 V, 20 A maximum.
Dimensions: 87 x 55 x 55 mm.

· Fit on 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).

Option FX/BOITIER/2

The power modulator can be fitted in an IP 65 (195 x 195 x 110 mm).

External timer option FX/HOR

- Weekly programm
- 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.

| | Vertic | al risers Ami | bient tempera | ture : 15°C | Insulation 0.0 | 42 W/m.°C | | |
|------------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| Nominal diameter | 1/2" | | | | | | | |
| Ext. diameter (mm) | 21 | 27 | 34 | 42 | 48 | 60 | 76 | 89 |
| Thermal lagging th. mm | | | | Maintenance te | emperature 45°C | | | |
| 9 | 14.07 (70) | 17.05 (85) | | | | | | |
| 13 | 10.81 (55) | 12.91 (65) | 15.33 (80) | 18.07 (90) | | | | |
| 19 | 8.43 (45) | 9.91 (50) | 11.61 (60) | 13.52 (70) | 14.93 (75) | 17.75 (90) | | |
| 32 | 6.23 (30) | 7.17 (35) | 8.23 (40) | 9.41 (50) | 10.28 (50) | 12.00 (60) | 14.25 (70) | 16.07 (80) |
| | | | | Maintenance te | emperature 50°C | | | |
| 9 | 16.41 (90) | | | | | | | |
| 13 | 12.61 (70) | 15.06 (80) | | | | | | |
| 19 | 9.84 (55) | 11.56 (65) | 13.54 (75) | 15.77 (85) | | | | |
| 32 | 7.27 (40) | 8.36 (45) | 9.60 (50) | 10.97 (60) | 11.99 (65) | 14.00 (75) | 16.63 (90) | |
| | | | | Maintenance te | emperature 55°C | | | |
| 9 | | | | | | | | |
| 13 | 14.41 (85) | | | | | | | |
| 19 | 11.24 (65) | 13.22 (80) | 15.48 (90) | | | | | |
| 32 | 8.30 (50) | 9.56 (55) | 10.97 (65) | 12.54 (75) | 13.70 (80) | 15.99 (95) | | |
| | Base | ment Aera A | mbient tempe | erature: 5°C | Insulation 0.0 | 36 W/mK | | |
| Nominal diameter | 1/2" | | | | | | | |
| Ext. diameter (mm) | 21 | 27 | 34 | 42 | 48 | 60 | 76 | 89 |
| Thermal lagging th. mm | | | | Maintenance te | emperature 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 te | emperature 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) |

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FLEXELEC (UK) Ltd

TECHNICAL GUIDE

GENERAL INSTALLATION

AND INSTRUCTIONS FOR USE OF ALL FLEXELEC PRODUCTS



BASIC RULES

Persons involved in the installation and testing of electrical trace heating systems shall be suitably trained in all special techniques required. Installations are intended to be carried out under the supervision of a qualified person.

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 our repair work afterwards than to "waste" time reading these instructions to the end and installing your system in keeping with the recommendations given.

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 insuating 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 ifextra lengths need to be provided for valves, flanges, pumps, etc.

Heat loss calculations for flanges, valves, piping supports or otherelements may turn out to be complex because of difficulty in measuringthe exact heat transfer surfaces. Many accessories such as flanges andvalves are manufactured according to standards, while others, such asfilters or pumps differ from one manufacturer or application to another.

To determine heat losses, follow the recommendations below:

| Туре | Diameter | Equivalent cable length |
|---------|----------------------|-------------------------|
| Flanges | ≤ DN 200 > DN 200 | 0.3 m 1.0 m |
| Valves | ≤ DN 200 > DN 200 | 1.0 m 3.0 m |

Notes: The extra length of cable calculated in these 4 cases may not be used in full for practical reasons. All constant poPower 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 afterfitting 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 poPower 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.

In the case of an installation in an explosive atmosphere, please read carefully paragraph "INSTALLATION IN ATEX OR EXPLOSIVE ATMOSPHERE AREA".

* FITTING THERMOSTATS AND JUNCTION BOXES

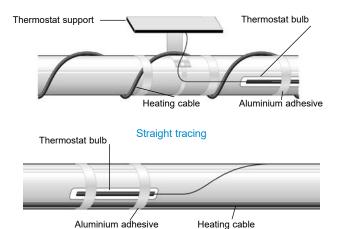
To protect against freezing, air thermostats are generally used. These must be fitted in the area most exposed to freezing and can be fixed to the piping or any other support. If they are fitted to piping the heating cable can be connected directly into the thermostat. Self-regulating heating cables 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:

Spiral tracing



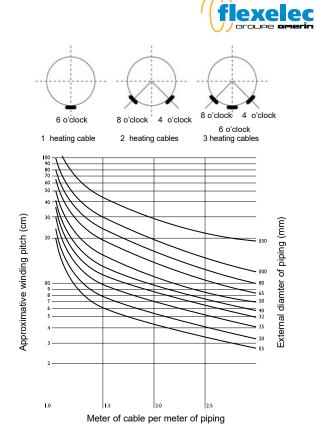
INSTRUCTIONS

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.

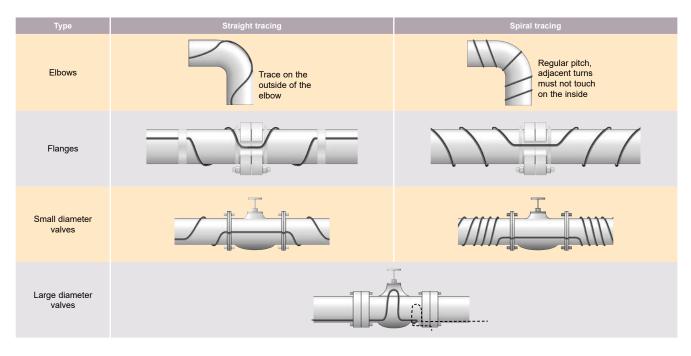
Straight tracing Heating cable Aluminium adhesive Spiral tracing Aluminium adhesive Pitch 1 meter maximum



*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).



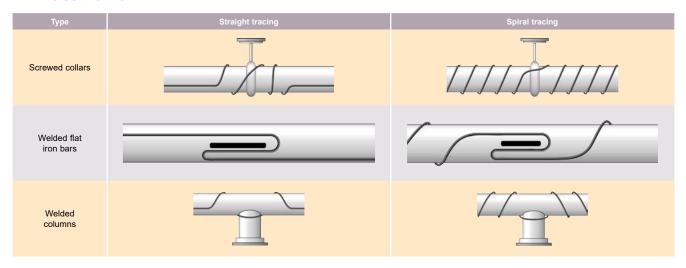
TECHNICAL GUIDE

GENERAL INSTALLATION

AND INSTRUCTIONS FOR USE OF ALL FLEXELEC PRODUCTS



PIPING SUPPORTS



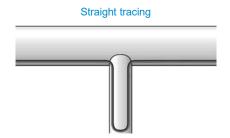
*TRACING A BRANCH JOINT

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.

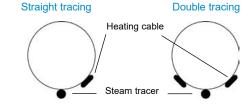




FITTING A HEATING CABLE TO PIPING WITH A STEAM TRACER

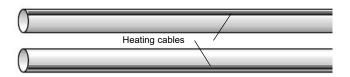
Check that the cable sheath will withstand the temperature of the steam. Never use spiral tracing, which would cause the cable to come into contact with the steam tracer.

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.
- If applicable, check that the metal sheath, braid, screen or equivalent electrically conductive covering of the trace heater is connected to an earth terminal.

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 poPower cables
- 1 Check the resistance and continuity of the circuits using a multimeter.
- Check the insulation resistance les 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.

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. (in case of Atex area the minimum value should be 20 megohms)

- 1 Between conductors and piping if the cable is not braided.
- 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.

Repair / Modification / Trouble shooting / Others issues

In case you do not find the appropriate information, please contact the technical service on www.flexelec.com.

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 bolids.
- 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 lic
- Visually inspect the installation in order to detect any damage to piping or insulation.

INSTALLATION IN ATEX OR EXPLOSIVE ATMOSPHERE AREA

In case of installation of ATEX products, the following conditions are imperative:.

- The personnel involved in the installation and controls must have the appropriate qualification.
- Use the products and accessories in line with the installation requirement.
- The equipment must be certified and suitable for the installation area.
- Documents must be kept for the entire life of the product.

PIPING QUESTIONNAIRES

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 | mm | OR | outside diameter of the piping | mm |
| Length of piping | | | | m |
| Piping material The material that the piping is made of is is since it will influence the choice of power r | · | | | |
| Max. surface temperature of the The max. temperature of the piping is som for example if there are high temperature s | etimes a decisive criterion, | | | °C |
| Type of substance being conversal This is important, as it must be ensured the the insulation of the heating cable will not | at, in the event of leakage | | | |
| Thickness of the insulation | | | | mm |
| Type of insulation | | | | |
| Thermal conductivity of the insu | ılation | | | W/m.K |
| Max. temperature acceptable for | or the insulation | °C | | |
| Available voltage | | | | V |
| Safe area | | OR | ATEX hazardous area (indicate the temperature class) | |
| Network geometry: nozzles, "T' | , any diagram | | | |
| Others flanges, pumps, valves, max. or min. temp | perature acceptable by the flui | d, etc | | |

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

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 |
| Inside diameter mm OR Piping thickness | mm |
| Specific heat of the piping material | kJ/kg.K |

VESSEL - HOPPER QUESTIONNAIRES

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





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 |
| 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 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 | |
| Max. surface temperature of the vessel The max. temperature of the vessel can be a decisive criterion, for example if there are steam cleaning cycles. | °C |
| Type of substance contained 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. | |
| 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 (indicate the temperature class) | |
| Obstacle on the surface of the vessel: nozzles, feet, any diagrams | |
| Other flanges, pumps, valves, max. or min. temperature acceptable by the fluid, etc | |

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 m ³ |
| Max. fill rate | % |
| Vessel thickness | mm |
| Specific heat of the vessel material | kJ/kg.K |

PRODUCTS QUESTIONNAIRES

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.





Cords

| Linear ohmic value | ohm/m |
|---|-------|
| Type of insulation PVC/Silicon elastomer/Fluoropolymer | |
| Outside diameter | mm |
| OR | |
| Final circuit length | m |
| Power | W |
| Voltage | V |
| Type of insulation PVC/Silicon elastomer/Fluoropolymer | |

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

| Length | mm |
|--|----|
| Width | mm |
| Other geometry details diagram and dimensions | |
| Power | W |
| Voltage | V |
| Power cable length | mm |
| Location of power cable diagram and dimensions | |

| OPTIONS Adhesive surface for permanent fitting (YES/NO) | |
|---|--|
| Type of removable fitting Hook + spring / Velcro / Eyelets + silicon tape | |
| Location for thermostat sensor (YES: state diameter / NO) | |
| Temperature limiter (60°C / 80°C / 150°C / NO) | |
| PT 100, J Thermocouple (YES / NO) | |
| Location of options diagram and dimensions | |

Cables - Tapes

| Total length | mm |
|---|--------|
| Heating length | mm |
| Power | W |
| Voltage | V |
| Nature of insulation | |
| Braid | |
| Braid material tinned copper, stainless steel, glass silk | |
| Outside diameter | mm |
| Number of power cables | 1 or 2 |
| Length of power cables | mm |
| Type of insulation for the connection between heating and cold part(s) (sleeving, moulding, etc.) | |
| Other | |

D

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 standard : maximum = 25 mm

| Total hose length | m |
|--|-----|
| Operating temperature | °C |
| Max. operating | |
| temperature | °C |
| Voltage | V |
| Power | W |
| Sensor type | |
| (P = PT 100, N = NiCr-Ni or F = Fe-CuNi) | |
| Max. pressure | bar |
| Type de connections | |

Other

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E-mail: omeringmbh@omerin.com

mm

TECHNICAL GUIDE

OPERATING PRINCIPLES

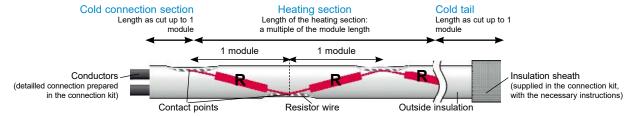


CONSTANT POWER CABLES

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:

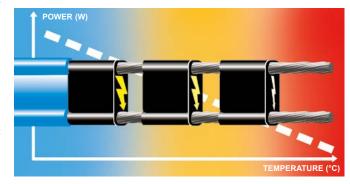


* SELF-REGULATING CABLES

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

TECHHNICAL FORMULAE

OHM'S LAW:

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

$$\begin{array}{ll} U=RxI=P/I=\sqrt{(PxR)} & Where: \\ I=U/R=\sqrt{(P/R)}=P/U & U: voltage in Volt (V) \\ R=U/I=P/I^2=U^2/P & I: current in Amps (A) \\ P=UxI=I^2xR=U^2/R & R: resistance in Ohm (\Omega) \\ P: power in Watt (W) & R: resistance in Vertex (W) & R: resistance in$$

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.

$$P = \frac{\pi \times D \times L}{\sqrt{T^2 - L^2}} \qquad T = \sqrt{\frac{(\pi \times D \times L)^2}{P^2} + L^2} + L^2 \qquad \begin{array}{l} \text{All measurement in mm} : \\ P : \text{winding pitch in mm} \\ D : \text{outside diameter of the support} \\ L : \text{Total length of the piping} \end{array}$$

USUAL METAL PIPE DIAMETERS

| Nominal diameter DN (inches) | 1/4 | 3/8 | 1/2 | 3/4 | 1 | 11/4 | 11/2 | 2 | 21/2 | 3 | 31/2 | 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

| $\alpha = \pi x$ (Tr | |
|--|-----------|
| 1 x Ln | D + 2 x e |
| $\overline{2 \times \lambda} \wedge \overline{2} \wedge 2$ | D / |

| /here : | | |
|---------------------------|----|-------|
| Ambient temperature | Та | °C |
| Maintenance temperature | Tm | °C |
| Outside dia. of piping | D | mm |
| Thickness of heat lagging | е | mm |
| Heat lagging lambda | 1 | 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.

Total length of the cable



LOSSES in W/m FOR INSULATED PIPING

| Thermal | al T | | | | | | | | Dir | nensio | n o <u>f the</u> | pi <u>pin</u> o | | | | | | | | | |
|-------------------|------------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|------------------|-----------------|--------------|--------------|--------------|--------------|-------------|------------|-------------|------------|------------|
| insulation | dT - | ND (mm) | 8 | 15 | 20 | 25 | 32 | 40 | 50 | 65 | 80 | 100 | 150 | 200 | 250 | 300 | 350 | 400 | 450 | 500 | 600 |
| thickness (mm) | °C | Out.D (mm | 14 | 21 | 27 | 34 | 42 | 48 | 60 | 76 | 89 | 114 | 168 | 219 | 273 | 324 | 356 | 406 | 457 | 508 | 610 |
| () | 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 |
| 10 | 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 | | 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 |
| 20 | 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 |
| 20 | 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 |
| | 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 |
| 25 | 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 |
| | 100 | | 16 20 | 18 23 | 20 26 | 23 32 | 27 30 | 30 39 | 35 45 | 41 53 | 47.4 61.2 | 58.2 75.2 | 81 105 | 102 132 | 125 161 | 146 189 | 159 206 | 180 233 | 201 | 222 | 265 342 |
| | 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 |
| 00 | 80 | | 14 | 16 | 18 | 21 | 24 | 26 | 31 | 36 | 41.2 | 50.3 | 69.4 | 87.3 | 106 | 124 | 135 | 153 | 171 | 188 | 224 |
| 30 | 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 |
| | 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 80 | | 9 | 10 14 | 11 16 | 13 18 | 15 20 | 16 22 | 19 25 | 21 | 24.3 | 29.3 | 39.9 54.8 | 49.8 68.4 | 60.3 82.7 | 70.1 96.2 | 76.2 105 | 86 118 | 95.8 132 | 106 145 | 125 172 |
| 40 | 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 |
| | 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 |
| 50 | 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 |
| | 140 160 | | 22 25 | 24 28 | 27 31 | 30 35 | 34 40 | 37 43 | 42 50 | 48 56 | 54.7 64.4 | 65.6 77.2 | 88.2 104 | 109 129 | 132 155 | 153 180 | 166 195 | 186 220 | 207 244 | 228 268 | 269 317 |
| | 180 | | 29 | 33 | 36 | 41 | 46 | 50 | 58 | 65 | 74.6 | 89.4 | 120 | 149 | 179 | 208 | 226 | 254 | 282 | 311 | 367 |
| | 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 |
| 00 | 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 |
| 80 | 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 |
| millimetres | x | 0.03937 | = | inches |
| millimetres | х | 39.37 | = | mils |
| metres | х | 39.37 | = | inches |
| metres | х | 3.28 | = | feet |
| inches | х | 25.4 | = | millimetres |
| feet | х | 0.3048 | = | metres |
| mils | х | 0.0254 | = | millimetres |
| kilograms | х | 2.205 | = | pounds |
| pounds | х | 0.4536 | = | kilograms |

| Multiply | | by | | to obtain |
|--------------------|---|-------------|---|--------------------|
| Unit | x | Coefficient | - | Unit |
| Ω / km | х | 0.3048 | = | Ω / 1000 feet |
| Ω / 1000 feet | Х | 3.281 | = | Ω / km |
| pounds / 1000 feet | х | 1.488 | = | kilograms/km |
| square inches | х | 645.2 | = | square millimetres |
| square millimetres | Х | 1.273 | = | circular mms |
| square millimetres | х | 1973.5 | = | circular mils |
| square mils | х | 1.273 | = | circular mils |
| circular mms | х | 1550 | = | circular mils |
| circular mils | Х | 0.7854 | = | square millimetres |



BEHAVIOUR WITH COMMMON CHEMICALS

| A Excellent B Good | | Fluoropolymer | | icon elastome |
|---|----------------------|----------------|----------|---------------|
| C Average | | bol | | stol |
| D Not good | | 010 | PVC | as |
| Unknown 1 At 20°C | | Ě | ۵ | n |
| 2 Up to 50°C | | ᆵ | | .8 |
| 3 For O-ring | | PF | | S |
| Acetaldehyde | i | Α | l D | l A |
| Acetamide | | Α | D | В |
| Acetic acid | 000/ | Α | D | С |
| | 20% 80% | A | D D | B |
| | glacial | A | D | В |
| Acetic anhydride | g | Α | D | С |
| Acetone | | Α | D | В |
| Acetylene | | A | A1 | В |
| Aluminium fluoride Aluminium hydroxide | | A | A2 A2 | В |
| Aluminium sulphate | | A | A2 | Α |
| Alums | | Α | - | A1 |
| Ammonia | 10% | Α | B1 | - |
| Ammonia ahydrous Ammonia liquid | | A | A2 A1 | C - |
| Ammonium carbonate | | A | A2 | С |
| Ammonium chloride | | Α | A2 | С |
| Ammonium hydroxide | | Α | Α | Α |
| Ammonium nitrate | Dibasia | A | A2 | C |
| Ammonium phosphate | Dibasic Monobasic | A2 A | A2 | A |
| | Tribasic | A | A | A |
| Ammonium sulphate | . Tibacio | A | A2 | A |
| Ammonium thoisulphate | | - | - | - |
| Amyl alcohol | | A | A2 | D |
| Amyl chloride Aniline | | A | D C1 | D B |
| Aniine Aqua regal | | ^ | 01 | 0 |
| (80 % HCI + 20 % HNO3) | | Α | C1 | D |
| Arsenic acid | | Α | A1 | Α |
| Arsenic salts | | - | Α | - |
| Asphalt | | Α1 | A2 | D |
| ASTM n°1oil | | - | - | В |
| ASTM n°2 oil ASTM n°3 oil | | - | - | B |
| Barium carbonate | | A | A2 | - |
| Barium chloride | | Α | A1 | Α |
| Barium hydroxide | | Α | A2 | Α |
| Barium sulphate | | Α | B1 | Α |
| Barium sulfide Beer | | A | A2 A2 | A |
| Beet sugar liquids | | A1 | A2 | A |
| Benzaldehyde | | A1 | D | D |
| Benzen | | Α | C1 | D |
| Benzyl chloride | | - | - | D |
| Borax (Sodium borate) Boric acid | | A | A1 A2 | B |
| Bromine | | A | C1 | D |
| Butane | | Α | C1 | D |
| Butyl alcohol | | A2 | C1 | В |
| Butyl ether | | A1 A2 | A2 B1 | D D |
| Butyric acid Calcium bisulfate | | A | В | A |
| Calcium chloride | | Α | С | Α |
| Calcium hydroxide | | Α | В | Α |
| Calcium hypochlorite | | Α | B1 | В |
| Carbalia asid | 20% | A | A | В |
| Carbolic acid Carbon dioxyde | | A | D A1 | D B |
| Carbon monoxide | | A | A2 | A2 |
| Carbon oxide | | Α | A2 | A2 |
| Carbon tetrachloride | | Α | - | D |
| Carbon tetrachloride dry | | A | - A1 | D |
| Caustic potash Caustic soda | | А | AI | |
| | 20% | Α | Α | A2 |
| | 50% | Α | Α | A1 |
| Oblamatia a 1.1 | 80% | A1 | A | A1 |
| Chloracetic acid Chlorine | | A | B1 A2 | D D |
| Chlorine anhydrous liquid | | A | D | D |
| Chlorine dry | | Α | D | D |
| Chlorobenzene | | В | D | D |
| Chloroform | | A | D | D |
| Chloroform Chlorosulfonic acid | | A1 A | D D | D D |
| Chromic acid | | ^ | U | J |
| | 5% | Α | A2 | С |
| | 10% | Α | A2 | С |
| | 30% | A | A1 | C |
| Citric acid | 50% | A | D B2 | A |
| Coconut oil | | A | A1 | A |
| Cod liver oil | | Α | A1 | В |
| Copper chloride | | Α | A1 | A1 |
| Copper cyanide | | A | A2 | Α |
| Copper nitrate Copper sulphate | | Α | A2 | - |
| Copper surpriate | 5 % | Α | A2 | Α |
| | > 5 % | Α | A2 | Α |
| Corn oil | | Α | В | Α |
| Cottonseed oil | | A | B2 | Α |
| Cresylic acid Cyclohexane | | A | D D | D D |
| Cyclohexanone | | A | D | D |
| | | A | B1 | D |

| Diethylamine | | Α | D | D |
|--|-------------|---|--|--|
| | | D | D | В |
| Diethyleneglycol | | A2 | C1 | B1 |
| Dimethylaniline | | A | D | D |
| Dimethylformamide Diphenyloxide | | D A1 | D | C |
| Distilled water | | A | A2 | C |
| Ethane | | A | A1 | D |
| Ethanol | | Α | С | В |
| Ethanolamine | | Α1 | D | В |
| Ether | | Α | D | D |
| Ethyl alcohol | | Α | С | В |
| Ethyl bromide | | Α | D | D |
| Ethyl chloride | | A | D | D |
| Ethylene chlorhydrine | | A | D | С |
| Ethylene diamine | | Α | D | Α |
| Ethylene dichloride | | A | D | D |
| Ethylene glycol Ethylene oxide | | A | A D | A D |
| Fatty acids | | A | A | С |
| Ferric chloride | | A | A | В |
| Ferric sulphate | | Α | Α | В |
| Ferrous chloride | | Α | Α | - |
| Ferrous sulphate | | Α | Α | - |
| Formaldehyde | | | | |
| | 40% | Α | Α | - |
| | 100% | Α | Α | В |
| Formic acid | | Α | A1 | В |
| Freon 11 | | Α | A2 | D |
| Freon 12 | | A | A2 | D |
| Freen 22 | | A | A | D |
| Freon 113 | | Α | В | D |
| Freon TF Fuel oil | | - D | B | D |
| Furane (resin) | | B A | A2 A | D |
| Furfural | | A | D | D |
| Gasoline | | В | A | D |
| Gelatine | | A | В | A |
| Glucose | | Α | A2 | Α |
| Glycerine | | Α | Α | Α |
| Grease | | Α | Α | D |
| Hexane | | Α | B1 | D |
| Hexyl alcohol | | Α | A2 | В |
| Hydraulic oil | | Α | Α | В |
| Hydrobromic acid | | | | |
| | 20% 100% | A | B2 A1 | D D |
| Hydrochloric acid | 10070 | ,, | | |
| ,, | 20% | Α | A2 | D |
| | 37% | Α | В | В |
| | 100% | Α | D | D |
| Hydrocyanic acid | | Α | В | С |
| Hydrofluoric acid | | | | |
| | 20% | A | В | D |
| | 50% | Α | B1 | D |
| | 75% 100% | A | C | D |
| Hydrogen | 100 /0 | A | A2 | С |
| Hydrogen (dry) | | Α | A2 | С |
| Hydrogen gas | | Α | A2 | С |
| Hydrogen peroxide | 10% | A | A1 | A |
| Try at ogott poroxido | 30% | A | A1 | В |
| | 50% | Α | A1 | В |
| | 100% | Α | Α | В |
| Hydrogen sulphide | | Α | B1 | С |
| Isobutyl alcohol | | A2 | A1 | Α |
| Isooctane | | Α | A1 | D |
| Isopropyl ether | | A1 | В | D |
| | | A2 | A1 | Α |
| Isopropyl alcohol | | | С | l D |
| Isopropyl alcohol Jet fuel | | Α | | |
| Isopropyl alcohol Jet fuel Kerosene | | Α | A2 | D |
| Isopropyl alcohol Jet fuel Kerosene Lacquers | | A A | A2 D | D D |
| Isopropyl alcohol Jet fuel Kerosene Lacquers Lactic acid | | A A A | A2 D B1 | D D A |
| Isopropyl alcohol Jet fuel Kerosene Lacquers Lactic acid Lard | | A A A | A2 D B1 A1 | D D A B |
| Isopropyl alcohol Jet fuel Kerosene Lacquers Lactic acid Lard Lead nitrate | | A A A A | A2 D B1 A1 A2 | D D A B |
| Isopropyl alcohol Jet fuel Kerosene Lacquers Lactic acid Lard Lead nitrate Lead sulfamate | | A A A A A1 B | A2 D B1 A1 A2 B | D D A B B1 B |
| Isopropyl alcohol Jet fuel Kerosene Lacquers Lactic acid Lard Lead nitrate Lead sulfamate Linseed oil | | A A A A A1 B | A2 D B1 A1 A2 B A2 | D D A B |
| Isopropyl alcohol Jet fuel Kerosene Lacquers Lactic acid Lard Lead nitrate Lead sulfamate Linseed oil Magnesium Carbonate | | A A A A1 B A | A2 D B1 A1 A2 B A2 B | D A B B1 B |
| Isopropyl alcohol Jet fuel Kerosene Lacquers Lactic acid Lard Lead nitrate Lead sulfamate Linseed oil Magnesium Carbonate Magnesium chloride | | A A A A A1 B | A2 D B1 A1 A2 B A2 | D D A B B1 B |
| Isopropyl alcohol Jet fuel Kerosene Lacquers Lactic acid Lard Lead nitrate Lead sulfamate Linseed oil Magnesium Carbonate | | A A A A1 B A A1 A | A2 D B1 A1 A2 B A2 B | D A B B1 B A |
| Isopropyl alcohol Jet fuel Kerosene Lacquers Lactic acid Lard Lead nitrate Lead sulfamate Linseed oil Magnesium Carbonate Magnesium hydroxide | | A A A A1 B A A1 A | A2 D B1 A1 A2 B A2 B B | D A B B1 B A |
| Isopropyl alcohol Jet fuel Kerosene Lacquers Lactic acid Lard Lead nitrate Lead sulfamate Linseed oil Magnesium Carbonate Magnesium hloride Magnesium hibrate Magnesium nitrate | | A A A A1 B A A1 A A1 A | A2 D B1 A1 A2 B A2 B A2 A2 | D D A B B1 B A - A |
| Isopropyl alcohol Jet fuel Kerosene Lacquers Lactic acid Lard Lead nitrate Lead sulfamate Linseed oil Magnesium Carbonate Magnesium hydroxide Magnesium nitrate Magnesium sulphate Magnesium sulphate | | A A A A A A A A A A | A2 D B1 A1 A2 B A2 B A2 A2 A1 A2 C | D A B B1 B A - A |
| Isopropi alcohol Jet fuel Kerosene Lacquers Lactic acid Lard Lead nitrate Lead sulfamate Linseed oil Magnesium Carbonate Magnesium hydroxide Magnesium nitrate Magnesium sulphate Malic acid Magnese sulphate Menouric Sulphate Menouric Sulphate Menouric Sulphate Mercuric chloride | | A A A A A A A A A A A | A2 D B1 A1 A2 B A2 B A2 A1 A2 C A | D D A B B1 B A A A A B B A1 - |
| Isopropyl alcohol Jet fuel Kerosene Lacquers Lactic acid Lard Lead nitrate Lead sulfamate Linseed oil Magnesium Carbonate Magnesium chloride Magnesium hydroxide Magnesium sulphate Malic acid Manganese sulphate Mercuric chloride Mercuric cyanide | | A A A A A A A B | A2 D B1 A1 A2 B A2 B A2 A2 A1 A2 C A | D D A B B1 B A A A A A B B A1 - A |
| Isopropyl alcohol Jet fuel Kerosene Lacquers Lactic acid Lard Lead nitrate Lead sulfamate Linseed oil Magnesium Carbonate Magnesium chloride Magnesium sulphate Magnesium sulphate Malic acid Manganese sulphate Mercuric chloride Mercuric cyanide Mercury | | A A A A A A A A A A A A A A A A A A A | A2 D B1 A1 A2 B A2 B B A2 A2 A1 A2 C A | D D A B B1 B A - A A B B A1 - A A - A B A1 - A A A A A A A A A A A A A A A A A |
| Isopropyl alcohol Jet fuel Kerosene Lacquers Lacquers Lactic acid Lard Lead nitrate Lead sulfamate Linseed oil Magnesium Carbonate Magnesium holoride Magnesium hitrate Magnesium sulphate Magnesium sulphate Malic acid Mangnese sulphate Mercuric cyanide Mercury Methane | | A A A A A A A A A A A A A A A A A A A | A2 D B1 A1 A2 B A2 B B A2 A2 A1 A2 C A A B | D D A B B1 B A - A A B B A1 - A D |
| Isopropyl alcohol Jef fuel Kerosene Lacquers Lactic acid Lard Lead nitrate Lead sulfamate Linseed oil Magnesium Carbonate Magnesium chloride Magnesium hydroxide Magnesium sulphate Malic acid Manganese sulphate Mercuric chloride Mercury Methane Methane Methane Methyl alcohol | | A A A A A A A A A A A A A A A A A A A | A2 D B1 A1 A2 B A2 B B A2 A1 A2 C A A A B B | D D A B B1 B A - A A B B A1 - A A D A |
| Isopropyl alcohol Jet fuel Kerosene Lacquers Lactic acid Lard Lead nitrate Lead sulfamate Linseed oil Magnesium Carbonate Magnesium chloride Magnesium sulphate Magnesium sulphate Magnesium doi Magnesium of the | | A A A A A A A A A A A A A A A A A A A | A2 D B1 A1 A2 B A2 B B A2 A1 A2 C A A A B B | D D A B B1 B A - A A B B A1 - A D A D D |
| Isopropyl alcohol Jet fuel Kerosene Lacquers Lacquers Lactic acid Lard Lead nitrate Lead sulfamate Linseed oil Magnesium Carbonate Magnesium holoride Magnesium hydroxide Magnesium nitrate Magnesium sulphate Malic acid Manganese sulphate Mercuric cyanide Mercury Methane Methyl alcohol Methyl chloride Methyl chloride Methyl chloride Methyl ethyl ketone | | A A A A A A A A A A A A A A A A A A A | A2 D B1 A1 A2 B A2 B B A2 A1 A2 C A A A B A1 D D | D D A B B1 B A A A A A B B A1 - A A D D D D |
| Isopropyl alcohol Jef fuel Kerosene Lacquers Lactic acid Lard Lead nitrate Lead sulfamate Linseed oil Magnesium Carbonate Magnesium chloride Magnesium hydroxide Magnesium sulphate Malic acid Manganese sulphate Mercuric chloride Mercury Methane Methyl alcohol Methyl chloride Methyl ethyl ketone Methyl ethyl ketone Methyl ethyl ketone Methyl ethyl ketone | | A A A A A A A A A A A A A A A A A A A | A2 D B1 A1 A2 B A2 B B A2 A1 A2 C A A A B B A1 D D | D D A B B1 B A - A A B B A1 - A D D C C |
| Isopropyl alcohol Jet fuel Kerosene Lacquers Lactic acid Lard Lead nitrate Lead sulfamate Linseed oil Magnesium Carbonate Magnesium chloride Magnesium sulphate Magnesium sulphate Magnesium sulphate Magnesium carbonate Magnesium of the did Magnesium sulphate Magnesium sulphate Magnesium sulphate Malic acid Manganese sulphate Mercuric chloride Mercuric cyanide Mercury Methane Methyl alcohol Methyl chloride Methyl ethyl ketone Methyl methacrylate Methyliene chloride Methyleic chloride | | A A A A A A A A A A A A A A A A A A A | A2 D B1 A1 A2 B A2 B A2 A1 A2 C A A A B A1 D D A D | D D A B B1 B A - A A B A1 - A D D C C - |
| Isopropyl alcohol Jef fuel Kerosene Lacquers Lacquers Lactic acid Lard Lead nitrate Lead sulfamate Linseed oil Magnesium Carbonate Magnesium chloride Magnesium sulphate Magnesium sulphate Malic acid Manganese sulphate Mercuric cyanide Mercuric cyanide Mertyl alcohol Methyl chloride Methyl ethoride Methyliebothylketone Methyliebothylketone Methyliebothylketone | | A A A A A A A A A A A A A A A A A A A | A2 D B1 A1 A2 B A2 B A2 A1 A2 C A A A B A1 D D A | D D A B B1 B A - A A B A1 - A A D D C C - D |
| Isopropyl alcohol Jef fuel Kerosene Lacquers Lactic acid Lard Lead nitrate Lead sulfamate Linseed oil Magnesium Carbonate Magnesium chloride Magnesium hydroxide Magnesium hydroxide Magnesium sulphate Malic acid Manganese sulphate Malic acid Manganese sulphate Mercuric chloride Mercuric chloride Mercury Methane Methyl alcohol Methyl chloride Methyl ethyl ketone Methyl methacrylate Methyliene chloride Methylisobutylketone Milk | | A A A A A A A A A A A A A A A A A A A | A2 D B1 A1 A2 B A2 B A2 A1 A2 C A A A B A1 D D A D | D D A B B1 B A - A A B A1 - A D D C C - |
| Isopropyl alcohol Jet fuel Kerosene Lacquers Lactic acid Lard Lead nitrate Lead sulfamate Linseed oil Magnesium Carbonate Magnesium chloride Magnesium sulphate Magnesium sulphate Magnesium sulphate Magnesium carbonate Magnesium of the did Magnesium sulphate Magnesium sulphate Magnesium sulphate Malic acid Manganese sulphate Mercuric chloride Mercuric cyanide Mercury Methane Methyl alcohol Methyl chloride Methyl ethyl ketone Methyl methacrylate Methyliene chloride Methyleic chloride | | A A A A A A A A A A A A A A A A A A A | A2 D B1 A1 A2 B A2 B B A2 A1 A2 C A A A B A1 D D A2 | D D A B B1 B A - A A A - A A D D C C - D A |
| Isopropyl alcohol Jet fuel Kerosene Lacquers Lactic acid Lard Lead nitrate Lead sulfamate Linseed oil Magnesium Carbonate Magnesium chloride Magnesium sulphate Magnesium sulphate Magnesium sulphate Magnesium sulphate Magnesium itirate Magnesium sulphate Malic acid Magnesium sulphate Mercuric chloride Mercuric cyanide Mercuric cyanide Mercury Methane Methyl alcohol Methyl chloride Methyl ethyl ketone Methyl wethacrylate Methylisobutylketone Milk Mineral oils | | A A A A A A A A A A A A A A A A A A A | A2 D B1 A1 A2 B A2 B B A2 A2 A1 A2 C A A A B B A1 D D A D D A2 B | D D A B B1 B A A A A B B A1 A A D D C C D A C C |
| Isopropyl alcohol Jef fuel Kerosene Lacquers Lactic acid Lard Lead nitrate Lead sulfamate Linseed oil Magnesium Carbonate Magnesium hydroxide Magnesium hydroxide Magnesium sulphate Malic acid Manganese sulphate Mercuric chloride Mercuric cyanide Mercury Methane Methyl alcohol Methyl chloride Methyl ethyl ketone Methyl methacrylate Methylisebotutylketone Milk Mineral oils Monobasic | | A A A A A A A A A A A A A A A A A A A | A2 D B1 A1 A2 B B A2 A2 A1 A2 C A A A B B A1 D D A2 B B A2 A2 B B A2 B B A2 B B A2 B B A2 B B A2 B B B A2 B A2 | D D A B B1 B A A A A B B A1 A A D D C C A C A |
| Isopropyl alcohol Jef fuel Kerosene Lacquers Lactic acid Lard Lead nitrate Lead sulfamate Linseed oil Magnesium Carbonate Magnesium chloride Magnesium hydroxide Magnesium hydroxide Magnesium sulphate Malic acid Manganese sulphate Malic acid Manganese sulphate Mercuric chloride Mercuric chloride Mercury Methane Methyl alcohol Methyl chloride Methyl ethyl ketone Methyl methacrylate Methyliene chloride Methylisobutylketone Milk Mineral oils Monobasic Monochiorobenzene | | A A A A A A A A A A A A A A A A A A A | A2 D B1 A1 A2 B A2 B A2 C A1 A A B A1 D D A D D A2 B A D D B | D D A B B1 B A A A A A A B B A1 A A D D C C A D D B B B B B B B B B B B B B B B B B |
| Isopropyl alcohol Jef fuel Kerosene Lacquers Lactic acid Lard Lead nitrate Lead sulfamate Linseed oil Magnesium Carbonate Magnesium chloride Magnesium hydroxide Magnesium sulphate Magnesium sulphate Magnesium sulphate Magnesium sulphate Malic acid Manganese sulphate Mercuric chloride Mercuric chloride Mercury Methane Methyl alcohol Methyl chloride Methyl ethyl ketone Methyl methacrylate Methyliene chloride Methylisobutylketone Milk Mineral oils Monobasic Monochlorobenzene Monoethanolamine Mustard Naphta | | A A A A A A A A A A A A A A A A A A A | A2 D B1 A1 A2 B A2 B A2 C A1 A2 C A A A B A1 D D A2 B A D D B B A1 | D D A B B B B A A A A A B B A D D C C A D D B C D D D D D D D D D D D D D D D D |
| Isopropyl alcohol Jef fuel Kerosene Lacquers Lactic acid Lard Lead nitrate Lead sulfamate Linseed oil Magnesium Carbonate Magnesium hydroxide Magnesium hydroxide Magnesium mitrate Magnesium sulphate Malic acid Manganese sulphate Mercuric chloride Mercuric cyanide Mercuric bloride Mertyl tchloride Methyl etholohol Methyl etholohol Methyl chloride Methyl etholoride Methyl ketone Methyl wethacrylate Methylisobutylketone Milk Mineral oils Monobasic Monochlorobenzene Monoethanolamine Mustard | | A A A A A A A A A A A A A A A A A A A | A2 D B1 A1 A2 B A2 B A2 C A1 A A B A1 D D A D D A2 B A D D B | D D A B B1 B A A A A A A B B A1 A A D D C C A D D B B B B B B B B B B B B B B B B B |

| Nickel nitrate | | A2 A | A | - A |
|---|-------------------|---------|----------|--------|
| Nickel sulphate Nitric Acid | | А | А | А |
| | 5 - 10 % | Α | A1 | С |
| | 20% | Α | A1 | D |
| | 50% concentrated | A | B1 B1 | D D |
| Nitrobenzene | Concentrated | A | D | D |
| Oelic Acid | | Α | C2 | D |
| Olive oil | | A1 | С | D |
| Oxalic acid | | A1 | В | В |
| Ozone Palmitic acid | | A A2 | B B1 | A D |
| Paraffin | | A | В | - |
| Peanut oil | | Α | A1 | Α |
| Pentane | | Α | Α | D |
| Petrol | | A | В | D |
| Petroleum Phenol | | A2 A | D | D D |
| Filerioi | 10% | A | C1 | D |
| Phosphoric acid | | | | _ |
| | ≤ 40 % | Α | В | С |
| | > 40 % | Α | В | D |
| Phosphorus trichloride Phtalic anhydride | | A2 A | D D | - |
| Pine oil | | A | D | D |
| Pitric acid | | Α | D | D |
| Potassium bichromate | | Α | Α | Α |
| Potassium bromide | | Α | Α | A1 |
| Potassium carbonate Potassium chloride | | - A | A | - A |
| | | A | A | A |
| Potassium cyanide solutions Potassium hydroxide | | A | A A1 | C |
| Potassium nitrate | | A | A | A |
| Potassium permanganate | | Α | A1 | - |
| Potassium sulphate | | Α | A2 | Α |
| Propane liquid | | Α | A1 | D |
| Propyl alcohol | | Α | A1 | Α |
| Propylene glycol | | A | C1 | A |
| Pyridine Salted water | | A | D B | D B |
| Salycilic acid | | A2 | B1 | - |
| Sea water | | Α | A2 | A1 |
| Silicone oil | | Α | Α | С |
| Silver nitrate | | Α | A1 | Α |
| Soap solutions | | A | A A2 | A |
| Soda (sodium carbonate) Sodium bicarbonate | | A | A2 | A |
| Sodium carbonate | | Α | A2 | A |
| Sodium chloride | | Α | A2 | Α |
| Sodium cyanide | | Α | A2 | Α |
| Sodium fluoride | | A1 | A2 | - |
| Sodium hydroxide | 20% | Α | Α | A2 |
| | 50% | A | A | A1 |
| | 80% | A1 | Α | A1 |
| Sodium hypochlorite | | Α | В | В |
| Sodium nitrate | | Α | A2 | D |
| Sodium peroxide | | Α | B2 | D |
| Sodium phosphate Sodium silicate | | A | A1 A2 | D A |
| Sodium sulphate | | A | A2 | A |
| Sodium sulfide | | Α | A2 | Α |
| Sodium thoisulphate | | Α | A2 | Α |
| Soybean oil | | Α | A1 | Α |
| Stearic acid | | A | B2 | В |
| Styrene Sugar liquids | | A | D | D A |
| Sulphuric acid | | А | - | A |
| Calphano dola | < 10 % | Α | A1 | С |
| | 10 - 75 % | Α | A1 | D |
| | 75 - 100 % | Α | D | D |
| | concentrated cold | Α | D | D |
| Culturary | concentrated hot | A | D | D |
| Sulfurous acid Sulphur chloride | | A | A2 C1 | D |
| Sulphur trioxide | | A | A | В |
| Synthetic hydraulic oil | | A | A | В |
| Tannic acid | | Α | A1 | В |
| Tartric acid | | Α | A1 | Α |
| Tetrachloroethylene | | Α | D | D |
| Toluene | | A | D A | D A |
| Tribasic Trichloroethylene | | A | D | D |
| Tricresilphosphate | | A | D | С |
| Triethylamine | | Α | В | - |
| Turpentine | | Α | D | D |
| Unleaded petrol | | Α | C2 | D |
| | | | | A |
| Vinegar | | A | В | A |
| Vinegar Vinyl chloride | -0000 | A2 | D | - |
| Vinegar | <80°C | | | - B |



*LEGAL UNITS IN THE INTERNATIONAL MEASUREMENT SYSTEM (SI)

| | Variables | | Unit | Customary | units |
|-----------|--|---------------------------------------|---|-------------------------|------------------------------------|
| | Names Sym | bols | Names | Names and | SI value |
| | | | and symbols | symbols | |
| | Length | | metre (m) | | |
| | Wavelength | λ | metre (m) | | |
| TRY | Wavenumber | σ | metre to the power minus one (m ⁻¹) | | |
| GEOMETRY | Surface area | A | square metre (m²) | are (a) hectare (ha) | 10 ² 10 ⁴ |
| Ä | Cross section | σ | square metre (m²) | barn (b) | 10-28 |
| • | Volume | V | cubic meter (m³) | litre (L or I) | 10 ⁻³ |
| | Plane angle | α | radian (rad) | | |
| | Solid angle | sr | steradian (sr) | | |
| | Mass | m | kilogram (kg) | tonne (t) | 10 ³ |
| | Atomic mass | m _a | kilogram (kg) | | |
| | Mass per unit length | ρ | kilograms par metre (kg/m) | tex (tex) | 10-6 |
| SS | Surface density | $ ho_{\scriptscriptstyle m A}$ | kilogramme par mètre carré (kg/m²) | | |
| MASS | Density | ρ | kilograms par cubic metre (kg/m³) | | |
| | Volume per unit mass | s v | cubic metre per kilogram (m³/kg) | | |
| | Concentration | $ ho_{\scriptscriptstyle \mathrm{B}}$ | kilograms per cubic metre (kg/m³) | | |
| TIME | Time | t | second (s) | | |
| Ē | Frequency | f | hertz (Hz) | | |
| | Velocity | V | metre per second (m/s) | | |
| | Angular velocity | ω | radian per second (rad/s) | | |
| | Acceleration | а | metre per second squared (m/s²) | gal (Gal) | 10-2 |
| | Angular acceleration | α | radian per second squared (rad/s²) | | |
| | Force | F | newton (N) | | |
| | Moment of force | М | newton-metre (N.m) | | |
| | Surface voltage | γ | newtons per metre (N/m) | | |
| MECHANICS | Work, energy, quantity of heat | w | joule (J) | | |
| Ŧ | Radiant intensity | 1 | watts per steradian (W/sr) | | |
| MEC | Power, radiant flux thermal flux | Р Ф | watt (W) | | |
| | Strain | σ | pascal (Pa) | bar (bar) | 10 ⁵ |
| | Pressure | ρ | | | |
| | Dynamic viscosity | η | pascal-second (p.s) ou poiseuille | poise (P) | 10-1 |
| | Kinetic viscosity | v | square metre per second (m²/s) | stockes (St) | 10-4 |
| | - | | . , | . , | |

| | Variables | | Unit | Customary units | | |
|--------------------------------------|--|--------|---|----------------------------|-----------------|--|
| | Names Symbo | | Names and symbols | Names and symbols | | |
| | Electric current | 1 | ampere (A) | biot (bi) | 10 | |
| | Electromotive force | Е | volt (V) | | | |
| | Potential difference, voltage | U | | | | |
| | Electrical resistance | R | ohm (Ω) | | | |
| | Electric field strength | Ε | volt per metre (V/m) | | | |
| É | Electrical conductance | G | siemens (S) | mho | 1 | |
| ELECTRICITY | Amount of electricity, electrical charge | Q | coulomb (C) | | | |
| ä | Electrical capacity | С | farad (F) | | | |
| | Self-induction | L | henry (H) | | | |
| | Magnetic flux induction | Φ | weber (Wb) | maxwell (Mx, M) | 10 ⁴ | |
| | Magnetic induction | В | tesla (T) | Gamma (γ) Gauss (Gs, G) | 10-9 104 | |
| | Magnetic field strength | Н | ampere per metre (A/m) | | | |
| | Magnetomotive force | F | ampere (A) | | | |
| | Temperature | Т | kelvin(K) degree Celsius (°C) | | | |
| HEAT | Heat capacity entropy | C S | joule per kelvin (J/K) | | | |
| Ψ | Specific heat capacity, specific entropy | c s | joule per kilogram kelvin (J/(kg.K)) | | | |
| | Thermal conductivity | λ | watt per metre-kelvin (W/(m.K)) | | | |
| S S | Activity | Α | becquerel (Bq) | | | |
| SH | Exposure | Χ | coulomb per kilogram (C/kg) | | | |
| ΖÌ | Absorbed dose | D | gray (Gy) | rad(rd) | 10-2 | |
| ≥ & | Dose equivalent | Н | sievert (Sv) | rem (rem) | 10-2 | |
| PHYSICAL IONISING CHEMISTRYRADIATION | Quantity of matter | n | mole (mol) | | | |
| J | Light intensity | - 1 | candela (cd) | | | |
| | Luminous flux | Φ | lumen (lm) | | | |
| SS | Illuminance | Е | lux (lx) | | | |
| OPTICS | Luminance | L | candela per square metre (cd/m²) | | | |
| | Optical system vergence | | metre to the power minus one (m ⁻¹) | | | |

MAIN CONVERSION FACTORS

| Length (conversion into | metres) | | | | | |
|--|------------------------------|--------------------------------|-----------------------------|--|--|--|
| () | | | | | | |
| angström (Ä) | 1x 10-10 | mile | 1.609344 x 10 ₃ | | | |
| light year | 9.46073 x 10 ₁₅ | mile (nautical mile) | 1.852 x 10₃ | | | |
| fermi (fm) | 1 x 10 ₋₁₅ | pica | 4.2175 x 10₃ | | | |
| foot (ft) | 3.048 x 10 ₋₁ | point (US) | 3.515 x 10₄ | | | |
| inch (in) | 2.54 x 10 ₋₂ | rod | 5.029 2 | | | |
| micron (μ) | 1 x 10-₅ | sigma (σ) | 1 x 10 ₋₁₂ | | | |
| mil | 2.54 x 10 ₋₅ | yard (yd) | 9.144 x 10 ₋₁ | | | |
| Area (conversions into sq | uare metres) | | | | | |
| are (a) | 1 x 10 ₂ | rood | 1.01171 x 10₃ | | | |
| circular mil | 5.067075 x 10 ₋₁₀ | acre | 4.04686 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 10₄ | | | |
| bushel (UK) | 3.63687 x 10 ₋₂ | liquid pint [US](liq pt) | 4.73176 x 10₄ | | | |
| bushel [US](bu) | 3.52391 x 10-2 | liquid quart [US](liq qt) | 9.46352 x 10₄ | | | |
| dry barrel [US](bbl) | 1.15627 x 10-1 | litre (L, I) | 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 10₃ | minim [US](min) | 6.16115 x 10₃ | | | |
| fluid ounce [UK](fl oz) | 2.84130 x 10 ₋₅ | peck (UK) | 9.0922 x 10₃ | | | |
| 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 10₃ | | | |
| gallon [US](gal) | 3.78541 x 10 ₋₃ | | | | | |
| Plane angle (conversion | into radians) | | | | | |
| degree (°) | 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 se | conds) | | | | | |
| hour (h) | 3.6 x 10₃ | minute (min) | 60 | | | |
| day (d, j) | 8.64 x 10 ₄ | | | | | |
| Mass (conversion into kil | lograms) | | | | | |
| cental | 4.53592 x 10 | ton (ton) | 1.016047 x 10₃ | | | |
| long ton (US) | 1.016047 x 10 ₃ | tonne (t) | 1 x 10₃ | | | |
| 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 | | | |
| quintal (q) | 1 x 10 ₂ | unité de masse atomique (u) | 9.07185 x 10 ₂ | | | |
| short ton (sh tn) | 1.66054 x 10 ₋₂₇ | | | | | |
| Velocity (conversion into metres per second) | | | | | | |
| International knot, knot | 5.144 44 x 10 ₋₁ | | | | | |

| Unit Co | onversion factor | Unit C | onversion 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 | on into joules) | | | | | |
| british thermal unit (Btu) (Intern Table) | 1.055056 x 10 ³ | kilogrammetre (kgm) | 9.80665 | | | |
| calorie I.T. (cal I.T) | 4.186 8 | therm | 1.055056 x 10 ⁸ | | | |
| calorie 15°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) | | | | | |
| metric horse power | 7.354 99 x 10 ² | var (var) | | | | |
| mechanical horse power [UK] | 7.457 0 x 10 ² | | | | | |
| Strain and pressure (co | nversion into p | ascals) | | | | |
| normal atmosphere (atm) | 1.013 25 x 10 ⁵ | inch of mercury (inHg) | 3.386 39 x 10 ³ | | | |
| technical atmosphere (at) | 9.806 65 x 10 ⁴ | millimetre of water (mmH20) | 9.806 65 | | | |
| bar (bar) | 1 x 10 ⁵ | millimetre of mercury (mmHg) | 1.333224 x 10 ² | | | |
| foot of water (ftH20) | 2.989 07 x 10 ³ | pound-force per square inch (psi) | 6.894 757 x 10 ³ | | | |
| inch of water (inH20) | 2.490 89 x 10 ² | torr (Torr) | 1.333 224 x 10 ² | | | |
| Magnetomotive force (c | onversion into | amperes) | | | | |
| gilbert (Gb) | 7.957 7 x 10 ⁻¹ | | | | | |
| Quantity of electricity, | electrical charg | ge (conversion into could | ombs) | | | |
| ampere-hour (Ah) | 3.6 x 10 ³ | franklin (Fr) | 3.335 64 x 10 ⁻¹⁰ | | | |
| farafay (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. | Ср | Heat of vaporis. |
|------------------------|-------------------|---------------------|------------------|--|------------------|
| 2.40.20 | kg/dm3 | | | K.Cal/kg/°C | K.Cal/kg |
| Acetone | 0,814 | - 95 | 57 | 0,53 | 124,5 |
| Acetic acid | 1,07 | 17 | 118 | 0,51 | 117 |
| Hychloridric acid | 1,2 | -114 | 83 | 0,60 | 97,5 |
| Formic acid | 1,23 | 8,4 | 100,7 | 0,39 | 120 |
| Nitric acid | 1,52 | -42 | 86 | 0,66 | 115 |
| Sulfuric acid at 66° B | 1,80 | 10 | 330 | 0,33 | 123 |
| Ethyl alcohol | 0,80 | -130 | 78 | 0,68 | 210 |
| Methyl alcohol | 0,80 | -97,8 | 65 | 0,60 | 269 |
| Ammonia | 0,82 | -78 | -33,4 | 1,1 | 327 |
| Benzene | 0,87 | 5 | 80 | 0,45 | -94 |
| Beer | 1 | 2 | | 1 | |
| Bromine | 3 | -7 | 58,8 | 0,11 | 43,7 |
| Chloroform | 1,48 | -63 | 61 | 0,23 | 60 |
| Methyl chloride | 1,33 | -96 | 40 | 0,60 | 95 |
| Water | 1 | 0 | 100 | 1 | 539 |
| Turpentine | 0,86 | | | 0,42 | |
| Ether | 0,74 | -117 | 35 | 0,54 | 90 |
| Freon 12 | 1,33 | | -30 | 0,20 | 40 |
| Glycerine | 1,27 | 17 | 290 | 0,58 | |
| Mineral oil | 0,84 | | | 0,50 | |
| Paraffin oil | 0,88 | | | 0,52 | |
| Castor oil | 0,96 | | | 0,43 | 68 |
| Milk | 1,03 | | | 0,94 | |
| Methacrylate | 0,9 | | | 0,25 | |
| Mercury | 13,6 | -39 | 358 | 0,033 | 73 |
| Paraffin | 0,8 | | | 0,45 | |
| Tetrachlorethylene | 1,6 | -20 | 120 | 0,22 | 52 |
| Petroleum | 0,89 | | | 0,50 | |
| Phenol | 1,08 | 41 | 182 | 0,56 | |
| Carbon disulphide | 1,27 | -108 | 46 | 0,23 | 90 |
| Carbon tetrachloride | 1,63 | -23 | 76,8 | 0,21 | 45 |
| Toluene | 0,87 | -95 | 110,6 | 0,39 | |
| Trichlorethylene | 1,49 | -73 | 87 | 0,23 | 57,3 |
| Wine | 0,99 | | | 0,90 | |
| Vinegar | 1,02 | | | 0,92 | |
| Honey | 1,395 to 1,445 | | | 0,6 to 0,65 (liquid) 0,65 to 0,70 (solid) | |

Metals, liquids, air

| TEMP. Te | Wictais, liquids, all | | | | | | |
|---|-----------------------|-------------|---------|---------|--------|--------|--|
| Metals m°C m°C J/Kg°C | | | | | | | |
| Pure aluminium | | | | | | J/Kg°C | |
| Steel (c =1,5) 20° 45 52 0,115 481 Pure copper 20° 332 385 0,094 393 Birass 20° 63 73 0,092 385 Zinc | Metals | | | | | | |
| Pure copper 20° 332 385 0,094 393 Brass 20° 63 73 0,092 385 Zinc Various material Asbestos 20° 0,13 0,15 0,20 837 Asphalt 20° 0,80 0,93 0,22 921 Concrete (2000 Kg/m²) 20° 0,80 0,93 0,22 921 Bitumen 20° 0,14 0,16 0,15 628 Solid bricks 20° 0,42 0,49 0,215 990 Cement mortar 20° 0,44 0,51 0,22 921 Plaster rendering (1200 Kg/m²) 20° 0,37 0,43 0,273 1143 Liquids Alcohol 20° 0,15 0,17 0,56 2344 Alcohol 20° 0,15 0,17 0,56 2344 Alcohol 20° 0,12 0,14 0,42 1758 Benzol 20° 0,12 0,14 0,42 1758 Benzol 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 Company 100 100 100 100 100 100 100 100 100 10 | Pure aluminium | 20° | 197 | 228 | 0,22 | 921 | |
| Brass 20° 63 73 0,092 385 Zinc | Steel (c =1,5) | 20° | 45 | 52 | 0,115 | 481 | |
| Narious material National Status National National National National National National National National National | Pure copper | 20° | 332 | 385 | 0,094 | 393 | |
| Various material Asbestos 20° 0,13 0,15 0,20 837 Asphalt 20° 0,80 0,93 0,22 921 Concrete (2000 kg/m²) 20° 0,80 0,93 0,22 921 Bitumen 20° 0,14 0,16 0,15 628 Solid bricks 20° 0,42 0,49 0,215 900 Cement mortar 20° 0,44 0,51 0,22 921 Plaster rendering (1200 kg/m²) 20° 0,37 0,43 0,273 1143 Liquids Alcohol 20° 0,15 0,17 0,56 2344 Alcohol 20° 0,15 0,17 0,56 2344 Heavy fuel 20° 0,16 0,13 0,48 2010 Petroleum 20° 0,13 0,15 0,50 203 Water 0° 0,477 0,553 1,005 4207 20° 0,505 0,566 0,999 | Brass | 20° | 63 | 73 | 0,092 | 385 | |
| Asbestos 20° 0,13 0,15 0,20 837 Asphalt 20° 0,80 0,93 0,22 921 Concrete (2000 Kg/m²) 20° 0,80 0,93 0,22 921 Bitumen 20° 0,14 0,16 0,15 628 Solid bricks 20° 0,42 0,49 0,215 900 Ement mortar 20° 0,44 0,51 0,22 921 Plaster rendering (1200 Kg/m²) 20° 0,37 0,43 0,273 1143 Liquids Alcohol 20° 0,15 0,17 0,56 2344 at 0,20 at 0,23 Benzol 20° 0,15 0,17 0,56 2344 Benzol 20° 0,16 0,135 0,48 2010 Petroleum 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 Eight fuel oil (domestic) d = 0,846 Steam Saturated water at constant pressure 100 to 440° 10 to 620° - 0,04717 1975 Superheated steam 150° 0,4713 1973 110 to 620° 0,4717 1975 Superheated steam 150° 0,488 2034 1 bar 250° 0,488 2034 1 bar 350° 0,488 2034 1 bar 550° 0,486 2034 1 bar 550° 0,486 2034 1 bar 550° 0,486 2034 1 bar 550° 0,518 2188 Air Air Air à 20° 0,0259 0,030 0,245 1026 Polyol d = 1,1 | Zinc | | | | | | |
| Asphalt 20° 0,80 0,93 0,22 921 Concrete (2000 Kg/m²) 20° 0,80 0,93 0,22 921 Bitumen 20° 0,14 0,16 0,15 628 Solid bricks 20° 0,42 0,49 0,215 900 a 0,60 a 0,70 Cement mortar 20° 0,44 0,51 0,22 921 Plaster rendering (1200 Kg/m²) 20° 0,37 0,43 0,273 1143 Liquids Alcohol 20° 0,15 0,17 0,56 2344 Alcohol 20° 0,15 0,17 0,56 2344 Heavy fuel 20° 0,116 0,13 0,48 2010 Petroleum 20° 0,116 0,13 0,48 2010 Petroleum 20° 0,477 0,553 1,005 4207 20° 0,505 0,586 0,999 4182 Comparison 20° 0,562 0,652 0,998 4177 Light fuel oil (domestic) d = 0,046 20° 0,048 Saturated water at constant pressure 100 to 270° - 0,4713 1973 110 to 620° 0,4717 1975 Superheated steam 150° 0,4639 1942 Their 350° 0,471 1975 Superheated steam 150° 0,468 1959 1 150° 0,486 2034 1 bar 350° 0,477 1997 1 bar 450° 0,486 2034 1 bar 350° 0,486 2034 1 bar 350° 0,486 2034 1 bar 550° 0,495 2072 2 4 bars 350° 0,495 2072 4 bars 350° 0,495 2072 4 bars 350° 0,490 2051 4 bars 350° 0,524 2193 4 bars 350° 0,490 2051 4 bars 550° 0,0216 0,025 0,240 1005 Air Air Air à 20° 0,0259 0,030 0,242 1013 200° 0,0314 0,036 0,244 1021 250° 0,0336 0,039 0,245 1026 | Various material | | | | | | |
| Concrete (2000 Kg/m²) 20° 0,80 0,93 0,22 921 | Asbestos | 20° | 0,13 | 0,15 | 0,20 | 837 | |
| Bitumen 20° 0,80 0,93 0,22 921 | Asphalt | 20° | 0,80 | 0,93 | 0,22 | 921 | |
| Solid bricks | | 20° | 0,80 | 0,93 | 0,22 | 921 | |
| A 0,60 | Bitumen | 20° | 0,14 | 0,16 | 0,15 | 628 | |
| Cement mortar 20° 0,44 0,51 0,22 921 | Solid bricks | 20° | 0,42 | 0,49 | 0,215 | 900 | |
| Plaster rendering (1200 Kg/m²) 20° 0,37 0,43 0,273 1143 | | | à 0,60 | à 0,70 | | | |
| (1200 Kg/m³) 20° 0.37 0.43 0.273 1143 Liquids Alcohol 20° 0,15 0,17 0,56 2344 Heavy fuel 20° 0,112 0,14 0,42 1758 Heavy fuel 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 Steam Saturated water at constant pressure 100 to 270° - 0,4713 1973 Tito to 620° - 0,505 0,4639 1942 Superheated steam 150° - 0,4713 1973 Superheated steam 150° - 0,4648 1959 1 bar 250° - 0,468 1959 1 bar 350° - 0,468 2034 1 bar 450° - 0,468 2034 1 bar 550° - 0,488 2034 1 bar 550° - 0,490 2051 4 bars 350° - 0,490 2051 4 bars 350° - 0,0232 0,027 0,241 1008 Air Air A Air A Polyol d = 1,1 | Cement mortar | 20° | 0,44 | 0,51 | 0,22 | 921 | |
| Alcohol 20° 0,15 0,17 0,56 2344 at 0,20 at 0,23 Benzol 20° 0,12 0,14 0,42 1758 Heavy fuel 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) 0,48 (domestic) 0 = 0,846 Steam Steam | | 20° | 0,37 | 0,43 | 0,273 | 1143 | |
| Benzol | Liquids | | | | | | |
| Benzol | Alcohol | 20° | 0,15 | 0,17 | 0,56 | 2344 | |
| Heavy fuel 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 0,662 0,998 4177 Light fuel oil (domestic) 20° 0,562 0,662 d = 0,846 20° 0,48 Saturated water at constant pressure 100 to 270° - | | | at 0,20 | at 0,23 | | | |
| 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 | Benzol | 20° | 0,12 | 0,14 | 0,42 | 1758 | |
| 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) 0,48 0,48 Steam Saturated water at constant pressure 100 to 440° - - 0,4639 1942 100 to 440° - - 0,4713 1973 1973 110 to 620° - - 0,4717 1975 Superheated steam 150° - - 0,16 1925 1 bar 250° - - 0,468 1959 1 bar 350° - - 0,468 1959 1 bar 450° - - 0,486 2034 1 bar 450° - - 0,495 2072 4 bars 150° - - 0,495 2072 | Heavy fuel | 20° | 0,116 | 0,135 | 0,48 | 2010 | |
| 20° 0,505 0,586 0,999 4182 | Petroleum | 20° | 0,13 | 0,15 | 0,50 | 2093 | |
| Company | Water | 0° | 0,477 | 0,553 | 1,005 | 4207 | |
| Light fuel oil (domestic) d = 0,846 Steam Saturated water at constant pressure 100 to 270° 0,4639 1942 100 to 440° 0,4717 1975 Superheated steam 150° 0,468 1959 1 bar 250° 0,468 1 bar 350° 0,477 1 bar 450° 0,486 2034 1 bar 450° 0,486 2034 1 bar 550° 0,486 2034 1 bar 550° 0,486 2034 1 bar 550° 0,495 2072 4 bars 150° 0,495 2072 4 bars 150° 0,524 2193 4 bars 550° 0,524 2193 4 bars 550° 0,518 2168 Air Air à 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 | | 20° | 0,505 | 0,586 | 0,999 | 4182 | |
| (domestic) d = 0,846 Steam Saturated water at constant pressure 100 to 270° 0,4639 1942 100 to 440° 0,4713 110 to 620° 0,4717 1975 Superheated steam 150° 0,468 1959 1 bar 250° 0,488 1959 1 bar 350° 0,477 1997 1 bar 450° - 0,486 2034 1 bar 450° 0,486 2034 1 bar 550° 0,486 2034 1 bar 550° 0,485 2072 4 bars 150° 0,495 2072 4 bars 150° 0,524 2193 4 bars 350° 0,524 2193 4 bars 550° 0,518 2168 Air Air 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 | | 60° | 0,562 | 0,652 | 0,998 | 4177 | |
| Steam Saturated water at constant pressure 100 to 270° - - 0,4639 1942 1900 to 440° - - 0,4713 1973 110 to 620° - - 0,4717 1975 | Light fuel oil | | | | | | |
| Saturated water at constant pressure 100 to 270° 100 to 440° 110 to 620° 0,4713 1973 1975 Superheated steam 150° 0,468 1959 1 bar 250° 0,468 1959 1 bar 350° 0,468 1959 1 bar 450° 0,466 2034 1 bar 550° 0,486 2034 1 bar 550° 0,495 2072 4 bars 150° 4 bars 350° 0,495 2072 4 bars 150° 0,524 2193 4 bars 350° 0,524 2193 4 bars 350° 0,524 2193 A bars 350° 0,518 2168 Air Air à 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 | | 20° | | | 0,48 | | |
| constant pressure 100 to 270* 100 to 440° 110 to 620° 0,4713 11973 110 to 620° 0,4717 1975 Superheated steam 150° 0,468 1925 1 bar 250° 0,468 1959 1 bar 350° 0,477 1997 1 bar 450° 0,486 2034 1 bar 550° 0,486 2034 1 bar 550° 0,495 2072 4 bars 150° 0,495 2072 4 bars 150° 0,524 2193 4 bars 350° 0,490 2051 4 bars 550° 0,518 2168 Air Air Air 20° 0,0216 0,025 0,0240 1005 50° 0,0232 0,027 0,241 1008 100° 0,0259 0,030 0,242 1013 200° 0,0314 0,036 0,045 1026 Polyol d = 1,1 | Steam | | | | | | |
| 110 to 620° 0,4717 1975 Superheated steam 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° 0,486 2034 1 bar 550° 0,495 2072 4 bars 150° 0,495 2072 4 bars 350° 0,524 2193 4 bars 350° 0,490 2051 4 bars 550° 0,518 2168 Air Air à 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 | | 100 to 270° | - | - | 0,4639 | 1942 | |
| Superheated steam | | 100 to 440° | - | - | 0,4713 | 1973 | |
| 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° 0,485 2072 4 bars 150° 0,495 2072 4 bars 150° 0,524 2193 4 bars 350° 0,490 2051 4 bars 550° 0,518 2168 Air Air 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 | | 110 to 620° | - | - | 0,4717 | 1975 | |
| 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 bars 150° 0,524 2193 4 bars 350° 0,524 2193 4 bars 350° 0,490 2051 4 bars 550° 0,518 2168 Air Air à 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 | Superheated steam | 1 | | | | | |
| 1 bar 350° 0,477 1997 1 bar 450° 0,486 2034 1 bar 550° 0,486 2034 1 bar 550° 0,495 2072 4 bars 150° 0,524 2193 4 bars 350° 0,490 2051 4 bars 550° 0,518 2168 Air Air à 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 | | 150° | - | - | 0,16 | 1925 | |
| 1 bar 450° 0,486 2034 1 bar 550° 0,495 2072 4 bars 150° 0,524 2193 4 bars 350° 0,490 2051 4 bars 550° 0,518 2168 Air Air à 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 | 1 bar | 250° | - | - | 0,468 | 1959 | |
| 1 bar 550° 0,495 2072 4 bars 150° 0,524 2193 4 bars 350° 0,490 2051 4 bars 550° 0,518 2168 Air Air à 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 | 1 bar | 350° | - | - | 0,477 | 1997 | |
| 4 bars 150° 0,524 2193 4 bars 350° 0,490 2051 4 bars 550° 0,518 2168 Air Air à 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 | | | - | - | | | |
| 4 bars 350° 0,490 2051 4 bars 550° 0,518 2168 Air Air à 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 | 1 bar | 550° | - | - | 0,495 | 2072 | |
| 4 bars 550° 0,518 2168 Air Air à 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 | | | - | - | | | |
| Air Air à 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 | 4 bars | 350° | - | - | 0,490 | 2051 | |
| Air à 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 | 4 bars | 550° | - | - | 0,518 | 2168 | |
| 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 | Air | | | | | | |
| 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 | Air à | | | | | | |
| 200° 0,0314 0,036 0,244 1021 250° 0,0336 0,039 0,245 1026 Polyol d = 1,1 0,525 2200 | | | | | | | |
| 250° 0,0336 0,039 0,245 1026 Polyol d = 1,1 0,525 2200 | | | | | | | |
| Polyol d = 1,1 0,525 2200 | | | | | | | |
| · · | | 250° | 0,0336 | 0,039 | 0,245 | 1026 | |
| · · | | | | | | | |
| Isocyanate d = 1,1 0,332 1390 | - | | | | | | |
| | Isocyanate d = 1,1 | | | | 0,332 | 1390 | |

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°: 537 Kcal/kg.

* SPECIFIC WEIGHTS AND DENSITIES OF GASES

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

| GAZ | Specific weight | Density | GAZ | Specific weight | Density | |
|-------------------|--------------------|---------|-------------------------|--------------------|---------|----------|
| Acetylene | 1,173 | 0,906 | Chlorine | 3,219 | 2,49 | ŀ |
| Hydrobromic acid | 3,5035 | 2,71 | Ethyl chloride | 2,87 | 2,219 | N |
| Hydrochloric acid | 1,6393 | 1,268 | Methyl chloride | 0,991 | 0,766 | |
| Hydrofluoric acid | 0,922 | 0,713 | Nitrosyl chloride | 2,9863 | 2,31 | Carbo |
| Hydriodic acid | 5,688 | 4,4 | Cyanogen | 2,3348 | 1,806 | Nitr |
| Hydroselenic acid | 3,67 | 2,84 | Dimethylamine | 0,6804 | 0,526 | Nit |
| Hydrogen sulphide | 1,5378 | 1,1895 | Ethane | 1,3566 | 1,057 | Carbo |
| Air* | 1,2928 | 1 | Ethylene | 1,264 | 0,975 | (|
| Allylene | 1,786 | 1,381 | Fluorine | 1,635 | 1,264 | Carbon o |
| Ammoniac | 0,7718 | 0,597 | Silicon tetrafluoride | 4,684 | 3,62 | |
| Carbon dioxide* | 1,9779 | 1,53 | Producer gas | 1,141 | 0,893 | Chlor |
| Sulphur dioxide | 2,9269 | 2,264 | Natural das (processed) | 0,74 | 0,57 | PI |
| Argon | 1,7828 | 1,38 | Helium | 0,1768 | 0,1368 | F |
| Nitrogen | 1,2515 | 0,968 | Hydrogen | 0,08982 | 0,06948 | Nitrog |
| Nitrogen dioxide | 1,3402 | 1,0367 | Arsine | 3,484 | 2,695 | Carbo |
| Bromine | 7,5887 | 5,87 | Hydrogen phosphide | 1,529 | 1,18 | |
| n-Butane | 2,5985 | 2,01 | Hydride-silicon | 1,44 | 1,11 | |

| GAZ | Specific | Density | |
|------------------------|----------|---------|--|
| GAZ | weight | Density | |
| Krypton | 3,6431 | 2,818 | |
| Methane | 0,7168 | 0,554 | |
| Neon | 0,8713 | 0,674 | |
| Carbonyl chloride | 4,47 | 3,46 | |
| Nitrous oxide | 1,9781 | 1,53 | |
| Nitric oxide | 1,340 | 1,036 | |
| Carbon monoxide | 1,2514 | 0,968 | |
| Oxygen | 1,4289 | 1,1053 | |
| Carbon oxygen sulphide | 2,71 | 2,10 | |
| Ozone | 2,1434 | 1,658 | |
| Chlorine dioxide | 3,01 | 2,33 | |
| Phosgene | 4,5313 | 3,505 | |
| Propane | 1,966 | 1,52 | |
| Nitrogen protoxide | 1,9779 | 1,53 | |
| Carbon disulphide | 3,4 | 2,63 | |
| Xenon | 5,8564 | 4,53 | |



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 the current presented to each purchaser to enable that party to place an

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

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.

in writing prior to shipment of in 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

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.

5.1. 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 cancella 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 to any teason order train to the majectic, the sale may trent 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, the following training the following training the following training the following training trai

which release the vertour into congration to deliver. Wal, 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 out if the purchaser has fulfilled his obligations towards the vendor for hydroger sea.

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.

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 thedefects 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 warrantee 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 case of olders where installation and a first 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

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.

With the exception of orders with particular specifications while exception of orders will 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, actions 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

Unless the vendor provides written agreement, carriage costs shall always be borne by the purchase

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

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 assimilable to 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 installment 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

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 damage

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

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

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

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 - Franc 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 defenders 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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