Classification of ECOFLOOR products

The range of products offered by the ECOFLOOR group is very varied and it isn't easy to navigate one's way through it. The individual types were created one by one over a length of time on the basis of the requirements for the technical properties of cables for individual applications. If a cable is to be placed, for example, into the cement directly under floor tiling, it is important that it is thin and has a wattage of approx. 10 W/m. If we want to heat a driveway, the diameter of the cable doesn't matter as it is more important that the cable is mechanically resistant (robust) and that it is possible to load it with a wattage of up to 30 W/m. Protection against UV radiation is important for eaves trough cables, while for floor heating cables this characteristic is useless. That's why the choice is so varied – from the point of view of the life span, good functionality of the individual applications as well as of the prices of the products, it is more advantageous to produce more types of heating cables than one universal one. ECOFLOOR products can thus be divided according to the following characteristics:

Resistance, self-regulating and constant wattage heating cables

Heating circuits and heating mats

Single conductor and two-conductor cables

Single and stranded resistances

Cables with and without a protective screen

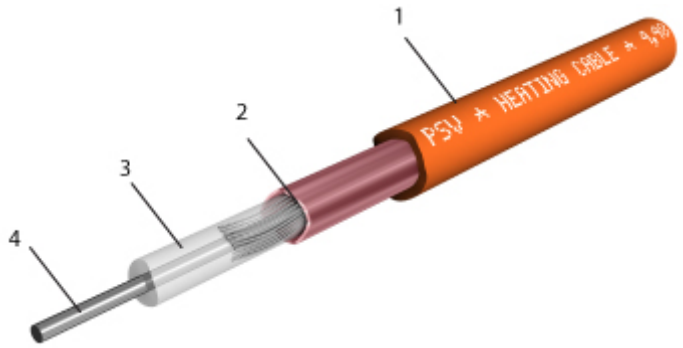
Cables of the same construction with different wattages per standard metre

Marking of heating cables

The individual types of heating cables are then created by various combinations of the above-mentioned properties.

Resistance, self-regulating and constant wattage heating cables

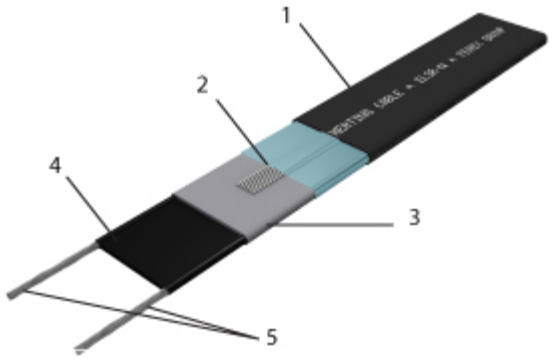
Resistance cables are the most widely used type of heating cables. The core of these cables is made of what is known as resistance (resistance material) which heats up when electric current is passing through it. Electric voltage is standardized (230V, 400V, 110V – depending on the country) but resistance is produced with different resistance values. It is possible to determine by calculation how long the cables need to be so that they have the required wattage at a given voltage – i.e. that they heat but simultaneously do not overheat. Therefore, it isn't possible to sell resistance cables by the metre and they are sold only in specific lengths and with connecting conductors already fitted – and known as heating circuits. If it is determined by calculation that a certain length of cable will have a wattage of 10W/m, its additional shortening will increase the wattage per metre. Therefore, it isn't possible to shorten heating circuits further as the cable will overheat.



1. Jacket
2. Protective screen
3. Core insulation
4. Resistance (resistance conductor)

Self-regulating cables, unlike resistance cables, don't have resistance inside the jacket but there are two conductors which lie concurrently and are "encased" in a resistance (heating) core. Electricity "flows" across the core from one conductor into the other, thus warming up the core. This core has an important property – its resistance varies depending on its temperature. The warmer

the core, the higher its resistance. Because of this, these cables are called self-regulating. A self-regulating cable can be shortened to any length and its wattage per standard metre remains the same. Thanks to self-regulation, the cable cannot overheat and therefore it doesn't matter if it crosses or is in contact with another cable or passes through environments with different temperatures. However, these properties are naturally reflected in the price of the cables and therefore they aren't used on a mass scale but only in certain applications. This self-regulating ability may seem interesting for floor heating applications, but paradoxically self-regulating cables aren't suited for this use – you can find more information, the individual types of self-regulating cables as well as their performance characteristics **here…**.



1. Jacket
2. Protective screen
3. Core insulation
4. Self-regulating resistance core
5. Conductors

Constant wattage cables are produced with different wattages per standard metre, usually 20, 30, 40 and 50 W/m – and they are constructed in such a way that they have a high temperature resistance (up to 200°C with a silicon jacket). These cables can be cut along the cuttable lengths and the wattage per standard metre always remains the same – therefore, they are known as constant wattage cables. They are, in fact, 1m long resistance cables (or 0.5m – according to the manufacturer) which have a defined wattage per 1 m. The heating cable is composed of these one metre pieces which are connected so that they form an "endless" coil. The technical properties as well as the construction of the cables are again reflected in the price, and therefore they are used mainly in special and industrial applications.

Heating circuits and heating mats

There are often enquiries as to what a heating circuit is and what the difference is between a heating circuit and a heating mat. **A heating circuit** is a cable which is shortened to a certain length by the manufacturer, fitted with an end and supply cables – known as a cold end. The installation company doesn't adapt the heating cable in any way; it can perhaps only adapt the lengths of the cold ends, and it has to install the whole length of the heating cable.

A heating mat is basically a heating circuit which is fixed into loops with regular spacing (onto fabric or using strips) in the factory. As far as the functionality is concerned, there is no difference between a circuit and a mat – it is still a heating cable. The difference is in the way it is laid – the heating circuit is more flexible but its installation is more demanding – it is suitable particularly for irregular, atypically dimensioned areas. As for heating mats, their laying is considerably easier and also an even distribution of the wattage across the surface is ensured; however, they is more suitable for regularly shaped heating surfaces.

Type-wise, heating circuits and mats are produced only from resistance cables. It is possible to prepare heating circuits also from self-regulating cables or constant wattage cables if ordered by a customer but heating mats aren't produced from these cables in practice.

Single conductor and two-conductor cables

In order for the heating cable to heat, it is necessary to close the electric circuit – it there is only one conductor (resistance) inside the cable, it is a single conductor cable. One end of the cable is connected to the phase, the other to the working conductor – the cable then has a connecting conductor at both ends (cold end) and it has to be installed in such a way that it starts and finishes at the same place.

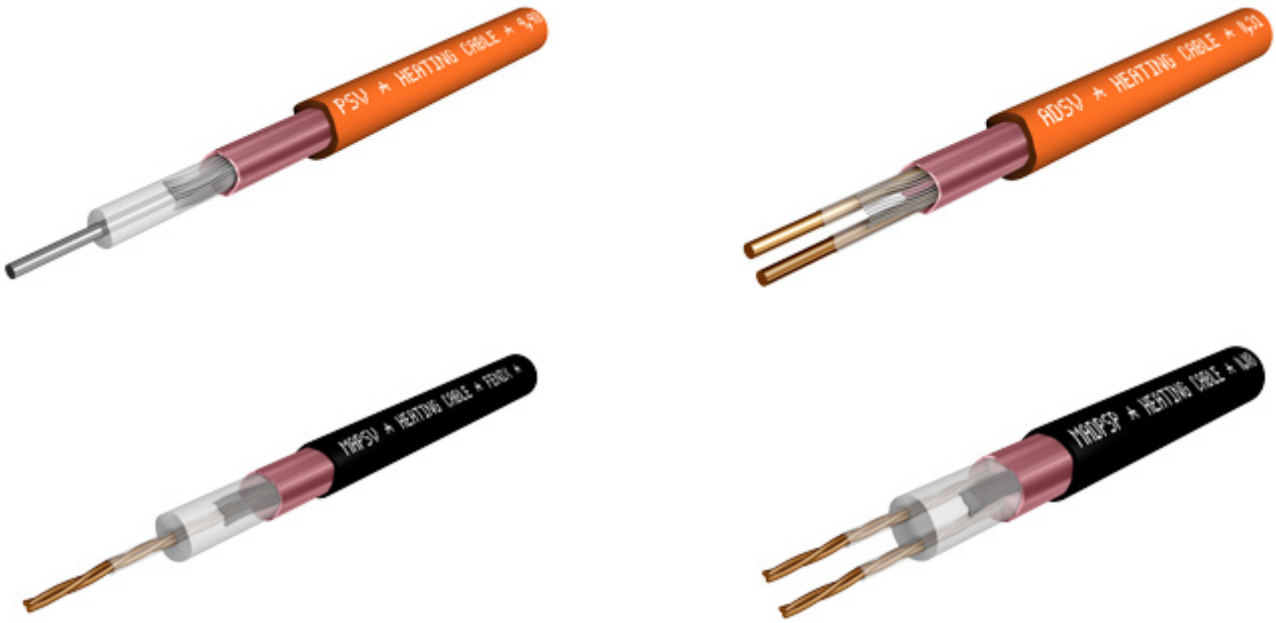
A two-conductor cable has two resistances under the jacket. On one end of the cable there is a connecting conductor which is connected into a wiring box, while the other end is fitted with a connector which connects both resistances and thus creates a closed circuit. It isn't thus necessary to return with the cable to the place of connection during installation.

Depending on whether a single conductor or two-conductor cable is used for the production of the mat, mats are either single conductor or two-conductor in type. Only resistance heating cables are divided into single conductor and two-conductor types; **constant wattage and self-regulating cables** can be only two-conductor cables for constructional reasons.

Single and stranded resistances

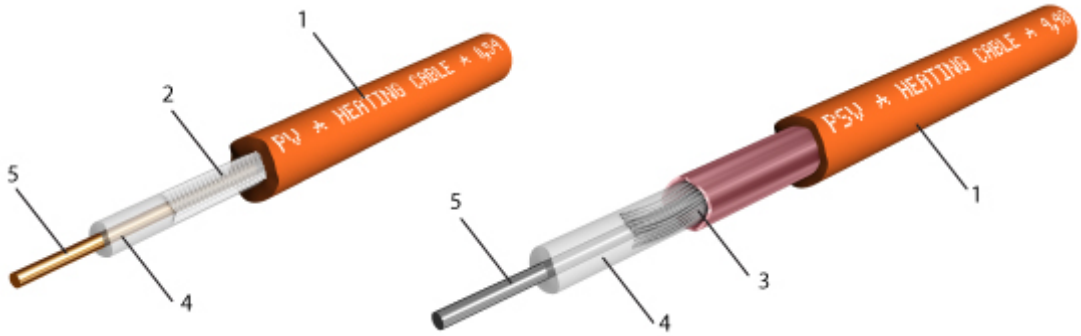
This division is again used only for resistance heating cables. The inner heating core (resistance) can consist of either one "wire" – single resistance, or it can be wound into a strand from several wires – stranded resistance.

Cables made from **single resistance** are thinner; they are loaded with wattage up to 20 W/m and they are suitable particularly for floor heating. Cables from **stranded resistance** are more robust, they have higher mechanical and temperature resistance and it is possible to load them with wattage up to 40 W/m; they are used mainly for outdoor applications such as the heating of pavements and driveways, or in storage floor heating where higher performance is needed.



Cables with and without a protective screen

The protective screen protects the user from electric current particularly if the cable is mechanically damaged. If the heating cable is damaged by a conductive object (e.g. a nail, knife or also a non-metal object in the presence of moisture), this object will first touch the protective screen which encases the heating cable and only subsequently the resistance which is under current. This will cause what is known as a short circuit and the circuit breaker will cut off the flow of electricity. Therefore, products (heating circuits, heating mats) made from cables without a protective screen must not be used in moist rooms (bathrooms) where there is a higher risk of the potential negative influence of moisture, and in standard rooms, they can be connected only via an earth-leakage breaker. However, current legislation is placing a higher and higher emphasis on the safety of applications and therefore cables with a protective screen are, thanks to their higher protection and versatility, replacing cables without a screen, whose production is gradually being terminated.



1. Jacket
2. Supporting fibreglass
3. Protective screen
4. Resistance insulation
5. Resistance

Cables of the same construction with different wattages per standard metre

Not only are heating cables produced with different constructions but also single types of construction are offered with different wattages per standard metre. For example, the PSV heating cable is offered in 10 W/m and 15 W/m versions. There are two reasons for this division:

1. **Cable placement**

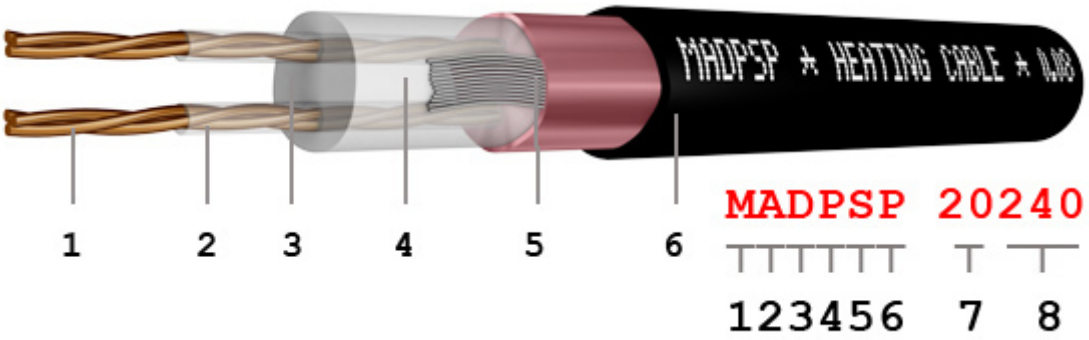
   For example, if you want to install floor heating with a wattage of 150W/m² in a bathroom, you can use a cable which has 10W/m – for one m², you will need 15m of cable (10W/m x 15m = 150W/m²) and the cable will be laid with a spacing of approx. 6.6 cm. However, if you use a 15W/m cable, you will need only 10m of cable per one m² (the circuit will thus be cheaper – there is less cable); however, the spacing of the loops will be 10 cm. If the cable is placed on thermal insulation in this bathroom and a 4-6cm layer of anhydride or concrete is placed on it, the 10cm spacing isn't then a problem and the 15W/m cable will be more suitable – the laying of the shorter cable will be easier and the circuit will also be cheaper. However, if the heating cable is placed in cement under floor tiling, the cable with the 10W/m wattage will be more suitable because thanks to the smaller spacing of the loops, the floor tiling will be heated more evenly and there is no danger that cold and warm zones will arise. Hence, the closer the heating cable is to the wear layer, the lower its wattage per standard meter (co called linear wattage) should be, so that the loops of the cable may be closer to one another.

2. **Extension of the performance series**

   The resistances from which resistance heating cables are produced have different values, but despite that, the resultant wattages cannot rise in regular intervals. In order to scale the offered wattages better, the heating circuits from one type of cable are produced with several different linear wattages. For example, if the user needs a wattage of 3000W to heat the steps in front of a house, they have a choice of MADPSP circuits of either 2400W or 3600W from 20W/m cable, or 3000W from 30W/m cable. As the cable spacing isn't crucial in the case of outdoor applications, the optimum choice would be a circuit from 30W/m cable with a wattage which corresponds exactly to the original requirement.

Marking of heating cables

A wide range of heating cables can be obtained by various combinations of the properties stated above. In order that it is clear what kind of heating cable is involved, marking with a series of letters and numbers is used. This marking isn't random – the letters are allocated according to the construction of the cable. Each letter marks one layer, starting from the inner resistance (the first letter) and continuing towards the jacket (the last letter). The numbers express the linear wattage and the total wattage of the cable circuit:



1	**M**	multi-resistance – stranded resistance wire (to be used for higher outputs); no letter is used for a non-stranded (simple) resistance wire
2	**A**	FEP (fluorpolymer)
	P	XLPE (cross-linked polyethylene)
3	**D**	double-core cable; no letter is used for a single-core cable
4	**P**	XLPE (cross-linked polyethylene); no letter is used for a cable without the second plastic insulation
5	**S**	full screen protection (tinned copper wires and aluminium tape)
	SL	linear screen protection; no letter is used for a cable without screen protection
6	**P**	XLPE (cross-linked polyethylene)
	1P	PP-LDPE (mixed polypropylene & low density PE)
	V	PVC (polyvinyl chloride)
7		Linear input of cable [W/m]
8		Total input of circuit [W]

2010-12-20