ThermaWire™

ELECTRIC HEATING CABLE SOLUTIONS

INSTALLATION MANUAL

Applicable to the following products only:

CFH-T-120/5.6 Floor Heating Cables
CFH-T-240/5.6 Floor Heating Cables

C US

ThermAtlantic™

ENERGY PRODUCTS INCORPORATED

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1. Preface

This document outlines the best practices developed by ThermAtlantic for the proper installation of ThermaWire™ CFH-T Heating Cable Sets when used for indoor heating applications. The methods described were developed to increase performance and reduce labour and material costs where possible.

These guidelines differ depending on what type of finish flooring will be used and also take into consideration floor height and sub-floor deflection.

2. Zoning

Since heating cables are electrical their zoning requirements are similar to that of electric baseboard heaters in that a thermostat is required for each closed room or open area. Because floor-heating thermostats use floor temperature logic to ensure comfort and protect flooring it is also possible to introduce more than one thermostat in a large open area if differing flooring types exist. This is typically true for kitchen & dining room areas where ceramics and hardwood may coexist. If a quote has been prepared by a dealer, each zone may be identified with a unique number.

3. Choosing the best cable wattage

After having determined the layout of your room or heating zone, you must determine which of several available wattages or sizes to choose from. Although a heat loss calculation can be completed, floor heating cable sets tend to be over-sized in most instances in order to prevent hot & cold spots, decrease heating response time and ensure the room will heat up even on the coldest days of the year.

First you must calculate the net floor space of a room. Heating cables may not be installed under cabinetry and fixed appliances; therefore you must subtract these objects from a room's overall gross area in order to move onto the next step. Note that it is recommended that you heat toe-kick space under cabinets so ensure you include the extra 4" or 10 cm in your net heating space from the edge of your countertops.

General floor warming guidelines for mid-sized and large areas are 10 W/SF under wood flooring and 12 W/SF under tile and natural stone. In kitchens, bathrooms and laundry rooms where floor space is limited relative to the actual room size, it is common to increase wattage by 2-3 W/SF so as to compensate for reduced heating area. You may increase wattage to a maximum of 15 W/SF in rooms with higher heat losses due to northern exposures, many windows or outside doors.

Once you have a target W/SF in mind, multiply it by the net heating area of your zone and choose the closest cable size available from the product selection guide. In some cases it may be desirable to combine two cable sets to best achieve the desired wattage for the room. Finally, make sure you select the best operating voltage for your installation. ThermaWire™ floor warming products are available in 120V and 240V Series.

4. Locating Thermostats

Thermostat should be located using conventional guidelines for each heating zone identified. If the heating cables will be installed after gyprock is in place, it is important to install fish wires from the thermostat location to the area directly below where heating cable cold leads and the floor temperature sensor will be pulled-up later on. Make sure that any drilled holes are large enough to pull up fish wire and that base plate is notched so that cables can be recessed out of the way of baseboard mouldings. If you will have access to the open ceiling under the room being heated it is recommended that cold leads

and sensor wires be installed through the sub-floor and back up through wall base plate so as to prevent damage from nails when baseboard moldings are installed.

5. Important Do's and Don'ts

Before proceeding with floor warming cable or mat installation, here is a list of best practices and common mistakes to avoid:

1. ThermaWire™ floor heating CFH series cables are intended for indoor floor heating and wet applications as designated by the X & W marks on the label.
2. Never cut the heating part of the cable. This is the long portion of the cable set before the black splice and cold lead. You may shorten the length of the cold leads, however, once they have been fished into the thermostat box.
3. 18.5 W/M floor heating cables should never be laid any closer than 4 ½" or 11.5 cm apart.
4. If more than one cable and / or mat set is used in a room, ensure they are connected in parallel and not in series. Also ensure that the total wattage of cable or mats set connected to a thermostat does not exceed 15A (1,800 W for 120V & 3,600 W for 240V systems) or as specified by thermostat manufacturer.
5. Do not install cables when it is colder than -15°C or 5°F in the room.
6. Always clean floor surface properly before laying down heating cables or mats. Mortar bed installations require a dust-free surface to guarantee proper bond to the sub-floor surface.
7. Rigid foam insulation board is recommended under heating cables when installed within concrete slabs. Up to ¼" or 6 mm of cork underlayment may also be used when installing over existing un-insulated floors. Adding under-floor insulation to your installation will reduce response time and increase the energy efficiency of the system.
8. A minimum of ¼" or 6 mm of mortar is required over floor heating cables once they are attached to floor surface. This can be done either by pouring self-leveling underlayment over them or by using a ¼" or 6 mm high notched trowel when installing tile or stone flooring.
9. Do not allow heating cables to cross over each other or touch since this will likely lead to overheating and failure.
10. Never install cable loops any tighter than with a bending radius less than 2 ¾" or 70 mm.
11. Heating portion of cables must be embedded in some form of cement mortar mixture and may not be used in applications where they are left un-covered in open air. The heating portion of a cable is blue in color.
12. Only use Listed electrical conduit from the bottom of the wall where cold splice enters wall cavity to the thermostat or junction box.
13. Always ensure that the black cable splices are located in the floor and not in the wall cavity since this is where the heating cable meets the cold leads; this applies to tail splice as well. It may be necessary to create a narrow recess or depression in the sub-floor to better accommodate the thickness of splices since they are thicker than the heating cable portion.
14. Slide product label on cold lead so that it is enclosed within the thermostat or junction box for future reference purposes. A spare product label is included with each floor warming cable or mat set for you to attach it where it can be seen in the electrical room as a warning that in-floor heating has been installed in a room.
15. Heating cables must be ground fault protected either with a GFCI thermostat or a GFCI breaker at the electrical panel. This requirement is there to protect you from electrical shock or your home from fire in the event of a heating cable fault. 10-35 ma sensitivity is recommended for most applications to avoid nuisance tripping and 5 ma sensitivity for wet areas such as bathrooms or as required by your electrical code.

16. When laying out cables or mats, try to maintain a consistent spacing between cables so as to ensure even floor heating. It is permissible to narrow cable spacing somewhat when covering colder areas in a room such as outside perimeter walls with many windows as long as it does not get any narrower than nominal allowed spacing.
17. Do not install heating cables under cabinets, fixed appliances, bathroom fixtures or any other permanent fixtures.
18. Flooring type and thickness must not exceed an insulation R value of 1. This limitation does not affect the use of tile or stone flooring which exhibit very low R-values but does limit carpet to a thickness of ¼" or 6 mm and most wood flooring in thicknesses from 3/8" or 10 mm to ¾" or 20 mm. Check with finish flooring manufacturer for their R-values if you are uncertain.
19. Heating cables should not be installed any closer than 8" or 20 cm from the wax ring of a toilet or of the heated surface of another heating source such as a baseboard heater.
20. Check your local electrical codes or contact your local building authority to qualify whether you can install your own floor heating cables, with or without the supervision of an electrician. In any case, actual hook-up to thermostat must be done by an electrician.
21. If heating cable is damaged during installation it is recommended that it be removed and replaced. ThermAtlantic will accept return of damaged cables and offer repairs, exchanges or credit notes at its own discretion for a nominal fee; shipping costs not included.
22. Walking on heating cables in high traffic areas should be avoided wherever possible to minimize chance of damage before they are embedded in cement mortar. They can be covered temporarily with cardboard and / or plywood in traffic areas if necessary. It is recommended that rubber soled footwear be used by installers during installation.
23. It is recommended that cable fault alarms be used when laying down cables or installing tile directly over them. The alarm will sound if cables are damaged but are not a substitute for insulation testing using a megaohm meter or insulation tester.
24. Warranty requires that all heating cables be tested for both heating lead resistance and insulation leakage by an electrician or qualified installer or as dictated by local electrical code. Heating lead resistance should fall within -5% to +10% of the resistance indicated on the label and product selection table. Heating cables should also be checked for insulation leakage using a megaohm meter. Each heating lead should be individually checked to the common ground lead at approximately 4 times the operational voltage of the heating cable or mat set. Any leakage within 5 megaohm range should be a warning that cable has been compromised and that is should be replaced or repaired before continuing with installation.
25. Heating cables may only be repaired by a qualified installer or electrician as dictated by local electrical code or inspection authority. Only ThermaWire™ provided crimp connectors and heat shrink repair kits can be used. All field repairs must be properly tested for both heating lead resistance and insulation leakage to qualify for limited warranty.
26. When used in wet locations, installation shall be in accordance with CAN/CSA-C22.1, Canadian Electrical Code, Part I (CEC) and final acceptance is to be made in the field by the Authority Having Jurisdiction (AHJ).
27. Floor Warming Cable & Mat installations are to be made in accordance with section 62 of the CEC, Part 1.
28. Contact ThermAtlantic Energy Products Inc. technical support for advice and assistance regarding any installation or repair related matters.

6. Zoning & Cable On-Center Calculations

Before the actual layout and spacing of heating cables can commence it is important to accurately measure the heating zone's interior floor area and subtract all fixed objects where cables cannot be installed such as cabinetry, dish washers, fridges, stoves, washing machines, dryers, fixed islands, stairs

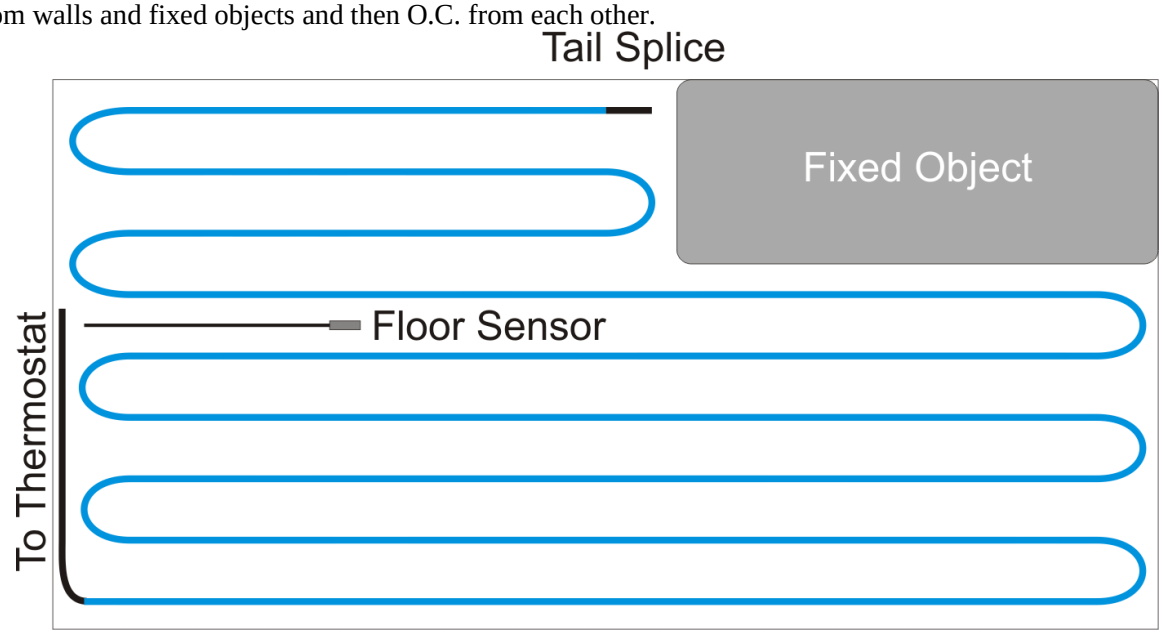
and mantles. Use kick-board location when calculating cabinetry depth; standard for kitchens is 19’ and 16’ for bathrooms.

Once actual floor area is determined, use the following formula to calculate each zone’s cable on-center spacing (O.C.):

$$\frac{\text{Net Floor Area x 12}}{\text{Cable Length(s) in Feet}}$$

It is important that each zone be calculated individually since the factory cable sets cannot be cut to fit. The formula is not always perfect but does provide a spacing that should result with tail splice at or near the end of the room. It is recommended that OC spacing be rounded-down by at least 1/8” or 3mm to ensure you will not have too much cable.

Start the cable run below the thermostat and plan for the end of the cable to be near a “buffer” area if possible in the event that you have too much cable left over. Each cable has 7’ of cold lead at each end that is identified with the black splice joining the cold leads to the blue heating cable. This splice must be located in the floor to ensure that no hot cable enters the wall space. Cables are to be installed ½ O.C. from walls and fixed objects and then O.C. from each other.



Sample Cable Layout

7. Cable installation within Concrete Slabs

When installing in-floor heating in new basements, garages and slab on grade homes, the cables are embedded in concrete. Before the heating system can be installed it is important to install rigid foam insulation and reinforcement mesh. Install sheets of 2-3” of EPS-2/3 or SM foam over crushed stone and 6mm vapour barrier and then cover with 6x6 welded wire mesh. Now time must be taken to mark room divisions and fixed cabinetry with string lines and spray paint so that cables can be located within each zone and around fixed objects. Cables are then laid out in long loops while maintaining O.C. spacing and attached to mesh using mid-size cable ties every 12-18”. Use 12-18” long lengths of ¾” plastic electrical conduit and 90° bends to hold cold leads up off the floor below future thermostat location. Fix conduit vertically in center of future wall partitions using small wooden stakes attached using tape or large cable ties.

8. Cable Installation over Wooden Sub-Floors

Over wooden sub-floors, cables are attached to the sub-floor using T37A staplers and 9/16" rounded electrical staples approximately every 12". Note that more readily available T-25 staplers should not be used since they will catch the cable and damage it. One simple technique is to lay down chalk lines and measure O.C. spacing in advance, install temporary nails at the O.C. locations at each end of the room and then quickly pull the cable back and forth to fit before stapling it down. This allows any spacing adjustments to be made before final stapling.

It is recommended that cables run in the same direction as self-leveling cement underlay will be pulled so that the cable tops can act as a good screed guide. Although it isn't necessary to follow this best practice all the time, doing so will result in a smoother finish.

Once cable sets are down it is necessary to pull cold leads up to each thermostat. Excess cold lead can be cut off and 6" ends stripped of PVC insulation before being maretted to 12-2 leads or line voltage thermostat connections. Ground wires must grounded to electrical box or ground wire.

9. Installing Cables over an Existing Concrete Floor

In the event that cables are to be installed over an existing concrete floor it will be necessary to either use metal clip strip fastened approximately every 3' or to tape cables down. Clip strip can be fastened by drilling small holes into the concrete and using ¾" concrete nails or Tapcon™ screws. If cables are to be taped down, it is recommended that spray-on adhesive be used as a primer and allowed to dry before duct tape is secured to concrete.

10. Optional Sub-Floor Reinforcement or Raising

In areas with ceramic tile or low profile floating floors it is important to determine if the sub-floor will need to be reinforced and/or raised. Reinforcement is required for ceramic tile installation over wooden sub-floors and can be accomplished in two different ways: If the adjoining rooms are using ¾" heated hardwood flooring then you must install 3/8" select plywood screwed or nailed down every 4-6" before installing the cables. The same applies to floating floors if similar floor levels are expected between adjoining rooms.

If the floor level does not need to be raised then the second option for reinforcement is to install 1/8" diamond lath metal mesh over the heating cables before pouring the self-leveling cement. Mesh comes in 2'x8' sheets and is best secured to sub-floor every 6-8" OC using 1 ¼" roofing nails. It is recommended that a pneumatic roofing nailer be used for larger jobs to save time. The tops of the mesh-covered cables will be used as a screed so make sure they are tight to the floor. Do not rely solely on mesh reinforcement if spans are > 16' and joists are > 16" OC.

If you will be using engineered hardwood or laminate flooring it is still recommended that reinforced mesh installations be used. This will ensure that underlayment will not crack and compromise flooring installed over it.

11. Cement Underlay Installation for Ceramic Tile, Floating & Glue-Down Flooring

Once optional reinforcement plywood or mesh has been installed, the area must be covered with self-leveling cement underlayment. It is necessary to prime the floor with the recommended latex primer which can be sprayed-on or applied with a sponge roller to the sub-floor and allowed to dry after the cables are installed before the self-leveling cement is poured.

Self-leveling cement typically comes in 50lb / 22.5 kg bags and can be mixed 1-3 bags at a time. Product is typically mixed in a large plastic garbage canister with a proper mixing paddle powered by a ½" drill. After approximately 3 minutes of mixing the resulting liquid slurry is poured and spread with a wide hand trowel or rigid squeegee over the cables and optional mesh. The underlay finds its own level and will result in a perfectly smooth floor if sufficient material is used. Spiked pin rollers are recommended as the best means of pulling self-leveling cement to consistent depth.

When using just over heating cables it is possible to get approximately 16 SF per bag. When applying over 3/8" reinforcement mesh and cables you should get 14 SF per bag. In order for material to set properly it is important that room temperature be no lower than 15°C and no higher than 20°C for the first 24 hours or as specified by underlayment manufacturer. Self-leveling cement sets fairly fast, can be walked on within 12 hours and finish flooring can be usually be installed within 72 hours. Note that in-floor heating must be disabled for at least 21 days after the underlay is installed and another 21 days from the time ceramic tile or adhesives are installed since the heat will prevent proper curing. It is not uncommon for the underlay to be installed and the in-floor heating to be engaged well before the finish flooring is installed. This practice is often preferred during the winter construction season since the heating can be used for plastering and painting.

12. Strapping under Hardwood Flooring

In zones with hardwood flooring it is necessary for cable layout to be done so loops are perpendicular to hardwood strip direction and to provide an adequate nailing surface. To accomplish this it is recommended that 3" wide 3/8" plywood strips be installed around the perimeter of the room and in-between cable runs. This will result in hardwood nailing surfaces approximately every 6" O.C. Plywood strips can be screwed-down or glued and brad-nailed to the existing sub-floor; they must be held tightly to the sub-floor to ensure that cement does not leak under their surface. To approximate amount of plywood required, use 50% of the room floor space and divide by 32 SF/sheet.

If using engineered hardwood it is important to pre-determine if it will be stapled or glued-down. Many lower-profile engineered products cannot be stapled without splitting the tongues and must therefore be glued-down. Under these circumstances it is necessary to use the self-leveling cement installation method used under ceramic tile and floating floors

13. Cement Underlay Installation for Hardwood

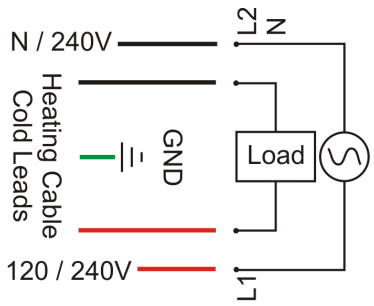
Hardwood installations do not require expensive self-leveling cement since the underlay will be securely sandwiched between the sub-floor and the finish flooring by hardwood staples. Therefore it is recommended that stiff cement-sand slurry of 1:3 Portland cement and fine sand be used with 33% latex admix to water solution. A trowel is used for cement application, using plywood strips as a screed guide. Although some shrinkage and cracking may occur, this is of little concern since hardwood will be attached to plywood nailing strips and keeps the cement in place. It is important, however, that any parallel cable runs be leveled so that gluing can be used if necessary to attach hardwood.

14. Floor Sensor Installation

Floor sensors come with all in-floor heating or warming thermostats and must be installed in-between two heating cable runs in order to measure the mean floor temperature. Sensors can be installed with the underlayment or after when flooring is installed. Although installing sensors in concrete at the time of cable installation is often more convenient, installing them as close to the finish-flooring surface as possible will result in better floor temperature control. Sensors can be tested by checking for impedance within the 10 K Ohm range.

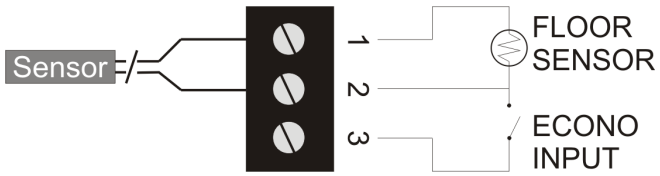
15. Thermostat Installation

Power connections are made to the red L1 & black L2 / N wires off the thermostat. Floor warming cable red & black cold lead wires are connected to the load connections off the thermostat and the green wire is connected to ground in the thermostat box.



TH115-AF Thermostat power & heating cable connections

It is important that correct voltage model thermostats be used and that each thermostat's load is not exceeded. For 120V models you may connect up to 1,800 Watts and up to 3,600 Watts for 240V models. Next you must fish the thinner floor sensor lead through one of the small holes on the bottom of the thermostat and screw them into the floor sensor connection terminals 1 & 2 as shown below:



TH115-AF Floor Sensor Connection

ThermaWire floor warming & heating thermostats can be setup to maintain floor temperature only (F mode) or air temperature with floor temperature limitation (AF Mode). It is recommended that floor warming mode be used in situations where the floor warming system is a secondary heat source. Air-floor mode should be used when the floor warming system is the only heat source in a room – with the exception of bathrooms where floor warming mode may be preferable. To select the mode simply set the 3rd dip switch on the back of the removable cover to either F or AF mode; the factory default is for floor warming or F mode.

Next you may enable Early-Start or ES mode using the 2nd dip switch. Early-start mode enables the thermostat to estimate how long it takes to reach the desired temperature when scheduling is used based on past usage. The factory default is OFF but it is recommended that it be turned ON.

Lastly you may select whether to use imperial or metric time and temperature settings using the 1st dip switch. C/24h is the factory default and will use Celsius and a 24 hour clock; F/12h will use Fahrenheit and a 12 hour clock.

TH115-AF Thermostat DIP Switches

Once all DIP switch settings have been made you may connect the cover to the power base of the thermostat and tighten the bottom screw to hold it in place. Please refer to Thermostat User Guide for instructions on how to program and use thermostats.

Once thermostat is installed it is important to verify that its GFCI Test function is working properly. To do this you will need to turn its breaker on, take the thermostat off standby mode, temporarily raise the target temperature until heating mode clicks on and heating waves show up on the LCD screen. Now that heating is engaged, press down on the plastic tab on the very top of the thermostat to test the GFCI. If it is working properly then the tab will turn red and the message GFI will show on the LCD. To reset the thermostat, merely switch it on standby mode and then back ON. This test should be repeated at least once a month to verify that the GFCI circuitry is working properly. Should this safety feature cease to work correctly, contact your electrician and be prepared to replace the thermostat.

Once your floor warming system is running it is possible that you may experience a GFI error. If after resetting the thermostat once it happens again immediately or shortly after the heat goes on, contact your electrician so they can determine if you have a faulty thermostat or a cable fault.

In the event of a GFI error, floor warming cables must be checked for insulation leakage and resistance by an electrician or qualified installer.

16. Cable Testing, Fault Detection and Repair

Throughout the installation process it is advisable to test each cable set to ensure that hot lead resistance is within 10% of published resistance and that no leakage exists between the inside hot lead and the grounded shield. Hot lead resistance is tested using a standard Ohm meter and insulation resistance is measured with a MegaOhm meter or “Megger” running at 500-1000V with no leakage accepted below 2 MegaOhms.

It is recommended that cables be tested after they are secured to the sub-floor. Any detected leakage can easily be located by measuring resistance of cold lead to ground and calculating estimated distance from each end using the cables known impedance per meter. Testing should be repeated before, during and after finish flooring is installed. If a possible fault is suspected during hardwood installation it is recommended that work stop and location be tested for leakage.

In situations where the heating cable has been broken by a fastener or as a result of a blow-out you will need to use a TDR (time domain refractometer) to determine the distance from each cold lead to the location of the open fault. For this reason it is advisable that digital photographs and/or a cable layout diagram exist for each room prior to being covered by concrete or underlayment.

Although performing a splice is fast and easy. Locating a fault under a finished tile or hardwood floor usually requires the use of an infrared video camera; a tool which is now becoming affordable and easier to rent in the event it is needed.

Glossary of Terms

Cold Lead: Non-heating, 16' or 5m long, white cable ends that are joined to the heating portion of the cable with a visible black splice. Cold leads are used to supply power to the heating portion of the cable set and are intended to be fished up to a wall mounted thermostat.

Hot Lead: Variable length, colored heating portion of the cable which is joined to the cold lead with a visible black splice. This is the part of the cable set which heats up and must therefore always be in the floor section of the installation.

Splice: Black, 4" or 10 cm long heat shrink section of the cable set where cold & hot leads are joined. Note that splice must always be located in the floor section, not in the wall. The splice is the weakest part of the cable set so try not to bend it. It is advisable to always leave at least a little bit of cold lead in the floor before entering the wall cavity.

Tail Splice: Twin conductor cable sets have a visible, black tail at the end of the hot lead. The tail must be located in the floor and embedded in cement mortar since it heats up.

Resistance: The heating cable's nominal resistance in Ohms is printed on the cable set and included in the product matrix and specifications. This resistance must be checked before and after installation to ensure the cable has not been damaged. Resistance is measured between both cold lead primary conductors and must fall within -5% / +10% of nominal resistance printed on the label and product selection guide.

Voltage: Each cable set is designed for specific voltages. The voltage is included as part of the product specification. 240V cable sets may be utilized at 208V; however this will lower their wattage or heat output by 25% so make sure you size floor warming cables & mats accordingly.

Wattage: This is the measure of energy that will be transferred into heat. Wattage is specified in the suffix of product code for the cable's design voltage. Note that the wattage will change if a different voltage than the one specified is used.

Earth Leakage: Earth leakage occurs when the internal insulation, outer jacket or splice has been compromised during or after installation. It is therefore important to test for insulation leakage for each heating cable set before, during and after installation using a megaohm meter or "Megger". Testing insulation leakage requires measuring the resistance between one primary cold lead conductor and the grounding sheath at a minimum of four times the operating voltage. For example, use 500V for 120V & 1000V for 240V systems. The meter should show zero leakage in the < 20 megaohm range; however it is acceptable to experience over, but not less than 2 megaohms of insulation leakage.

Installed Product Registration Form

ThermaWire™ Installation Details

Room Name	Product Code	Cable	Mat	120V	240V	208V	Area SF	Cable O.C. "	Resistance Checks in Ohms: Out of the Box	Resistance Checks in Ohms: After Layout	Resistance Checks in Ohms: After Mortar	Insulation Leakage Checks: Out of the Box	Insulation Leakage Checks: After Layout	Insulation Leakage Checks: After Mortar

Installation Services Information

	Printed Name	Signature	Date
Cable or Mat Installation			
Cable Resistance Testing			
Insulation Leakage Testing			
Thermostat Installation			

Home Owner Information

Customer Name		Telephone No.	
Site Address		Mobile No.	
		Fax No.	
		Email Address	

Forms may be emailed or faxes to registration@thermatlantic.com or you may register on-line at thermawire.com

Product Warranty

ThermAtlantic Energy Products Inc. warrants the ThermaWire™ floor warming system ("the Product") to be free from defects in materials and workmanship for ten years from the date of purchase, provided that the Product is installed in accordance with the accompanying Installation and Homeowner's Manual, and any special written design or installation guidelines provided by ThermAtlantic Energy Products Inc. for this project, the applicable Electric Code, and all applicable local building and electrical codes.

ThermAtlantic Energy Products Inc. assumes no responsibility under this warranty for any damage to the product caused by any trades people, or visitor on the job site, or damage caused as a result of post installation work.

Contact us if you have any questions about your installation.

Under this Limited Warranty, ThermAtlantic Energy Products Inc. will provide the following remedy:

If the Product is determined to be defective in materials and workmanship, and has not been damaged as a result of misuse or misapplication, ThermAtlantic Energy Products Inc. will reimburse the costs for location of the fault, repair of Product, as well as labor and materials required to perform the repair.

If the repair of the product is not feasible, ThermAtlantic Energy Products Inc. will replace the Product or refund the original cost of the Product.

The Limited Warranty is null and void if the project owner or his representative attempts to repair the Product without receiving authorization. Upon notification of a real or possible problem, ThermAtlantic Energy Products Inc. will issue an Authorization to Proceed under the terms of the Limited Warranty.

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