

## ▶▶ Table of content

Introduction

Product description

Planning

Installation

Testing

Trouble shooting

Accessories

Appendixes

- a. AHT safety statement
- b. Radiant heating technical notes
- c. Repair manual
- d. Products technical information
- e. A comparison between radiant heating technologies
- f. Q & A

# Introduction

As a heating professional, you may ask or be asked questions by clients regarding a variety of subjects related to the functions, installation and performance of the AHT products.

The purpose of this document therefore is to provide you with additional information and tools that will enable you to properly address most questions you have regarding the product as well as questions received from customers and field technicians.

Under floor (radiant) heating provides an even and extremely comfortable heat with no blasts of hot air that stir up dirt and dust.

The absence of radiators makes furniture placement easier and creates a safer environment with no hot surfaces present.

Under floor heating radiates a comfortable, even heat that is healthy, safe and clean to the occupants and to the surfaces of the room. There are no noisy fans or blowers and the heat is soft, quiet and pleasant. Additional technical information regarding radiant heating can be found in appendix B.



**AHT** Underfloor heating systems are based on a unique and patented amorphous metal heating technology, and have significant advantages over any other type of hydronic or cable based Underfloor-heating systems:

**It** fits directly under all types of floor covering, dismisses the need of costly additional sub constructions.

**It** reaches the working temperature faster than other systems.

**It** generates more even heat.

**It** is less costly and more economic to operate.

**It** has low profile and superior flexibility.

**It** is extremely simple and easy to install.

**It** is perfectly safe from electrical shock hazards and electromagnetic radiation.

**It** is reliable and durable.





## 1. Product Description

- a. Packaging – AHT mats may be supplied, packed in bulk or individually.
- b. The Heating Mat – AHT heating mats are made of flat ribbons (the active heating element) that are integrated in a fiberglass net that adds structure and definition to the heating mat. Attached to the mat are two cold wire leads measuring 4m (12ft) each.
- c. The ribbons cover at least 30% of the area of the heating mat, in order to achieve low working temperature and extremely even heat.
- d. Ribbon Color – The widths of AHT's ribbons are color coded, as below:

Color	Purple	Orange	Blue	Green	White	Grey	Yellow
Ribbon width(mm)	7	10	12	15	18	20	25

The various widths enable manufacturing different sizes of heating mats with the same output power per sqm. Larger mat area requires the use of a wider ribbon.

- e. For Heating Mat sizes and electrical specifications – please refer to Appendix D.
- f. AHT heating mats are designed individually to receive electricity directly from the line supply and therefore should be connected in parallel to the supply and not in series one to another.

## 2. Planning

- a. While planning the implementation of the AHT heating system, the first step should be the determination of the purpose of the system after installation, ie. The system can be used as the primary heat source, or it can be used as a supplementary heat source to provide comfort heat only. In case of primary heating, the performance of the heating system is a function of the heat supply capability of the system against the heat losses through the ceiling, walls, windows and from the floor etc. The expected outside temperature, the quality of the insulation of the house as well as the expected behavior of the household, dictate the heat loss. Whenever any doubt should arise, have a heat loss calculation performed by an expert .
- b. The second step is the planning of the floor lay out. Each heated room requires covering of approximately 80% (in case that the unit has been planned to serve as a primary heat source) of the floor area by heating mats. The variety of available heating mat sizes will allow you to cover almost every floor shape while achieving the recommended 80% value. You should plan using the larger heating mats as much as possible and the smaller ones as gap fillers. Note that heating mats should not overlap each other.
- c. When planning the floor-covering layout do not place heating mats in areas under cabinets or fixtures (toilets, sinks, tubs, etc.). Try to leave a gap of at least 10 cm (4 inches) from the room walls.
- d. Whenever possible prefer using 230 Volts units to 110 Volts. Standard home electrical supply circuits are limited to 16 Amps. By using 230 Volt units you will be able to support twice the area on a given electrical circuit.
- e. Cost considerations:  
While estimating operating costs, you should take into account the local electricity rates, including off peak rates, if available. You should measure the total heated area, multiply by the specific input power of the heating system (e.g. 120 watts per sqm) and then estimate the expected duty cycle: in normally insulated houses you should expect 20% on time and 80% off time. Installation costs for AHT mats are the lowest and this in comparison with all other under floor heating alternatives, due to the thin profile and the possibility to install directly under all types of floor covering.

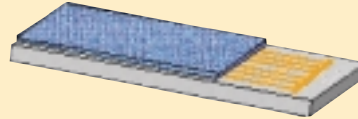
### 3. Installation

Installing AHT heating mats is extremely simple, and the installation procedures are thoroughly described in the installation manual. However people will make every possible mistake and thus you must insist that the installer will follow meticulously the installation manual.

## Installation examples

#### Under wall to wall carpeting

1. Wall to wall carpet.
2. Heating mat.
3. Insulation material.



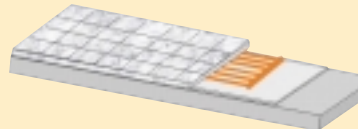
#### Under timber/parquet flooring.

1. Timber/parquet flooring Material.
2. Heating mat.
3. Insulation material.
4. Floor slab.



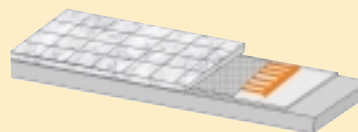
#### Under ceramics tiles/ in dry surroundings.

1. Ceramic tile.
2. Grout.
3. Heating mat
4. Grout.
5. Floor slab (optional with insulation material).



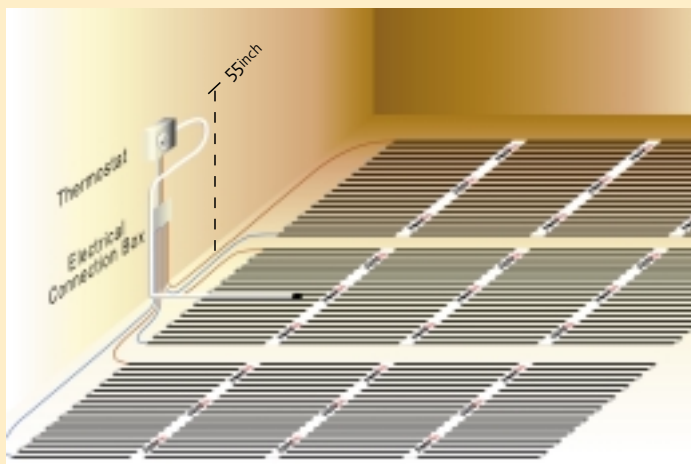
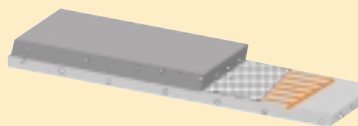
#### Under ceramics tiles/ in wet surroundings.

1. Ceramic tile.
2. Grout.
3. Grounding net.
4. Heating mat.
5. Grout.
6. Floor slab (optional with insulation).



#### In concrete/ in the top layer.

1. Top layer ca. 5cm.
2. Heating mat.
3. Reinforcing rods.
4. Bottom layer of concrete (optional with insulation material).



#### 4. Testing and quality:

##### a. Certifications:

Three independent certification authorities tested AHT heating mats, and approved the products:

- Nemko in Europe – for meeting the requirements of EN IEC 60335-1 and EN IEC 60335-2-96.
- UL in the USA – for meeting the requirements of UL 1693.
- Ukraine Government of Meteorology and standards in the Ukraine – for meeting the requirements of D CTY 3135.0-95.

##### b. testing during production:

Each unit is tested in the factory for proper output power as well as for proper insulation conformity, to withstand 2,500 volts.

##### c. Testing after installation:

In order to ensure that the heating mats were not damaged during installation, the units should be tested again after ninstallation, preferably before the floor covering and immediately after the floor covering. For details see the installation manual.

#### 5. Trouble Shooting

AHT heating mats are practically maintenance free. There are no moving elements or active components. Failures may occur as a result of damage caused to the heating elements during installation.

Problem	Possible Cause	Remedy / Action
No heat in the entire room/floor	Main circuit breaker is off	Set the main breaker on. If main breaker can't be reset, verify that the breaker suits the heating system load.
	GFCI tripped	If GFCI cannot be reset, there is a fault with one of the mats. Using a Megger test, identify the faulty mat and disconnect the mat. Then consult your AHT representative for a solution.
	Faulty thermostat	Verify the thermostat setting (On position, temperature setting, clock setting) Replace thermostat if it indicates a failure.
No heat in a part of the room/floor	A heating mat is disconnected	Check the heating mat connections at the electrical connection box, tighten connection if loose.
	A heating mat is short circuited	Check continuity (electrical resistance) between the cold leads, if there is a short circuit, follow the instructions of the repair manual.
Overheating in the entire room/floor	Thermostat setting is too high	Set thermostat to a comfortable level.
	Faulty thermostat	Replace thermostat
Overheating in a part of the room/floor	Wrong power line supply (230 V instead of 110 V, 380 V instead of 230 V)	Make sure that the right line voltage is being used, rewire if necessary.
	Thermal blocking	Avoid placing floor level furniture – futons, mattresses, etc. on the floor.
Room not warm enough	Thermostat setting too low	Set thermostat to a higher temperature.
	Floor sensor is under thermal blocking	Move disturbing furniture.
	Floor sensor setting incorrect	Modify up floor sensor setting.
	Improper insulation under the heating mat	Requires system upgrade
	Initial heat loss calculations were wrong	Requires system upgrade.



## 6. Accessories

### a. Thermostats

You can use various models of thermostats, from simple manual thermostats, to digital thermostats, from fully programmable and till even wireless thermostats. Some thermostats offer 7 days a week clock and others are equipped with a temperature set back functionality etc. Thermostats may be equipped with three types of temperature sensors:

- Air temperature sensor – usually embedded in the thermostat itself that will control the room temperature in primary heat system.
- Floor temperature sensor – The sensor is installed under the floor covering, preferably in a conduit, and connects to the thermostat through special wiring supplied with the thermostat. This sensor type is used to control the floor temperature when the system is used as a comfort (supplementary) heating system.
- Floor temperature safety sensor – when installed under materials that have a maximum temperature limitation, like some timber floor materials or carpets, a safety sensor is incorporated as a cutoff mechanism for keeping the maximum temperature of the floor within the prescribed level.

The below table summarizes the control requirements:

Flooring type	Primary heating	Comfort heating
Under tiles	Room temperature sensor	Floor temperature sensor
Under timber/parquet/ carpet	Room temperature sensor and a floor temperature safety sensor	Floor temperature sensor

### b. Grounding Nets

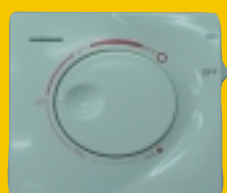
Both IEC and UL standards require a grounding net to be installed on top of the heating mat when the installation is done under tiles in wet places, such as: bathrooms, saunas, etc.

AHT supplies these grounding nets in three different sizes, each with 4 meters (12 feet) cold lead (electrical wire) attached to the grounding net.

The grounding nets are supplied in sizes: 0.5 x 1.0 m, 0.5 x 2.0 m and 0.5 x 3.0 m.

### c. Repair Kit

A repair kit is available and usually be used in cases where the units were damaged during the floor covering process. For details see the repair manual.





# Appendix A

## AHT safety statement

AHT heating mats are designed and manufactured to the highest safety standards.

The heating mats meet class II appliance requirements, constructed with double insulation and passed extremely successfully testing of the applicable IEC safety standards: IEC 60335-1 (Household and similar electrical appliances – safety, general requirements) and IEC 60335-2-96 (particular requirements for flexible sheet heating elements for room heating).

As such the product proudly carries the CE mark, the Nemko N mark and a British standard certification.

When installed according to the installation instructions and manual, the product is perfectly safe.

We are some times asked why some other under floor heating elements (mainly heating wires) are constructed with a metallic sheath or shield around the heating element, whilst AHT heating elements are not, and what is the difference in safety performance between the sheathed and non sheathed elements.

The fact is that the additional metallic shield is not a significant factor in the prevention of electrical shock hazard. The risk us of a person (a baby, a kid or a grown up) inadvertently punching a metallic object, a nail or needle through the floor covering (carpet or timber) and into the electricity carrying heating metallic ribbon. This will create similar physical effects on the person as the effects created by sticking the same object into a common electrical socket in the house. At the later case there is no other way to protect the person from a shock hazard except by using an RCD (residual current detector) or GFCI (ground fault circuit interrupter).

The above is the reason why all the applicable standards, codes and practices mandatory require incorporation of an RCD or GFCI in the electrical circuitry of electrical under floor heating systems, while leaving the alternative of having 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 more than for 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.

British standard BS 6351-1 **Electric surface heating** clearly defines (in paragraph 11) the construction of ESH (Electrical Surface Heating) devices: "It shall have a metallic covering unless the type of over-current / earth fault protection on the ESH device gives a degree of protection equivalent to metallic covering with over-current and RCD protection".

Some other references in this regard:

British standard BS 7430:1998 **Earthing**, Paragraph 21.5 states: "For installations and locations of increased shock risk, additional measures may be necessary. Sub paragraph b) "RCDs with rated residual current of 30 mA or less".

British standard BS 6351-1 **Electric surface heating** defines the allowed construction for heating cables and tapes. Paragraph 5 (construction), note 2: "In order to suit particular operating conditions, heating cables and tapes may have additional protective layers comprising one or more of the following:

- a) Non – metallic covering;
- b) Metallic covering;
- c) Corrosion resistance covering."

The above mentioned IEC standard 60335-2-96, paragraph 7.12.1 dictates that: "the heating units are to be supplied through a residual current device (RCD) having a rated residual operating current not exceeding 30mA." Annex AA of the same standard defines the summery of installation requirements, combinations of RCD or isolating transformers, whether the basic heating element is shielded or not.

All above references assure the user that our product was designed and manufactured according to all relevant standards, and comply with these standards.



We paid maximum emphasis to the performance of the electrical resistance of the coating. As mentioned above our product is a class 2, double insulation product. As such it was tested and found to comply with IEC standard 60335-1 (Which is harmonized with the British standard BS EN60335-1) to withstand 3750 volts for 1 minute. The above means that the product has sufficient electrical resistance according to the strictest standards.

We test each unit in the production line for electric withstand of 2500 volts, again according to the relevant IEC standard 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.

The RCD itself should meet one of the following standards:

BS 4293

BS EN 61008

BS EN 61009

BS EN 60947-2

With 30 mA maximum tripping current, and a response time of 0.2 seconds.

We were also asked about the Magnetic field generated by our heating mats. Measurements of the magnetic field strength generated by the AHT heating mats prove that it is extremely low. At distances as close as 10 mm from the heating element the magnetic field strength is less than a third of the Earth magnetic field (which is 420 mH) and it is totally negligible at distances of few more cm.

Therefore the usage of the heating mats is full safe in these regards.

## Appendix B

### Radiant Heating 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 in order to 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.

Glass, particularly low-e glass, reflects long-wave radiance produced by residential radiant systems. This greenhouse effect serves to contain radiant energy within the heated building cavity, reducing heat loss.

Air-infiltration heat loss is reduced with radiant heat. Air infiltration and exfiltration increase as the difference between inside and outside temperature 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 effect 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, exfiltration, 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 35% over convective systems.



# Radiant Heat



## 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 structures with high ceilings. In fact, the more difficult the heating situation, the greater the savings are with radiant under floor heating.

Consider these advantages:

- Heat is down on the work floor, not up in the ceilings of a warehouse or factory.
- Heat stored in a concrete floor can protect perishable products in the event of a power failure.
- Constant temperatures help to keep precision equipment calibrated.
- As overhead doors are opened, comfortable temperatures are re-established quickly.
- Radiant heat is quiet and clean with no noisy fans or dust blown around the workplace.

# Appendix C

## Repair manual

This repair manual guides a qualified underfloor heating technician with step-by-step repair procedures in case a heating ribbon is found short-circuited.

### Step 1 – Identification of the short circuit location

- Identify the faulty heating mat by measuring its resistance through its connections in the electrical connection box.
- Identify the approximate location of the short circuit using your standard tools for underfloor short circuit identification, e.g. Advanced Wire Tracker models AT-2001, 2002, 2003, 2004 of Amprobe Instrument.



### Step 2 – Expose the failure location

### Step 3 – Fix preparation

- Cut the faulty area and leave a gap of about 50 mm between the ribbon ends.
- Have available a repair kit
- Prepare your tools: A hand crimping tool (Tyco Electronics, AMP Termi-Foil model 68026) and a heat gun or fan.



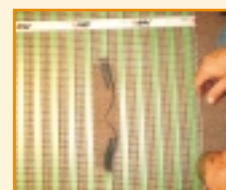
### Step 4 – Repair

- Crimp the connectors onto each of the ribbon sides using the crimping tool
- Place the heat shrinks on each the connectors.
- Shrink the heat shrink using the heat gun. Start heating from the narrow side (the wire side) and work towards the ribbon side
- Squeeze with your hands the shrink over the ribbon and make sure that the glue comes out of the end to ensure moisture resistance of the repair area.



### Step 5 – test

Test the heating mat resistance and verify that it is within the specified tolerances.



# Appendix D

## Technical Information of the Indoor products

AHT heating mats are manufactured in families. The two standard families are the 100 watts per sqm, and the 120 watts per sqm (12 watts per sq.ft.). The manufacturer will, on special order, manufacture different sizes of mats and different output powers.

The UL and IEC standards allow for manufacturing tolerance of – 10% up to +5% from the nominal power value. IEC standard allows – 10% up to +10% for the low power units (200 watts per unit).

Due to the fact that the heating mats are composed of a discrete even number of heating ribbon runs, the nominal power rating of every type of heating mat is somewhat different from the basic standard family value, as noted in the following tables.

The heating mats are manufactured for 220-240 volts as well as for 110-120 volts. The units are indifferent to line frequency 50 or 60 Hz.

Standard sizes and their values:

### 220-240 Volts, 100 watts per sqm family:

Width/m	Length/m	SQM	Nominal Watts/m <sup>2</sup>	Nominal Total power (w)	Nominal current (Amp)
0.5	2	1	99	99	0.43
0.5	3	1.5	105	157.5	0.68
0.5	4	2	106	212	0.92
0.5	5	2.5	102	255	1.10
0.5	6	3	106	318	1.38
1.0	1	1	99	99	0.43
1.0	2	2	106	212	0.92
1.0	2.5	2.5	102	255	1.10
1.0	3	3	106	318	1.38
1.0	4	4	110	440	1.91

### 220-240 Volts, 120 watts per sqm family:

Width/m	Length/m	SQM	Nominal Watts/m <sup>2</sup>	Nominal Total power (w)	Nominal current (Amp)
0.5	2	1	123	123	0.53
0.5	3	1.5	118	177	0.76
0.5	4	2	132	264	1.15
0.5	5	2.5	122	305	1.33
0.5	6	3	118	354	1.54
1.0	1	1	123	123	0.53
1.0	2	2	132	264	1.15
1.0	2.5	2.5	122	305	1.33
1.0	3	3	118	354	1.54
1.0	4	4	110	440	1.91



110 - 120 Volts, 12 watts per sqf family:

Width (Inch)	Length (Inch)	SQF	Nominal Watts/f <sup>2</sup>	Nominal Total power(W)	Nominal current(Amp)
20	40	5.6	11.1	62	0.29
20	60	8.3	10.6	88	0.59
20	80	11.1	11.9	132	1.32
20	100	13.9	11.0	153	1.77
20	120	16.7	11.3	188	2.66
20	160	22.2	9.9	220	3.67
40	40	11.1	11.1	124	0.58
40	60	16.7	10.6	176	1.18
40	80	22.2	11.9	265	2.65
40	100	27.8	11.0	306	3.54
40	120	33.3	11.3	375	5.32
40	160	44.4	9.9	441	7.35

Note: Power is calculated based on an average 115 Volts

## Appendix E

### A comparison between radiant heating technologies

	Water Based	Hiting cablis	Heating Ribbons
Uniformity of heating	+	+	+++
Working temperature	Medium (50-60C)	Medium (50-60C)	Low (30-40C)
Floor covering:			
Tiles	+++	+++	+++
Timber	Only with protection	Only with protection	+++
Carpets	layer	layer	+++
Maintenance	+	+++	+++
Ease/cost of installation	High cost	+(as stand alone cable)	+++
Price	High	Medium	Medium (-)
Energy consumption	Low-Medium	Medium	About 8% less than heating cables
Safety	+++	+++	+++

# Appendix F

## AHT's Amorphous Heating Elements Q&A

- **What is an amorphous material?**  
Amorphous material is a solid with internal structure of liquid. Contrary to an amorphous composition, a crystalline solid possesses a crystalline lattice, i.e. periodical structure forming a lattice in space. The structure of the liquid differs from that of the crystalline solid by absence of the periodical order. The atoms of the liquid are chaotically distributed in space. Cooling of liquid results in arising the crystalline structure at some specific temperature (crystallization temperature). However if the cooling is very rapid then the liquid solidifies without forming the crystalline lattice. This is true for multi-component alloys, which include two kinds of atoms (binary alloy) or more.
- **What is amorphous metallic alloy ribbon?**  
Amorphous metallic alloys, which are often referred to as metallic glasses, are relatively new materials, mainly known in the form of thin ribbons. They are prepared from molten alloys by rapid quenching technique. In this technique the melt of a metallic alloy is poured onto rapidly rotating copper drum. Due to low thickness of the ribbon (20 to 30 micron) it is cooled at a very high rate (about million degrees per second). It prevents the crystalline structure from growing during solidification. During such a short time the crystalline structure has no chance to arise. Instead the amorphous solid in the form of a very thin ribbon (width varies from few millimeters to 20 cm) is prepared.
- **What are the specific features of the amorphous ribbon?**  
The leading feature of these materials is the absence of the crystalline structure. The crystalline solids are typically built from small crystallites with grain boundaries between them causing most of the material faults. Amorphous metallic alloys have homogeneous structure providing high physical, mechanical, anticorrosion, wear resistant and magnetic properties making them superior in many aspects with respect to crystalline metals.
- **Why AHT's amorphous metallic ribbon is an excellent heating element for moderate temperature heaters?**  
Due to the absence of the crystalline order the amorphous ribbons possess elevated specific electrical resistance compared with crystalline solids of the same composition. Together with the physical form of the ribbon, which provides low mass-to-specific 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 temperature difference between the heater and environment. The higher the surface area the lower the temperature difference needed to transfer the energy from the heater to the environment. Since the surface area of the ribbon is pretty high (compare it with the surface area of a conventional wire used in many heaters) it is able to efficiently transfer the heat to the environment without arriving to high temperatures. If we are speaking about, for example, domestic heating then lower temperature provides healthier environment and higher safety.
- **Why AHT heating elements?**  
All the producers of amorphous ribbons are targeting electromagnetic applications using the ribbon as soft magnetic materials for various electronic components.  
AHT is the only company, which developed special ribbons for heating applications (US Patent 5,641,421). The AHT ribbons are more reliable, reveal higher electrical and corrosion resistance. Their main physical and geometrical characteristics are:

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

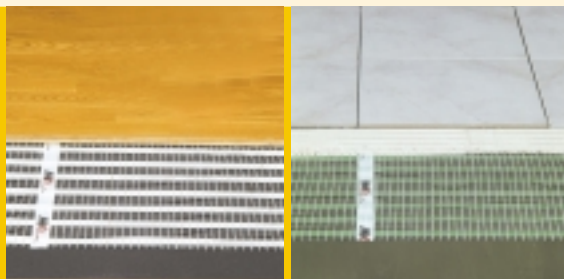
- Comparison of the heat transfer efficiency from wire and ribbon

Using the following conditions:

1. The length of the tested ribbon and wire = 1m.
2. Resistivity of the ribbon and the wire was  $1.4 \times 10^{-6}$  Ohm x m.
3. The cooling conditions were assumed as free convection, and heat transfer coefficient in both cases was taken as 5.6 w/ m K.
4. The temperature difference between the surfaces of the ribbon and wire and the ambient air was 100 °C.

Wire Diam, mm	Ribbon width, mm	Heat transfer area, $m^2/m \cdot 10^{-3}$		Power, W	
		Wire	Ribbon	Wire	Ribbon
0.50	9.80	1.57	19.6	0.88	1.96
0.60	14.1	1.88	28.20	1.05	15.8
0.70	19.2	2.20	38.4	1.23	21.5
0.80	25.1	2.50	50.2	1.40	28.15
0.90	32.0	2.86	63.6	1.58	35.6

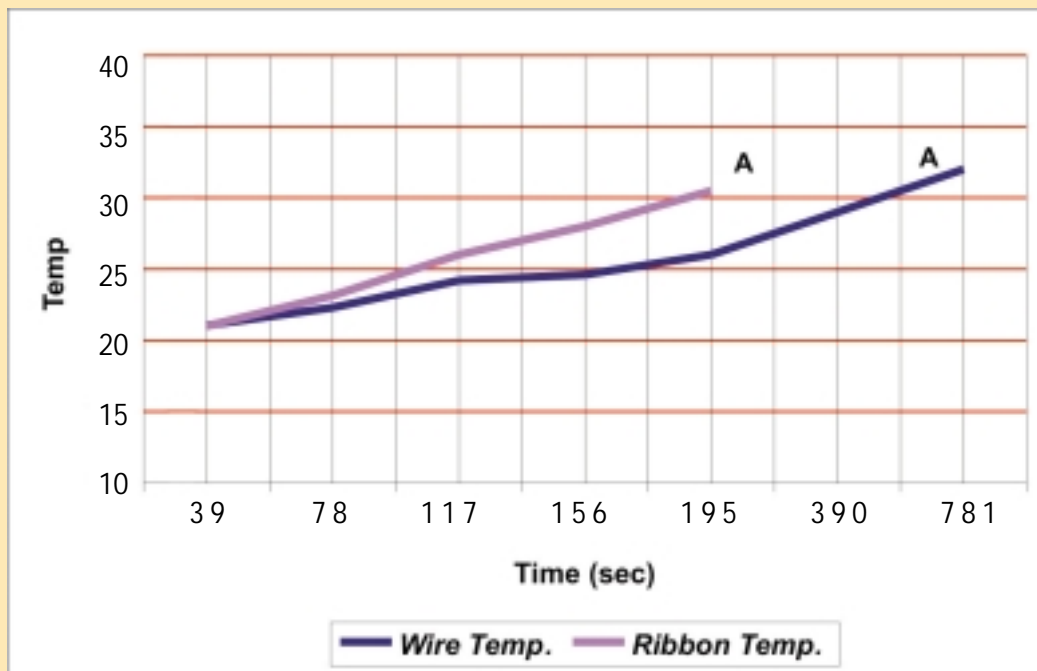
Wire Diam, mm	Ribbon width, mm	Heat transfer area, $m^2/m \cdot 10^{-3}$		Power, W	
		Wire	Ribbon	Wire	Ribbon
0.50	9.80	1.57	19.6	0.88	1.96
0.60	14.1	1.88	28.20	1.05	15.8
0.70	19.2	2.20	38.4	1.23	21.5
0.80	25.1	2.50	50.2	1.40	28.15
0.90	32.0	2.86	63.6	1.58	35.6



The conclusions derived from the above table:

1. The large heat transfer area of the ribbon allows achieving the same heating power at lower temperature of the heating element, thus providing improved safety.
2. The heat efficiency of the ribbon is significantly superior over the wire.
3. The same heat transfer power can be achieved at lower temperature in the ribbon case.
4. Due to low temperature the ribbon element can be packed in polymer insulation that is impossible with the wire element.

Temperature development:



A. The ribbon will reach a comfortable 30C after 3 minutes; the wire will reach this temperature after 10 minutes, more than 3 times slower!

- Why the AHT ribbons are of special interest for under floor heating, de-icing of the pavements, roads, etc.?

Many features of the AHT heating elements make them attractive for surface heating:

1. Efficient heat transfer. Provided by the large surface of the ribbons.
2. Possibility to use cheap insulating materials. Provided by the low temperature.
3. Very convenient physical shape allowing fast installation.
4. High reliability. Provided by low heating temperature, high mechanical and corrosion resistance properties.
5. Low heating inertia. Provided by the low mass of the ribbon. In unsteady mode (on/off mode) allows energy saving due to both low heating inertia and efficient heat transfer.
6. Patented technology (US Patent 5.641,421).

A. H. T.