Introduction and Product Overview

Thank you for choosing AHT Underfloor Heating.

As a heating professional, you or your customers may have questions regarding the components, installation or performance of the AHT underfloor heating system.

This product description provides the information you need to respond to questions and concerns from customers and field technicians.

Comfortable and Safe

AHT's underfloor heating system radiates a comfortable, even warmth. It is clean, efficient, and non-polluting, in line with AHT's commitment to provide environmentally friendly products. The heat level is maintained quietly and safely without any noisy fans or blowers.

The AHT Advantage

AHT underfloor heating systems are based on a unique and patented amorphous metal ribbon heating technology. This technology is extremely efficient and poses no risk of any damage to the floor surface, unlike other systems operating at substantially higher temperatures. AHT Heating Mats:

- Provide safe, comfortable heating for any room, or the entire home.
- Are easily installed directly under all types of floors, eliminating costly sub-floor construction, because of the large heat transfer area and low temperatures on the ribbon surface.
- Provide warmth faster and more evenly than any other underfloor heating system.
- Are more efficient because they are not embedded in cement, thereby eliminating the need to heat the cement before heating the room.

Repairs

When you repair or replace an existing floor, you may have a limited space between the old floor and the new one. Our heating mats are made of ribbons (not wire) 2.2 mm in depth making it the only choice when you have limited clearance. Our ribbon system is perfect when using mixed floor covering as our mats fit under any floor surface.

The mats are backed by a 15-year limited warranty from date of production. See the limited warranty attached to each mat for details.

AHT's Product

Product Description

AHT manufactures ultra-thin heating mats of flat amorphous metal ribbons (the active heating element), covered by two layers of polyethylene electric insulation. The ribbons cover approximately 30% of the area of the heating mat. This design enables the heating mat to provide a very high level of even heat at low working temperatures. Attached to the mat are two cold wire leads measuring 5 meters. Longer cold leads can be supplied upon request.

AHT heating mats are available in several convenient sizes. Effective room heating requires approximately 65%-80% of the floor area to be covered; the more coverage, the less set-up time needed. AHT offers mats in a wide variety of sizes, which enable coverage of virtually any area.

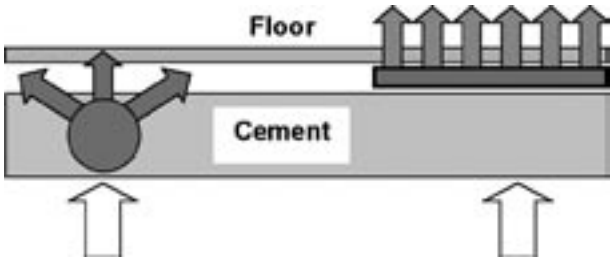
The technology is extremely efficient and poses no risk of any damage to the floor surface, unlike most other underfloor heating systems.

AHT Heating Mats

AHT heating mats are the only mats that can be installed directly under any kind of floor because of the large heat transfer area and low temperature on the ribbon surface

The mats are easily installed directly under all types of floors, eliminating costly sub-floor construction. The ultra-thin construction (+25 microns) means that the mats can be placed beneath any type of floor surface with no need to raise the surface at all.

By using AHT mats you can save up to 20-40% energy by incorporating a thermostat; and the cooling cycle is essentially longer than the heating one. For well insulated houses the heating cycle consumes only 25% of the energy in a 24-hour period.



Standard underfloor heating is achieved with a cable or pipe embedded in the concrete screed. This means that a large percentage of the heat generated is actually absorbed in the concrete which in turn means higher consumption to achieve the desired heat.

In addition, maintenance is extremely difficult and expensive.

The AHT system is laid directly under the flooring resulting in quicker and more efficient heat transfer.

The Concept of Radiant Heat

Technical Notes

Advantages of Radiant Heat

Studies conducted by the American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) indicate that with radiant heating systems people can be comfortable at temperatures 2°C to 4°C lower than with convective systems. Forced-air and baseboard (whether electric or hot-water) heating systems are convective systems because they use air as the primary heat-transfer medium.

Typically, heating outlets or baseboards are placed on outside walls, and the system is designed to fill the area with warm air until the preset temperature on the thermostat is reached. The warm air rises to the ceiling until it cools, falling to the floor for return to the furnace or to fill the convective vacuum created by a baseboard heater. Air stratification and heat loss to the ceiling are significant with convective heat.

Air is transparent to the transfer of radiant energy, which occurs directly from warmer to cooler objects. With radiant ceiling heat, the temperature varies only about 1°C to 2°C between the ceiling and the floor, with the floor being about 1°C warmer than the air; and radiant floor heating results in reverse stratification.

Humidification is unnecessary with a radiant system because radiant heat does not alter residential air moisture content, which is generally adequate if the air isn't dried out by combustion or by increased infiltration of cold, dry outside air.

Air-infiltration Heat Loss is Reduced With Radiant Heat

Air infiltration and ex filtration increase as the difference between inside and outside temperature – ΔT – becomes larger. When super-heated air from a furnace or baseboard heater flows against relatively cold exterior walls, the increased temperature differential results in a stack affect that draws cold air into the house through any cracks. With radiant systems, the air is only warmed to the temperature of the thermostat setting (which is usually lower to start with), so the temperature differential at the outside wall is less, thereby reducing air infiltration.

When applied to the sizing of a radiant system, conventional heat-loss analysis often includes a reduction in design temperature from 21°C to 18°C and a 10% to 25% reduction in building air infiltration, ex filtration, stratification and glass heat loss.

The average 21°C radiant comfort temperature with 18°day/night setback should reduce building heat load by 25% to 40% over convective systems.

An Intelligent Alternative for Commercial Applications

Radiant heating offers tremendous benefits in commercial and industrial applications – including energy savings of 25-40% over conventional heating systems. Because radiant heat warms the occupants rather than the space, it's a natural solution for large, high-ceiling structures.

Other Advantages

- Heat is down at floor level, not up in the ceilings of your mall, shop, theatre, warehouse or factory
- Constant temperatures help to keep precision equipment in calibration
- After overhead doors are opened, comfortable temperatures are re-established quickly
- Radiant heat is quiet and clean with no noisy fans to blow dust around the workplace
- Heat stored in a concrete floor can protect perishable products in the event of a power failure

Cost Effectiveness

The following table provides an estimate for the cost effectiveness of AHT's radiant heat system. The calculation is for a room 96 m^2 and 2.4 m height. The thermal resistance of the room is based on a common building code of R=2.86°Cm^2/W. The floor covering is 14 mm parquet or 12 mm granite porcelain. A month is calculated as 30 days.

The following table displays the electric power usage (in kW per square meter per month) of AHT's radiant heat system during one month of 24/7 heating at various outdoor temperatures.

Temperature difference between indoor and outdoor °C	Electric power usage (kW/m^2/Month)
12.00	4.350
22.00	8.070
27.00	10.000
32.00	11.610
42.50	15.480
47.00	17.100

Cost Considerations

Installation costs for AHT mats are lower than all other underfloor heating alternatives due to their relatively low operating temperature, which allows installation of the mats directly under all types of floor covering. No sub-floor construction is needed.

When estimating operating costs, take into account local electricity rates, including off-peak rates if available. Measure the total heated area, multiply it by the specific input power of the heating system (for example, 120W per square meter), and then estimate the expected duty cycle (% time the heating elements are turned on). With typical heat loss parameters, a duty cycle of about 25% is expected. This means that the underfloor heating system needs to work only six hours out of every 24, thus saving an enormous amount of energy.

Standard Sizes and Electrical Values of Heating Mats

AHT heating mats are manufactured in standard families:

100 watts/m², 220-240 Volts family – for Europe:

Width/m	Length/m	m²	Nominal Watts/m²	Nominal Total power (w)	Nominal current (Amp)
0.5	1.5	0.75	100	75	0.32
0.5	2.0	1.0	99	99	0.43
0.5	3.0	1.5	105	157.5	0.68
0.5	4.0	2.0	106	212	0.92
0.5	5.0	2.5	102	255	1.10
0.5	6.0	3.0	106	318	1.38
1.0	1.5	1.5	104	157	0.68
1.0	1.0	1.0	99	99	0.43
1.0	2.0	2.0	106	212	0.92
1.0	2.5	2.5	102	255	1.10
1.0	3.0	3.0	106	318	1.38
1.0	4.0	4.0	110	440	1.91

120 watts/m2, 220-240 Volts family – for Europe:

Width/m	Length/m	m²	Nominal Watts/m²	Nominal Total power (w)	Nominal current (Amp)
0.5	1.5	0.75	125	94	0.41
0.5	2.0	1.0	123	123	0.53
0.5	3.0	1.5	118	177	0.76
0.5	4.0	2.0	132	264	1.15
0.5	5.0	2.5	122	305	1.33
0.5	6.0	3.0	118	354	1.54
1.0	1.0	1.0	123	123	0.53
1.0	1.5	1.5	118	176	0.76
1.0	2.0	2.0	132	264	1.15
1.0	2.5	2.5	122	305	1.33
1.0	3.0	3.0	118	354	1.54
1.0	4.0	4.0	110	440	1.91

150 watts/m², 220-240 Volts family – for Europe:

Width/m	Length/m	m²	Nominal Watts/m²	Nominal Total power (w)	Nominal current (Amp)
0.5	1.2	0.6	157	99	0.43
0.5	1.5	0.75	150	113	0.49
0.5	2.0	1.0	148	148	0.64
0.5	2.5	1.25	151	189	0.82
0.5	3.0	1.5	161	241	1.04
0.5	3.5	1.75	148	259	1.12
0.5	4.0	2.0	159	318	1.38
0.5	4.5	2.25	151	339	1.47
0.5	5.0	2.5	153	383	1.66
0.5	5.5	2.75	140	385	1.67
0.5	6.0	3.0	157	471	2.04
0.5	6.5	3.25	167	542	2.36
0.5	7.0	3.5	144	504	2.19
1.0	1.0	1.0	148	148	0.64
1.0	1.5	1.5	161	242	1.05
1.0	2.0	2.0	159	318	1.38
1.0	2.5	2.5	153	383	1.66
1.0	3.0	3.0	157	471	2.04
1.0	3.5	3.5	144	504	2.19

Note: Power is calculated to IEC standards which allow for manufacturing tolerance of -10% to +5% of the nominal power value. The IEC standard also allows -10% to +10% for low power units up to 132 watts per square meter.

Performance

You can use the AHT heating system as a primary heat source, or as a supplementary (added comfort) heat source. If it is a primary heat source, then the performance of the heating system is a function of the heat supply capability minus the heat loss through ceiling, walls, windows, floor, etc.

Heat loss is a function of the outside temperature, the quality of house insulation, and household behaviour. The heat watt loading must be checked due to watt losses of the structure itself.

Accessories

Grounding Nets

When installing heating mats in wet areas [Wet areas include saunas, bathrooms, kitchen areas and utility rooms within 50 cm of sinks or any metallic kitchen appliance] AHT recommends installing grounding net to increase the safety of our underfloor heating system notwithstanding that AHT heating mats have double polyethylene insulation.

AHT supplies the required grounding nets in the following sizes

- 0.5 x 1.0 m
- 0.5 x 2.0 m
- 0.5 x 3.0 m

A 5-meter cold lead (electrical wire) is attached to the grounding nets.

Insulation of the Heating Mat

Heat transfer takes place by conduction, convection and radiation. The purpose of heat insulation is to prevent heat losses in unheated areas. For this purpose different kinds of insulation materials can be used. The R-value parameter defines the insulation properties of material (in other words how good the material insulates). R-value is the ratio of material thickness to the thermal heat conductivity of the material. The more the R-value is, the better heat insulation. High R-value can be achieved by using materials with low coefficient of thermal conductivity. This is the main parameter for checking materials for insulation. The R-value depends also on the insulation thickness. The higher the thickness, the better the material insulates. Usually the thickness of insulation material is defined by heat transfer conditions and price of insulation material.

Soft Insulation Material

This type of material is typically used for parquet and wooden floors and under carpet (without adhesive). The R-value of the material must be at least 0.1 m^2 °C/W and compressive strength more than 0.02 Kg/cm^2 (see Installation Manual for checking appropriate materials).

Hard Insulation Material

Insulation of this type is usually used for tiles floors and under carpet (with adhesive). In such a case the R-value of the material must be at least 0.1 m^2 °C/W and compressive strength more than 2 Kg/cm^2 (see Installation Manual for checking appropriate materials).

Important Note: When installing insulation material under carpeting, always make sure that the R-value of the insulation is at least the same or greater than the R-value of the carpet.

Installing Your AHT Heating Mats

Typical Heating Mat Installation

Please refer to the Installation Manual for typical heating mat installation.

Effective room heating requires approximately 80 % of the floor area to be covered. AHT offers mats in a variety of sizes, which enable coverage of virtually any area. Plan to use the larger heating mats as much as possible, with smaller mats used only as gap fillers. Consult the Installation Manual for the installation process.

It must be strongly emphasized that the wooden floors should be no thicker than 18 mm.

Wood is a heat insulator and if the thickness is >18 mm the safety drops because of drastically rising heating mat temperature.

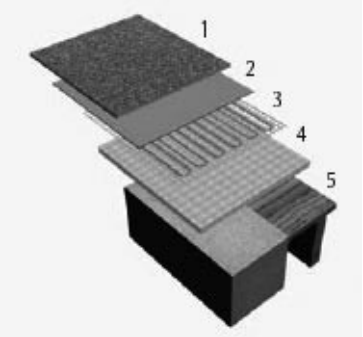
Sometimes floors are covered with different types of carpeting. We recommend that R- value of the carpet not exceed 2.0 Tog.

Installation Examples

Installation procedures are fully described in the Installation Manual. The following are examples of installations under various flooring types.

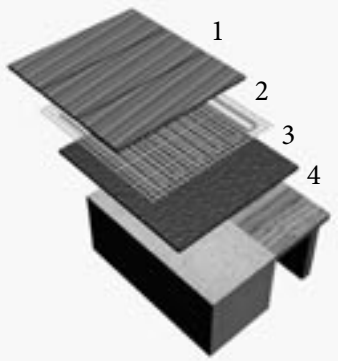
Under vinyl or linoleum in dry surroundings (*)

1. Vinyl or linoleum
2. Self levelling flooring cement or latex compound of at least 6mm thickness
3. Heating mat
4. Hard or soft insulation material
5. Floor slab (wood or concrete)



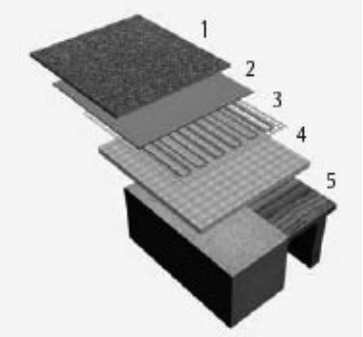
Under wood, laminate, parquet flooring in dry surroundings(*)

1. Wood flooring material
2. Heating mat
3. Soft insulation material
4. Floor slab (wood or concrete)



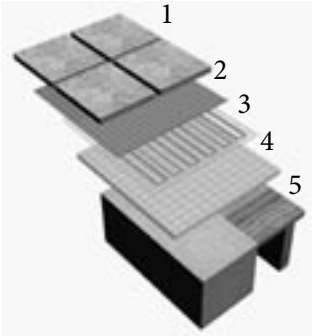
Under Tiles in dry surroundings

1. Tiles
2. Thin-set/Grout /Tile adhesive
3. Heating mat
4. Hard insulation material
5. Floor slab (wood or concrete)



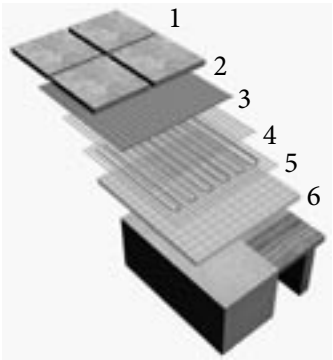
Under Tiles in wet surroundings

1. Tiles
2. Thin-set/Grout/Tile adhesive
3. Grounding net
4. Heating mat
5. Hard Insulation material
6. Floor slab (wood or concrete)



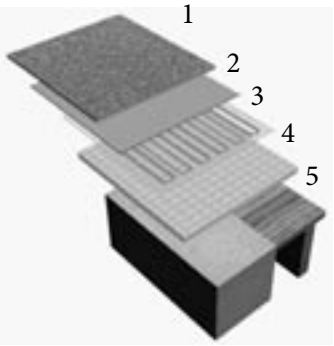
Under glued type carpet (with adhesive)(**)

1. Carpet, vinyl or linoleum with adhesive
2. Self levelling flooring; cement or latex compound of at least 6mm thickness
3. Heating mat
4. Hard or soft insulation material
5. Floor slab (wood or concrete)



Under non-glued type carpet (without adhesive)(**)

1. Carpet without adhesive
2. Underlay
3. Heating mat
4. Soft insulation material
5. Floor slab (wood or concrete)



Remarks:

(*) In wet surroundings the heating mat layer should be referred to as heating mat with grounding net installed directly above it.

(**) Please check local building codes and regulations and act according to them if they contradict the instructions above.

Do not use carpet underlay with more than 0.8 Tog.

Use a Hessian backed carpet with a lower than 2.0 Tog. Always ensure that the Tog value of the insulation is at least the same as the carpet.

Installation Options

Noise Insulation

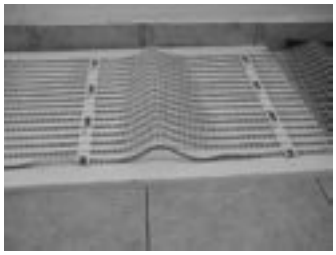
To prevent traffic noise on wood (parquet) flooring, sound protection materials must be used. Typically soft insulation materials also possess good sound prevention qualities. In cases where the soft insulation does not provide adequate sound protection, additional layers of the acoustic material between the heating mat and wood floor can be used. R-value of the layer must be lower than 0.014 m^2 °C/W. The same R-value limit applies to the carpet underlay.

Installing heating mats when the double sided sticker does not hold satisfactorily

While installing the heating mats you may find some wrinkles that will concern you.

There are two ways of solving this problem.

Installation with AHT Glue gun:*



Step 1

Cut a square piece of duct tape.

Step 2

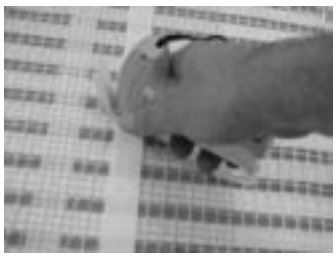
Press the heating mat to the surface and apply a small amount of glue.

Step 3

Squeeze out the glue with the piece of duct tape toward the insulation at the mat level and wait a few seconds.

(NOTE: Apply glue between the heating wires, on the fibreglass net only)

Installation with AHT–Plastic Tag Nail Gun:



Step 1

Place a piece of scotch tape on the wrinkle.

Step 2

Press the heating mat to the insulation and start shooting the plastic tags.

Step 3

The final appearance.

(NOTE: shoot between the heating wires, on the fibreglass net only).

Remarks:

(*) AHT Glue can be used with all makes of heat glue guns

Electrical Wiring and Electrical Accessories

Each room with an AHT heating system must be provided with its own electrical junction box and control thermostat. Each AHT thermostat has a maximum capacity of 16 Amps. If the amperage in the room is greater than 16, divide the amperage over several thermostats, or add a contactor between the mats and the thermostats.

Residual Current Device (RCD)

The electric circuit that supplies electricity to the AHT heating system should be equipped with a Residual Current Device (RCD) according to local regulations.

Control Thermostats

Control Thermostats come equipped with two types of temperature sensors:

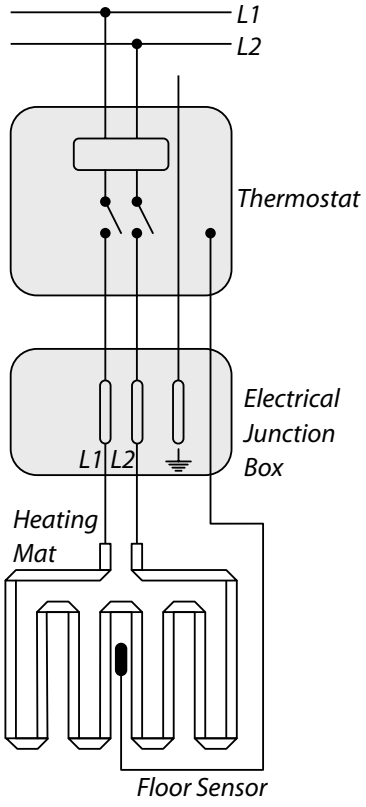
- Air temperature sensor – usually embedded in the thermostat itself. This sensor controls the room temperature for primary heating systems.
- Floor temperature safety sensor – This sensor acts as a cut-off mechanism to keep the floor temperature within the prescribed limit.

In bathrooms, use a thermostat with only a floor temperature sensor. You can use the same kind of thermostat for other wet areas such as kitchen, but it is not obligatory.

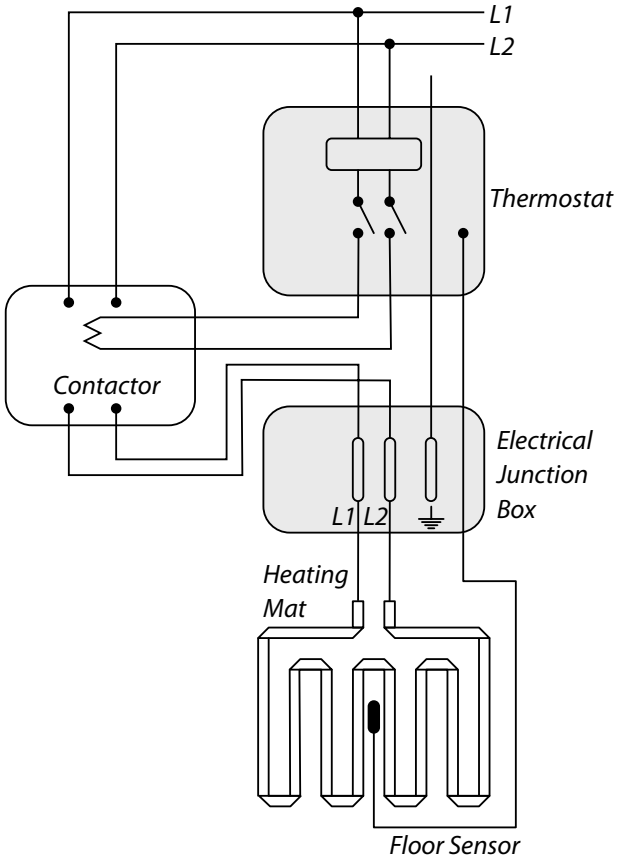
Use a thermostat with air and floor temperature sensors for all other installations.

Typical Wiring Diagrams

For circuits less than 16 amps



For circuits more than 16 amps



Making the Electrical Connections

Typical Electrical Connections

Please refer to the Installation Manual for typical connections of the heating mats' cold wires to one connection box.

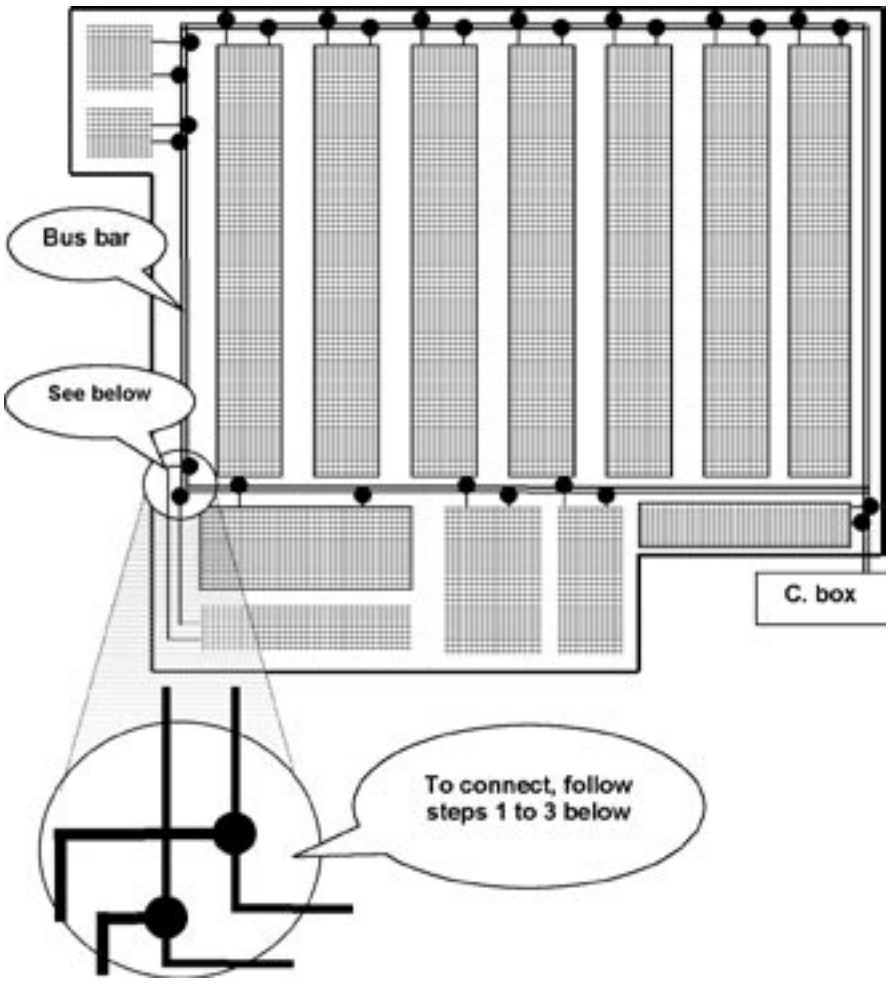
Electrical Connections - Options

Installing the heating mat using a bus bar (not for use in wet areas)

If it is not possible to install the mats with cold leads between the mats facing towards the connection box (as per the Installation Manual), then you can install the heating mat using a bus bar.

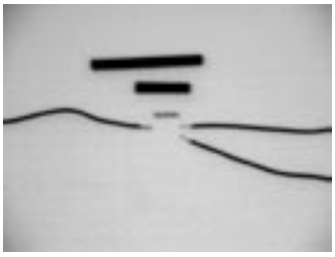
Note: The bus bar is double insulated 2.5 mm^2 wire (the blue and brown wires can be ordered from AHT in 500-meter rolls).

Electrical Connection Diagram



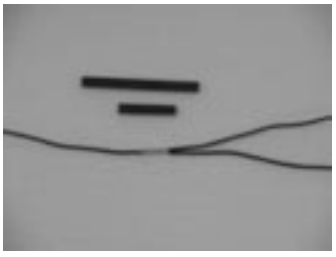
Please follow these simple steps:

The bus bar is a closed circle of two cables, 2.5 mm2 double insulated as shown in the drawing above. After installing the cables around the room:



Step 1

Cut the cable at the desired place.



Step 2

Connect 4 mm crimp sleeve on the cable.

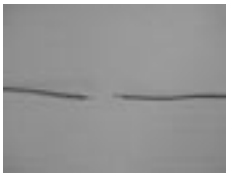
Step 3

Shrink in waterproof double shrinking tubes above the crimp sleeve.

Extension Kit for Cold Leads

AHT mats are provided with 5-meter cold leads. However, in some cases this length is not sufficient and an extension must be made by a qualified electrician.

The following is a step-by-step guide for extensions:

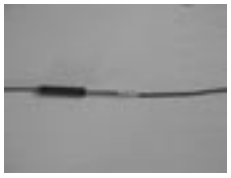


Step 1

Expose 6 mm of the wires edge on the extension and the original wire.

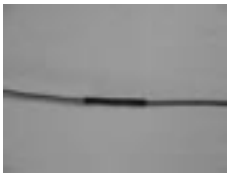
Step 2

Insert the exposed edges into the copper crimp sleeve (standard sleeve 2.5 mm diameter), then crimp the edges using the crimping tool.



Step 3

Slide the shrink tube over the crimped copper tube.



Step 4

Use the heat gun to shrink the tube.

Repairing Heating Mats

The following provides step-by-step instructions for repairing a short-circuited heating ribbon. This type of repair should only be performed by qualified technicians.

Step 1 – Identify the location of the short-circuit

- Identify the faulty heating mat by measuring the resistance through its connections in the electrical connection box.
- Locate the physical location of the faulty mat in the recorded installation floor plan. Verify the approximate location of the short-circuit using a standard tool for underfloor short-circuit identification, for example, Advanced Wire Tracker models AT-2001, 2002, 2003, and 2004 from Am probe Instruments.
- Remove the floor covering to expose the faulty mat and locate the exact location of the electric short-circuit.

Step 2 – Prepare for the repair

- Have the following available:
- AHT repair kit
- A hand crimping tool (Tyco Electronics AMP Termi-Foil, model 68026)
- A heating gun.
- Cut the faulty area leaving a gap of about 50 mm between the ends of the ribbon.

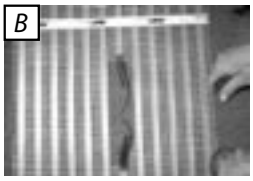
Step 3 – Repairing the Fault

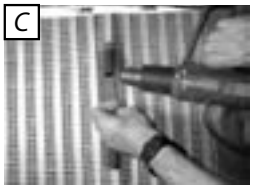
A. Using the crimping tool, crimp the connectors from the AHT repair kit to the severed ribbon ends.

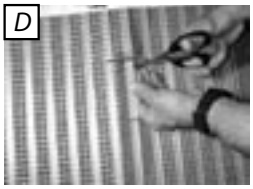
B. Slide the heat shrink-tubes over the crimp connections.

C. Starting from the wire end (narrow end) of the heat shrink-tube, and moving towards the ribbon side, use the heat gun or hair blower to shrink the tubes.

D. Squeeze the heat shrink-tube over the ribbon with your hands. Make sure that glue comes out of the end of the tube to ensure that the repaired area is moisture resistant.

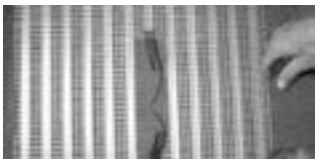






Step 4 – Testing the Repair

Test the repaired heating mat's resistance to verify that it is within tolerances.



Troubleshooting

AHT heating mats are designed to be maintenance free. Failures may occur as a result of damage to the heating elements during installation. The following table provides a list of possible problems you may encounter. For each problem, possible causes and solutions are provided.

Problem	Possible Cause	Remedy – Action
No heat in the entire room/floor	Main circuit breaker is off	Reset the main circuit breaker. If the breaker cannot be reset, verify that it can handle the heating system load.
	RCD tripped	Reset the RCD. If the RCD cannot be reset disconnect the wires from the RCD and try to reset the RCD. If it doesn't reset replace the RCD. If it does reset it means that there is a fault with one of the mats. Use a Megger to identify the faulty mat; disconnect it and consult your AHT representative.
	Faulty thermostat	Check that the thermostat settings (on/off position, temperature setting, and clock setting) are correct. If all the settings are correct, replace the thermostat.
No heat in part of the room/floor	A heating mat is disconnected	Check the heating mat connections in the electrical connection box. Tighten any loose connections.
	A heating mat has short-circuited	Check the electrical resistance between the cold leads. If there is a short-circuit, follow the Repair Manual instructions.
Overheating in the entire room/floor	Thermostat setting is too high	Set the thermostat to a comfortable level.
	Faulty thermostat.	Replace the thermostat.
	Wrong power line supply (230/240 V instead of 110 V, 380 V instead of 230 V)	Make sure you are using the correct line voltage. Rewire if necessary.
Overheating in a part of the room/floor	Thermal blocking	Avoid placing floor level furniture (futons and mattresses, for example) on the floor.
Room not warm enough setting.	Thermostat setting is too low	Set thermostat to a higher temperature.
	Floor sensor is under thermal blocking	Avoid placing floor level furniture (futons and mattresses, for example) above the floor sensor.
	Floor sensor setting is incorrect	Raise the floor sensor setting.
	Improper insulation under the heating mat	Requires system upgrade.
	Initial heat loss calculations were wrong	Requires system upgrade.
Different level of heat in the room	Wrong connection –possible that some mats connected in series instead of parallel.	Open the connection box and reconnect the mats correctly.

AHT Safety Standards and Patents

AHT heating mats are designed and manufactured to the highest safety standards. They are Class II, double insulation products that meet the following certification standards:

IEC 60335-1 (general requirements for household electrical appliances)
IEC 60335-2-96 (particular requirements for flexible sheet heating elements used for room heating)
BS 6351-1
BS 7430:1998
NF C 32-330:02
UL -1963
CNL-CSA - C22.2 No 217

Each AHT heating mat bears a CE mark (Conformité Européenne); an N mark (Nemko - Norway); the British Standards Institute's Kitemark for safety certification; UL certification. NF mark and cULus.

Testing and Quality

Certifications – The following four independent certification authorities have tested and approved the use of AHT heating mats: add NF

- UL in the USA – for meeting the requirements of UL 1693.
- Nemko in Europe – for meeting the requirements of EN IEC 60335-1 and EN IEC 60335-2-96.
- NF in France – NF C 32-330:2
- Ukraine Government of Meteorology and Standards in the Ukraine – for meeting the requirements of D CTY 3135.0-95.

Testing During Production

Each heating mat is tested in the factory for proper output power, as well as for the proper insulation conformity (ability to withstand 2,500V).

Testing After Installation

To ensure that the heating mats are not damaged during installation, test the mats before laying down the floor covering, and retest them immediately after laying down the floor covering. For details, refer to the Installation Guide.

Safety Summation

Since each individual AHT heating mat undergoes stringent production line testing according to the certification standards noted above, if installed correctly according to the guidelines published in our Installation Guide, the mats are perfectly safe, and will provide warmth and comfort for many years.

Patent

AHT holds international patents regarding underfloor heating with amorphous metal technology.

Comparison of Radiant Heating Technologies

Feature	Water Based	Heating Wire Cables	AHT Heating Ribbons
Covered area	5%-10%	1%-3%	20%-30%
Heating Uniformity	Poor	Poor	Excellent
Working temperature	50-60° C	50-60° C	28-30° C
Installation cost	High	Medium	Low
Maintenance	Needed	Not needed	Not needed
Cost of maintenance	High cost	Low	Low
Installation	Difficult	Easy	Easy
Energy consumption	High	Medium	Low -Medium

Comparing the Heat Transfer Efficiency of Amorphous Ribbon and Wire

A calculation was made using the following parameters:

1. The length of the ribbon/wire was 1 meter
2. Ribbons thickness was 20μm
3. The resistance of both was 1.4 x 10^{-6} Ohm per meter
4. The heat transfer coefficient of both was taken as 5.6 Watts/m^2 °C.
5. The temperature difference between the surface of the ribbon/wire and ambient air was 100 °C.
6. Cooling conditions were assumed to be free convection.

Temperature comparison at the same heating power between ribbon and wire heating element

Cross section m^2 10^{-6}	Wires diameter, m 10^{-3}	Ribbon Width, m 10^{-3}	Heat transfer Area for unit length m^2/m 10^{-6} Wire	Heat transfer Area for unit length m^2/m 10^{-6} Ribbon	Temperature difference ratio of Wire to Ribbon*
0.0177	0.15	0.885	0.471	1.77	3.76
0.031	0.20	1.55	0.625	3.10	4.89
0.049	0.25	2.45	0.785	4.90	6.25
0.071	0.30	3.55	0.942	7.10	7.54
0.096	0.35	4.8	1.10	9.60	8.73
0.126	0.40	6.3	1.26	12.60	10.00
0.196	0.50	9.8	1.57	19.60	12.47

**"Temperature difference" is the difference between the surface and air temperatures.*

The conclusions derived from the above table are as follows:

1. The ribbon's larger heat transfer area provides the same heating power at a lower temperature than the wire.
2. The ribbon's heat efficiency is significantly superior to the wire's heat efficiency.
3. The low temperature of heating element allows the use of low temperature electric insulation (e.g. polyethylene).

AHT Amorphous Ribbons FAQs

- *How easy is the system installation?*
- *How efficient are the heating mats under wooden or carpeted floors?*
- *What are the safety measures against electrical shock hazard?*
- *Why are certain other under floor heating elements (mainly heating wires) constructed with a metallic sheath or shield around the heating element, while AHT heating elements are not?*
- *What are the recommended RCD characteristics to be used with the system?*
- *What is an amorphous solid?*
- *What is an amorphous metallic alloy ribbon?*
- *What's special about amorphous ribbons?*
- *Why is AHT amorphous ribbon an excellent heating element for moderate temperature heaters?*
- *What's unique about AHT amorphous ribbons?*
- *Why are AHT mats of special interest for underfloor heating?*

How easy is the system installation?

AHT heating mats are extremely simple to install. In the case of installation under tiles the heating mats are simply laid directly between the sub-floor and tile. The same materials used for laying tiles are used for bonding the electric radiant heating mats to your sub-floor. In the case of installation under timber or parquet floors, the installer lays the heating mats on the sub-floor and lays the timber elements directly on the mats in the same manner as a standard timber installation. A certified electrician can complete the connection between the heating mats and the electrical circuit. No time-consuming calculations, labor or additional materials are required.

How efficient are the heating mats under wooden or carpeted floors?

Because AHT heating mats are constructed of ultra-thin amorphous ribbon – 25 microns – heat is not absorbed by the metal. It is therefore immediately transferred to the floor area and the ribbon temperature remains relatively low at around 28-30 °C. This attribute is crucial under wood and carpet installations which can be easily damaged by higher temperatures.

What are the safety measures against electrical shock hazard?

We have placed maximum emphasis on the performance of the electrical resistance of our coating. Our product is a class 2, double insulation product. As such it has been tested and found to comply with safety standard IEC/EN 60335-2-96:2002 and IEC 60335-1:2001/EN 60335-1:2002 to withstand 2500 volts for 1 minute. This means that the product has sufficient electrical resistance according to the strictest standards. We also test each unit in the production line for electric withstand of 2500 volts, again- according to the relevant IEC standards for unit inspections in the production line. The electric withstand testing is repeated on each unit after installation using a Megger tester, and the measured resistance value is recorded on the warranty card.

Why are certain other under floor heating elements (mainly heating wires) constructed with a metallic sheath or shield around the heating element, while AHT heating elements are not?

The fact is that the additional metallic shield is not a significant factor in the prevention of electrical shock hazard. The risk at issue is someone inadvertently punching a metallic object like a nail or needle through the floor covering (carpet or timber) and into the electricity carrying metallic heating ribbon.

The resulting physical effects on the person will be similar to the effects created by sticking the same object into a common electrical socket in the house. In the latter case there is no other way to protect the person from a shock hazard except by using a RCD (Residual current device). All under floor heating mats needs to be connected to a RCD which is an integral part of our thermostats line.

This is the reason why all the applicable standards, codes and practices require the mandatory incorporation of a RCD in the electrical circuitry of an electrical under-floor heating system, while leaving the alternative of including a metallic shield around the heating element as a design consideration for the element manufacturer. Note that most heating wire manufacturers include metallic shield for mechanical strength considerations for more than safety reasons. AHT flat ribbon has an inherent strength (because of the flatness and the large horizontal cross section) so that metallic strengthening is not required.

What are the recommended RCD characteristics to be used with the system?

Ensure that the electric circuit that supplies electricity to the under floor heating system is equipped with a 30 mA Residual Current Device (RCD).

According to safety standard IEC/EN 60335-2-96:2002 AND IEC 60335-1:2001 /EN 60335-1:2002

What is an amorphous solid?

An amorphous solid has the random internal structure of a liquid. In contrast to an amorphous solid, a crystalline solid possesses an ordered, periodic internal structure forming a latticework. Usually, if you cool a liquid it solidifies into a crystalline structure. However, if cooling is very rapid then the liquid solidifies without forming any crystalline structure. This is true for liquid (melted) multi-component metallic alloys (alloys which include two or more kinds of atoms).

What is an amorphous metallic alloy ribbon?

Amorphous metallic alloys, often referred to as metallic glasses, are relatively new materials, mainly available in the form of thin ribbons. They are prepared from molten metallic alloys by a rapid cooling technique. In this technique a ribbon of molten metallic alloy is poured onto a rapidly rotating copper drum. Due to the thinness of the ribbon 20 to 30 microns, it cools very quickly (at a rate of about 1,000,000 degrees/second). Since solidification occurs so quickly, no crystalline structure has any chance of forming. Instead, an amorphous solid, in the form of a very thin ribbon, is created (the width varies from a few millimeters to 10cm.

What's special about amorphous ribbons?

Obviously, the lack of any crystalline structure in amorphous ribbons is special. However, other sproperties of the material are affected by this lack of crystalline structures. The boundaries between crystals in crystalline solids typically cause most of the material's faults. The homogeneous, non-boundary structure of amorphous metallic alloys provides unique mechanical, anti-corrosion, wear resistant, and magnetic properties. It makes amorphous metallic alloys superior in many ways to the more common crystalline metals.

Why is AHT amorphous ribbon an excellent heating element for moderate temperature heaters?

Due to the absence of crystalline structure, amorphous ribbons have higher electrical resistance than crystalline solids of the same composition. Together with the physical form of the ribbon, which provides a low mass to surface area ratio, it makes the ribbon a very attractive candidate as a heating element. Why?

The explanation is very simple: energy transfer from any heating element is proportional to its surface area and the temperature difference between the heater and its environment. The larger the surface area,

the lower the temperature difference needed to transfer energy from the heater to its environment.

Since the surface area of the ribbon is relatively large (compare it with the surface area of a conventional wire used in many heaters) it is able to efficiently transfer heat to its environment at lower temperatures. In a domestic heating environment, lower temperature means a healthier environment and greater safety and durability.

What's unique about AHT amorphous ribbons?

All other producers of amorphous ribbons are targeting electromagnetic applications using the ribbon as soft magnetic material for various electronic components. AHT is the only company using amorphous ribbons for heating applications (US Patent 5,641,421). The AHT ribbons are more reliable, with higher electrical and corrosion resistance. Their main characteristics are:

Thickness	20-30 μm
Width	2-100 mm
Corrosion resistance	high (nickel and chrome based)
Ductility and flexibility	high
Heat transfer area	high
Warm-up time to steady state	low

Why are AHT mats of special interest for underfloor heating?

Many features of AHT heating mats make them attractive for surface heating:

- Efficient heat transfer because of the large surface area and the ultra-thinness of the ribbons that prevents heat absorption by the metal. This enables the mats to be used under wood and carpets.
- They eliminate risk, never heating too much to change the characteristic of the metal.
- Faster and more efficient heating because the mats can be placed directly under the surface in most cases (while most of the other systems need to be embedded in cement due to their high temperature.)
- Low heating inertia because of the low mass of the ribbon. Especially in a more rapidly fluctuating (on/off) mode, you can expect energy savings due to both low heating inertia and efficient heat transfer.
- Possibility of using cheaper/less insulating material because of the lower heating temperature used.
- Very convenient physical shape, allowing fast and easy installation.
- Higher reliability because of the low heating temperature, high mechanical strength and corrosion resistance properties.