

## Determine the Type of Heating Element

2.1 You have purchased a Heatizon System that utilizes either Tuff Cable heating element, a 10 gauge coated copper cable that is chemical and gasoline resistant, or ZMesh heating element, a 9" or 12" wide woven bronze screen.

**Remember: "After Installation Element Test" #1 should be conducted after the heating element has been installed, and "After Installation Element Test" #2 should be conducted following the covering of the heating element and immediately prior to installing the Control Unit.**

### Tuff Cable

Heatizon Systems Tuff Cable is a low-voltage electric radiant heating element that must always be installed in an acceptable heatsink. For this manual, a heat sink means asphalt, concrete, mortar, mud bed, sand, Invizimelt, or a Heatizon Heatsink Kit. Tuff Cable is designed to be spaced at specific intervals and lengths to produce a specified amount of heat per square foot.

#### Installations for Tuff Cable include:

- concrete or asphalt
- light-weight concrete or mortar bed
- Heatizon Invizimelt or Heatsink Kit under metal roof covering\*
- existing concrete slab or asphalt
- sand under pavers or concrete

#### Spacing between element runs for various applications are:

- snow melting — 4 " to 6"
- roof de-icing under metal roof coverings — 6" \*
- floor warming under hard surfaces — 6"
- floor warming under other surfaces — 6" to 8"
- space heating (Must be determined by heat-loss calculations)

**Heat Density:** The density per square foot of the Tuff Cable Heating Element is dependent on the spacing between adjacent runs of Tuff Cable, the total length of the Tuff Cable Heating Element, and the size of the transformer. More details about system sizing can be found in the "System Operating Tables" section of this manual.

**\*Requires special procedures for installation. Please see specific installation procedures.**



If your project uses  
**Tuff Cable heating element,**  
go to  
**Page 2-3.**

### ZMesh

Heatizon Systems ZMesh is a low-voltage electric radiant heating element that is designed to go on a wood or concrete subfloor or subroof, and under any non-conductive floor or roof covering.

#### Installation for ZMesh include:

- under carpet over concrete or wood subfloor
- under hardwood flooring
- under tile or marble over wood subfloor or concrete
- under linoleum/vinyl flooring over concrete or wood subfloor\*
- under non-metallic roofing systems \*

#### Spacing between element runs for various applications are:

- roof de-icing — 2"
- floor warming under hard surfaces — 2"
- floor warming for other surfaces — 2" to 6"
- space-heating (Must be determined by heat-loss calculations)

**Heat Density:** The density per square foot of the ZMesh Heating Element is dependent on the spacing between adjacent runs of the ZMesh, the total length of the ZMesh Heating Element, and the size of the transformer. More details about system sizing can be found in the "System Operating Tables" section of this manual.

**\*Requires special procedures for installation. Please see specific installation procedures.**



If your project uses  
**ZMesh heating element,**  
skip to  
**Page 2-30.**

**Note:** Tuff Cable AND the connection between Tuff Cable and Cold Lead must always be installed in an acceptable heatsink—a heatsink means asphalt, concrete, mortar, mud bed, sand or a Heatizon Heatsink Kit. Failure to do so may burn the insulation off of the Tuff Cable, which may result in risk of fire.

**Warning:** All electric products, including Tuff Cable, produce an electro-magnetic field which can cause ferrous metals (or metals which are magnetic because they contain iron) to vibrate. Two or more layers or pieces of vibrating ferrous metal in contact with one another may result in a hum or noise. Separating contact between ferrous metals with Heatizon Drip Edge Protector (Heatizon Part # NI144) may reduce the audible effects of the vibration. In order to minimize the size of the flux lines or lines of force of any magnetic field given off by the Tuff Cable heating element, always run an even number of lengths of heating element and begin and end the heating element at approximately the same place.

A temperature limiting thermostat set at 180°F should be used for all Tuff Cable installations where high temperature operation is a possibility.

## 2.2 General Tuff Cable Installation Instructions:

All applications using Tuff Cable heating element will utilize similar procedures for installing the element. You should also review your specific application installation procedures and jumpering instructions before completing the element installation.

- a. Beginning at the point where the Cold Lead and Tuff Cable element will be spliced together (see “Rough-In” section of this manual), plan the element layout for each zone. Proper element spacing is determined by heat-loss calculations or heat density requirements and watts per square foot desired.
- b. Connect Tuff Cable to one Cold Lead. Lay out the Tuff Cable element in a continuous loop. Make sure the Tuff Cable element never crosses or touches itself, and will never be outside of an approved heat sink. For ease of installation, an even number of Tuff Cable runs are recommended. Allow enough Tuff Cable Heating Element at each end of the run to make the connection to the Cold Lead.
- c. Firmly anchor the Tuff Cable element to the subfloor, subroof, or welded wire fabric in three places on 180 degree turns, and two places on 90-degree turns by using an adhesive or anchoring system designed for your specific use. See the specific anchoring method instructions for the Tuff Cable application you have selected.
- d. Continue with each zone until all zones have been laid out and anchored. Insure that the Tuff Cable element and its insulation are not crimped, cut, or severed. If the Tuff Cable or its insulation is compromised or damaged in any way, the copper wire core will deteriorate over time, and the Tuff Cable element will require repair. Immediately repair all damage to Tuff Cable with an approved Cable Repair Kit (Heatizon Part # CABREPKIT).
- e. Connect the end of the Tuff Cable heating element to the Cold Leads with the Heatizon E210BS butt splice connector. See Section 7, “Making the Connection,” for details on how to make this connection.
- f. If a temperature/moisture sensor such as the Heatizon M331, M336, or M431 is to be installed in the concrete, mud bed, mortar, or sand bed, it must be in place prior to covering. See the sensor installation instructions for details.

### NOTE FOR PROJECTS WITH TUFF CABLE ON ROOF:

Most Tuff Cable roof snow and ice melting systems operate effectively between 13 to 18 watts per square foot. If your application, location or climate requires watts that exceed that range, Heatizon Systems recommends installing a sensor to shut off the system when the roof temperature reaches 50°F or the air temperature reaches 60°F.

### NOTE FOR PROJECTS WITH TUFF CABLE SNOW MELTING OR TUFF CABLE ROOF SNOW AND ICE MELTING:

In extreme conditions, automated activation devices may need to be operated manually to override the sensor or to extend operation time.

### CAUTIONS:



- TUFF CABLE ELEMENT MUST NEVER COME INTO CONTACT WITH FLAME.
- TUFF CABLE ELEMENT MUST BE ENCASED IN CONCRETE, ASPHALT, SAND BED, MORTAR BED OR A HEATIZON INVIZIMELT OR HEATSINK KIT, AND MUST NEVER BE EXPOSED TO AIR.
- TUFF CABLE MUST NEVER TOUCH OR CROSS ITSELF
- DAMAGED TUFF CABLE ELEMENT OR ITS INSULATION MUST BE REPAIRED IMMEDIATELY USING A HEATIZON CABLE REPAIR KIT (PART # CABREPKIT).

# TUFF CABLE

## Tuff Cable Specifications

Solid or stranded  
 PVC insulation  
 Nylon jacket  
 194°F (90°C) dry (THHN)  
 194°F (90°C) wet (THWN-2, 8AWG and larger)  
 167°F (75°C) wet (THWN)

## Tuff Cable Accessories

### Your Tuff Cable application may require some of these Heatizon supplies and parts:

NI101 3M Skotchkote  
 NI102 3M23 Plastic Electrical Tape, 30' roll  
 NI104 Acrylic Paint, Clear 12 oz. Can  
 NI137 Backer Rod, 3/8" - 100 Feet  
 NI146 Chairs, Castle, bag of 96  
 NI112 Chairs, Dobies - bag of 96  
 NI105 Chalk String, 100' in Steel Case  
 NI109 Chalk, 8 oz. Red  
 NI138 Concrete Sealant Gun for Sika Flex Cartridge  
 NI139 Blacktop Sealant, 8 Tubes (100 Feet)  
 NI114 Ice & Water Shield  
 NI117 Insulation - Concrete Barrier Foil - 500 sf.  
 NI118 Insulation - Rigid - 4' x 8' x 1" sheet  
 NI119 Insulation - Slab Shield - 252 sf.  
 NI120 Remesh - 4" x 4" - 4 ga. - 140 sf.  
 NI121 Remesh - 6" x 6" - 4 ga. - 140 sf.  
 NI122 Remesh - 6" x 6" - 6 ga. - 140 sf.  
 NI127 Sikaflex Caulking, 1A - 10.5 oz tube  
 NI128 Sikaflex Caulking, 1CSL - 30 oz tube  
 NI129 Solder, 40/60  
 NI133 Weather Bond - 100 sf.  
 NI136 Wire Ties, 8" - 100 count

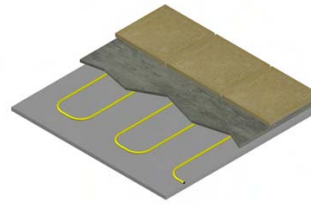
### Your Tuff Cable application may require some of these Heatizon System Kits:

ANCHPLUGKIT Tuff Cable Anchoring Plug Kit  
 CABCENKIT Tuff Cable Heatsink Kit  
 CABREPKIT Tuff Cable Repair Kit  
 CABSPLKIT Tuff Cable Splice Kit  
 JUMPERKIT Joint Jumper Kit  
 PAVERKIT Paver Kit  
 PLASCLIPKIT Plastic Clip Kit  
 CLDEXTKIT Cold Lead Extension Kit

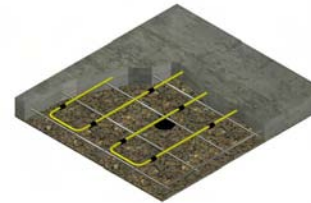
### Your Tuff Cable application may require some of these tools and equipment:

Hammer  
 Tape measure  
 Marking pencil and chalk line  
 Crimpers  
 Appropriate drill with 1/4" diameter cement bit  
 Wire Strippers and Cutters and/or Remesh Cutters  
 Razor Blade or Box Cutter  
 True RMS Clamp On Meter  
 Heatizon Roof Alarm (Part Number NI126)  
 Propane Torch  
 Saw cutter  
 Power Washer

## Tuff Cable Application Guide

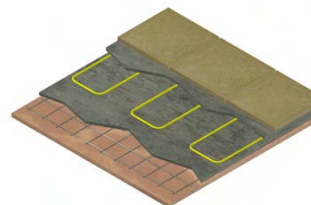


**Section 2.2**  
 General Tuff Cable  
 Installation  
 Instructions

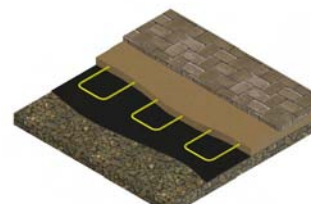


**Section 2.3**  
 Tuff Cable In and Under  
 New Pour Concrete

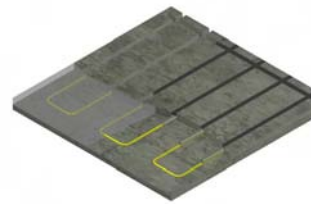
**Section 2.4**  
 Tuff Cable Jumpers



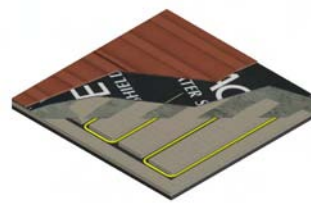
**Section 2.5**  
 Tuff Cable in a Mortar  
 Bed or Lightweight  
 Concrete



**Section 2.6**  
 Tuff Cable in a Sand  
 Bed under Asphalt,  
 4" (or less) Concrete,  
 Pavers or Stone



**Section 2.7**  
 Tuff Cable Retrofit  
 Installation in  
 Concrete or  
 Asphalt



**Section 2.8**  
 Tuff Cable in Heatizon  
 Invizimelt Kit

**Section 2.9**  
 Tuff Cable in Heatizon  
 Heatsink Kit

## 2.3 Tuff Cable In and Under New Pour Concrete

Tuff Cable is the heating element designed to be used in poured concrete installations. It is recommended that Tuff Cable element be installed just prior to pouring the concrete in order to reduce the potential for damage to the Tuff Cable. The precise location of any and all types of joints, walls, cabinets, bathroom fixtures, hand rails, and equipment to be permanently installed must be known prior to the installation of the Tuff Cable in order to avoid damage to the Tuff Cable heating element or heating unnecessary or unwanted areas. Running Tuff Cable under an area where a wall, rail, joint etc. will be installed allows for possible severing of the Tuff Cable by anchoring devices or other penetrations into concrete or by movement of the concrete.

**Pre-installation considerations.** Tuff Cable element is installed just prior to pouring the concrete. Concrete must be a minimum of 3 ½" in thickness. Heatizon recommends 5" thick concrete (see "A Few Concrete Facts" on page 2-6 of this manual). Tuff Cable's maximum efficiency occurs when it is raised 1 ½" to 2" from the slab surface.

If the element is not within 2" from the slab surface, the Heatizon System will either: (1) not heat evenly, or (2) have slower response time and less efficiency. The use of "chairs" under welded wire fabric will raise the Tuff Cable to the desired height prior to and during the concrete pour.

You should refer to and become familiar with Section 2 of this manual, "Tuff Cable Heating Element," including Section 2.4, "Tuff Cable Jumpers and Connections," and Section 2.2, "General Tuff Cable Installation Instructions."

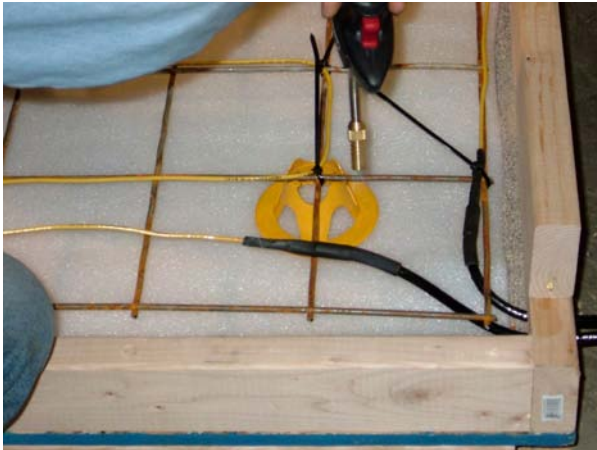
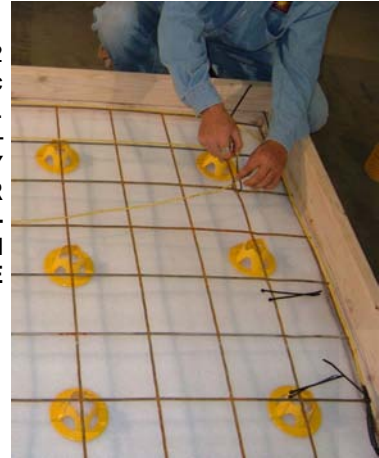
**Note:** Heatizon Systems recommends a meeting between the general contractor, the concrete contractor and the installer of your Heatizon System take place prior to any work commencing. The purpose of this meeting is to insure that the Tuff Cable and its insulation will not be cut, crimped, nicked, or otherwise damaged or severed in any way, and to review the installation process during the meeting. The precise location of all joints (cold joints, expansion joints, etc) or concrete penetrations must be identified so that "Jumper Connections" may be planned and problem areas avoided. See Section 2.4, "Tuff Cable Jumpers and Connections".

1. Cut the insulation to size and lay it between the concrete forms. For the most efficient use of the Heatizon System use minimum of R-5 insulation below the concrete on grade and to provide perimeter insulation. Review all local and national building codes for recommendation of insulation practices.
2. Cut the welded wire fabric to size and lay it between the concrete forms.
3. Install the "Chairs" (Heatizon Systems Part NI112) under the 4 gauge welded wire fabric (2X2, 4X4 or 6X6). **Note:** During the concrete pour, constantly monitor the welded wire fabric and Tuff Cable to insure that the element is within 2" from the slab surface.
4. Once the area is ready for concrete, use spray paint to mark the location of all joints. Cut welded wire fabric and insulation, then dig the holes for Cold Lead jumpers wherever Tuff Cable will cross through a joint of any kind. Line the hole with gravel.
5. Connect one end of the Tuff Cable element to one Cold Lead. See Section 7, "Making the Connection," for details on how to make this connection. Lay out the element, anchoring it to the welded wire fabric in three places on 180-degree turns and two places on 90-degree turns



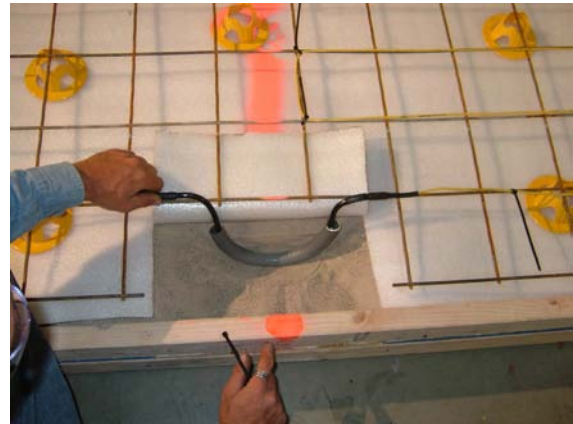
# TUFF CABLE

6. Attach the Tuff Cable heating element to the welded wire fabric every 12 to 18 inches. Attach the Tuff Cable to the welded wire fabric with plastic electrician's tape or plastic wire ties (available from Heatizon Systems). When beginning and ending a zone, leave enough extra element to allow for connection to the Cold Leads. **DO NOT INSTALL ANY LENGTH OF TUFF CABLE ELEMENT THAT WILL CAUSE YOUR HEATIZON PRODUCT TO OPERATE AT A SECONDARY AMPERAGE GREATER THAN 96. DO NOT EXCEED THE MAXIMUM LENGTH OF TUFF CABLE ELEMENT REQUIRED TO ACHIEVE THE DESIRED WATTS PER LINEAR FOOT FOR A ZONE.**



7. The Tuff Cable heating element is then connected to the Cold Lead with the Heatizon E210BS butt splice connector. The E210BS butt splice connection must be inside the concrete so that the concrete acts as a heatsink. This connection is to be made in the concrete; no junction box is to be used. When necessary, the Cold Lead can run under the concrete slab for some distance before exiting. It is recommended that the Cold Lead always be encased in PVC conduit and ran in pairs as much as possible.

8. Complete the jumpers under all joints by connecting the ends of the Tuff Cable to Cold Lead jumpers using Heatizon Joint/Mark Jumper Kit (Heatizon Part # JUMPERKIT). Tuff Cable element should never pass through a concrete expansion joint or any other type of joint or control mark. After the connection is made, fill the hole with sand, replace the insulation. See complete jumpering instructions and photos in Section 2.4



9. If a temperature/moisture sensor such as the M331 or M431 or a temperature sensor such as the M336 is to be installed in the concrete slab, it must be in place prior to the concrete being poured (see the sensor installation instruction for details).

10. Continue with the next zone until all zones are laid out and anchored to the welded wire fabric.

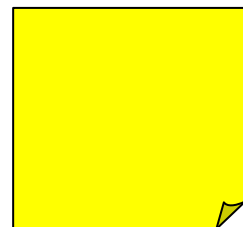


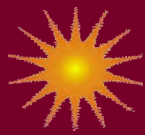
**CAUTIONS:** Do not use metal wire ties, or other conductive material to connect the Tuff Cable to the welded wire fabric. Always use electrical tape or plastic wire ties to attach the Tuff Cable to the welded wire fabric. Damaged Tuff Cable element or Tuff Cable element insulation must be repaired IMMEDIATELY. Tuff Cable element must never touch or cross itself.



**IMPORTANT!** A red plastic "STOP! DANGER!" sign indicating the presence of electric deicing, snow melting or warming equipment has been included with your Heatizon product packaging. This caution notice must be posted at the fuse or circuit breaker panel and be clearly visible.

**IMPORTANT!**  
Record the number of feet of Tuff Cable Element that you have installed for each zone here:





**Heatizon Systems** is not an asphalt, concrete or pavers expert, but we have a few suggestions that you may wish to discuss with your contractor. We make these suggestions in an effort to increase the likelihood that Heatizon Systems' Tuff Cable will be surrounded by products that are equal to it in both quality and expected longevity. In addition, we make these suggestions in an effort to reduce the possibility that your Tuff Cable heating element will get damaged or broken by the vertical or horizontal movement of asphalt, concrete, or pavers.

**Dry Base:** Make certain that the ground below where the new asphalt, concrete or pavers will be located is as dry as possible. It is recommended that it be covered whenever there is a risk of a storm for one to two weeks prior to the pour.

**Excavation:** Be sure that your excavation is deep enough to accommodate the thickness of the concrete, the thickness of the insulation, the depth of the aggregate base you will have below the concrete and a 1" sand bed if you elect to install the Tuff Cable below the concrete.

**Compaction:** Once the excavation is complete, it is highly recommended that a great deal of care be given to completely and properly compact the entire area where the asphalt, concrete or pavers will be located.

**Drainage:** In order to have proper drainage and to reduce the likelihood of vertical shifting of your asphalt, concrete, or pavers Heatizon Systems recommends that a minimum of 6 inches of high quality aggregate be laid over the entire area where the asphalt, concrete, or pavers are to be installed, plus one foot around all edges.

**Reinforcement:** In order to enhance the integrity of your asphalt, concrete or pavers, Heatizon Systems recommends that reinforcement be considered. Most of the time concrete can be reinforced with number 4 gauge welded wire fabric or ½ inch re-bar placed at least 2 inches from the top and bottom surfaces of the concrete.

**Insulation:** Insulation is a two edged sword. On the one hand, it acts as a good moisture barrier, reduces the response time of your snow melt or heating system, and saves money by reducing operating time. On the other hand, insulation does not allow the heat from the ground to get into the asphalt, concrete, or pavers.

**Maximum Area:** Heatizon Systems recommends that concrete be poured in square sections no larger than 9.5 feet X 9.5 feet. Pouring other geometric shapes without additional joints almost always results in cracking. Each square must always have a joint on each of its four sides.

**Thickness:** Heatizon Systems always recommends the following thickness be observed:

Concrete	5 or more inches
Asphalt	4 or more inches
Pavers	4 or less inches

**Suggested Mix:** Heatizon Systems recommends that a six-bag mix with fiber or steel fibers always be used when pouring concrete.

### CONCRETE JOINTS AND USING JUMPERS

**Control Joints:** Control Joints are intended to control where the slab will crack and are placed either in fresh concrete or saw cut in after the concrete is poured. Spacing of these joints will vary depending on the size and shape of the slab. Use a Tuff Cable Jumper to protect the heating cable when crossing control joints (Refer to Section 2.4 "Tuff Cable Jumpers and Connections").

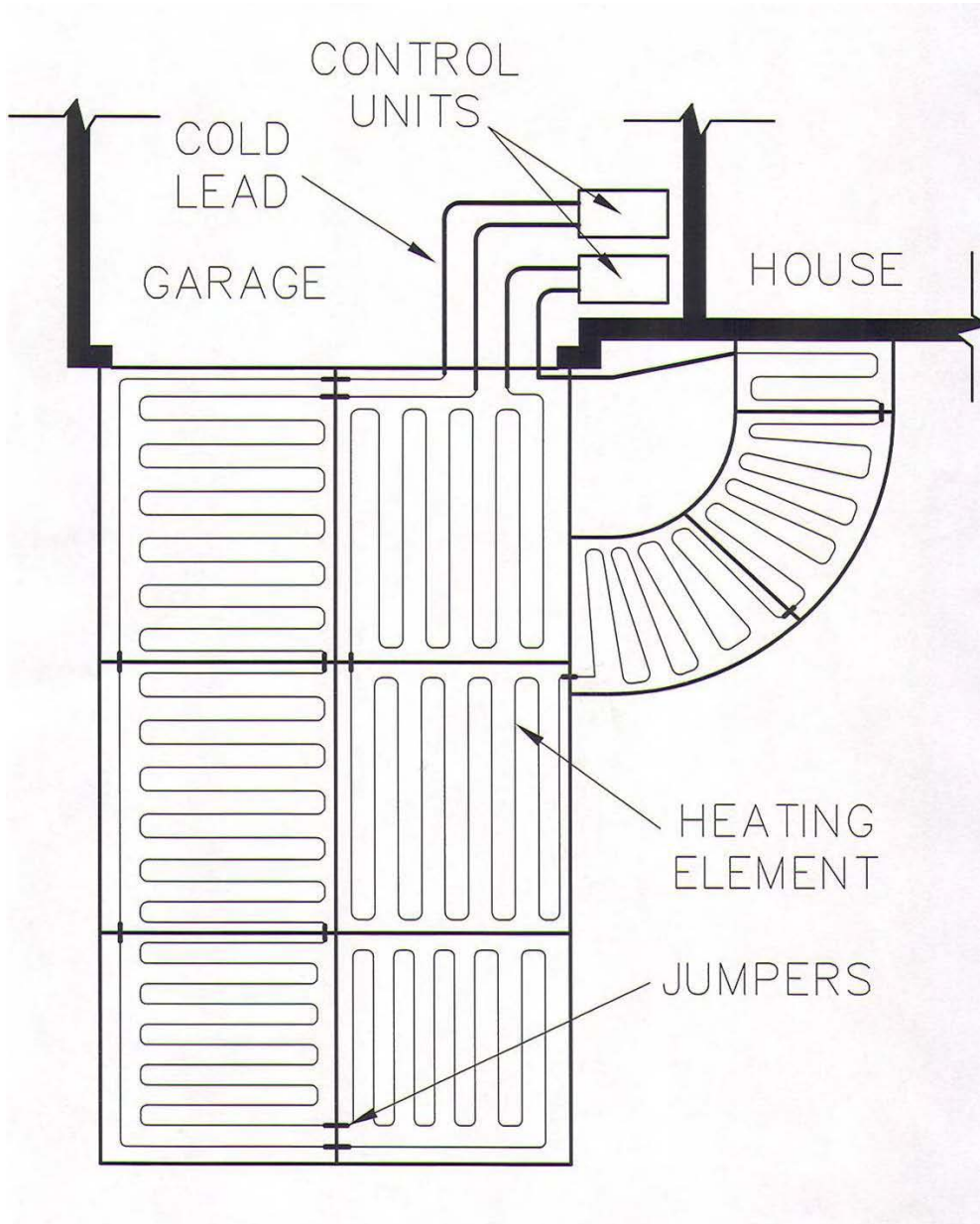
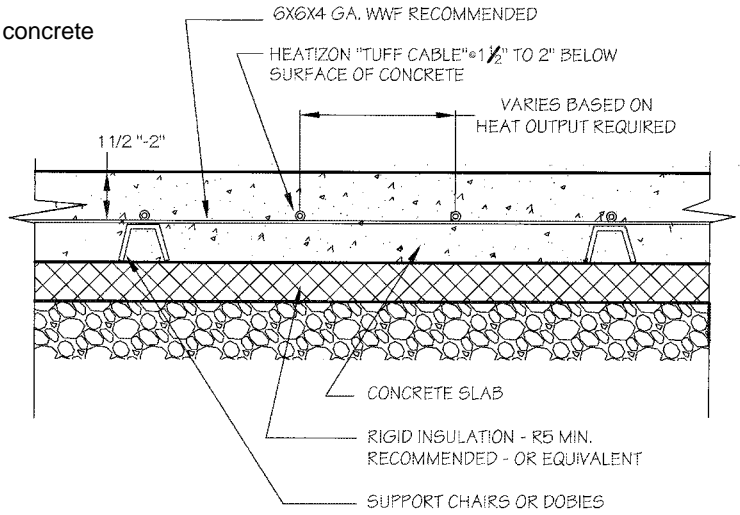
**Construction Joints:** Construction joints are a common result when multiple concrete pours are completed at different stages during construction. Use a Tuff Cable Jumper to protect the heating cable when crossing construction joints (Refer to Section 2.4 "Tuff Cable Jumpers and Connections").

**Expansion Joints:** Expansion or Isolation joints result when concrete is isolated from something else which can be concrete, a wall, column etc. When an expansion joint is used between two concrete slabs the two structures are not connected using rebar, therefore movement can/will occur between them. Do not cross expansion joints with the heating portion of the cable. The cold lead portion of the cable may cross expansion joints as long as the cold lead is buried under or sleeved with conduit at the bottom of the joint.

**Jumpers:** It does not matter what kind of joint is in the asphalt or concrete, heating cables should never be allowed to run through them unprotected. Always use a Heatizon Systems jumper under or through any and all joints. Use a Heatizon Tuff Cable Jumper Kit (Heatizon Part # JUMPERKIT).

# TUFF CABLE

Tuff Cable in new pour concrete



Sample Driveway and sidewalk layout for two zones of Tuff Cable snow melting systems. Note that jumpers extend the Tuff Cable heating element through all joints and marks.

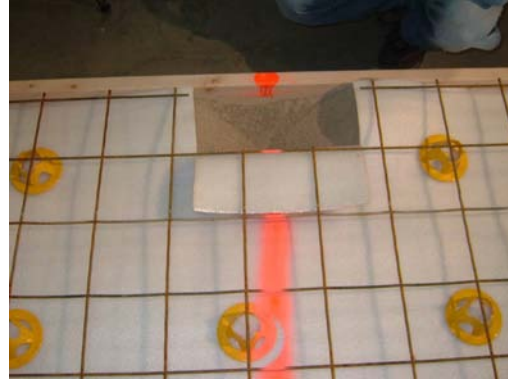
## 2.4 Tuff Cable Jumpers and Connections

In order to plan and install Tuff Cable Jumpers, the precise location of all walls, any and all kinds of joints (expansion, crack control, strike, etc.) and future floor penetrations must be known in order to avoid damage to Tuff Cable and/or Cold Lead.

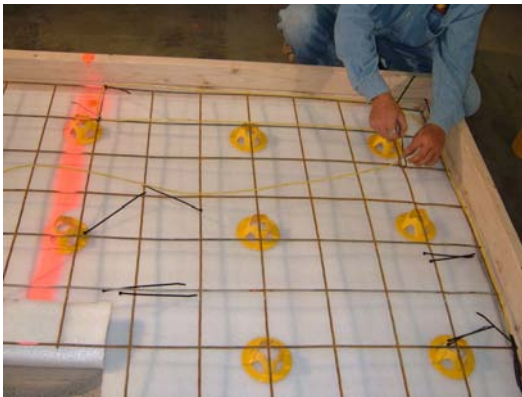
The example below demonstrates the steps necessary to install Tuff Cable jumpers in new-pour concrete.



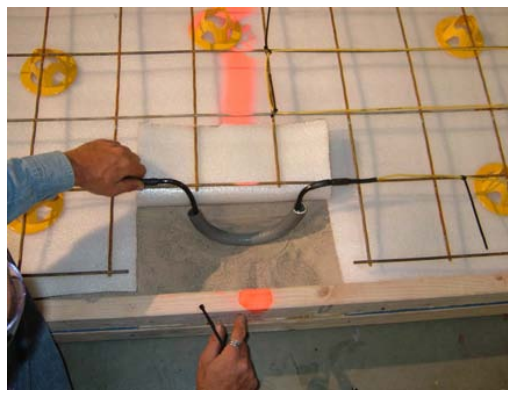
1. After insulation, castle chairs and welded wire fabric have been installed, use spray paint to indicate where any joint (expansion, mark, strike, etc) will be located.



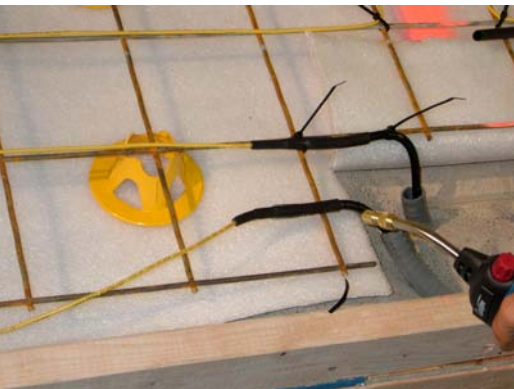
2. Trim welded wire fabric away from area. Cut insulation to expose area where jumpers will be installed; fold back to expose sand or gravel sub material.



3. Attach Tuff Cable element to welded wire fabric with wire ties, as shown in the following section, making sure Tuff Cable NEVER crosses through the indicated joint.



4. Use a Heatizon Tuff Cable Joint/Mark Jumper Kit (Heatizon Part # JUMPERKIT) to extend Tuff Cable through any joint. Note that the Tuff Cable does not cross the indicated joint at any point.



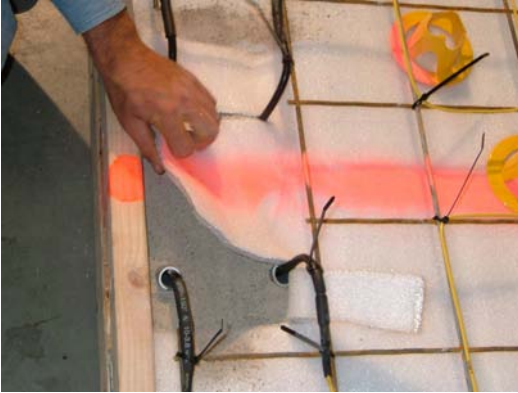
5. Follow Tuff Cable Jumper Kit instructions to complete the proper jumper connections. The Tuff Cable starting and ending points are also connected to the Cold Lead in a similar manner.



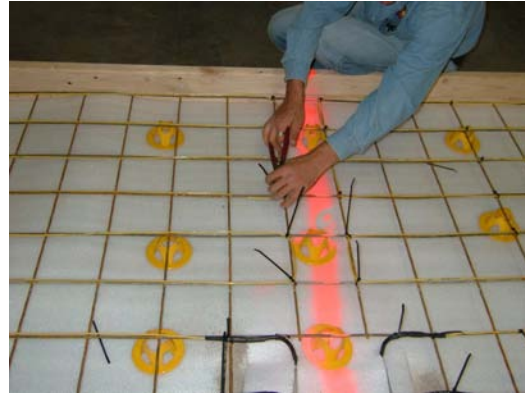
6. Once the jumper is complete, fill in the exposed area with sand so that conduit is completely covered.



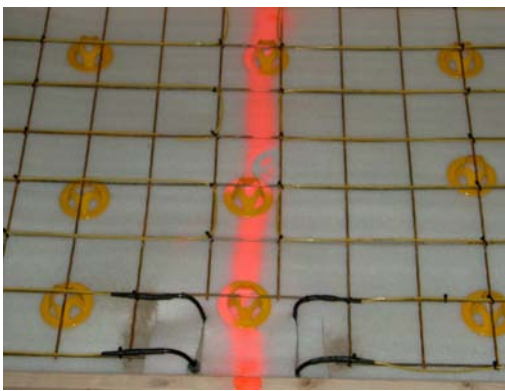
# TUFF CABLE



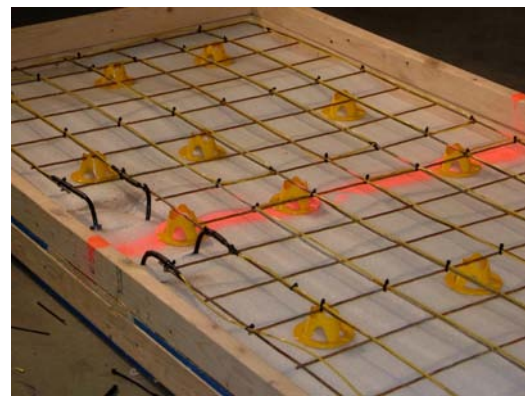
7. Replace the insulation over the top of the sand.



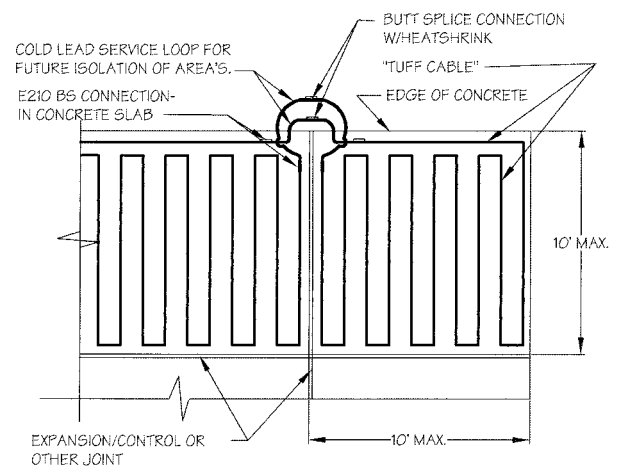
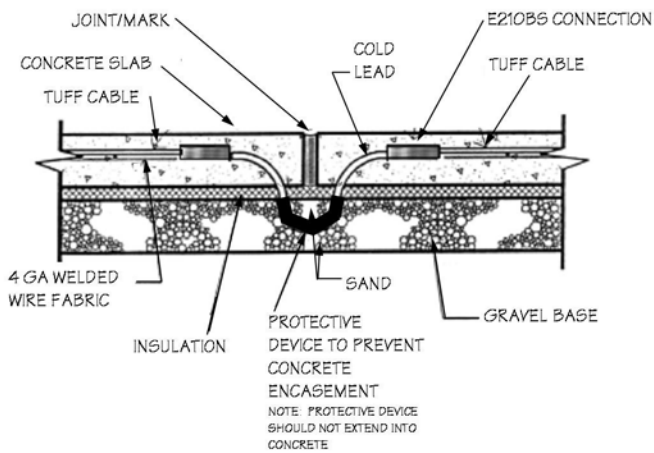
8. Complete tying of any Tuff Cable, and trim any un-trimmed wire ties.



9. Make certain that the painted lines are clear and visible for the concrete contractor so that joints are installed only in the indicated areas.



10. You are ready for concrete!



See Section 7, "Making the Connections" for more details on how to make this connection..

## 2.5 Tuff Cable in a Mortar Bed or Lightweight Concrete

Typical Tuff Cable installations for Interior Space Heating and Floor Warming include:

- in a mortar bed on a wood or concrete sub floor
- in lightweight concrete on a wood or concrete subfloor
- in thin set on a wood or concrete sub floor
- in a Heatizon Systems Heatsink Kit

You should refer to and become familiar with Section 2 of this manual, "Tuff Cable Heating Element," as well as reviewing Section 7, "Making the Connection."



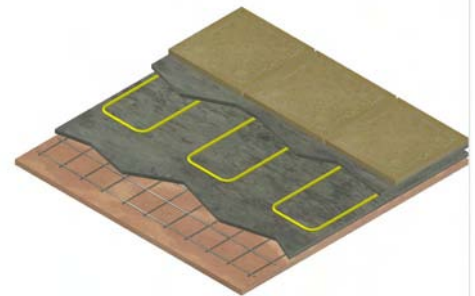
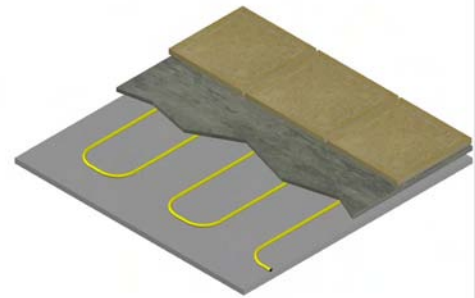
Note: For each application Tuff Cable must be completely embedded in mortar, lightweight concrete, Gypcrete, a Heatizon Systems Heatsink Kit, or other acceptable heat sink. Warning: Never design and install Heatizon Systems Tuff Cable products for space heating or floor warming applications in a manner that will result in the delivery of more than 15 watts per square foot.



**CAUTION:** Take extreme caution not to damage the insulation of the Tuff Cable. If the insulation is nicked or damaged in any way, the Tuff Cable must be immediately repaired using Heatizon Tuff Cable Repair Kit (Part Number CABREPKIT) before the mortar bed or lightweight concrete are installed.

Note: There is a minimum and maximum length of Tuff Cable that must be installed for your specific installation. See "System Operating Tables" section of this manual.

Note: Tuff cable needs to make a complete loop from one Cold Lead to the other when installed without crossing over or touching itself.



1. Follow design and layout procedures found in Section 2.1.

2. Transfer element design layout to floor using tape measure, marking pencil, and chalk line. Lay out perimeter of area to be heated first, keeping a minimum of 3 inches from walls and/or cabinets and the first run of element. Verify that you have enough Tuff Cable to heat area you have selected.



# TUFF CABLE

3. If Tuff Cable is being installed on wood subfloor, mark adjacent runs of element on the floor with appropriate spacing, usually 6 to 8 inches (but in some cases, may be 4, 10 or 12 inches). Verify specific spacing requirements for your installation with those in your heat loss calculation for space heating.

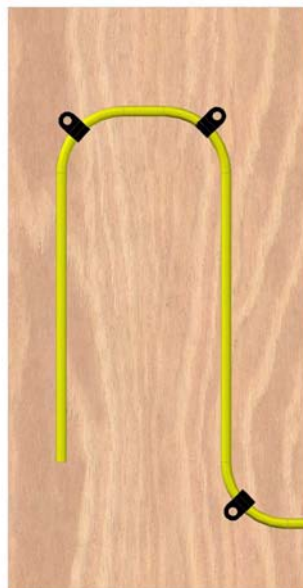
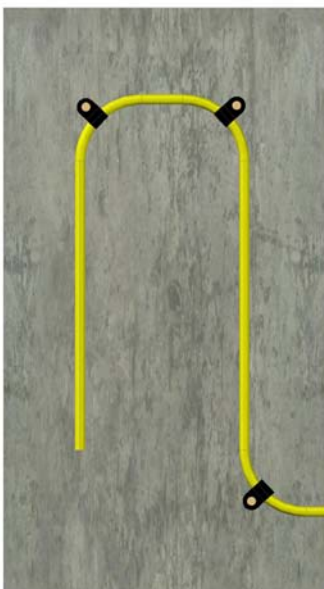
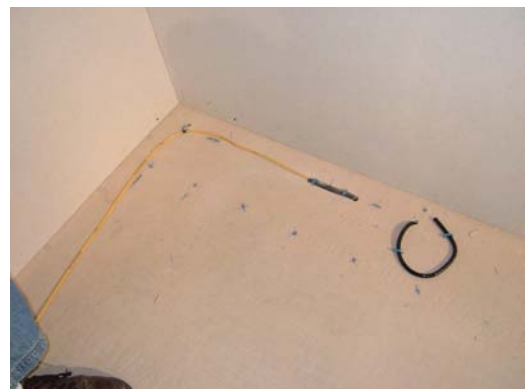
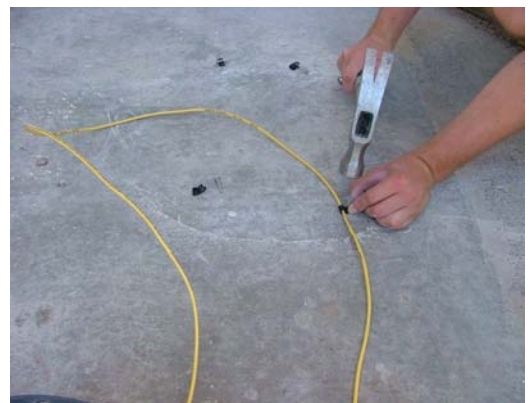
Anchor the Tuff Cable using a Heatizon Plastic Clip Kit (Part # PLASCLIPKIT) to hold Tuff Cable to wood subfloors. Never use any attachment that will compromise the Tuff Cable or its insulation in any way. Each 90° bend and each 180° turn requires two Heatizon Plastic Clips. Heatizon Plastic Clips should be spaced approximately every 18 or 24 inches apart along the length of the Tuff Cable heating element.

4. If Tuff Cable is being installed directly on existing concrete, use 1/4" cement drill bit to drill holes 1" deep in every location where a Heatizon Plastic Clip will be located. Install one Tuff Cable Anchoring Plug into each pre-drilled hole by tapping plugs until they are flush with the surface of the concrete. Tuff Cable Anchoring Plugs should fit tightly in pre-drilled holes.

5. Make the first connection between one Cold Lead and Tuff Cable by following directions in Section 7, "Making the Connection." You may need to notch out the floor to accommodate the connection.

6. Lay out Tuff Cable on designated chalk lines as planned in the layout. Secure Tuff Cable with Heatizon Plastic Clips by using the following procedures:

If Tuff Cable is being installed **directly on a wood sub floor or on top of a mortar bed**, Heatizon Plastic Clips can be inserted around Tuff Cable element, and secured to sub floor by hammering nail through anchor ends until both plastic tails are flat against sub floor surface. Repeat with each Heatizon Plastic Clip until all clips are secure.



# TUFF CABLE

If Tuff Cable is being installed **directly on existing concrete**, you should have already completed Step 4. If you have not completed Step 4, do so now. Insert Heatizon Plastic Clips around Tuff Cable element and secure by hammering nail through anchor ends directly into Tuff Cable Plug, until both plastic tails of the clip are flat against and concrete and plug. Repeat with each Heatizon Plastic Clip until all clips are secure.

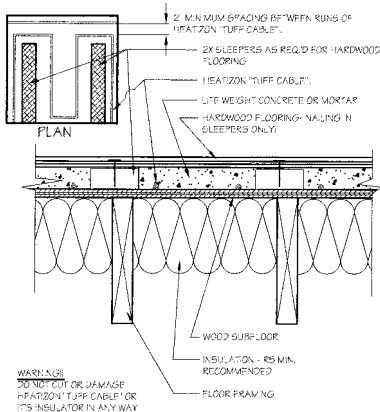
**Step 7:** Continue laying out and anchoring Tuff Cable until complete. Make sure end of Tuff Cable returns to the second Cold Lead location to make final connection between Tuff Cable and Cold Lead. Make the connection between the second Cold Lead and end of Tuff Cable by following directions in Section 7, "Making the Connection."

**Step 8:** Make note below of how much Tuff Cable was installed for future reference and trouble shooting. Length of element is printed in one-foot increments on the Tuff Cable.

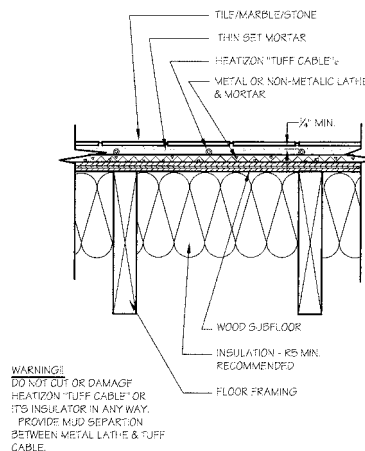
**Step 9:** Install the temporary paper "Stop! Danger!" signs to advise others not to damage or disturb the Tuff Cable. Remove the temporary signs prior to covering the Tuff Cable with cementitious material.



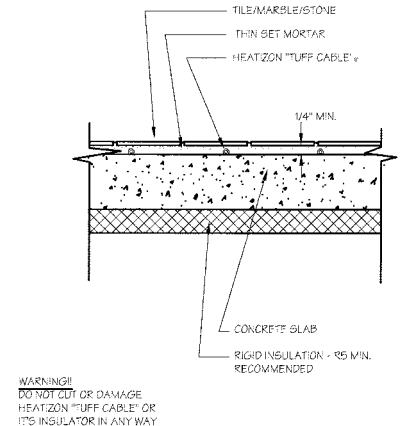
Tuff Cable under hardwood in lightweight concrete.



Tuff Cable under tile on a wood subfloor



Tuff Cable under tile on a concrete slab

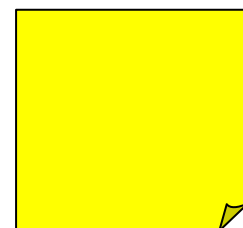


**CAUTIONS:** Damaged Tuff Cable element or Tuff Cable element insulation must be repaired **IMMEDIATELY**. Tuff Cable element must never touch or cross itself.

**IMPORTANT!**  
Record the number of feet of Tuff Cable Element that you have installed for each zone here:



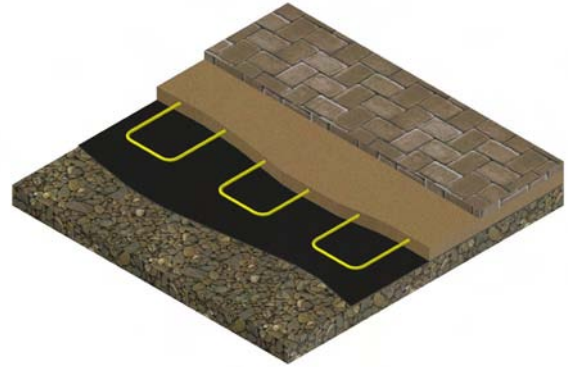
**IMPORTANT!** A red plastic "STOP! DANGER!" sign indicating the presence of electric deicing, snow melting or warming equipment has been included with your Heatizon product packaging. This caution notice must be posted at the fuse or circuit breaker panel and be clearly visible.



# TUFF CABLE

## 2.5 Tuff Cable in Sand Bed Under Asphalt, Concrete, Pavers, Stone, or Concrete (4" Maximum Thickness)

Heatizon Tuff Cable must be embedded in a 1" sand bed and should have approximately 1/2" of sand over and under it. Tuff Cable should never be installed in open air applications, nor directly on top of the rigid insulation. Heatizon recommends insulating where Tuff Cable is being installed to get maximum heat transfer. Rigid insulation that is at least one inch (1") thick R-5 minimum is recommended.

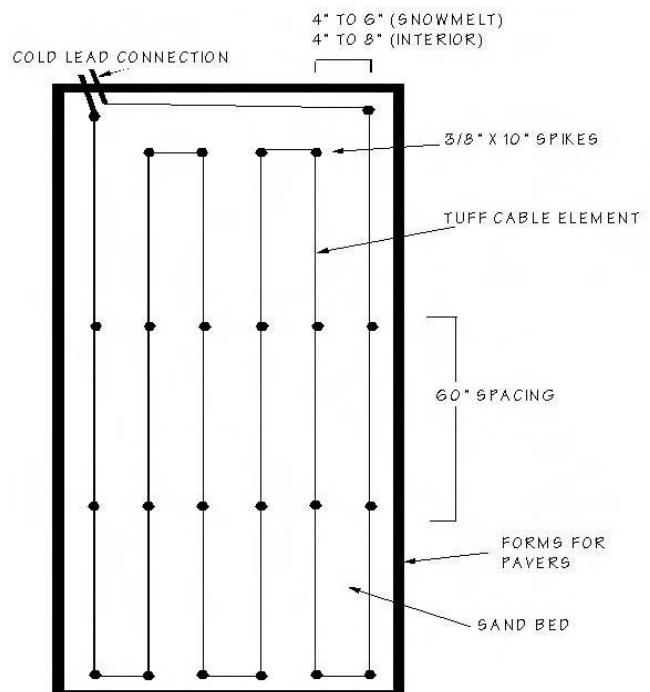


**Step 1.** Cover entire area to be heated with rigid 1" thick insulation, and then 1/2" of sand.



**Step 2.** Create a layout by determining which direction to run the Tuff Cable. Remember that Tuff Cable must be installed in lines that are parallel to one another. Make sure that both the beginning and end of the Tuff Cable element runs are in the same area as the Cold Leads.

**Step 3.** Beginning on the edge of area where Tuff Cable beginning and end are located, drive spikes into ground to establish widths between the Tuff Cable runs.



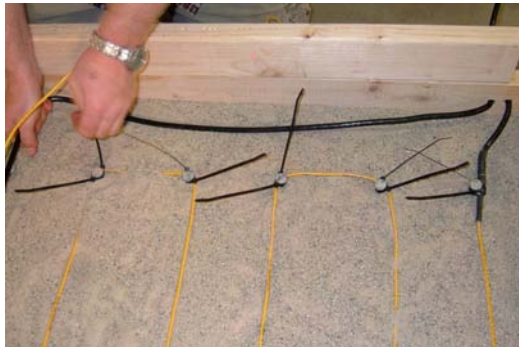
Sample Layout of Tuff Cable Under Pavers

## TUFF CABLE

**Step 4.** Place rows of spikes, driving a spike in every 60 inches on each row. Make sure the last spike in each row is at the very end of the area to be heated. Each spike head should remain  $\frac{1}{2}$ " above the sand.



**Step 5.** Connect one Cold Lead to Tuff Cable, then round the spikes with the Tuff Cable at each end and tie the Tuff Cable to the spikes using plastic wire ties. Make a continual loop of the Tuff Cable, making sure the end of the Tuff Cable returns to the Cold Lead location. Leave an extra 12" of Tuff Cable at the start and finish to make eventual connection to the Cold Leads.



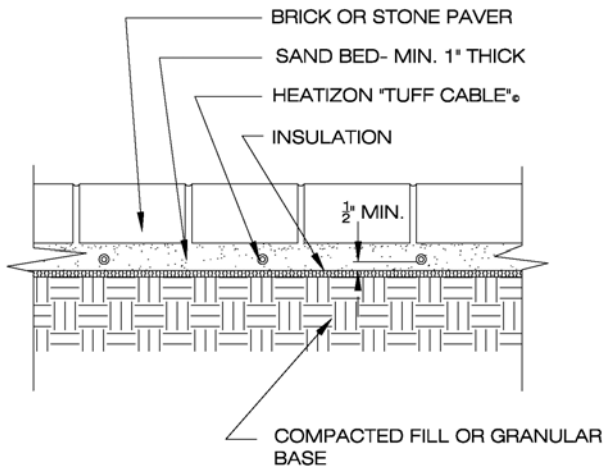
**Step 6.** Make the connections between the two Cold Leads and the beginning and end of the Tuff Cable by following directions in Section 7, "Making the Connection." Secure the Cold Leads to the spikes with plastic wire ties.



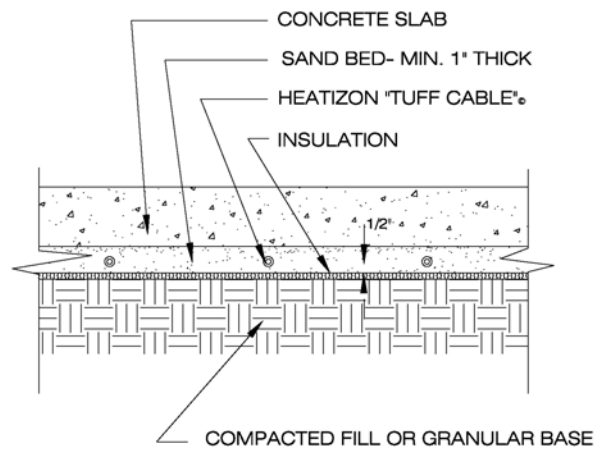
# TUFF CABLE

**Step 7.** Cover Tuff Cable with ½" of sand. Make certain that the Tuff Cable is surrounded by sand. Never allow Tuff Cable to directly touch itself or the insulation. Always make certain that some sand gets between the bottom of the Tuff Cable and the insulation. Great care must be taken to avoid damage to the Tuff Cable.

**Step 8:** Install asphalt, pavers, stone or concrete (4" maximum).



Tuff Cable in a Sand Bed  
Under Brick, Stone or Concrete Pavers

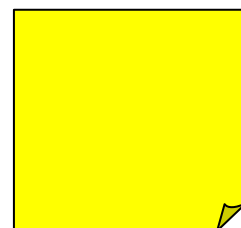


Tuff Cable in a Sand Bed  
Under a Concrete or Asphalt Slab



**CAUTIONS:** Do not use metal wire ties, or other conductive material to connect the Tuff Cable to the stakes. Always use electrical tape or plastic wire ties or plastic clips to attach the Tuff Cable to the stakes. Damaged Tuff Cable element or Tuff Cable element insulation must be repaired IMMEDIATELY. Tuff Cable element must never touch or cross itself.

**IMPORTANT!**  
Record the number of feet of Tuff Cable Element that you have installed for each zone here:



**IMPORTANT!** A red plastic "STOP! DANGER!" sign indicating the presence of electric deicing, snow melting or warming equipment has been included with your Heatizon product packaging. This caution notice must be posted at the fuse or circuit breaker panel and be clearly visible.

## 2.7 Tuff Cable Retrofit Installation

Tuff Cable element can be installed in existing concrete, asphalt, and/or pavers. This is accomplished by saw-cutting the concrete, asphalt or pavers with grooves that are ¼ - inch wide by 1 - inch deep spaced on appropriate centers, inserting the Tuff Cable (and backer rod for concrete and pavers only) into the grooves and then filling the grooves.

1. Determine the desired element spacing (usually 4 to 6-inch centers for exterior snow/ice melting, depending on elevation and weather patterns of your area, and 6 to 12-inch centers for interior heat and floor warming) and the dimensions of the area to be melted. NOTE: The combination of heated area desired, heat density, and Tuff Cable element spacing will determine the number of Heatizon Tuff Cable zones you will need.

2. Lay out the pattern of the Tuff Cable element such that it creates a continuous loop that never crosses or touches itself. Turns may be made by over cutting the lines at various angles. For example, two 90 degree cuts will create parallel paths.

3. Mark the determined Tuff Cable locations on the top of the asphalt or concrete with a chalk line.

4. Spray the chalk lines with clear lacquer to prevent the chalk line from washing away.

5. Saw cut each chalk line ¼" wide by 1" deep for the Tuff Cable element and ½" wide by 1½" deep for Cold Leads. Round outside corners of cuts and remove any sharp edges to avoid damage to Tuff Cable.





# TUFF CABLE

6. Thoroughly clean the sawcut cracks with a high power pressure washer to remove all dust and debris from the grooves. Allow to dry.



7. Make one connection between the Cold Lead and Tuff Cable. Lay the Heatizon Tuff Cable element in the bottom of the saw cuts leaving an extra 12" of element at the end for eventual connection to the Cold Lead.




8. The Cold Lead to Tuff Cable element connection is made by following directions in Section 7, "Making the Connection." This connection must be embedded in the concrete, asphalt or pavers.




9. Fill all cuts with sealant for asphalt retrofits, or backer rod and sealant for concrete and paver retrofits, in accordance with filler manufacturers recommended procedures.

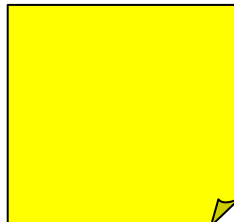
**Note:** To maximize performance, element should be installed in lines that are parallel to one another.

**Note:** All cuts will need to be slightly over cut to insure that the intersection of two cuts still result in a depth of one inch where the Tuff Cable element will lay.

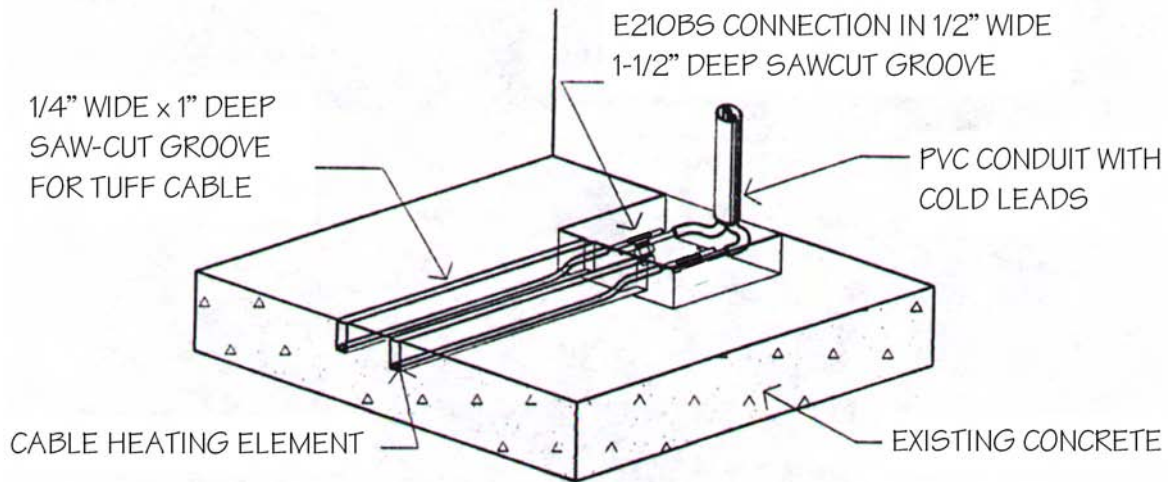
 **CAUTIONS:** Damaged Tuff Cable element or Tuff Cable element insulation must be repaired IMMEDIATELY. Tuff Cable element must never touch or cross itself.

**IMPORTANT!**  
Record the number of feet of Tuff Cable Element that you have installed for each zone here:

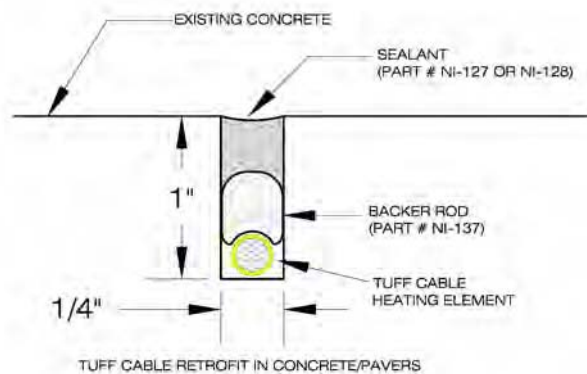
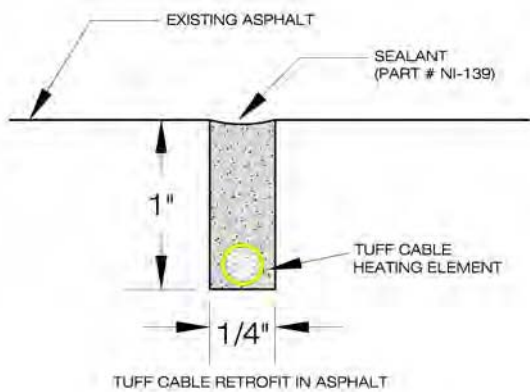
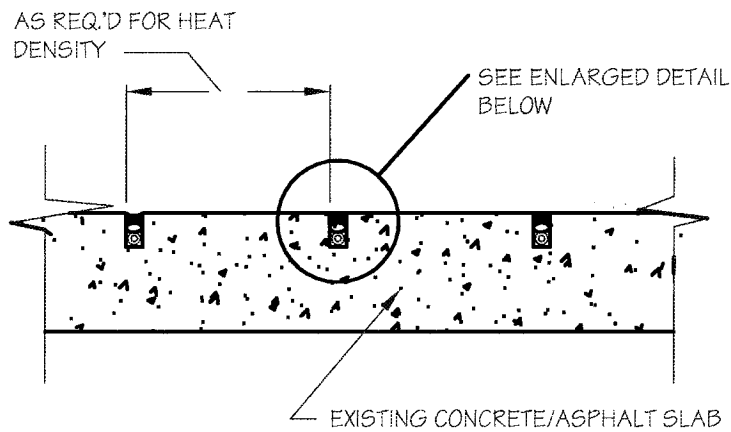
 **IMPORTANT!** A red plastic "STOP! DANGER!" sign indicating the presence of electric deicing, snow melting or warming equipment has been included with your Heatizon product packaging. This caution notice must be posted at the fuse or circuit breaker panel and be clearly visible.



# TUFF CABLE



E210 Retrofit Connection in Conduit

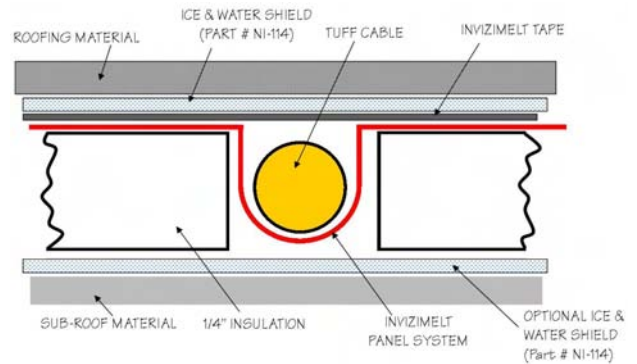


# TUFF CABLE

## 2.8 Tuff Cable in Invizimelt Panels Installation for Roofs, Steps, Decks, & Subfloor

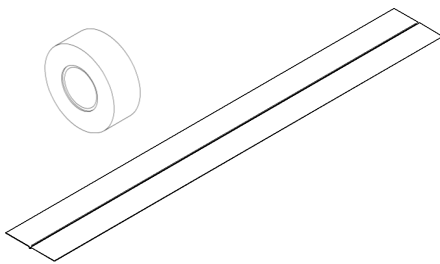
The Invizimelt Panel System uses Tuff Cable Heating Element to provide unparalleled roof deicing and roof snow melting. Heatizon Systems Tuff Cable is a low-voltage electric radiant heating element that must always be installed in an acceptable heat sink. For this manual, a heat sink means asphalt, a cementitious material like concrete or mortar, a mud bed, sand, Invizimelt Panel System or a Heatizon Heat Sink Kit. Tuff Cable is designed to be spaced at specific intervals and lengths to produce a specified amount of heat per square foot.

Heatizon's Invizimelt Panel System can be installed in a variety of configurations to conform to the requirements of any project.



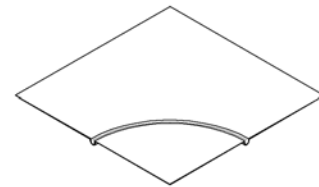
### INV6KIT: Heatizon Systems Invizimelt 6 Panel Kit Contains

- 25 6" x 48" Invizimelt Panels
- 1 150' Roll of Invizimelt Z-Tape



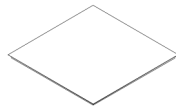
### INVTRNKIT: Heatizon Systems Invizimelt 6 Turn Kit Contains

- 8 6" x 6" 90 Degree Turn plates



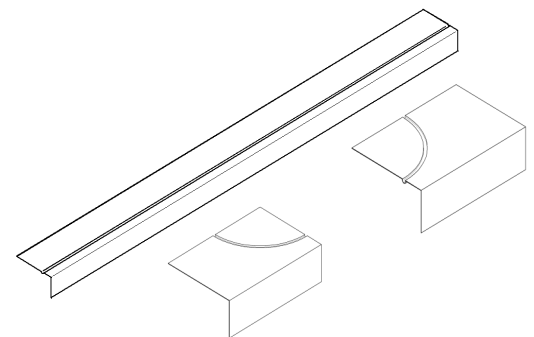
### INVGAPKIT: Heatizon Systems Invizimelt Gap Kit Contains

- 16 6" x 6" Invizimelt Gap Plates (with foam insulation, not attached)



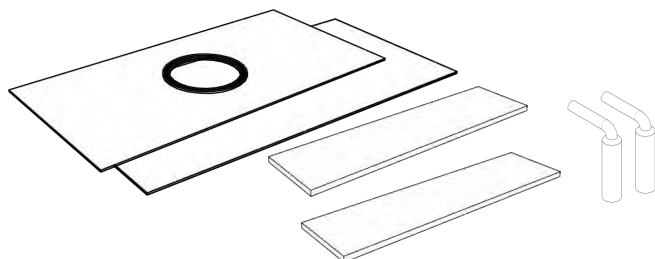
### INVDEKIT: Heatizon Systems Invizimelt Drip Edge Kit Contains

- 5 6" x 48" Drip Edge Panels
- 1 6" x 4" Left Drip Edge Turn
- 1 6" x 4" Right Drip Edge Turn



### INVORKIT: Heatizon Systems Invizimelt Origination Kit Contains

- 1 6" x 12" Origination Plate with Grommet
- 1 6" x 12" Cover Plate
- 2 Insulated Backing 12" x 2.5"
- 2 E210BS90 Butt Splice with 90° Turn
- 2 1/2" Heatshrink Tubes
- 2 3/4" Heatshrink Tubes
- 1 Roll Solder

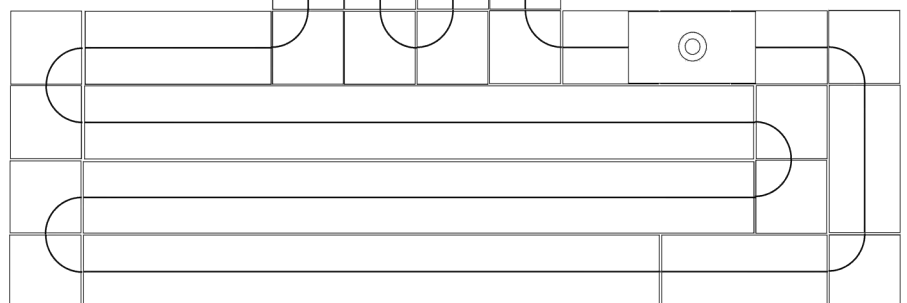
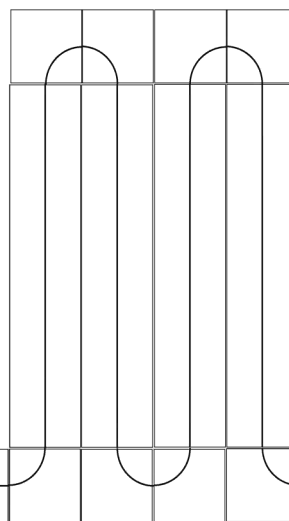
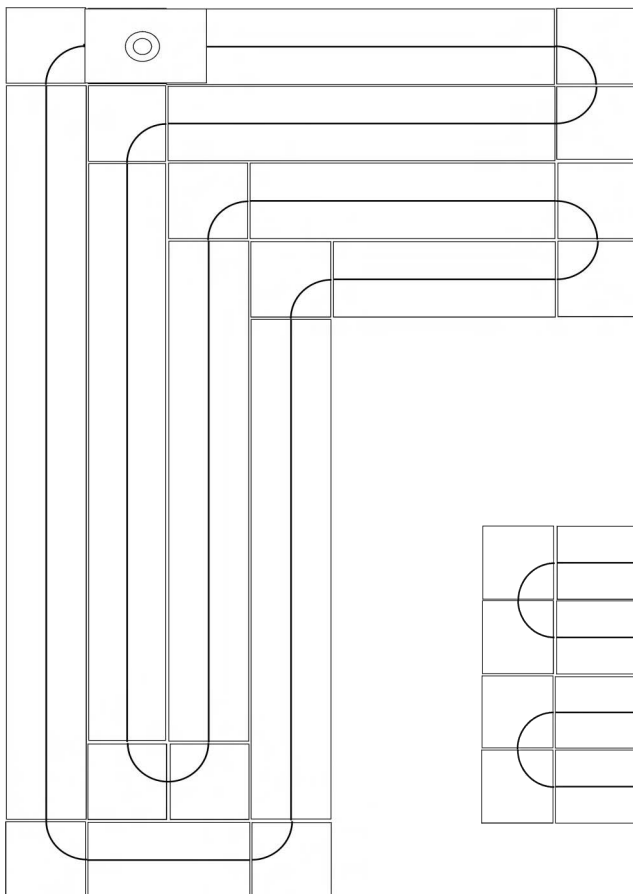
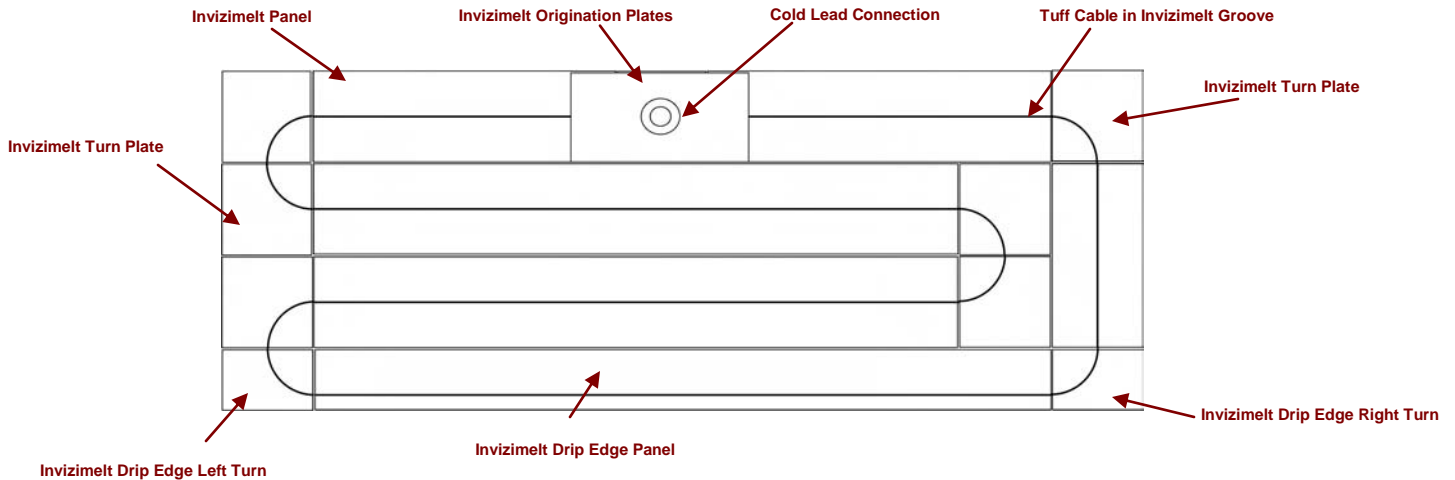


# TUFF CABLE

**DESIGN THE SYSTEM.** Determine the area to be covered by Invizimelt. Use the sample layouts below for ideas on how Invizimelt can be configured to meet the needs of your project. Note: Make certain that you have enough Invizimelt Panels to cover the entire area and for the amount of heating element to be installed.

Use a chalk line to mark the layout. The chalk line will become your guide to accurately line up the center channel of the Invizimelt panels.

Tip: Ensure that an even number of runs is planned so that the heating element begins and ends in the same location.



# TUFF CABLE

## INVIZIMELT PANEL INSTALLATION:

Once the layout design has been finalized and the starting place chosen on the sub-roof, begin the installation of the Heatizon Systems Invizimelt System as follows:

**Step One:** Determine where the Cold Leads will penetrate the sub-roof or sub-deck and for the location of the Origination Kit. The origination location is most conveniently located on the farthest row of panels from the edge of a roof or deck or farthest row of panels from the center of a valley. A layout plan makes this process much easier. The Origination Kit includes L-shaped Butt Splices (Heatizon Part Number E210BS90) with Solder and Heatshrink and is used to make the connection between Tuff Cable and Cold Lead.

**Note:** When all of the Invizimelt Panels and Turn Plates are installed, there should be an even number of Tuff Cable runs and a continuous loop of Tuff Cable from the origination to the termination point. See the layout examples to help with system configuration.

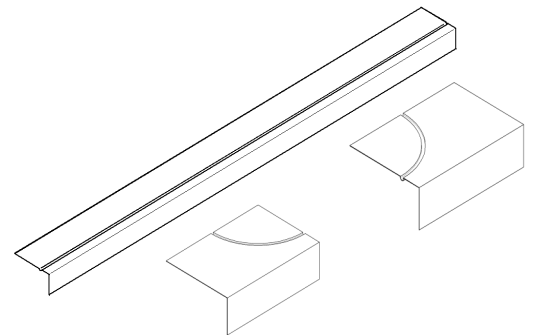
**Step Two:** If using the Optional Invizimelt Drip Edge Kit along the eaves or around the open perimeter of a deck, begin by installing the Drip Edge Panel along the entire edge of the roof or deck. Install a Drip Edge Left Turn Plate and a Drip Edge Right Turn Plate at the appropriate ends of the Drip Edge Panels. The Drip Edge turns will be matched with regular 6" turns or drip edge panels depending on your layout. Always work from the edge of a roof up when using a drip edge panel or the bottom of a valley out.

**Step Three:** Lay one row of Invizimelt Panels in place directly above the Drip Edge Panels or along a straight chalk line designed to establish the starting point. Leave 1/8" between long edges of the Invizimelt Panels to allow for expansion and contraction. Tack the Invizimelt Panels and Turns in place using roofing nails, screws, or other recommended fasteners staying at least 2" away from the Tuff Cable grooves. As an example, for a full 4' panel, use a fastener on each side of the groove 4" in from each end and an additional fastener in the middle of the panel on each side of the groove, for a total of 6 fasteners for a 4' Invizimelt Panel. Too many fasteners may cause difficulty installing Tuff cable in the grooves. Invizimelt 90 degree turn plates can be used to connect the Tuff Cable grooves between each row of Invizimelt Panels or to make a simple 90 degree turn. Invizimelt Turns can also be cleanly cut for sharper turns. Continue adding Invizimelt Panels and Turn Plates one row at a time until desired coverage is achieved. Be sure all turns line up to the proper spacing between the panels.

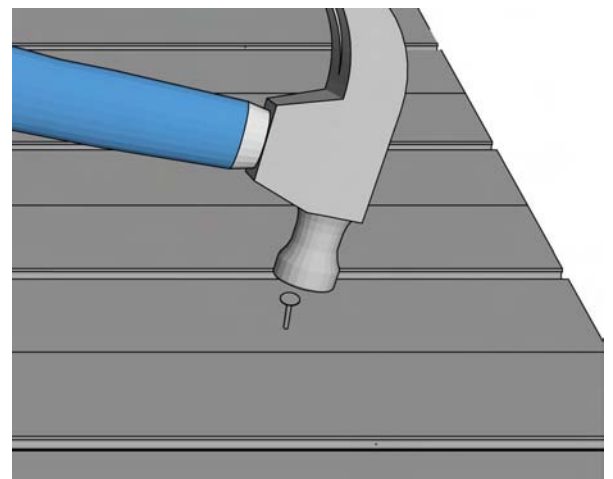
**Note:** Anytime Invizimelt Panels or Turns are cut, they must be inspected and filed down to smooth out any sharp edges that may penetrate the Tuff Cable jacket.



6" x 12" Origination Plate with Grommet



Optional Drip Edge Kit



Securing Invizimelt Panels

# TUFF CABLE

**Step Four:** Using the cold lead origination ending location that was determined in Step One, exact Cold Lead locations can now be marked, drilled and the origination kit installed. Mark the Cold Lead penetration point on the surface of the sub-roof or sub-deck by outlining the 2.5" hole in the Origination Base Plate. Remove the base plate used for marking the holes and drill a 2.75" hole at the marked location through the sub-roof or sub-deck, making sure it is in line with the recessed Tuff Cable grooves in the Invizimelt Panels.

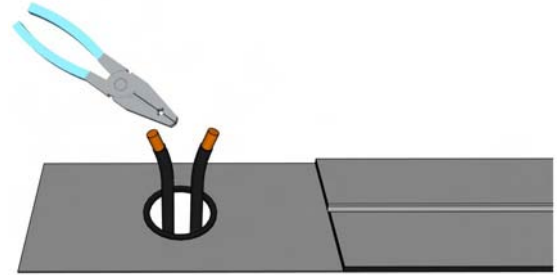
**Note:** When drilling through a metal roof deck, the sharp edges around the perimeter of the hole must not come into contact with the Cold Leads. You should take care to prevent sharp edges from penetrating or otherwise damaging the protective jacket of the Cold Leads.

The Origination Kit also includes a 12" x 6" cover plate with insulation that will cover the Origination plate on both sides of the 2.5" hole. Place the Origination Plate in the center of the 12" gap where the Cold Lead hole is drilled and secure the Origination Plate to the sub-roof or sub-deck. Fastener holes may need to be predrilled through the Origination Plate to avoid damaging it. Place a fastener 2" from each corner of the Origination Plate.

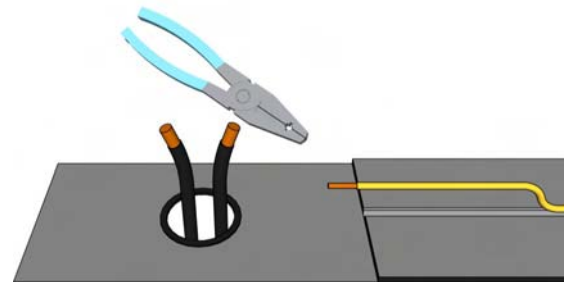
**Step Five:** Run the Tuff Cable into the grooves in the Invizimelt Panels and Invizimelt Turn Plates. Do not make the connection until all of the Tuff Cable is installed. Begin at the origination point leaving approximately 8 inches of Tuff Cable to make a connection to the Cold Lead. Work the Tuff Cable into the panel grooves toward the termination point. Ensure that the Tuff Cable is completely inserted into the Invizimelt Panel grooves and does not encounter any sharp edges from customizing the layout or otherwise.

**Step Six:** Secure the Tuff Cable in the grooves of the Invizimelt Panels and Turn Plates by covering it with the provided Aluminum Invizimelt Tape. Be sure to leave approximately 8 inches of Tuff Cable exposed at the origination and termination points.

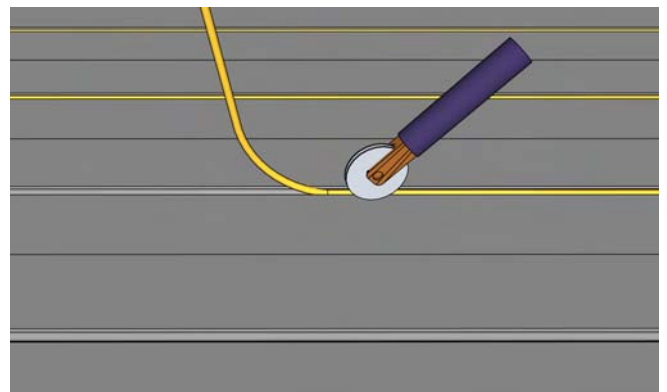
Warning: All Tuff Cable Heating Element must be in a groove in an Invizimelt Panel or Turn. A risk of fire exists any time Tuff Cable is not surrounded by something to pull the heat away from it, like a Heat Sink Kit, Invizimelt Panel, etc.



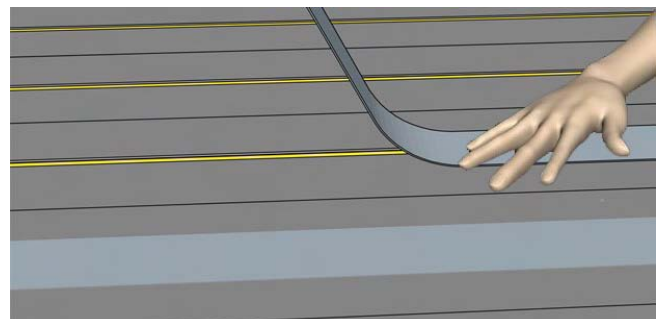
**Step 4: Cold Leads extend through Origination Base Plate.**



**Steps 5 and 6: Leave enough Tuff Cable and Cold Leads to make connections of the two possible**



**Step 5: Insert Tuff Cable into Invizimelt Panel and Turn Plate grooves.**



**Step 6: Cover all Tuff Cable with Invizimelt Tape.**

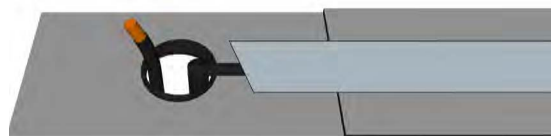
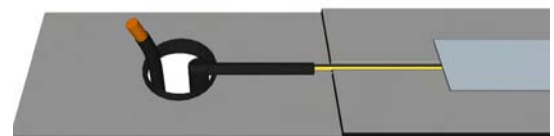
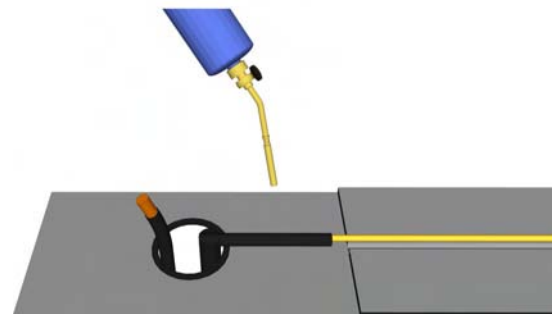
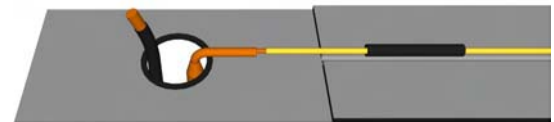
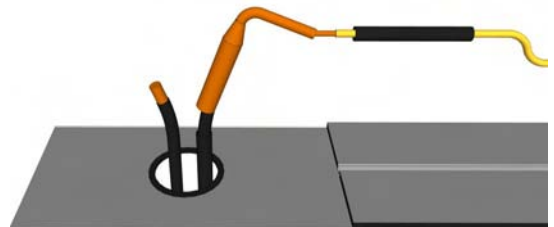
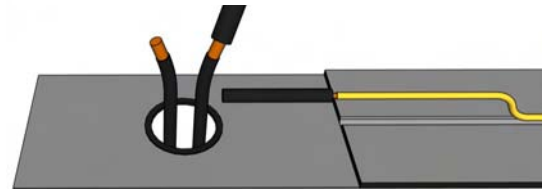
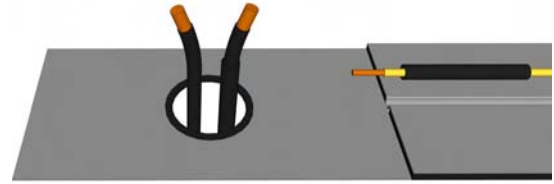
**Note:** Heatizon Systems suggests that a drawing with dimensions be made at this time, and that several photographs be taken for future reference.

**Step Seven:** After all of the Tuff Cable has been properly installed into the Invizimelt Panels, lengths recorded, and the layout documented, the Origination Kit can now be completed. Position the E210BS90 Butt Splice into the hole where it will later be secured and lay the Tuff Cable down toward and overlapping the Butt Splice in order to measure the proper length needed to transition into the Butt Splice. Mark the Tuff Cable so it will have at least 7/8" of stripped Tuff Cable that will be inserted and then crimped into the small end of the E2110BS Butt Splice. Do this for both sides. Insert the Cold Leads through the drilled hole in the sub-roof or sub-deck and bend a loop in them so they do not fall back through the hole. About 8" of Cold Lead for each hole should be on the roof. Excess Cold Lead can be pushed back down the hole after the connection is completed. Complete the #210BS90 Butt Splice connection by following the Invizimelt-Tuff Cable to cold lead using E210BS90 instructions in the "Making the Connection" Section of this manual. The Connection can be propped up in the air while crimping, soldering and shrinking the heat shrink.

**Step Eight:** After the connection has cooled, position the completed Butt Splice connections down into the Cold Lead hole so that the Tuff Cable is flush with the surface of the Origination Plate. The E210BS90 Butt Splices will sit across the Origination Plate so Tuff Cable can transition into the starting and ending Invizimelt panel grooves. Check for continuity between the Tuff Cable and Cold Lead and the Invizimelt Panels. Cover the butt splice and Tuff Cable transition with Aluminum Invizimelt Z-Tape to secure it flush to the Origination Plate. Secure tape over any remaining Tuff Cable in Invizimelt Panels that has not yet been covered.

**Step Nine:** Place the insulation pieces included in the Origination Kit on each side of the butt splice transitions across the Origination Plate. Using the 12" x 6" cover plate provided in the Origination Kit, cover the Origination Plate and connections by placing it on top of the Origination Plate, fastening the cover plate over the connections and insulation. Note and document the location of all Tuff Cable runs so that their location may be marked in Step Twelve below.

**Be sure to not pierce, cut or nick any part of the Tuff Cable to Cold Lead Connection.**



# TUFF CABLE

**Step Ten:** Do not allow the Invizimelt to get wet. Completely cover the Invizimelt and Tuff Cable with a high temperature rated roof water proofing underlayment. Keep the Invizimelt Panels dry so the Aluminum Invizimelt Z-Tape will stick. Do not cover the Invizimelt system with the water proofing underlayment while wet.



**Step Eleven:** Using a chalk line and the Cold Lead and Tuff Cable run locations noted above, mark the location of all Tuff Cable runs and Cold Lead connection points on the top of the high temperature rated roof water proofing underlayment so that nails, screws, or other devices will NOT penetrate or damage the Tuff Cable or Cold Lead elements. Reference the pre-planned layout as well as standard sizes of the Invizimelt Panels to help with marking the Tuff Cable runs. Spray the chalk line with clear lacquer to protect the chalk lines and reduce the potential that they may be removed by moisture.



## INVIZIMELT MAY BE SLIPPERY. TAKE PROPER PRECAUTIONS TO AVOID FALL OR INJURY

Warning: All electric products, including Tuff Cable, produce an electro-magnetic field which can cause ferrous metals (or metals which are magnetic because they contain iron) to vibrate. Two or more layers or pieces of vibrating ferrous metal in contact with one another may result in a hum or noise. Separating contact between ferrous metals with Heatizon Drip Edge Protector (Heatizon Part # NI144) may reduce the audible effects of the vibration. In order to minimize the size of the flux lines or lines of force of any magnetic field given off by the Tuff Cable heating element, always run an even number of lengths of heating element and begin and end the heating element at approximately the same place.

Warning: Risk of Fire! Make certain that neither the Tuff Cable nor the Cold Lead have been compromised and that continuity does not exist between the Tuff Cable or Cold Lead and any other metal including Invizimelt.

### Warnings:

- Do not penetrate or otherwise damage the Tuff Cable. Damaged or penetrated Tuff Cable heating element must be repaired or replaced prior to covering.
- Leave 1/8" between long edges of the Invizimelt Panels to allow for expansion and contractions.
- Make certain that all of the Tuff Cable heating element is secured in an Invizimelt Panel, Turn Plate, or Gap Plate, and covered with Invizimelt Z-Tape.
- Examine and eliminate any and all sharp edges in the Invizimelt Panels and Plates.
- Tuff Cable in Invizimelt for roofing applications should use only the following Transformers: 1kVA, 2kVA,



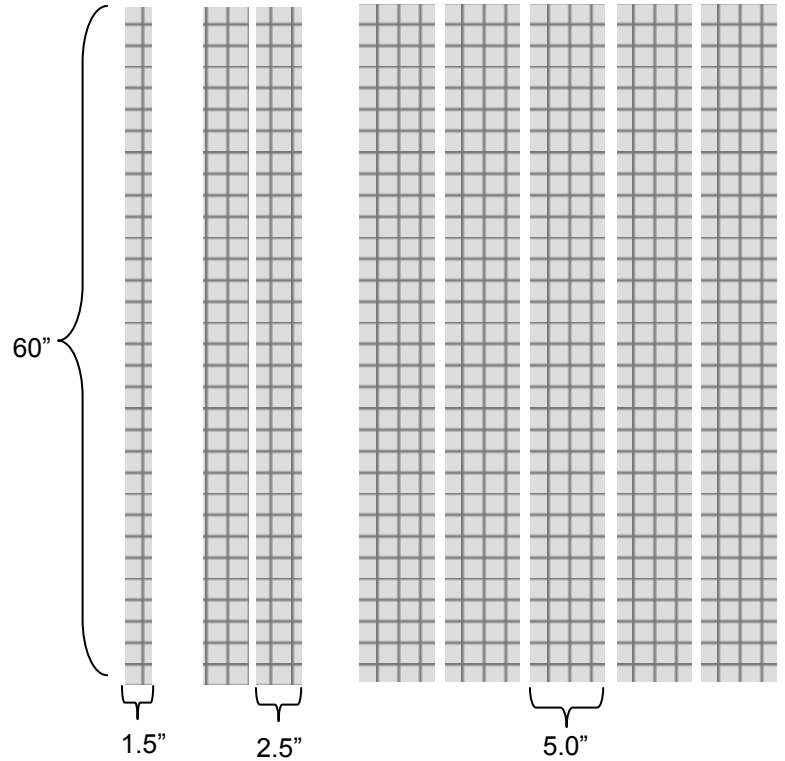
# TUFF CABLE

## 2.9 Tuff Cable Heatsink Kit Installation for Roofs, Steps, Decks, & Subfloor

### HEATIZON HEATSINK KIT PIECES

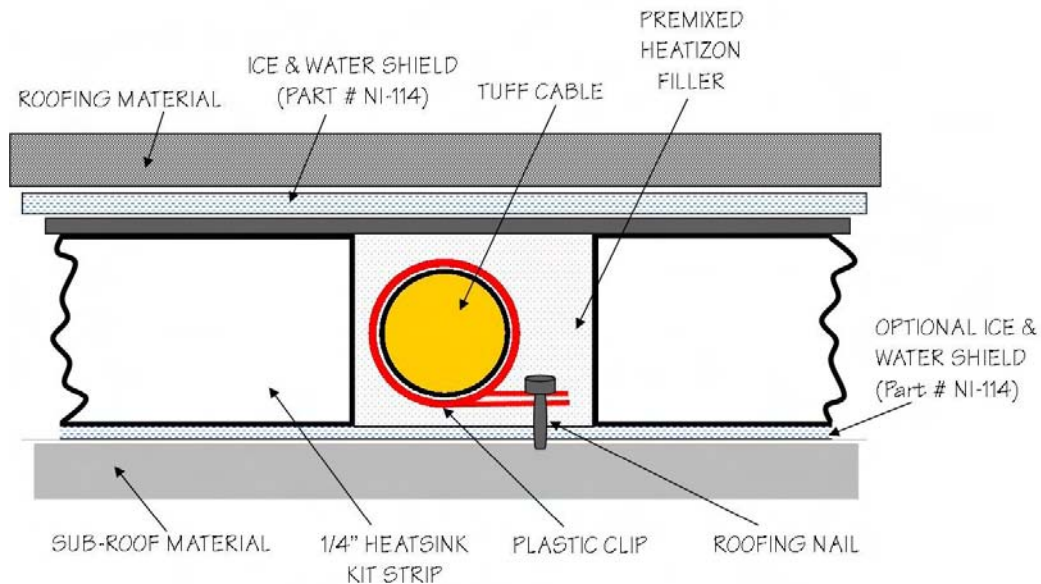
#### Heatizon Heatsink Kit

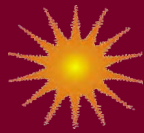
- 1 1.5" X 60" X 1/4" Heatsink Starting Strip
- 5 5.0" X 60" X 1/4" Heatsink Middle Strips
- 2 2.5" X 60" X 1/4" Heatsink Ending Strip
- 100 Heatsink Screws
- 30 Black Tube Clamps
- 30 Roofing Nails
- 13 lbs Premixed Heatizon Filler
- 1 5" Trowel
- 1 12" Trowel
- 1 Heatizon Filler Bag
- 1 5 Gallon Plastic Bucket and Lid
- 1 Filler Mixer Drill Attachment



US Patent 7,071,446B1

**Note:** Always allow for the space for one 2.5" Field-Cut Heatsink Return Cap plus a 1" gap and one 2.5" Field-Cut Origination Cap plus 1" for each Heatizon Tuff Cable (see Illustration above). Also, do not forget to always leave a 1" gap for the Tuff Cable between all Heatsink Strips.





## ROOF INFORMATION

### FOR ROOFING CONTRACTOR AND OTHER TRADES

The roofing contractor is responsible for insuring the Heating Element is not damaged during the installation of roofing materials.

Please communicate this information directly to anyone who will come into contact with the Heatizon Systems ZMesh or Tuff Cable heating element after it has been installed. Prior to beginning the installation of any Heatizon Systems product, read the applicable sections of the installation manual in their entirety. In order for Heatizon Systems installation instructions to be followed completely, **Heatizon Systems requires that a copy of this page be given to the General Contractor and the Roofing Contractor**, and additional copies be stapled on top of the ZMesh and near the Tuff Cable immediately after its installation. The copies and staples should be removed prior to installing the roof covering.

**A Heatizon roof deicing system has been installed on this project. Here are the steps you need to take to insure that the system is installed correctly and is not damaged:**

**Waterproof underlayment.** A high-temperature rate self-adhesive waterproof underlayment must be placed over Heatizon ZMesh and/or Heatizon Tuff Cable Heating Element in a Heatizon Heatsink Kit or in an Invizmelt Kit. If underlayment has not yet been installed over the Heatizon ZMesh and/or Heatizon Tuff Cable Heating Element, do not apply roofing material directly on top of the Heating Element. For membrane roofs, contact Heatizon Systems.

**Electrically Conductive Materials.** Heatizon ZMesh and Tuff Cable Heating Elements must not be cut or damaged, or allowed to come in direct contact with any other electrically conductive materials on the roof structure or elsewhere. The roofing contractor is responsible for insuring the element is not cut, or damaged in any way and does not come into contact with any conductive material. If the Tuff Cable Heating Element is penetrated during installation of roofing materials, the damaged Tuff Cable must be immediately repaired with a Heatizon Tuff Cable Splice Kit (Part # CABSPLKIT).

- Drip edge, flashing or any other conductive material on the roof structure must not connect to or come in contact with ZMesh or Tuff Cable Heating Element.
- Screws, nails, attachments or any other connectors securing the shingles (conductive or otherwise), drip edge, flashing, valley metal, skylights, etc or any other conductive material must not penetrate, connect to, or come in contact with ZMesh or Tuff Cable Heating Element.
- Do not cut, fold, twist, or alter the installed ZMesh or Tuff Cable Heating Element.
- All metal used over, under, in and/or on the roof must be kept away from ZMesh, or must be completely electrically insulated from it.

**Continuity Check. Immediately following installation, ZMesh or Tuff Cable Heating Element** has been visually inspected for cuts and other damage, tested for continuity and correct readings have been recorded. The Roofing Contractor is responsible for any penetration, cutting or other damage done to the ZMesh or Tuff Cable Heating Element. Wherever conductive material is used under, over, in, or on the roof, ZMesh and Tuff Cable Heating Elements should have a continuous continuity check performed during the installation of all conductive roofing materials. A Roof Alarm is available for rental or purchase from Heatizon Systems to assist the roofing contractor in performing this continuity check. The circuit must always be open. See Roof Alarm instructions for more detail.

**After the Installation.** Immediately following installation, the ZMesh or Tuff Cable Heating Element is to be visually inspected and electronically tested for continuity and the correct readings recorded in the Design and Installation Manual. The Roofing Contractor is responsible for any penetration, cutting, or other damage done to the ZMesh or Tuff Cable Heating Element.

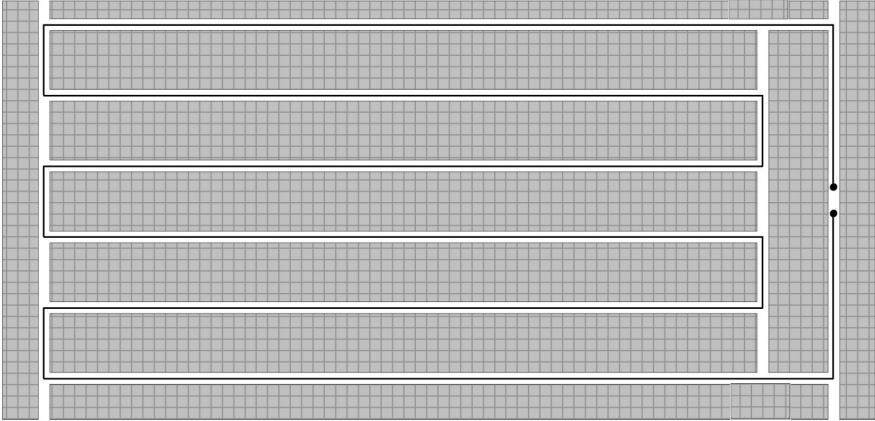
**Electrical Codes.** The Cold Leads of the Heatizon Roof Deicing System is considered part of a listed snow melt/deicing system. However, local electrical codes may require Cold Leads to be run in conduit between the Control Unit and the heated section. Consult with a local electrical inspector or other relevant authority prior to installation.

**Warnings.** Heed all warnings in the Heatizon Systems Design and Installation Manual, the product packaging, and attached to or affixed to the product.

# TUFF CABLE

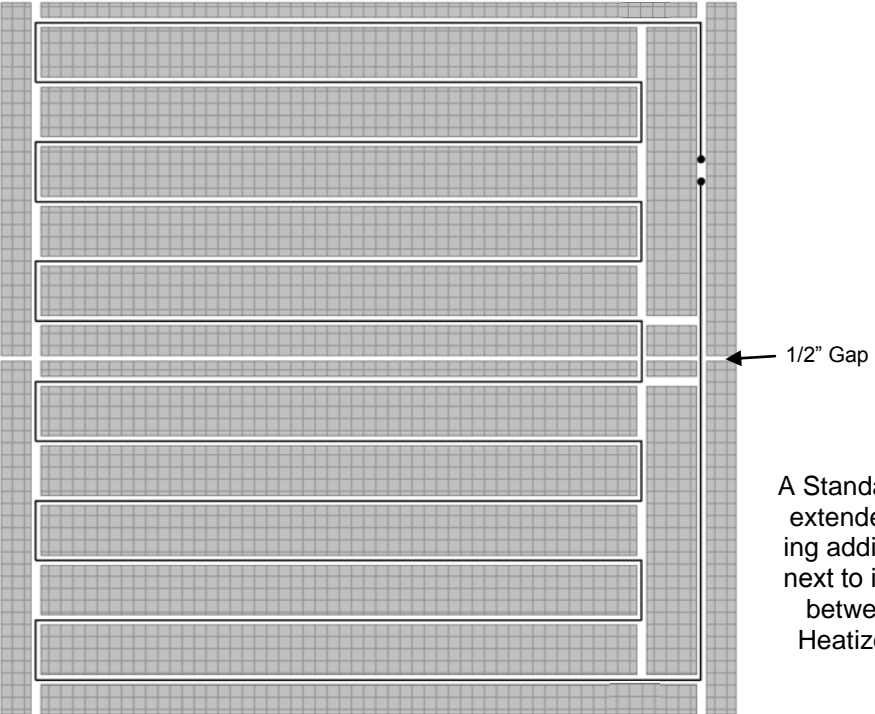
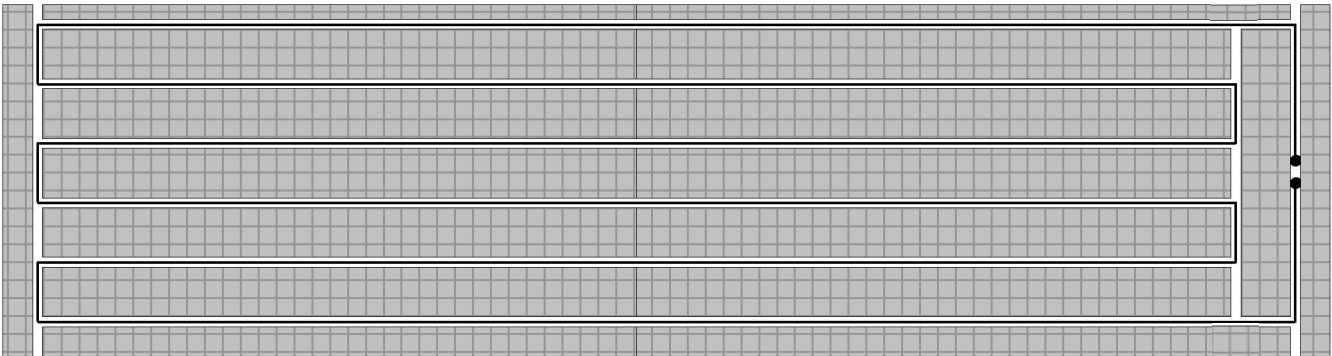
## Sample Tuff Cable in a Heatsink Kit Designs

Use these diagrams to assist you in connecting multiple Heatsink Kits to accommodate the specific design and square footage of the project.



**Note: The connection between Tuff Cable and Cold Lead must always be embedded in the Heatsink Kit.**

**SINGLE**  
Standard Heatizon  
Heatsink Kit



**ADD LENGTH**  
A Standard Heatizon Heatsink Kit can be extended to any length by simply inserting additional Heatsink Starting, Middle, and Ending Strips (end to end) from additional Heatsink Kits in between the Field-Cut Origination Strip and End Caps. Run Heatizon Systems Tuff Cable through the 1" spaces as shown.

← 1/2" Gap

**ADD WIDTH**  
A Standard Heatizon Heatsink Kit can be extended to any width by simply inserting additional Heatsink Kits (or portions) next to it. Be sure to leave a 1/2" gap in between each additional kit, and run Heatizon Systems Tuff Cable through the 1" spaces as shown.

## TUFF CABLE

Once the layout design has been finalized and the starting place chosen on the eaves, valleys, steps, deck or floor, begin the installation of the Heatizon Systems Heatsink Kit as follows:

**Step One:** Install one 1.5" X 60" Heatsink Starting Strip to the sub-roof, sub-step, or sub-deck, with enough of the provided wood screws or construction adhesive to secure in place; For floors, discard all 1.5" x 60" Heatsink Starting Strips and begin with a Field-Cut 2.5" Heatsink Starting Strip along one wall, or 5" x 60" Heatsink Middle Strips in the center of the room.

**Step Two:** After leaving a 1" gap for the Tuff Cable install one 5" X 60" Heatsink Middle Strip with enough of the provided wood screws or optional construction adhesive to secure in place.

**Step Three:** After leaving a 1" gap for the Tuff Cable, install a second 5" X 60" Heatsink Middle Strip. Repeat as necessary to cover the entire area to be warmed or snow and ice melted.

**Step Four:** After leaving a 1" gap for the Tuff Cable install one Field-Cut 2.5" Heatsink Ending Strip.

**Step Five:** At the end of the Heatsink or the point where the Tuff Cable will make two 90 degree turns and return back toward the point of beginning, leave a 1" gap for the Tuff Cable then install one Field-Cut 2.5" Heatsink Origination Strip.

**Step Six:** At the beginning of the Heatsink, or the point where the Cold Leads will connect to the Tuff Cable, leave a 1" gap for the Tuff Cable and install one Field-Cut 5" Heatsink Origination Cap, one Field-Cut 1.5" Heatsink Starting Strip, and one 2.5" Heatsink Large Ending Strip.

**Step Seven:** Connect one Cold Leads to one end of the Tuff Cable as shown in Section 7, "Making the Connection." Install the Tuff Cable into the 1" gaps following the instructions in this manual. Secure the Tuff Cable to the roof deck or subfloor with the plastic clips and screws provided. Plastic clips should be used to hold the Tuff Cable below the surface of the Heatsink strips.

**Note:** Leave 1" space between all Heatsink Origination Caps and the Heatsink Origination Strip for the Cold Lead/Tuff Cable beginning and ending connections.

**Step Eight:** Connect the second Cold Lead to the Tuff Cable as shown in Section 7, "Making the Connection."

**Step Nine:** Once the Tuff Cable has been installed into the gaps and the Tuff Cable connections are completed and in the 1" gaps, completely fill all 1" gaps with the provided Heatizon filler so that they are level with the top of the Heatsink Strips. Make certain that all Tuff Cable and all splices between the Cold Leads and the Tuff Cable are completely covered by the provided Heatizon filler.

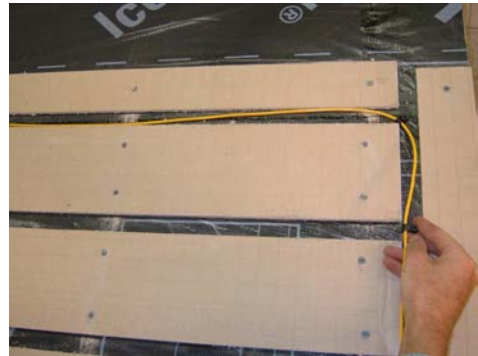


# TUFF CABLE

**Step Ten:** Note and document the location of all Tuff Cable runs so that its location may be marked in Step Twelve below.

**Step Eleven:** Do not allow the Heatsink to get wet. Completely cover the Heatsink and Tuff Cable with an appropriate high temperature rated self adhesive waterproof underlayment for your roof covering when using on roofs. A similar waterproofing is required for exterior stairs and decks.

**Step Twelve:** Using a chalk line and the Tuff Cable run locations noted in Step Ten above, mark the location of all Tuff Cable on the top of the Ice and Water Shield, EPDM, or other waterproofing product so that nails, screws, or other attachment devices will NOT penetrate or damage the Tuff Cable element. Spray the chalk lines with clear lacquer to protect the chalk lines and reduce the potential that they may be removed by moisture.



Tuff Cable in a Heatizon Heatsink Kit for roofing applications should use only the following Transformers: 1kVA, 2kVA, 3kVA, 2x2kVA, or 2x3kVA.

**Note:** In order to have the Tuff Cable connect to both Cold Leads at approximately the same point, an odd number of Heatsink Strips must be installed. Installing an odd number of Heatsink Strips will result in an even number of 1" gaps for Tuff Cable.



**Note:** When planning the layout of the Heatsink Strips, allow enough space to install one 2.5" Heatsink Ending Strip (plus a 1" gap for Tuff Cable), at the end of the Heatsink so the Tuff Cable can be looped back toward the point of beginning.

**Note:** All of the Tuff Cable, and the connection of the Cold Lead and the Tuff Cable, must be embedded into the Heatsink and entirely covered with the provided filler in order to embed the connection of the Cold Lead and the Tuff Cable.



Damaged Tuff Cable element or Tuff Cable element insulation must be repaired IMMEDIATELY. Tuff Cable element must never touch or cross itself.



**IMPORTANT!** A red plastic "STOP! DANGER!" sign indicating the presence of electric deicing, snow melting or warming equipment has been included with your Heatizon product packaging. This caution notice must be posted at the fuse or circuit breaker panel and be clearly visible.

**IMPORTANT!** Record the number of feet of Tuff Cable Element that you have installed for each zone here:

