Heatizon Systems Design and Installation Manual

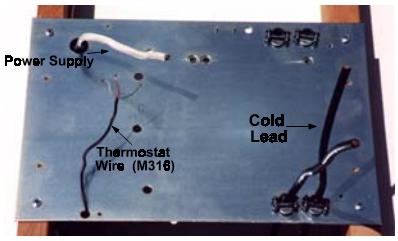
Table of Contents

Sections: **Page**

9700682
CONFORMS TO UL
STANDARD 1693

HEATIZON SYSTEMS™

System Description, Design Information, and Requirements



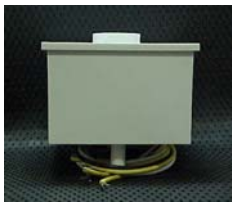
Rough-In Back Plate

Tuff Cable

Z Mesh

Transformer

Control Box



M326 Aerial Snow Switch

M321 Thermostat

SYSTEM DESCRIPTION

The Heatizon System is a low voltage, resistance type heating system, which utilizes **five** primary components:

1. The Rough-In Kit
The Rough-in Kit contains the Control Box and Transformer mounting plate ("Back Plate"), Thermostat Wire, Installation Manual, and Cold Lead wire. Each Cold Lead should be long enough to extend the total vertical and horizontal distance between the Back Plate location and the area where the heating element will be installed.

2. The Heating Element
• **Tuff Cable** is a durable 10 ga. coated copper cable that is chemical and gasoline resistant. Tuff Cable comes with footage marks, and Heatizon's name on it.
• **Z Mesh** is a durable 9" and 12" wide, woven 1/32" bronze screen. The Z Mesh element is approximately the same thickness as the fabric in a screen door.
Specific uses of each heating element vary based on application and installation conditions.

3. The Transformer
Both heating elements can produce up to 12 watts of heat per lineal foot. Z Mesh systems are sized with transformers from ½ to 3 kVA, 2x2, and 2x3kVA, and Tuff Cable systems are sized with transformers from ½ to 6 kVA.

4. The CBX6 and CBX23 Series Control Box
This component houses the appropriate sized step-down transformer and the other electronic components necessary to provide low-voltage electricity to the heating element. The Control Box continually monitors the system's operation and is self-testing and problem diagnosing. It is engineered to provide simple and problem free operation. One Control Box can energize one area or multiple areas that have been "jumpered" (connected in series) together on the same system. The Control Box operation is controlled by the "Activation Device". Dimensions for the Control Box are: 17" wide 12" high and 9" deep.

5. Activation Device
Activation Devices available for Heatizon's Control Box include many options for its varied applications. Devices include:

- Programable Thermostats
- Remote Temperature Sensors
- Temperature/Moisture Sensors
- Mechanical Timers

Most Heatizon Activation Devices include a system indicator light (LED) to notify the owner of the system status.

Z Mesh Applications and Roofing Requirements

Roofing Material	Requirements
Shake Shingles	**Ice and Water Shield over and under Z Mesh**
Composite or Asphalt Shingles	**Ice and Water Shield over and under Z Mesh**
Slate or Tile Shingles w/o Lattice	**Ice and Water Shield over and under Z Mesh**
Metal Roof, Valley Metal, Metal Flashing	**Tuff Cable in Heat Sink Recommended**
Membrane or Other Roofs	**Call Heatizon at 801-293-1232**

Z Mesh Applications and Flooring Requirements

Subfloor Material and Floor Covering	Overlayment Required/ Recommended
Carpet on Concrete Subfloor	**1/8" Particle Board, Plywood or Cement Board Recommended**
Carpet on Wood Subfloor	**1/8" Particle Board, Plywood or Cement Board Recommended**
Hardwood on Wood or Concrete Subfloor	**None Required**
Tile on Wood or Concrete Subfloor **	**Cement Board or Other Non-Metallic Product Required**
Sheet Vinyl or Vinyl tile on Concrete or Wood Subfloor	**1/8" Particle Board, Plywood or Cement Board Required**

****Cement Board or other non-metallic system may be installed over Z Mesh. Do not use metal lathe or other electrically conductive material.**

DESIGN INFORMATION

TUFF CABLE SYSTEMS

The Heatizon Tuff Cable system is a low-voltage electric radiant heating system.

Installations include:

- C concrete or asphalt
- C light-weight concrete or mortar bed
- C Heatizon Heatsink Kit
- C existing concrete slab or asphalt
- C sand under pavers or concrete

Applications and space between element runs:

- C snow melting (4" to 6")
- C roof de-icing (6")
- C floor-warming (6" for hard surfaces; 6" to 8" for other surfaces)
- C space-heating (Determined by heat loss calculations)

Tuff Cable is designed to be spaced at specific intervals and lengths to produce a specified amount of heat per square foot. Tuff Cable must always be installed in a heat sink.

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

Z MESH SYSTEMS

The Heatizon *Z Mesh* system is a low-voltage electric radiant heating system.

Installations include:

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

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

Applications and space between element runs:

- C roof de-icing (2")
- C floor-warming (2" for hard surfaces; 3" to 6" for other surfaces)
- C space-heating (determined by heat loss calculations)

Z Mesh is designed to be spaced at specific intervals and lengths to produce a specified amount of heat per square foot.

The heat density per square foot of the system is dependent on the spacing between adjacent runs of *Z* Mesh heating element, the length of the Z Mesh, and the size of the transformer. **More details about system sizing can be found in the "System Operating Tables" section of this manual.**

Z Mesh used in space heating of a sun room under tile.

Snow melting of handicap ramp with Tuff Cable.

Roof de-icing with Z Mesh under asphalt shingles.

SPACE HEATING

Heatizon Systems products can provide total space heating. Like all other space-heating products, heat-loss calculations should be performed prior to selecting the appropriate Heatizon Systems Product. Heat-loss calculations define the amount of heat which must be delivered in order to heat the given space. Heatizon Systems Tuff Cable in a Heatsink and Z Mesh products are suitable for installation under most floor coverings.

FLOOR WARMING

Heatizon Systems products can be used in conjunction with a primary heat source to provide warm floors or supplemental heat. Floorwarming applications typically require 7 to 15 Watts per square foot. Heatizon Systems Tuff Cable in a Heatsink and Z Mesh products are suitable for installation under most floor coverings.

SNOW-MELTING\ROOF DE-ICING

Rate of snow-fall, moisture content of the snow, ambient air temperature, ground temperature, wind velocity, orientation of exposure to the sun and installed heat density of the snow-melting system all affect the performance of a snow-melting/roof de-icing system. Heatizon Systems has proven products with long track records for all of your snow-melting/roof de-icing needs.

ELECTRICAL SERVICE REQUIREMENTS

- **½ and 1 kVA systems** - operate on either 120 or 240 volt power. Systems using 120 volt supply require a single pole, 15-amp minimum breaker. Systems using 240 volt supply require a double pole, 15-amp minimum breaker. Both voltages should use 12/2 conductors or equivalent.
- **2 and 3 kVA systems** - Require 208/240 volt service with double pole 20-amp breakers and 12/2 conductors or equivalent.
- **2x2, 2x3, 4, 5 and 6 kVA systems** - Require 208/240/277 volt service with double pole 30-amp breakers and 10/2 conductors or equivalent.

SYSTEM SIZING

Performance specifications for each size transformer, each type of heating element, lengths of heating element and for various heating element spacings are located in the **"System Operating Tables"** section of this manual. System Operating Tables can be used to select the proper size system as well as the length and type of heating element needed and the spacing between heating element runs necessary to achieve a given heat density.

INSULATION

Properly installed insulation is always recommended by Heatizon to enhance the efficiency and improve the performance of all Heatizon Systems products.

CUSTOMER INFORMATION

WARNING: The installation of all Heatizon Systems products must be done in accordance with the instructions provided in the Heatizon Systems Installation Instructions or Installation Manual and the Sales Agreement. After you have completely read the installation manual, Heatizon Systems encourages you to call our Technical Support Department at (801) 293-1232 with any comments or questions you have regarding our products or the installation and operation thereof. All work must be done by a qualified person and conform to local building codes, ordinances, trade practices and in accordance with all applicable sections of the National Electric Code (NEC).

Heatizon Tuff Cable System

● *Tuff Cable in concrete* – All concrete forms, insulation, chairs or dobies and remesh are to be in place prior to installation of Heatizon's Tuff Cable. Heatizon recommends 6"x6" - 4 gauge remesh for 6" spacing and 4"x4" – 4 gauge remesh for 4" spacing. The Tuff Cable is to be installed so that it will be 1.5 to 2 inches below the finished surface. Tuff Cable is to be installed prior to the concrete pour. Do not attempt to raise the Tuff Cable during the concrete pour. Caution must be exercised such that the Tuff Cable is not damaged before, during or after the concrete pour. Never run the Tuff Cable through cold/expansion, crack control, saw cut or any other joints regardless of whether the joints are created prior to, during or after the pour. Heatizon does not warrant damage to the Tuff Cable caused by actions of others, including but not limited to, saw cutting of expansion or control joints, core cutting or any other penetration of concrete, movement of concrete, cracking of concrete, abuse of the Tuff Cable prior to the pour, etc.

● *Tuff Cable in mortar, asphalt, or Heatsink roof application* – Tuff Cable must always be imbedded completely in asphalt, concrete, a mortar bed or Heatsink Kit regardless of which floor covering or roofing material is going over it. Heatizon Systems manufactures a Heatsink Kit that should be used whenever Tuff Cable is used for roof deicing and snow melt. Tuff Cable should never be installed in open-air applications.

Heatizon Z Mesh System

● *Z Mesh is not insulated* – Electrically conductive materials, other than nails or screws that are not in anyway also touching any other electronically conductive material, must never come in contact with the Z Mesh. Any time electrically conductive materials are allowed to come in contact with the Z Mesh a risk of fire will result. Examples of electrically conductive materials include, but are not limited to, metal thresholds, metal lathe, metal carpet strips, metal fasteners for metal roofing, drip edge, valley metal, any other metal object, etc. Once the Z Mesh is installed, it should be covered as soon as possible to avoid damage.

● *Z Mesh under tile, marble, etc.* – Z Mesh is to be installed under thinset mortar, Durarock, Wonderboard or Hardi Backerboard. Z Mesh should not be installed when metal lathe is used in the flooring installation.

● *Z Mesh on concrete and wood sub-floors* – Z Mesh is suitable for installation under most floor coverings. Heatizon Systems recommends an overlayment be installed over the Z Mesh prior to the installation of the floor covering anytime a danger of cutting or damage to the Z Mesh exists or may exist in the future.

To avoid danger of fire, NEVER cut Z Mesh. If Z Mesh is cut, use Heatizon Systems approved methods and materials to immediately repair damage.

Heatizon Roof De-icing System

● *Z Mesh under non-metal roof* – One layer of ice and water shield layer must be installed on the sub roof prior to the installation of the Z Mesh and a second layer must be installed over the Z Mesh. As stated above under the section headed "Heatizon Z Mesh System" electrically conductive materials must not come in contact with the Z Mesh or a risk of fire will result. Examples of some electrically conductive materials commonly used on roofs include valley metal, drip edge, metal roofing material, etc. Z Mesh is not recommended for use under metal roofing material.

● *Z Mesh over drip edge* – One layer of ice and water shield must be installed under the drip edge and a layer of EPDM over the drip edge and under the Z Mesh as shown in Heatizon's diagram labeled "Eave Detail with Z Mesh Over Drip Edge." A final layer of ice and water shield must cover all Z Mesh. Nails cannot be placed through the drip edge and Z Mesh simultaneously.

● *Z Mesh near conductive materials* – The drip edge, flashing, and valley metal and the screws or other attachments securing the drip edge, flashing or valley metal to the roof must not penetrate the Z Mesh or a risk of fire will result. A continuous continuity check should be made between any and all electronically conductive material or metal being placed over Z Mesh and one of the cold leads of the Heatizon system. The circuit should always be open.

● *Metal Roof* – Tuff Cable is recommended whenever metal roofing or other electronically conductive material is to be used or greater heat density is required. When Tuff Cable is installed in a roofing application it should always be imbedded in Heatizon Systems ¼ inch thick Heatsink kit. Prior to the Tuff Cable being installed, the roofing contractor must place ¼ inch thick sleepers in all areas where the roof will be attached to the sub-roof.

General

● *Electrical Requirements* – Floorizwarm AC, Floorizwarm DC and SLC500 products require a single pole, 120 V power supply with 20 amp breaker and with proper conductors run from the breaker to each Control Unit. Heatizon Systems CBX products sized ½ and 1kVA can operate on 120V, single pole, 15 amp breaker or 240V, double pole, 15 amp breaker. Heatizon Systems CBX products sized 2kVA and 3kVA require a 2-pole, 208/240V, 20 amp breaker with proper conductors run from the breaker to each Heatizon Control Unit and products sized 4kVA, 5kVA, 6kVA, 2x2kVA and 2x3kVA require a 2-pole, 208/240/277V, 30 amp breaker with proper conductors run from the breaker to each Control Unit. Heatizon Systems products requiring 208/240/277 V do not use a Neutral.

● *Insulation* – Properly installed insulation is always recommended by Heatizon to enhance the efficiency and improve the performance of your Heatizon Systems product.

● *Continuity Check* – A continuous continuity check should be conducted on the Tuff Cable or Z Mesh Screen and all electrically conductive material prior to, during the pouring of concrete, installation of floor coverings or roofing materials, and immediately prior to energizing all Heatizon System products. The circuit should always be open. It is highly recommended that an alarm buzzer, (available for purchase from Heatizon Systems), or other warning device be used at all times the danger of damaging or shorting the heating element to something conductive is present.

● *Element Test* – Always complete a Heatizon Systems "After Installation Element Test Form" immediately following the installation of the Tuff Cable or Z Mesh, and again just prior to energizing your Heatizon Systems product.

● *Magnetic Field* – Like all electric products, Heatizon Systems products create a magnetic field that may interfere with certain brands of televisions, computer monitors, etc. Unlike Cathode Ray Tubes ("CRT"), Plasma Display Panels ("PDP") and Liquid Crystal Displays ("LCD") do not seem to be affected by magnetic fields. In the event magnetic field interference is a concern for you please consult your sales representative about the Heatizon Systems DC Alternatives, prior to making your purchase.

9700682
CONFORMS TO UL
STANDARD 1693

HEATIZON
SYSTEMS™

Installation Instructions

Warning: Check contents of all boxes immediately upon receipt of your Heatizon shipment and notify Heatizon within 24 hours of any discrepancy or missing part.

Warning: Read this installation manual in its entirety before attempting to install Heatizon Systems Tuff Cable and Z Mesh Products.

Warning: Installation of Heatizon Systems products and associated work must be performed by qualified persons and conform to local building codes, ordinances, trade practices, and in accordance with all applicable sections of the National Electric Code (NEC).

Warning: Risk of fire! Risk of fire possible if installation of system is not completed according to all of the installation instructions including but not limited to the warnings and notes. In addition, allowing metal or any other conductive material to come into contact with the Tuff Cable or Z Mesh heating element may result in fire.

Warning: Risk of shock! Make sure all power to your Heatizon Systems product and thermostat is shut off at the electric distribution panel before installing, removing covers, servicing, or working on any of the components of any Heatizon System product.

Warning: All connections/joints between colds leads and Tuff Cable heating element must be embedded into mortar, asphalt, or other acceptable heat sink.

Warning: Knockout openings shall not be used except with devices that are designed to fill such openings.

Warning: Failure to eliminate loose strands of Z Mesh or Tuff Cable or failure to repair cuts in Z Mesh or Tuff Cable properly may result in fire danger.

Warning: Obtain written approval from Heatizon Systems for applications and installations that are different from those described herein.

Warning: In order for your Heatizon Systems product to operate correctly, the transformer portion of the Control Box must be installed so that it can dissipate the heat that it generates

Warning: Like all electric products, Heatizon Systems products create a magnetic field that may interfere with certain brands of televisions, computer monitors, etc. Contact Heatizon Systems prior to installing any of its products if magnetic field interference is a concern for you.

Warning: Never install Heatizon Systems products in space heating or floor warming applications to deliver more than 15 watts per square foot (or 160 watts/m^2).

Please call Heatizon Systems Technical Support Department at (801) 293-1232 with any questions you have regarding these Installation Instructions and The Customer Information Sheet, or the installation, operation, and maintenance of Heatizon Systems products.

9700682
CONFORMS TO UL
STANDARD 1693

HEATIZON
SYSTEMS™

Installation Instructions

This installation manual is designed to assist in the installation of:
•Tuff Cable heating element
•Z Mesh heating element

for use with the

•CBX6 Control Box series
•CBX6T Control Box series
•CBX23 Control Box series
•CBX23T Control Box series

A complete Heatizon System installation typically incorporates four main steps which are described in this manual:

Step 1. Rough-in
Step 2. Heating Element Lay-out and Installation
Step 3. Control Box and Transformer
Step 4. Activation Device

Rough-in Kit includes:

Illustration 1.1
Back Plate (P1320)
(Size- 17"x12")
Designed to mount on two studs (on 16" centers) or a Rough-In Box (P4184). Control Box and Transformer mount on this Back Plate.

Illustration 1.2
Cold Lead (E210)
One Cold Lead runs from the Transformer to the beginning of the Tuff Cable or Z Mesh heating element, and the other Cold Lead runs from the other end of the Tuff Cable or Z Mesh back to the Transformer. Note: 2X3kVA and 2X2kVA Transformers require two sets of Cold Leads–one set for the upper taps and the other set for the lower taps of the Transformer.

Illustration 1.3
Thermostat Wire (M316)
(5 conductor 18 ga.)

Step 1

ROUGH-IN

A. LOCATION OF BACK PLATE (See Illustrations 1.1 to 1.4)

Determining the placement location of the Back Plate is the first step in the electrical rough-in process.

The placement of this plate must allow for easy future access, good air flow, and protection from moisture. Acceptable locations include garages, basements, or utility rooms.

1. Use the following guidelines for locating the Back Plate.

a. Location must be easily accessible for installation, service and maintenance.

b. Maintain a minimum of 6 inches clearance between the Back Plate and any ceiling, wall, floor or adjacent Back Plate.

c. Do not locate Back Plate in an area where it will be covered.

d. Maintain 45 inches of clear space in front of every Back Plate.

e. Placement outdoors is acceptable only if enclosed in a Heatizon Systems Enclosure Kit (ENCLKIT), which measures 24" X 24" X 12", with customized Back Plate.

f. Do not place in an area where high humidity is present or where Control Box may be exposed to water.

g. Consideration for sound and vibration of transformer is advised. Proper sound attenuation insulation or vibration isolation is recommended.

2. Determine whether the Back Plate (P1320) will be installed on studs (spaced on 16" centers) or on a concrete or other non-framed surface using a Rough-In Box (P4184).

a. **Back Plate on studs.** If Back Plate will be mounted on studs, studs must be capable of supporting shear and lateral loads of at least 100 pounds per Back Plate.

b. Back Plate on concrete. If the Back Plate mounting area is to be a concrete or non-framed surface the use of a Heatizon Rough-in Box (P4184) is recommended, and should be installed at this point. The Rough-in Box provides several knock-outs for ease of conduit connections and 1/4-20 bolted connections of the Back Plate to the Rough-in Box . The Rough-in Box is to be surface mounted using adequate anchoring devices to accept shear loads and lateral loading of Control Box and Transformer (weight may equal 100 lbs. for larger systems).

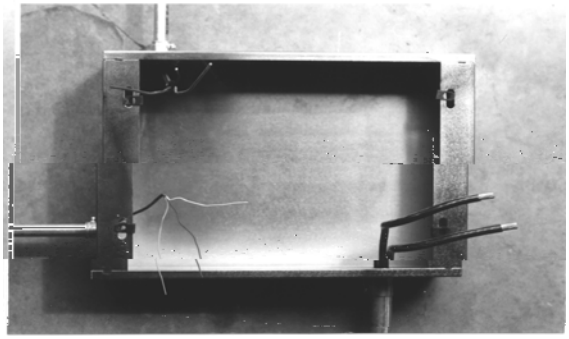


Illustration 1.4
Rough-In Box (P4184)
with conduit and wiring

Note: Knockout openings in all Heatizon Systems Products should never be used except with devices that are designed to fill those openings.

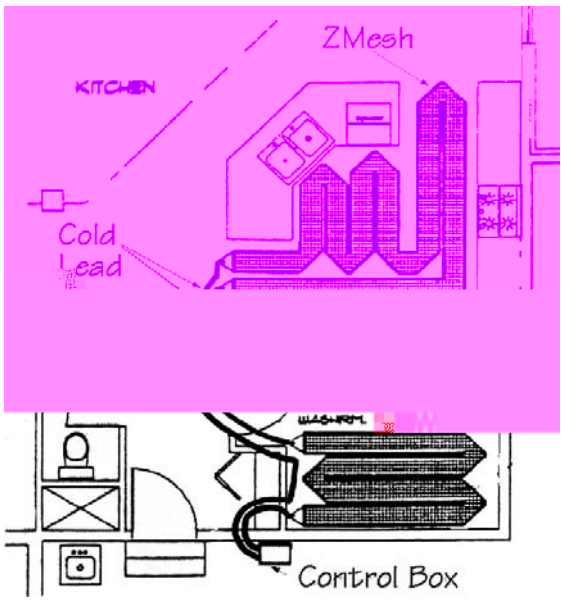


Illustration 1.5
Z Mesh and Cold Lead layout for areas connected in series.
Note that multiple areas are heated by the same system by "jumpering" areas together with Cold Lead. Cold Leads should always be in wall, joist, or truss space.

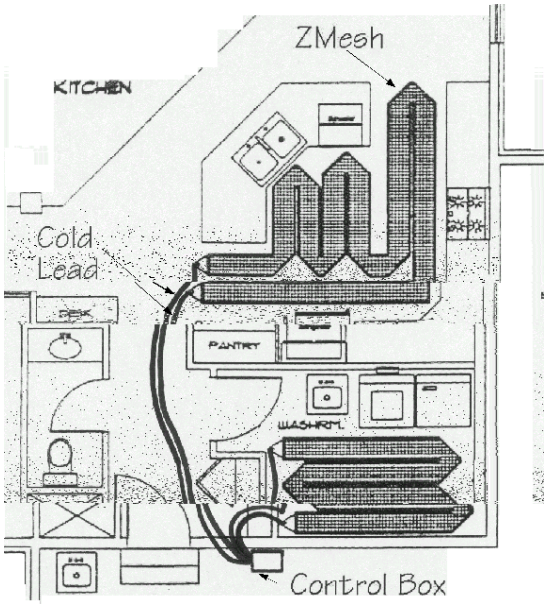


Illustration 1.6
Z Mesh and Cold Lead layout for a 2X2kVA or 2X3kVA system.
Note: All CBX23 systems require two pair of Cold Leads and are two closed loop systems.

B. RUNNING COLD LEAD (See Illustrations 1.5 To 1.9)

1. Run Cold Leads the total horizontal and vertical distance from the selected Back Plate or Rough-In Box placement location, to the location where the Tuff Cable or Z Mesh will eventually begin and end.

Once the Back Plate(s) placement location has been selected, plan the Cold Lead runs by walking through the building. All Heatizon Systems products are closed loop systems. Two Cold Leads are required for each zone - one to the beginning and one to the ending points of the Tuff Cable or Z Mesh heating element.

Note: CBX23 systems require two pair of Cold Leads, one pair for the beginning and ending points of the first length of Tuff Cable or Z Mesh heating element, and the other pair for the beginning and ending points of the second length of Tuff Cable or Z Mesh heating element (see Illustrations 1.6 and 1.11). Each length of Tuff Cable or Z Mesh must be approximately the same length.

2. When installing Heatizon Systems products, strict compliance with the National Electrical Code (NEC) and Heatizon Systems installation manual is essential. The following rules will help insure a proper and safe installation:

a. Cold Lead runs should be planned from the Tuff Cable or Z Mesh heating element connection point to the Back Plate. Leave 14 inches of Cold Lead protruding through the Back Plate, and 10 inches of extra Cold Lead wherever the connection between the Cold Lead and either the Tuff Cable or Z Mesh will be made.

b. Do not kink the Cold Leads.

c. Locate the Cold Leads in non-insulated walls whenever possible.

d. To minimize the size of the flux lines or lines of force of any magnetic field given off by the Colds Leads, always run two Cold Leads parallel to each other and as close to one another as possible. In order to minimize the potential for problems caused by any magnetic field given off by the Colds Leads, always avoid running Cold Leads in areas over, under, behind, or otherwise near the place where televisions and/or computer monitors using Cathode Ray Tube technology will be located.

e. Do not install Transition Plates under cabinets.

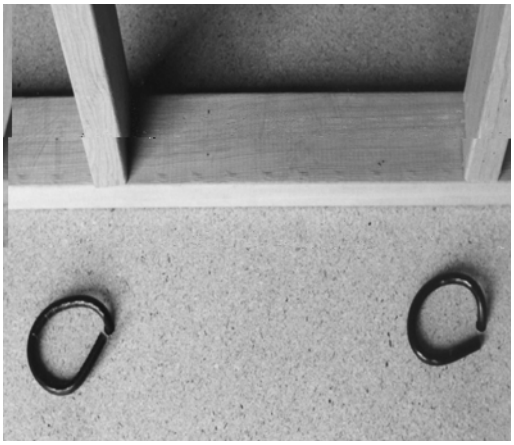


Illustration 1.7
Cold lead penetrating subfloor for floor installation of Transition Plates (E217).

Illustration 1.8
Cold lead roughed-in for wall installation of Transition Plate (E217).

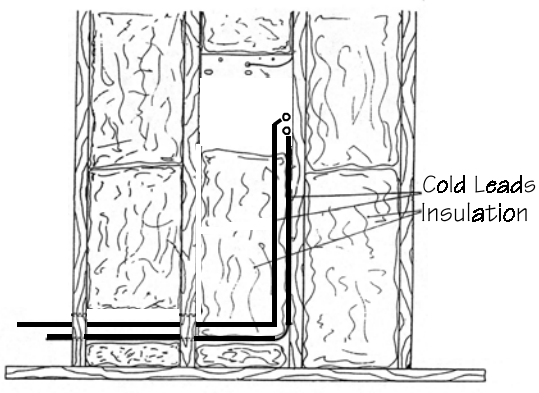


Illustration 1.9
Cold Lead Rough-In in standard wood frame wall.

f. When the Cold Leads are placed in a wall with insulation, place the Cold Leads on the same stud or put both Cold Leads in the same PVC conduit **(see Illustration 1.9).**

g. Magnetic and non-magnetic metal studs require special consideration. Refer to a current edition of NEC for installation considerations.

h. When using conduit, always run Cold Leads in pairs in the same conduit. Never run individual Cold Leads in metal conduit.

CAUTION: THIS IS AN ENTIRE COPPER SYSTEM. UNDER NO CIRCUMSTANCES ARE COMPONENTS MADE OF OTHER METALS SUCH AS ALUMINUM TO BE SUBSTITUTED FOR HEATIZON SYSTEM COMPONENTS. THE ADDITION OF ANY NON-HEATIZON SYSTEM COMPONENTS OR MATERIALS TO ANY HEATIZON SYSTEMS PRODUCT WILL VOID THE WARRANTY.

CAUTION: BUNDLE #2 COLD LEAD ONLY WITH PROPER SPACING AND ACCORDING TO NEC.

i. The Cold Lead length and element length affect the Watts per square foot your system will deliver to the area where the Tuff Cable or Z Mesh heating element is installed. If you have a question or concern, or if you are considering adding to the Cold Lead or heating element provided to you by Heatizon, contact Heatizon Systems or your Heatizon Distributor for more information.

j. When installing Transition Plates in floor heating installations and roof snow melting installations, extend Cold Lead up through sub-floor or sub-roof, leaving 10", and anchor in place (**see Illustration 1.7)**. For wall installations of Transition Plates, anchor Cold Lead to sill plate and extend beyond face of finished material 10" **(see Illustration 1.8).** Cold Leads should be placed such that Transition Plates will never touch one another, and the tips of the Transition Plates should not be closer than 2" apart at the nearest point.

k. When installing Cold Lead in Tuff Cable heating or snow melt systems, Cold Leads should be placed such that connection points of E210BS Butt Splices are a minimum of 6" apart. Extend Cold Lead by 10" and secure Cold Lead in place.

NOTE: All connections between Cold Leads and Tuff Cable must be imbedded in a mortar, asphalt or other acceptable heat sink material.

Note: Read the specific wiring instructions and installation instructions provided for the activator you have selected in Step 4 of this manual, "Activation Devices" and those provided by the manufacturer of the Activation Device.

C. INSTALLING THE THERMOSTAT WIRE

1. Run the Thermostat Wire (M316) the total horizontal and vertical distance from the Back Plate placement location to the location you have selected for the Activation Device.

2. Do not forget to provide the appropriate power to your chosen Activation Device.

D. INSTALLING THE ELECTRICAL SERVICE REQUIREMENTS FOR THE CONTROL BOX

1. Electrical Service Requirements are:

• **½ and 1 kVA systems** - can operate on either 120 or 240 volt power. Systems using 120 volt supply require a single pole, 15-amp minimum breaker. Systems using 240 volt supply require a double pole, 15-amp minimum breaker. Both voltages should use 12/2 conductors or equivalent.

• **2 and 3 kVA systems** - Require 208/240 volt service with double pole 20-amp breakers and 12/2 conductors or equivalent.

• **2x2, 2x3, 4, 5 and 6 kVA systems** - Require 208/240/277 volt service with double pole 30-amp breakers and 10/2 conductors or equivalent.

2. Run the appropriate conductor the total horizontal and vertical distance from the Back Plate to the electrical distribution panel.

Note: Run the appropriate line voltage wires from the distribution panel to the Back Plate or Rough-in box in accordance with NEC.

Note: All Heatizon Systems products require a dedicated circuit.

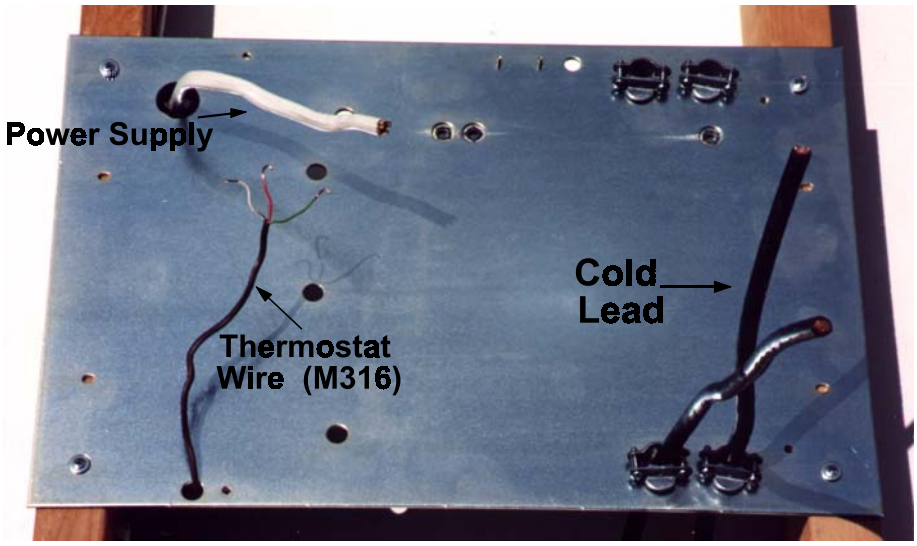


Illustration 1.10
Back Plate (P1320)
Configured with two Cold Leads, for 0.5kVA, 1kVA, 2kVA, 3kVA, 4kVA, 5kVA or 6kVA Transformers.

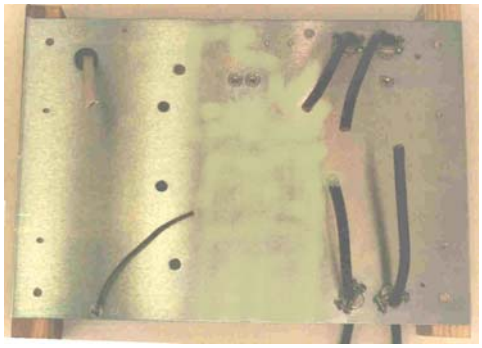


Illustration 1.11
Back Plate (P1320)
Configured with four Cold Leads for 2X2kVA or 2X3kVA Transformers

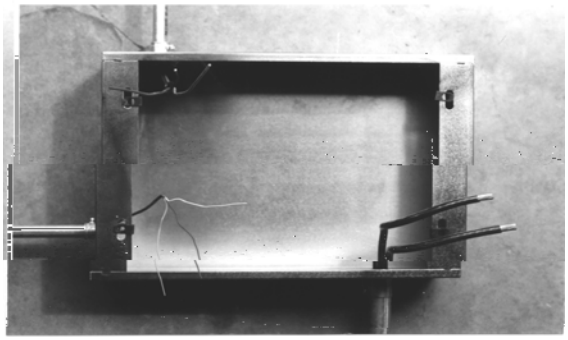


Illustration 1.12
Rough-In Box (P4184)
with conduit and wiring

E. INSTALLING THE BACK PLATE
(See Illustrations 1.10 to 1.12)

1. **Back Plate on studs**. Run the Cold Leads, the Thermostat Wire, and power supply conductor through the appropriate holes in the Back Plate. Install the Back Plate (P1320) on studs (spaced on 16" centers) **(see Illustrations 1.10 and 1.11)**. Anchoring devices which are capable of supporting shear and lateral loads of up to 100 pounds must be used to attach to Back Plate to the studs.

2. **Back Plate in Rough-In Box.** Using the bolts provided, install the Back Plate (P1320) to the Rough-In Box (P4184) after the Cold Leads, Thermostat Wire, and power supply conductor have been put through the appropriate holes in the Back Plate.

Note: Knockout openings can not be used except with devices that are designed to fill these openings.

F. JUMPERING (Illustrations 1.13 and 1.14)

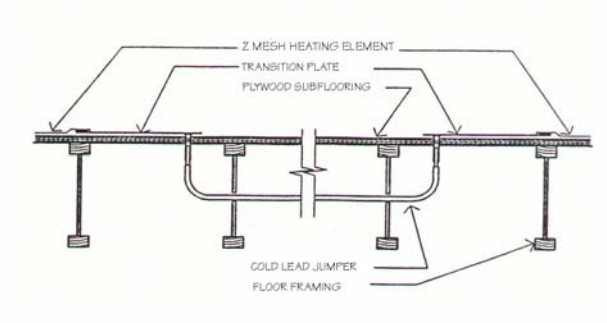


Illustration 1.13
Area to Area Jumper (Cold Lead jumper between two separate areas)

1. All Tuff Cable or Z Mesh heating element to be energized by a single Transformer or each side of a 2X2kVA (S202) or 2X3kVA (S203) Transformer must be connected in series.

2. Z Mesh heating element can be jumpered by using an adequate length of Cold Lead and two E217 Transition Plates. Tuff Cable heating element can be jumpered by using an adequate length of cold lead and two E210BS Butt Splices. All jumpering of element is to be done using Heatizon Cold Lead (E210) only. **All Butt Splices (E210BS) must be imbedded in a Heat Sink.**

a. Area to Area Jumper. It is not necessary that all heated areas be adjacent to one another. Jumpering between different areas can be accomplished by using and adequate amount of Cold Lead (E210) and two (2) Transition Plates (E217) or two (2) Butt Splices (E210BS). See **Illustrations 1.5 and 1.13.**

b. Jumpering through joints. Always jumper through every kind of joint in all types of mortar, asphalt, mud bed, concrete, sand or any other heat sink except Heatizon Systems Heatsink Kit (CABSINKKIT). See **Illustration 1.14.**

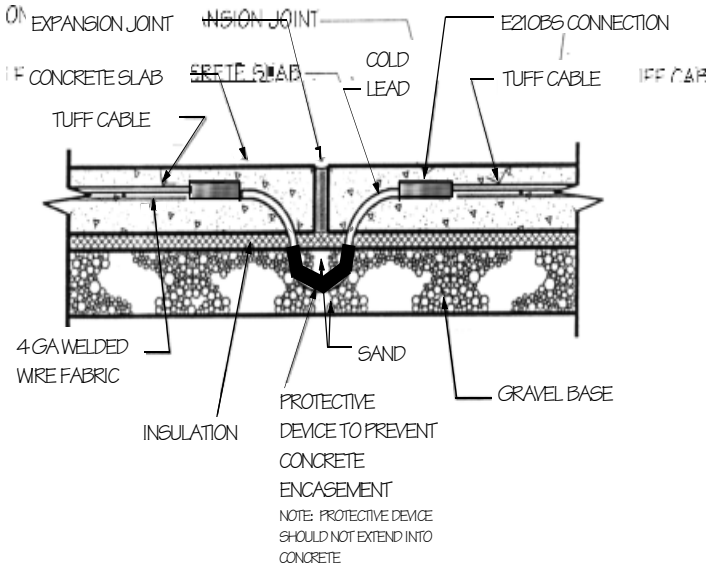


Illustration 1.14
Jumpering Through Joints (Cold Lead jumper for Tuff Cable in concrete application)

Note: Always determine the total length of Cold Lead and Tuff Cable or Z Mesh attached to each Control Box and Transformer, and make certain that the watts per square foot generated will meet your needs. See **System Operating Tables** and **Useful Information** sections of this manual for additional information.

Note: Never install Tuff Cable or Z Mesh element where they bridge or extend through any joint, unless provision is made for expansion and contraction.

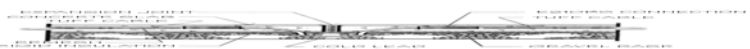


Illustration 2.1 Tuff Cable installed on top of mortar bed in space heating installation. Tuff Cable will be covered with thinset mortar prior to floor covering installation.

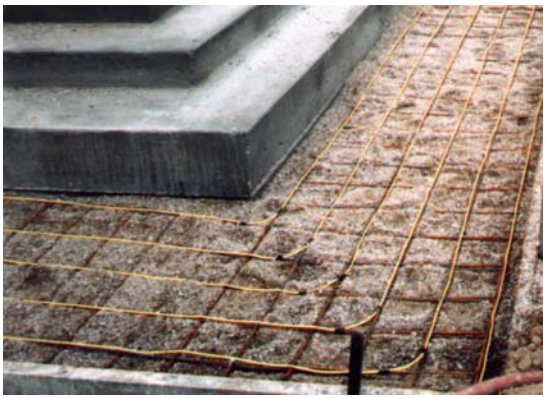


Illustration 2.2 Tuff Cable snow melting installation on stairs and landing. Tuff Cable is attached to welded wire fabric. Always jumper under joints of any kind–never run Tuff Cable through any kind of joint.

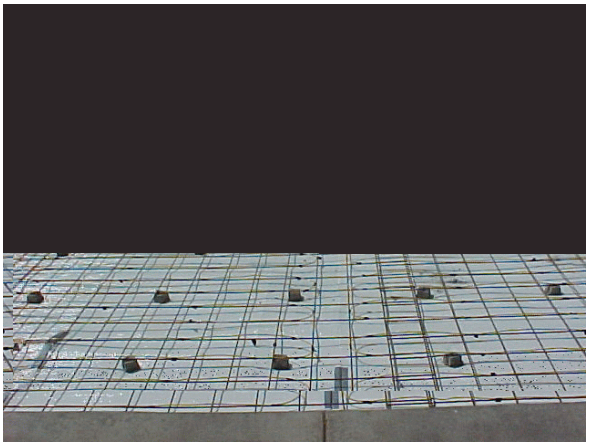


Illustration 2.3 Tuff Cable snow melting system in driveway. Note that Tuff Cable must be attached to welded wire fabric which is set on chairs or dobies so that the Tuff Cable will be within 1 ½ to 2" of the finished surface.

Step 2
HEATING ELEMENT INSTALLATION

A. TUFF CABLE ELEMENT DESIGN AND LAYOUT

Note: To minimize the size of the flux lines or lines of force of any magnetic field given off by the Tuff Cable or Z Mesh heating element, always run an even number of lengths of heating element and begin and end the heating element at approximately the same place.

1. The Heatizon Tuff Cable system is a low-voltage electric radiant heating system.

Installations include:

- concrete
- light-weight concrete or mortar bed
- Heatizon Heatsink Kit
- existing concrete slab or asphalt
- sand under pavers or concrete

Applications include:

- snow melting (4" to 6" spacing between element runs)
- roof de-icing (6" spacing between element runs)
- floor-warming (6" spacing between element runs for hard surfaces; 6" to 8" to other surfaces)
- space-heating (determined by heat loss calculations and floor coverings)

Tuff Cable, when spaced at specific intervals and using specified lengths, will produce a specified amount of heat per square foot.

Note: Tuff Cable must always be installed in mortar, asphalt, or another acceptable heat sink. Failure to do so may burn the insulation off of the Tuff Cable which may result in risk of fire.

The heat density per square foot of each Tuff Cable system is dependent on the spacing between adjacent runs of heating element, the length of element, and the size of the transformer. **More details about system sizing can be found in the "System Operating Tables" section of this manual.**

2. **Pre-installation considerations.** In order to plan and install Jumper Connections (See Illustration 2.11), the precise location of all **walls, joints (expansion, crack control, strike, etc.), and future floor penetrations** must be known in order to avoid damage to Tuff Cable or Cold Lead.

Illustration 2.4 Installation of Tuff Cable. Electrical tape or plastic wire tires must always be used to secure Tuff Cable to welded wire fabric.

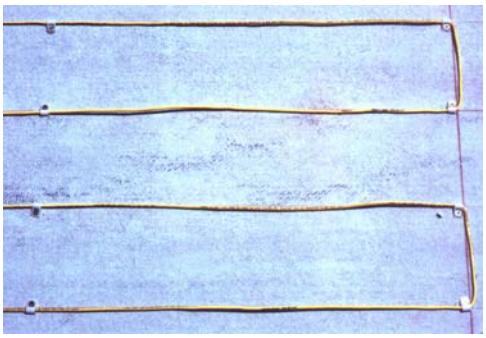


Illustration 2.5 Installation of Tuff Cable on mortar bed. Tuff Cable is held in place with plastic clips attached to the sub-floor or sub-roof with anchors, Plastic Clip Kit (Part Number PLASCLIPKIT).

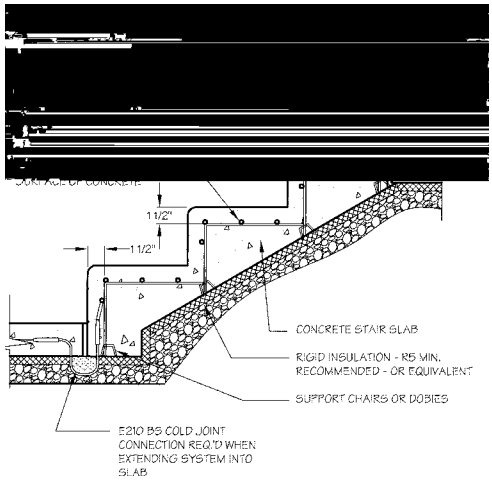


Illustration 2.6 Tuff Cable in Stairs.

3. Tuff Cable heating element must be firmly anchored to the sub-floor, sub-roof, or welded wire fabric using an adhesive or anchoring system designed for this use.

4. For ease of installation, an even number of Tuff Cable runs are recommended.

5. Lay out the Tuff Cable element in a continuous loop. Always make certain that the Tuff Cable never crosses or touches itself, and will never be outside of an approved heatsink.

6. Insure that the Tuff Cable and its insulation is not cut, crimped 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 (CABREPKIT).

Note: Always conduct a heating element test and complete the form "Heatizon Systems After Installation Element Test" immediately following the installation of the Tuff Cable. See the "Heatizon Systems After Installation Element Test" section of this Installation Manual.

Specific Tuff Cable Installations that are included in this Step are:

- **Section C--** Tuff Cable in New Pour Concrete
- **Section D--**Tuff Cable in Mortar Bed or Lightweight Concrete
- **Section E--**Tuff Cable in Sand Bed under pavers
- **Section F**--Tuff Cable Retrofit Installation in Concrete or Asphalt
- **Section G--**Tuff Cable in Heatizon Heat Sink Kit
- **Section H--**Tuff Cable Jumpers and Connections

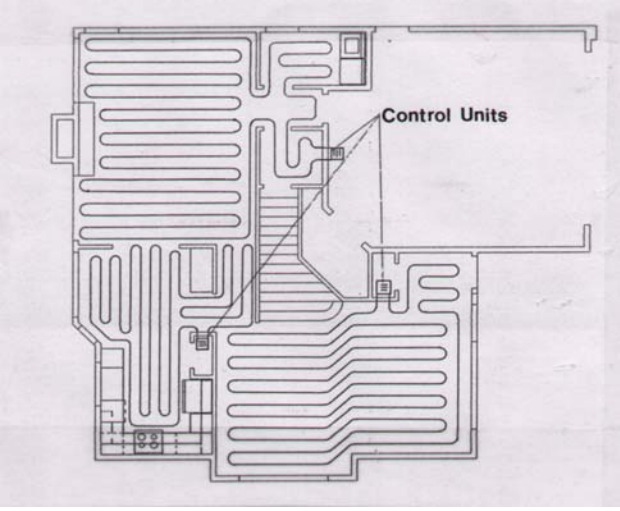


Illustration 2.7
Sample Floor Plan of Tuff Cable Layout, 3 zones

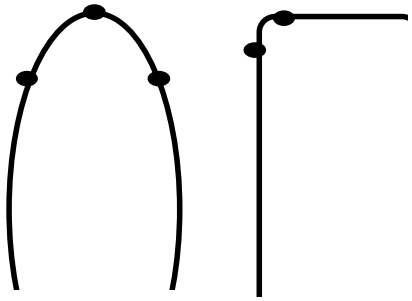


Illustration 2.8
Anchoring Tuff Cable to Subfloor, Subroof, or Welded Wire Fabric

B. TUFF CABLE INSTALLATION

Step 1. Beginning at the point where the Cold Lead and Tuff Cable will be spliced together (see "Rough-In" section of manual), plan the element run for each zone. Proper element spacing is based upon the results of the heat-loss calculations or heat density requirements utilized in sizing the heating system.

Step 2. Lay out the element, anchoring it to the sub-floor-, sub-roof, or welded wire fabric in three places on 180-degree turns and two places on 90-degree turns. See specific anchoring method instructions for the Tuff Cable application you have selected.

Step 3. Anchor the element approximately every 24 inches. Always use plastic wire ties, plastic clips, or electrical tape for anchoring the Tuff Cable.

Step 4. When beginning and ending a zone, leave 14 inches of extra Tuff Cable element to allow for connection to Cold Leads.

Step 5. Continue with the next zone until all zones are laid out and anchored.

Step 6. Connect the Tuff Cable Element to the Cold Leads with the Heatizon E210BS butt splice connector. See section in this Chapter, "Tuff Cable Connections" for details on how to make this connection.

Step 7. If a temperature/moisture sensor such as the Heatizon M331 or temperature sensor such as the Heatizon M336 is to be installed in the concrete slab, it must be in place prior to the concrete being poured. See the sensor installation instructions for details.

CAUTIONS:

• TUFF CABLE ELEMENT MUST NEVER COME IN CONTACT WITH FLAME.

• TUFF CABLE ELEMENT MUST BE ENCASED IN CONCRETE, ASPHALT, OR OTHER ACCEPTABLE HEAT SINK, AND SHOULD NEVER BE EXPOSED TO AIR.

• DAMAGED ELEMENT OR INSULATION MUST BE REPAIRED USING HEATIZON CABLE REPAIR KIT (PART #CABREPKIT).

• TUFF CABLE ELEMENT MUST NEVER TOUCH OR CROSS ITSELF.

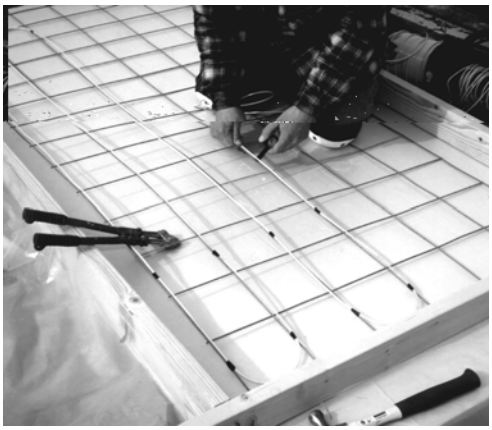


Illustration 2.9
Tuff Cable installation using welded wire fabric (6X6X4ga.) in preparation for new pour concrete. Always use plastic wire ties or electrical tape to secure Tuff Cable to welded wire fabric.

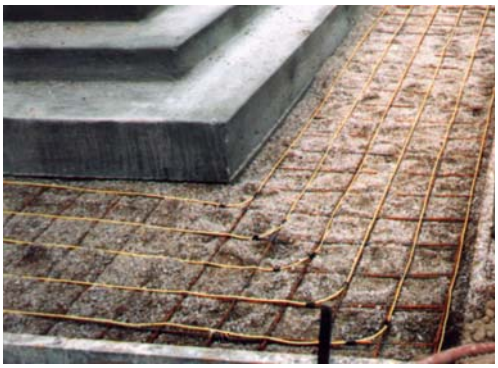


Illustration 2.10
Tuff Cable snow melting system on sidewalk.

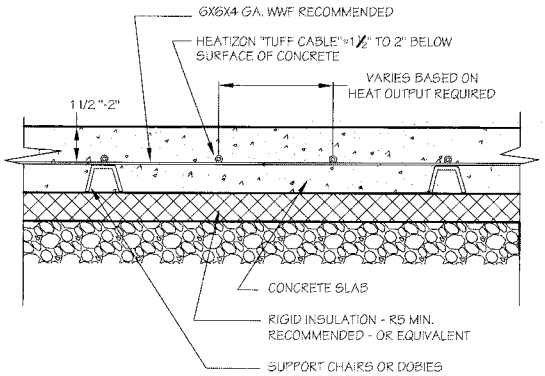


Illustration 2.11
Tuff Cable in New Pour Concrete

C. TUFF CABLE IN 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 walls, cabinets, bathroom fixtures, hand rails and equipment to be permanently sitting or mounted on the floor, as well as all types of joints, 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" in the **Useful Information Section** 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 1 ½" to 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 A of this Chapter, "Tuff Cable Design and Layout," Section B, "Tuff Cable Installation," and Section H, "Tuff Cable Jumpers and Connections."

IMPORTANT: 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" (see Illustration 2.12) may be planned and problem areas avoided.

What you will need:

- Tuff Cable Element Kit
- Cold Lead Ends
- Chairs, 2" shorter than depth of your concrete
- 4 ga. welded wire fabric
- Plastic electricians wire or plastic wire ties
- Joint Jumper Kits
- Insulation
- Conduit for Activator or Temperature/Moisture Sensor

Step 1. Once the area is ready for concrete, dig the holes for Cold Lead jumpers wherever a joint of any kind is to be placed. Line the hole with gravel, install the cold lead jumper, and cover with sand. (See Illustration 2.12.)

Step 2. 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.

Step 3. Install the "Chairs" (Heatizon Systems Part NI112) under the 4 ga. 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 1-1/2" to 2" from the slab surface.

Step 4. Cut the welded wire fabric to size and lay it between the concrete forms. **Note: never allow the welded wire fabric to extend through any joint.**

Step 5. 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 (See Illustration 2.8).

Step 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 INSTAL ANY LENGTH OF TUFF CABLE ELEMENT THAT WILL CAUSE YOUR HEATIZON PRODUCT TO OPERATE AT A SECONDARY AMPERAGE GREATER THAN 95. DO NOT EXCEED THE MAXIMUM LENGTH OF TUFF CABLE ELEMENT FOR A ZONE.**

Step 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 heat sink. 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.

Step 8. Complete the jumpers under all joints by connecting the ends of the Tuff Cable to Cold Lead jumpers using Heatizon E210BS Butt Splice Connectors. Tuff Cable element should never pass through a concrete expansion-joint or any other type of joint. A Cold Joint Jumper Kit (CLDJNTKIT) is available from Heatizon Systems (See Illustration 2.12).

Step 9. If a temperature/moisture sensor such as the M331 or 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).

Step 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.

. Under no circumstance should an outside electrical system be grounded to the welded wire fabric.

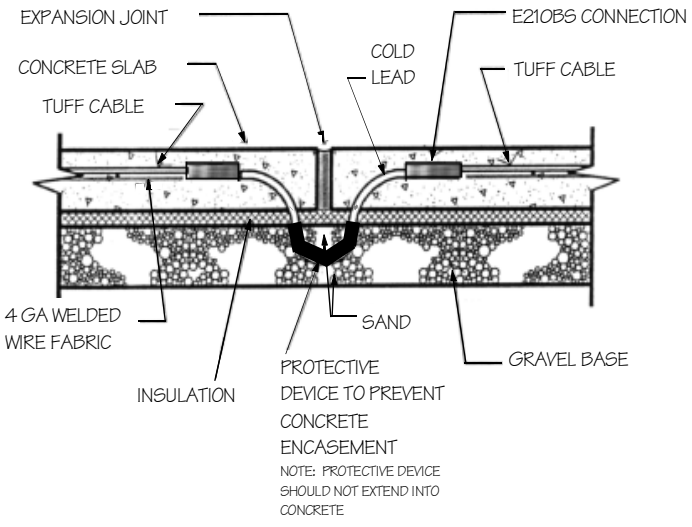


Illustration 2.12
Cold Lead jumper for Tuff Cable in new pour concrete.

Illustration 2.13 Tuff Cable installed on top of mortar bed in space heating installation. Tuff Cable will be covered with thinset mortar prior to floor covering installation.

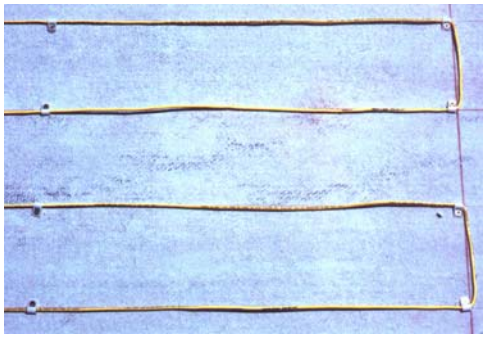


Illustration 2.14 Installation of Tuff Cable on mortar bed. Tuff Cable is held in place with plastic clips attached to the sub-floor or sub-roof with anchors, Plastic Clip Kit (Part Number PLASCLIPKIT).

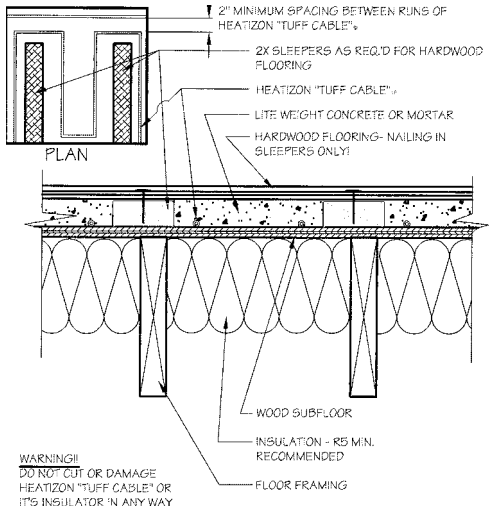


Illustration 2.15 Tuff Cable under hardwood in lightweight concrete.

D. TUFF CABLE INTERIOR SURFACES IN 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 sub floor
- in thinset on a wood or concrete sub floor

Note: For each application Tuff Cable must be completely embedded in mortar, lightweight concrete, Gypcrete, 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.

For each installation, you will need the following:

hammer
tape measure
marking pencil and chalk line
Heatizon Plastic Clip Kit (# PLASCLIPKIT)
Tuff Cable Element Kit
#2 Butt Splices and #10 Butt Splices
Crimpers for #2 and #10 Butt Splices

For installation on existing concrete, the following is also required:

Appropriate drill with 1/4" diameter cement bit
Heatizon Tuff Cable Anchoring Plugs (# ANCHPLUGKIT)

You should also be familiar with Section A of this Chapter, “Tuff Cable Design and Layout,” Section B, “Tuff Cable Installation,” and Section H, “Tuff Cable Jumper and Connections.”

Installing Tuff Cable on Interior Surface:

Step 1. Follow design and layout procedures found in Section A.

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

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.

Step 3. Mark adjacent runs of element on 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. Each

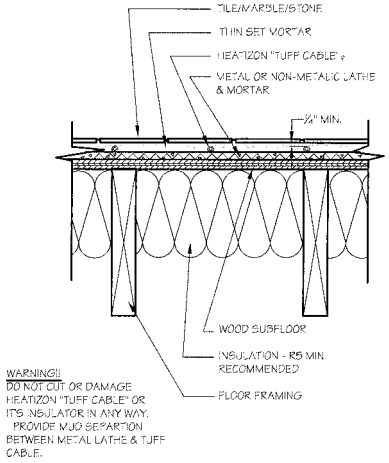


Illustration 2.16
Tuff Cable under tile on wood sub-floor

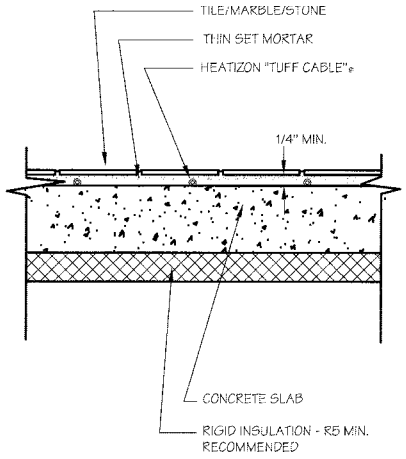


Illustration 2.17
Tuff Cable under tile on concrete slab

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 floor covering is installed.

90Ebend and each 180E turn requires two Heatizon Plastic Clips (See Illustration 2.15)). Heatizon Plastic Clips should be spaced approximately every 24 inches apart along the length of the Tuff Cable heating element.

Step 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.

Step 5. Make the first connection between one Cold Lead and Tuff Cable by following directions in Section H of this Chapter, “TUFF CABLE JUMPERS AND CONNECTIONS.”

Step 6. Lay out Tuff Cable on designated chalk lines as planned in 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.

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 H of this Chapter, “TUFF CABLE JUMPERS AND CONNECTIONS.”

Step 8: Make note 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.

E. TUFF CABLE IN SAND BED UNDER PAVERS, STONE OR CONCRETE (4" MAXIMUM THICKNESS)

Note: Tuff Cable under Pavers with mortar bed should be installed per Section D of this manual.

Heatizon Tuff Cable must be embedded in a minimum of ½ inch and no more than 1" sand bed, and should never be installed in open air applications nor directly on top of the rigid insulation.

Warning: Heatizon Tuff Cable should never be installed using metal wire ties or other conductive material to connect the Tuff Cable to the welded wire fabric.

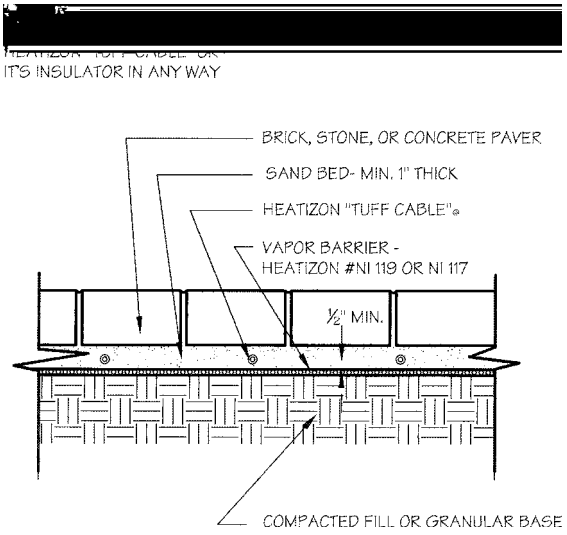


Illustration 2.18
Tuff Cable in Sand Bed Under Pavers

All Tuff Cable is installed just prior to laying the sand bed. Heatizon recommends insulating where Tuff Cable is being installed to get maximum heat transfer. Rigid insulation that is at least one inch (1") thick is recommended.

Maximum effectiveness occurs when Tuff Cable is installed on 4 to 6 inch spacing for exterior snow melt.

To install Tuff Cable Under Pavers, you will need:
- Heatizon Paver Kit (Part # PAVERKIT)
- 1" Rigid Insulation
- Heatizon Tuff Cable Kit

Step 1. Cover entire area to be heated with rigid 1" thick insulation, and then 1/4" to ½" 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. Leave an extra 12" of cable at the start and finish to make eventual connection to the Cold Leads.

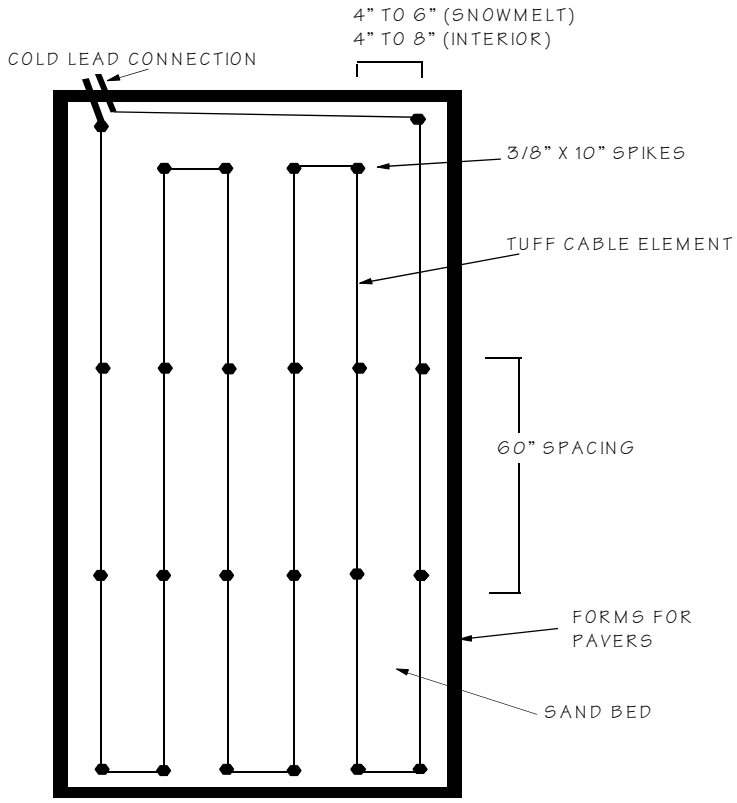


Illustration 2.19
Sample Layout of Tuff Cable Under Pavers

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.

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 ½" above the sand.

Step 5. 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 ends of the Tuff Cable return to the Cold Lead location.

Step 6. Make the connections between the two Cold Leads and the beginning and end of the Tuff Cable by following directions in Section H of this Chapter, "TUFF CABLE JUMPERS AND CONNECTIONS."

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 Pavers, stone or concrete (4" maximum).

Illustration 2.20
Retrofit snow melting system installed in driveway

Illustration 2.21
Filling saw-cuts of retrofit installation.

F. 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 into the grooves and filling the grooves.

Step 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 area and Tuff Cable element spacing will determine the number of Heatizon Tuff Cable zones you will need.

Step 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.

Note: All angle 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.

Step 3: Mark each determined Tuff Cable location on the top of the asphalt or concrete with a chalk line.

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

Step 4: Spray the chalk lines with clear lacquer to avoid washing away the chalk line.

Step 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.

Step 6: Lay the Heatizon Tuff Cable element in the bottom of the saw cuts leaving an extra 12" of element at each end for eventual connection to the cold leads.

Step 7: The Cold Lead to Tuff Cable element connection is made by following directions in Section H of this Chapter, "TUFF CABLE JUMPERS AND CONNECTIONS." This connection must be embedded in the concrete, asphalt or pavers.

Step 8: 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.

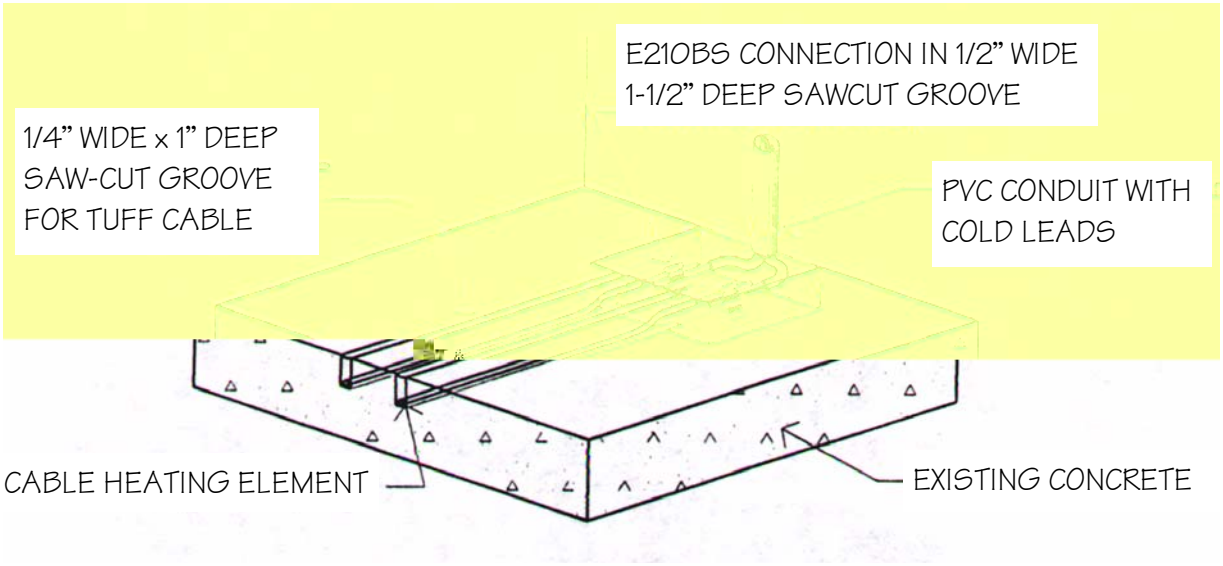


Illustration 2.22
E210BS Retrofit Connection in Conduit

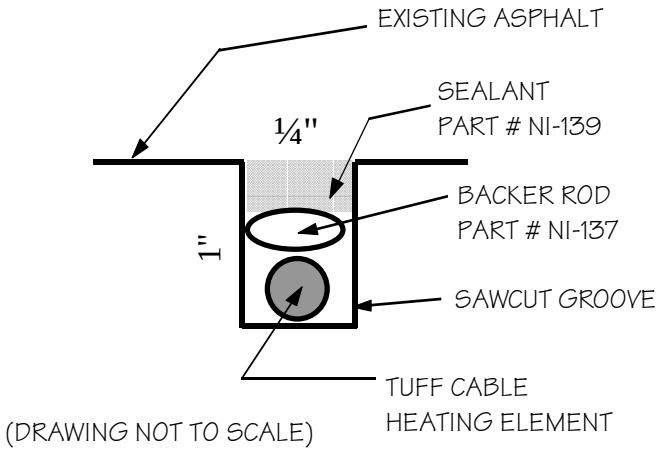


Illustration 2.23
Retrofit Tuff Cable In Asphalt

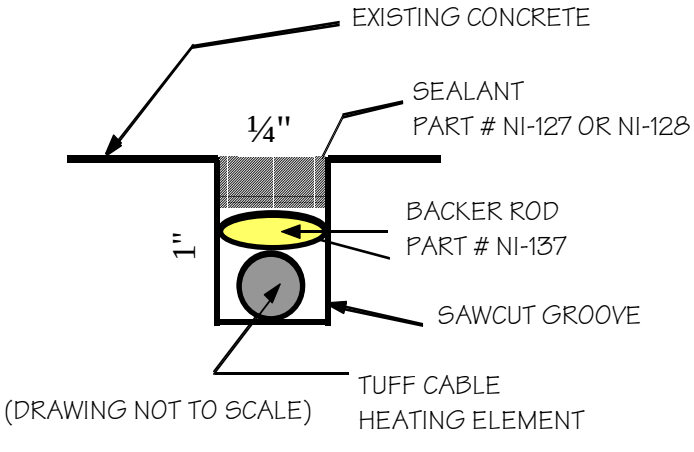


Illustration 2.24
Retrofit Tuff Cable in Concrete

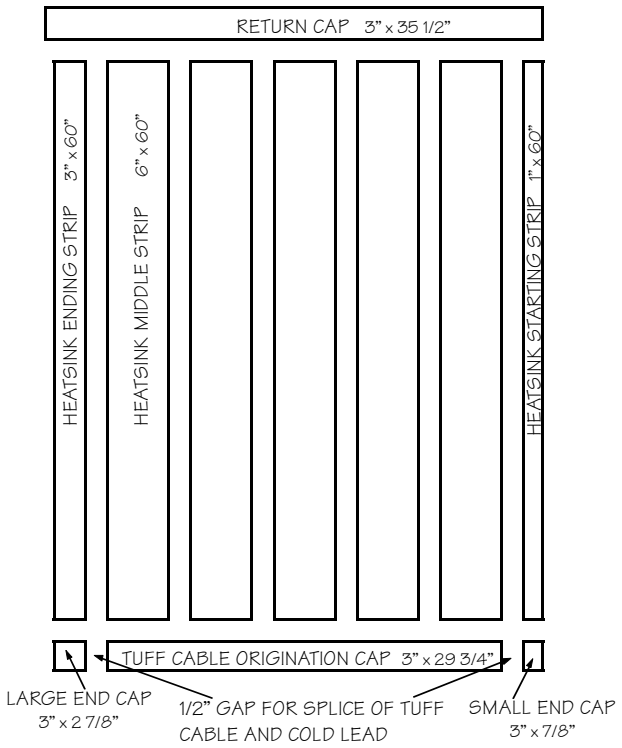


Illustration 2.25
Heatsink Layout

G. TUFF CABLE HEATSINK KIT INSTALLATION

Heatizon Systems Heatsink Cable Protector Kits include:

1	**1" X 60" X ¼" Heatsink Starting Strip**
5	**6" X 60" X ¼" Heatsink Middle Strips**
1	**3" X 60" X ¼" Heatsink Ending Strip**
1	**3" X 35.5" X ¼" Heatsink Return Cap**
1	**3" X 29 3/4" X ¼" Tuff Cable Origination Cap**
1	**3" X 2 7/8" X ¼" Heatsink Large End Cap**
1	**3" X 7/8" X ¼" Heatsink Small End Cap**
6	**1 ½ " X 60" Tuff Cable Protector**
2	**1 ½ " X 35 ½" Tuff Cable End Protector**
1	**One Gallon (U.S) Premixed Thinset Mortar**
60	**7/8" Wood Screws**
1	**2 ½" Putty Knife**

Note: Always allow for the space for one 3" X 35 ½" X ¼" Heatsink Return Caps plus a ¼" gap and one 3" x 29 3/4" x 1/4" Tuff Cable Origination Cap plus 1/4" for each Heatizon Tuff Cable System (see Illustration 2.25). Also, do not forget to always leave a ¼" gap for the Tuff Cable between all Heatsink Strips.

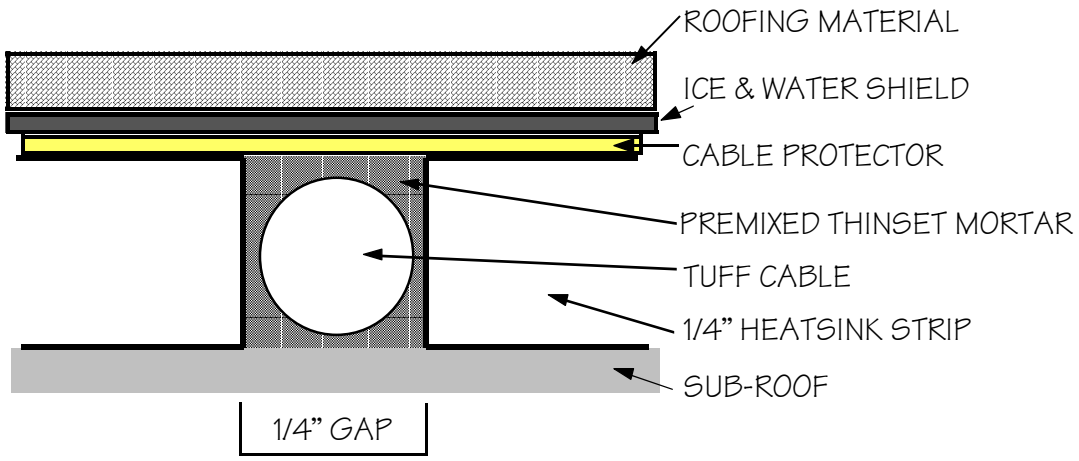


Illustration 2.26
Heatsink on roof

Suggested starting points:

- Eaves: Start at the edge of the roof (the point where drip edge will ultimately be installed) with one 1" X 60" X ¼" Heatsink Starting Strip. Continue to work your way up the eave using the 6" X 60" X ¼" Heatsink Middle Strips until you are at least 6" inside of the exterior cold wall. Finish by installing one 3" X 60" X ¼" Heatsink Ending Strip.

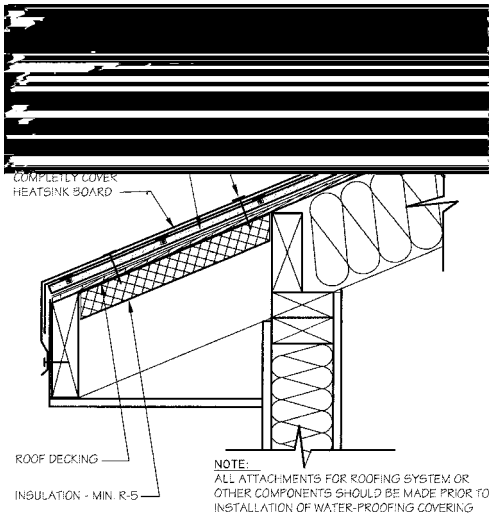


Illustration 2.27
Tuff Cable in Heat Sink under metal roof

- Valleys: Start at the bottom of the valley with one 1" X 60" X 1/4" Heatsink Starting Strip and work away from the vertical edge of the flashing using the 6" X 60" X 1/4" Heatsink Middle Strips. Finish by installing one 3" X 60" X 1/4" Heatsink Ending Strip.

- Flashing: Start at the vertical edge of the flashing with one 1" X 60" X 1/4" Heatsink Starting Strip and work away from the vertical edge of the flashing using the 6" X 60" X 1/4" Heatsink Middle Strips. Finish by installing one 3" X 60" X 1/4" Heatsink Ending Strip.

- Metal Roofs: The recommended installation procedure for under Metal Roofs is the same as that described above for each particular area.

Once the layout design has been finalized and the starting place chosen, begin the installation of the Heatizon Systems Heatsink Kit as follows**:**

Step One: Install one 1” X 60” X ¼” Heatsink Starting Strip to the sub-roof with enough of the provided wood screws to secure in place;

Step Two: After leaving a ¼” gap for the Tuff Cable install one 6” X 60” X ¼” Heatsink Middle Strip with enough of the the provided wood screws to secure in place;

Step Three: After leaving a ¼” gap for the Tuff Cable, install a second 6” X 60” X ¼” Heatsink Middle Strip repeat as necessary to cover the entire area of the roof to be snow and ice melted;

Step Four: After leaving a ¼” gap for the Tuff Cable install one 3” X 60” X ¼” 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 ¼” gap for the Tuff Cable then install one 3” X 35.5” X ¼” Heatsink Return Cap;

Step Six: At the beginning of the Heatsink, or the point where the Cold Leads will connect to the Tuff Cable, leave a ¼” gap for theTuff Cable and install one 3” X 29 3/4” X 1/4” Tuff Cable Origination Cap, one 3” X 7/8” X ¼” Heatsink Small End Cap, and one 3” X 27/8” X ¼”Heatsink Large End Cap;

Step Seven: Install the Tuff Cable into the 1/4" gaps following the instructions in this manual.

Note: Leave ½" space between the Origination Cap and each of the small and large end caps for the Cold Lead/Tuff Cable beginning and ending connections.

Step Eight: **Connect the Cold Leads to the Tuff Cable as shown in Section H, "Tuff Cable Jumpers and Connections."**

Step Nine: Once the Tuff Cable has been installed into the gaps and the Tuff Cable connections are completed and in the 1/4" gaps, completely fill all ¼" gaps with the provided premix thinset mortar 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 Premixed Thinset Mortar.

Step Ten: Install the Tuff Cable Protectors over the Tuff Cable using the provided wood screws.

Caution: Do not allow the provided wood screws or anything else to damage the Tuff Cable or Cold Leads.

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 ¼" gaps for Tuff Cable.

Note: When planning the layout of the Heatsink Strips allow enough space to install one 3" X 35.5" X ¼" Heatsink Return Cap (plus a ¼" gap for Tuff Cable), at the end of the Heatsink so the Tuff Cable can be looped back toward the point of beginning. In addition, plan the layout of the Heatsink Strips to allow enough space to install one 3" X 29 3/4" X ¼" Tuff Cable origination cap (plug large and small end caps) plus one ¼" gap for Tuff Cable at the end of the Heatsink where you plan to connect the Tuff Cable to the Cold leads.

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 pre-mixed mortar mix provided. In order to embed the connection of the Cold Lead and the Tuff Cable, the ¼" gap must be expanded to nearly ½" for a distance of approximately 4 inches.

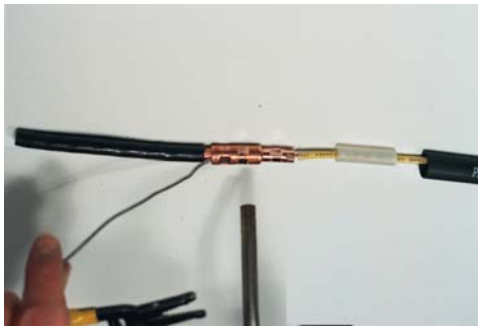


Illustration 2.28
Soldering of E210BS Butt Splice.

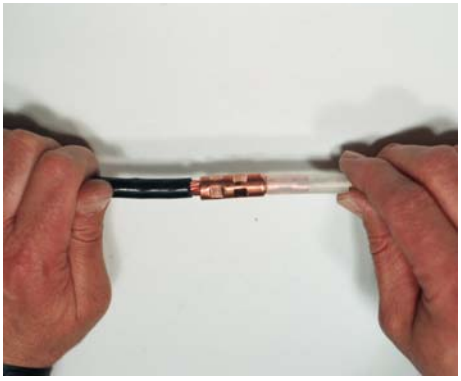


Illustration 2.29
Tuff Cable Splice is accomplished using a Heatizon Systems Splice Kit.

Illustration 2.30
Heating of Heat Shrink over E210BS.

Illustration 2.31
Completed E210BS Butt Splice Connection.

H. TUFF CABLE JUMPERS AND CONNECTIONS

The Tuff Cable element is connected to the Cold Lead with the Heatizon E210BS butt splice connector. This connection is accomplished by stripping back the insulation on the Tuff Cable and Cold Lead wires to be spliced 7/8". Slide heat shrink tubing and sleeve over the Tuff Cable to a point at least 8" beyond the splice. Insert the Tuff Cable and the Cold Lead into the E210BS butt splice connector. Crimp the connection in two locations on each side of the lug.

NOTE: The E210BS butt splice connection must be inside a heatsink to pull the heat away from the connection. This connection is to be made in the heatsink; no junction box is to be used.

Solder all exposed copper strands of Tuff Cable and Cold Lead with 40/60 rosin core solder provided. Make certain that heat is sufficient to draw solder completely into the splice. Never heat the small end of the E210BS butt splice or scorch the insulator on the Tuff Cable or Cold Lead. After soldered connection cools slide sleeve over Tuff Cable end of the E210BS butt splice and slide heat shrink over splice and center on the splice. Use broad soft flame torch or hot air gun. Shrink temperature is 250 degrees. Continually move the heat source around the diameter of the tube to warm and shrink it. Do not scorch the tube. The shrink is complete when adhesive oozes from between the tube and the Tuff Cable and Cold Lead.

From time to time the Tuff Cable element must be spliced. Splicing is accomplished by stripping back the insulation on the wires to be spliced 1". Then insert Tuff Cable into small #10 butt splice connector provided. Crimp the connection well. Solder with 40/60 rosin core solder and cover it with either a heat shrink or 3M23 tape followed by 3M33 tape then coat with 3M Skotchkote as described above.

Tuff Cable element should never pass through any joint in the concrete. A Cold Lead jumper between Tuff Cable elements should be made to pass through any and all cold-joints (See Illustration 2.12).

Illustration 2.32
E210BS Connection Kit.

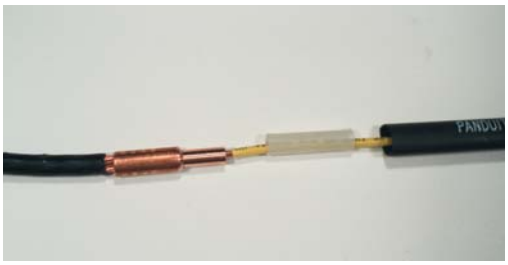


Illustration 2.33
Cold Lead and Tuff Cable in E210BS.

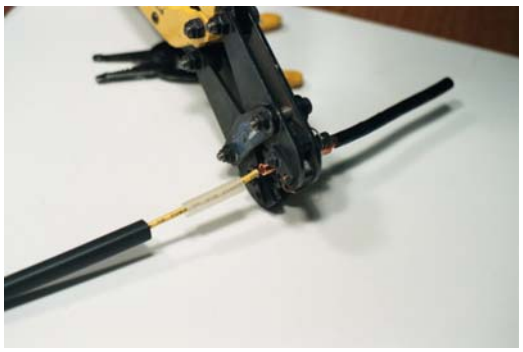


Illustration 2.34
Crimping of E210BS.

Z Mesh Applications and Roofing Requirements

Roofing Material	Requirements
Shake Shingles	**Ice and Water Shield over and under Z Mesh**
Composite or Asphalt Shingles	**Ice and Water Shield over and under Z Mesh**
Slate or Tile Shingles w/o Lattice	**Ice and Water Shield over and under Z Mesh**
Metal Roof, Valley Metal, Metal Flashing	**Tuff Cable in Heat Sink Recommended**
Membrane or Other Roofs	**Call Heatizon at 801-293-1232**

Z Mesh Applications and Flooring Requirements

Subfloor Material and Floor Covering	Overlayment Required/ Recommended
Carpet on Concrete Subfloor	**1/8" Particle Board, Plywood or Cement Board Recommended**
Carpet on Wood Subfloor	**1/8" Particle Board, Plywood or Cement Board Recommended**
Hardwood on Wood or Concrete Subfloor	**None Required**
Tile on Wood or Concrete Subfloor **	**Cement Board or Other Non-Metallic Product Required**
Sheet Vinyl or Vinyl tile on Concrete or Wood Subfloor	**1/8" Particle Board, Plywood or Cement Board Required**

****Cement Board or other non-metallic system may be installed over Z Mesh.**
Do not use metal lathe or other electrically conductive material.

D. Z MESH

ELEMENT DESIGN AND LAYOUT

1. The Heatizon Z Mesh system is a low-voltage electric radiant heating system.
Installations include:

- under floor coverings over concrete or wood sub floor
- under roofing systems *

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

Applications and space between element runs:

- roof de-icing (2" spacing)
- floor-warming (2" spacing for hard surfaces; 2"-4" spacing for other surfaces)
- space-heating (Spacing determined by heat loss calculations)

Z Mesh is designed to be spaced at specific intervals using specific lengths to produce a specified amount of heat per square foot.

The heat density per square foot of the system is dependent on the spacing between adjacent runs of *Z* Mesh heating element, the length of the Z Mesh, and the size of the transformer. **More details about system sizing can be found in the "System Operating Tables" section of this manual.**

2. Preparing a detailed layout of the element installation results in a superior installation. Preparing this layout on paper will save time.

3. Properly installed insulation is always recommended by Heatizon to enhance the efficiency and improve the performance of all Heatizon Systems products.

Illustration 2.35
Transition Plate and Splice Plate.

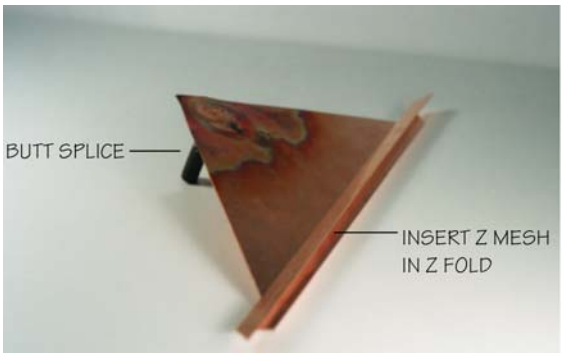


Illustration 2.36
Transition Plate.

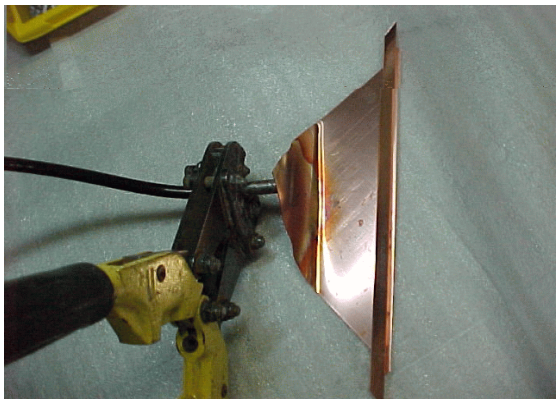


Illustration 2.37
Transition Plate being crimped to Cold Lead in floor installation.

E. Z MESH INSTALLATION

Note: Always conduct a heating element test and complete the form "Heatizon Systems After Installation Element Test" immediately following the installation of the Tuff Cable. See the "Heatizon Systems After Installation Element Test" section of this Installation Manual.

1. **Install Transition Plate**. The function of the Transition Plate **(Illustration 2.36)** is to connect the bronze Z Mesh heating element to the Cold Leads. Transition Plates may be terminated in the floor **(Illustration 2.36),** in the wall or on the roof. Placement of these connectors are done as follows:

a. Maintain 2" of space or more between Transition Plates. The location of the Transition Plates should be determined at the time the Cold Lead is installed. The spacing between Transition Plate's butt splices is dictated by the spacing between the Z Mesh and the direction that the Z Mesh runs from each Transition Plate**.**

b. Install the Transition Plate(s) at the time the Z Mesh element is installed. If it is necessary to install the Transition Plates at the same time as the Cold Lead, make certain that they are protected so that they will not be damaged, get dirty, or painted.

c. To connect Transition Plates to the Cold Lead, strip back 1-inch of insulation from the cold lead, insert the exposed cold lead into the butt-splice connector on the Transition Plate and crimp twice using the NEC approved crimping tool **(Illustration 2.37).**

Illustration 2.38
Cold Lead rough-in for wall installation of Transition Plate.

d. Solder all exposed copper strands of cold lead with 40/60 rosin core solder, heating the butt-splice sufficient to draw solder back into the splice. Heat butt splice at Cold Lead end only. Do not extend torch flame beyond the mid-point of the butt-splice.

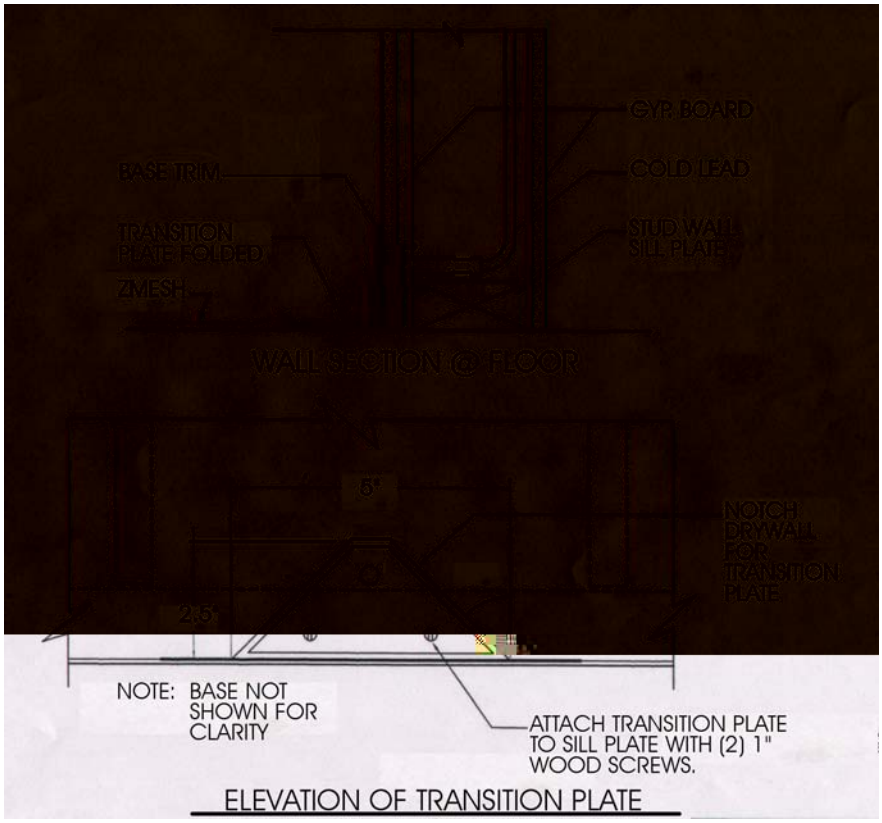


Illustration 2.39
Wall installation of Transition Plate.

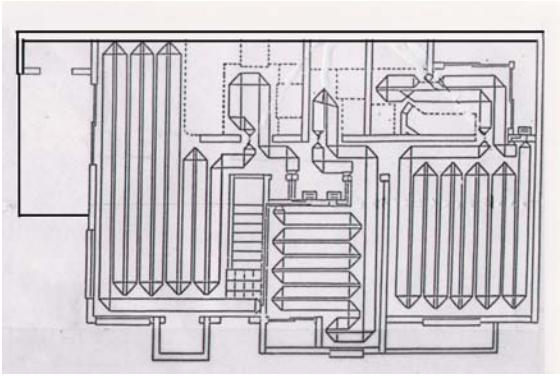


Illustration 2.40
Floor Plan of Sample Z Mesh Layout

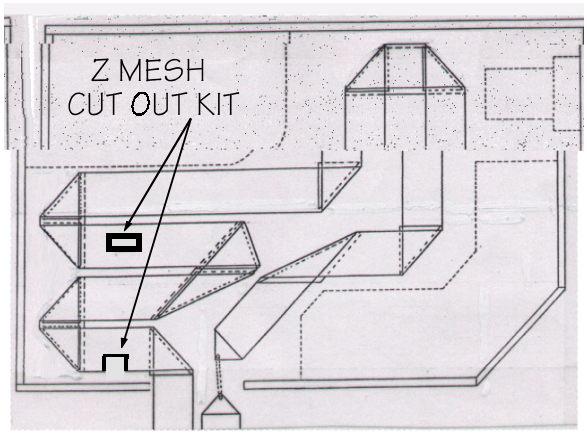


Illustration 2.41
Z Mesh Cut Out Kit in Z Mesh Layout.

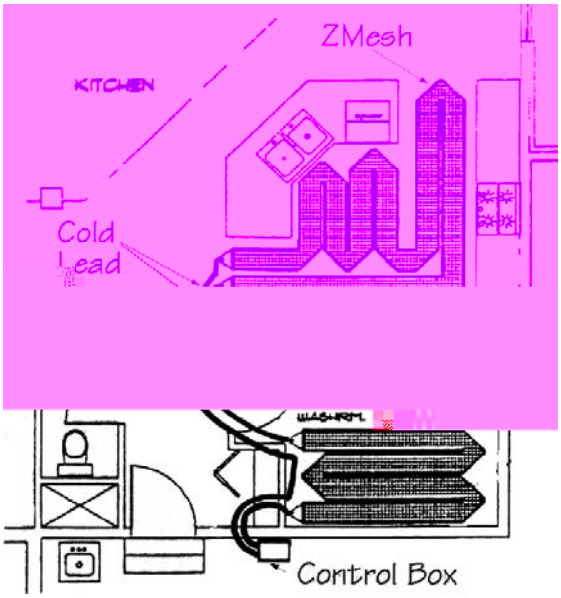


Illustration 2.42
Z Mesh lay-out and design. Note jumpering.

2. Placement of Z Mesh.

NOTE: Make certain that the surface area to be covered with Z Mesh is smooth and flat. Prior to installing the Z Mesh element, clean the areas to be covered of all dirt, nails, drywall, mud, etc.

NOTE: When installing Z Mesh on roofs, always install it between two layers of Ice & Water Shield (Heatizon Part Number NI114) or EPDM (Heatizon Part Number NI133).

a. Beginning at the point where the Cold Lead penetrates the floor, wall, or roof, plan the element run for each zone. Proper element spacing is based upon the results of the heat-loss calculations or heat density requirements that were performed to size the heating system. Maintain a minimum of 2" distance between adjacent runs of Z Mesh element, and do not allow Z Mesh to cross itself.

NOTE: Always use a Z Mesh Cut Out Kit whenever The Z Mesh has been damaged or whenever a portion of the Z Mesh must be cut away to avoid an object. Never cut away more than 4" of 12" Z Mesh nor more than 3" of 9" Z Mesh (see Illustration 2.41).

Illustration 2.43
Rolling out Z Mesh.

Illustration 2.44
Making 90º fold.

Illustration 2.45
Stapling Z Mesh.

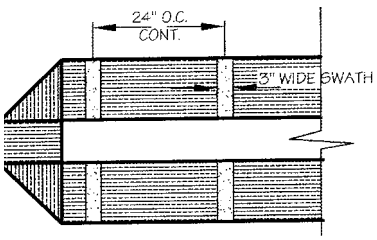


Illustration 2.46
Make 3 inch wide swaths of adhesive

b. Once location of runs of Z Mesh has been determined begin to roll out the Z Mesh. Starting at one of the Transition Plates, fold the Z Mesh element with two 90º folds to make parallel return runs and lesser degree turns to make non-parallel runs (see Illustrations 2.43 to 2.44). When you reach the first fold, crease the fold firmly (a scrap of 2 x 4 lumber can be used to create a crisp fold).

Note: If installation is over wood sub-floor or sub-roof, begin stapling the Z Mesh to the sub-floor or sub-roof, pushing loose Z Mesh ahead of you while pulling Z Mesh tight and stapling it every approximately 18" on opposite sides and center (see Illustration 2.45) The first staple should be 12" away from the Transition Plate connector, to allow for making the connection between the Transition Plate connector and the Z Mesh comfortably. "Bubbling up" of the Z Mesh must be avoided. Staple folded areas around the outside edge of the fold.

Note: If installation of Z Mesh is on concrete use an adhesive to hold the Z Mesh in place. With a 3" wide putty knife place 3" wide swaths of adhesive perpendicular to the length of the Z Mesh approximately every 18" (see Illustration 2.46). Duct tape may be used to temporarily hold the Z Mesh in place until adhesive dries. Follow directions of flooring adhesive manufacturer for application of floor adhesive. Once the adhesive is dry, remove and dispose of all duct tape.

c. Inspect the Z Mesh element for loose strands as you go and be sure to cut them off and discard them.

Note: When installing Z Mesh over a concrete slab that has elevated sleepers for hardwood flooring, the folds of the Z Mesh element must occur over the concrete areas not over the sleepers.

Illustration 2.47
Z Mesh inserted into fold of Transition Plate and fold flattened using hammer.

Illustration 2.48
Soldering of Transition Plate.

CAUTION: Before any covering is installed over the Z Mesh inspect area of heating very carefully and remove any objects or debris, specifically any metallic materials such as nails, screws, etc. and repair all cuts and tears.

Note: Encourage everyone to stay off the Z Mesh element until the element has been covered.

CAUTION: Z Mesh element must never touch or cross any other Z Mesh element or other metal or electrically conductive objects. Nails, staples or screws may penetrate the Z Mesh element as long as they <u>DO NOT</u> contact any electrically conductive material or metal other than the Z Mesh element.

<u>Z Mesh element should never be installed over a mudbed with metal lathe.</u>

d. Attachment of Z Mesh to Transition Plate. Cut the Z Mesh so that it can extend into the full depth of the fold the Transition Plate. (Cutting of the Z Mesh is best done using utility scissors.) Place the Z Mesh in fold of the Transition Plate. Hammer down the fold as flat as possible (**see Illustration 2.47**). Caution should be used when hammering fold to avoid hitting Z Mesh on lip of the Transition Plate fold. Z Mesh can be easily cut, thereby causing a fire danger; thus a great deal of caution must be taken. Apply heat to the Transition Plate only and never to the Z Mesh **(see Illustration 2.48**). Be extremely careful not to burn holes in the Z Mesh. Apply solder (60" is supplied with Z Mesh Kit) to the Z Mesh. The solder will be drawn back into the fold and create a permanent bond of the Z Mesh and Transition Plate **(see Illustration 2.49).**

Note: The Heatizon Systems Solder (Heatizon Part Number NI129) is the only Solder to be used.

Warning: Note precautionary measures for use of solder containing lead included in solder packet.

e. Once the element has been installed, the covering (acceptable coverings and applications are noted in table at the beginning of this section) must be installed immediately to prevent damage to the element and to prevent shorting of adjacent runs of element.

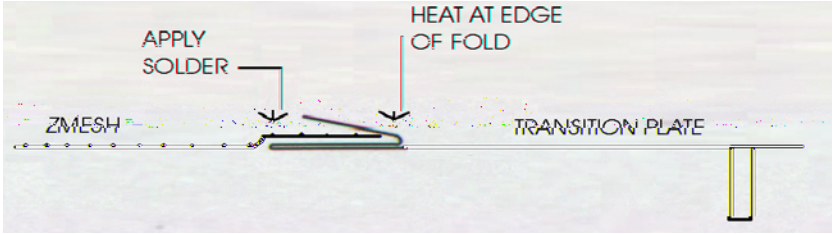


Illustration 2.49
Detail of Transition Plate

Illustration 2.50
Splicing of Z Mesh. Z Mesh being placed in fold of Splice Plate.

Illustration 2.51
Splice Plate and fold flattened using hammer.

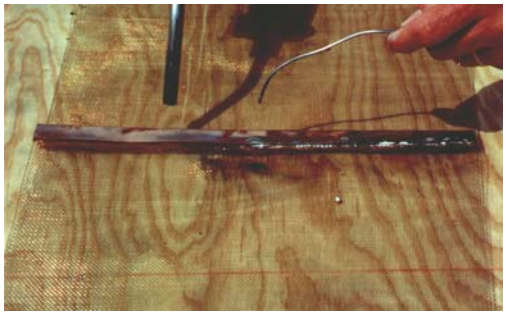


Illustration 2.52
Soldering of Splice Plate and Z Mesh.

f. **Splicing Z Mesh.** From time to time the Z Mesh element must be spliced. (See Illustration 2.50). Splicing is accomplished by cutting one run of Z Mesh leaving the cut straight and flat. The Splice Plate (E218) is placed on top of the Z Mesh with 1 inch of Z Mesh overlap. This overlap is folded up into the fold of the copper splice plate. The other piece of Z Mesh is then brought over the top of the splice plate. Mark the length of this piece of Z Mesh and cut and tuck it into the fold of the copper splice plate on top of the other Z Mesh. The Splice Plate fold is then flattened down on top of both pieces of Z Mesh using a short length of 2" x 4" or a hammer as shown (see Illustration 2.51). Apply heat to the splice plate using a propane torch (Illustrations 2.52 and 2.53). Place the tip of the solder ahead of the flame until solder flows into the fold. The entire length of the connection between Z Mesh element and Transition Plate must be soldered. Be careful not to scorch or burn holes in the Z Mesh or to ignite or damage the subsurface.

g. **End Plate.** Wherever a need exists to avoid having turns in the Z Mesh, Heatizon 26" End Plate may be used. Insert one length of Z Mesh into each end of the End Plate (leaving 2" of space between the Z Mesh), hammer the End Plate together, apply heat to the End Plate, and then apply solder.

h. **Z Mesh Cut Repair.** Use Heatizon Systems Z Mesh Cut Out Kit to repair any Z Mesh that is cut or damaged.

Note: **Loose strands of Z Mesh will get red hot if energized, and will result in fire danger. Eliminate all loose strands of Z Mesh prior to energizing your Heatizon product. In order to avoid danger of fire, never cut Z Mesh. If Z Mesh is cut, it must be repaired by using Heatizon Systems Z Mesh Cut Out Kit which must be properly installed.**

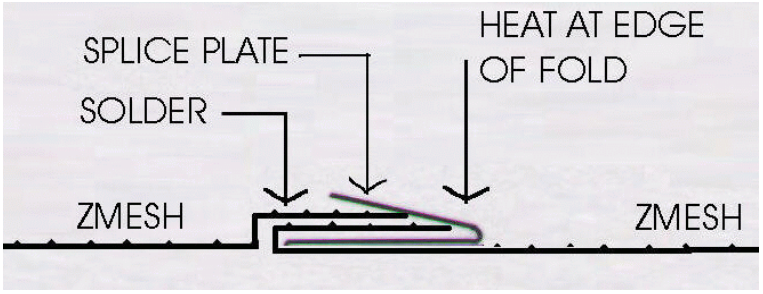


Illustration 2.53 Splice Plate Detail.

E. Z MESH RETROFIT/STAPLE-UP INSTALLATION

Z Mesh element can be retrofit by stapling the Z Mesh element beneath the sub-floor in the joist space by using a Heatizon Systems Joist Screen Kit (JSTSCRKIT). The Z Mesh element is then stapled to the Joist Screen Kit spacers, which maintains approximately 3/4-inch space between the sub-floor and the Z Mesh. Insulation is then installed below the Z Mesh heating element leaving a minimum of 2-inches of dead air space.

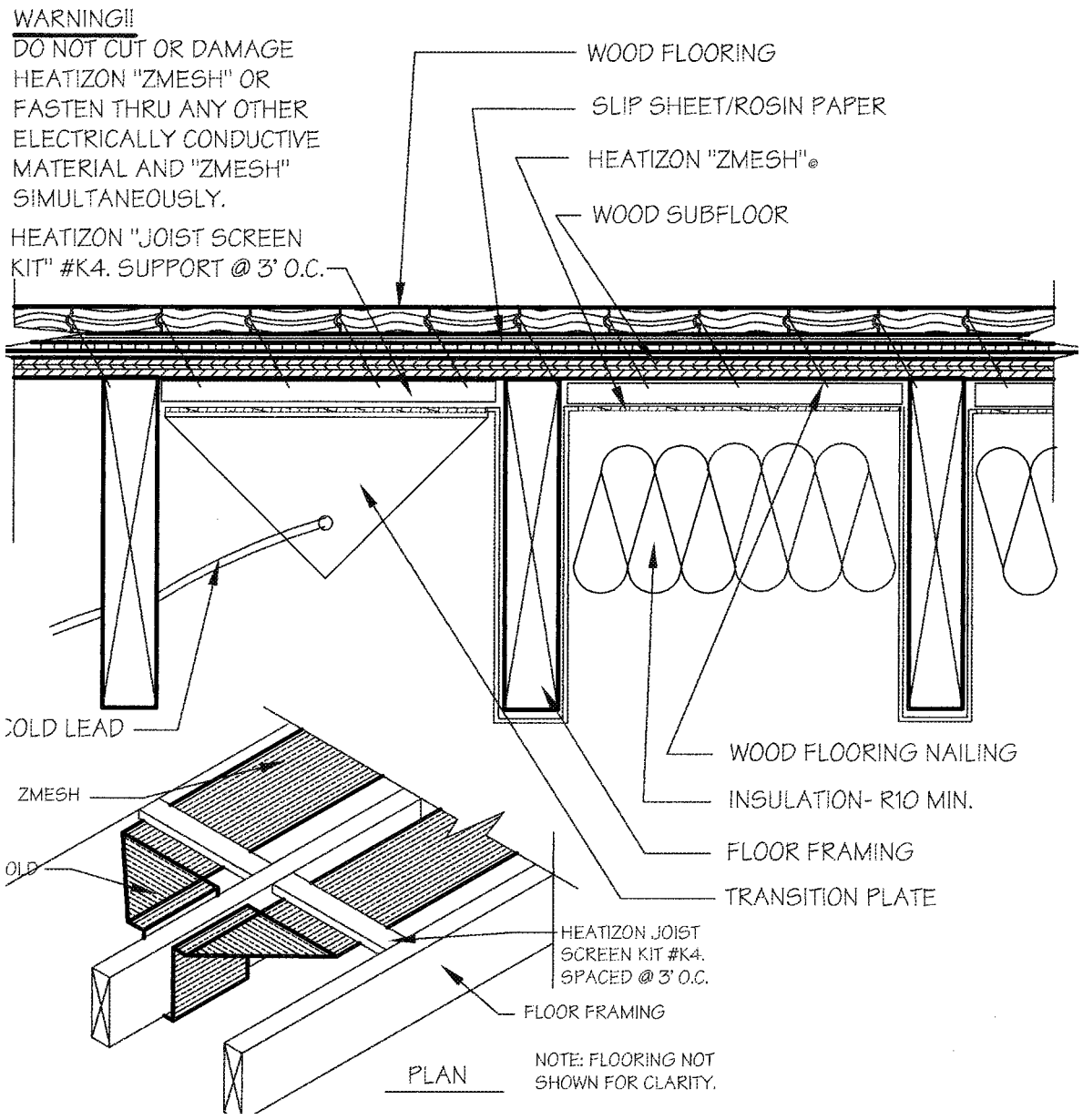


Illustration 2.54
Detail of Z Mesh retrofit. Z Mesh is placed between and ran under floor framing.

Illustration 2.55
Asphalt shingle roofing being installed over Z Mesh. Note sandwiching between "Ice and Water Shield"

Illustration 2.56
Heatizon Systems Element Alarm

F. Z MESH ELEMENT ROOF DE-ICING INSTALLATION

Z Mesh Heating Element can be used for de-icing in valleys and on eaves as well as other trouble areas on roofs. The Z Mesh must be sandwiched above and below with Ice and Water Shield (NI114) or EPDM (NI133). Great care must be taken to make sure that the element is shielded from moisture. Fasteners (screws, nails, etc.) must never penetrate simultaneously through the Z Mesh element and any metal. Valley metal , metal drip edge, metal flashings or other electrically conductive or metal roofing material or their attachments must never be allowed to come into contact with Z Mesh. Z Mesh is not recommended under metal roofs, valley metal, metal drip edge, or metal flashing etc.

CAUTION: Risk of fire will occur if Z Mesh is shorted to anything metal or electrically conductive. In order to reduce the risk, always use an Element Alarm (NI113) or amp meter with an alarm to check for continuity between the Z Mesh and all metal or electronically conductive material. Read Customer Information (See Page IV) regarding additional information and warnings for Heatizon Roof De-icing Systems.

Note: Always conduct a Heating Elemen tTest and complete the form "Heatizon Systems After Installation Element Test" immediately following the installation of the Z Mesh . See the "Heatizon Systems After Installation Element Test" section of this Installation Manual.

Illustration 2.57
Z Mesh under single ply membrane roof

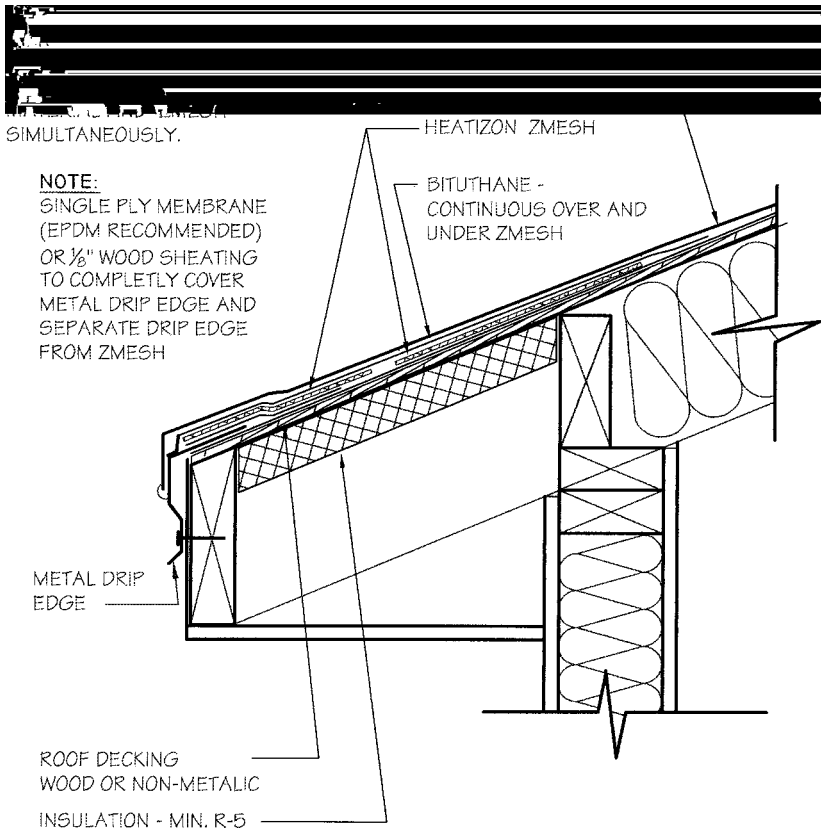
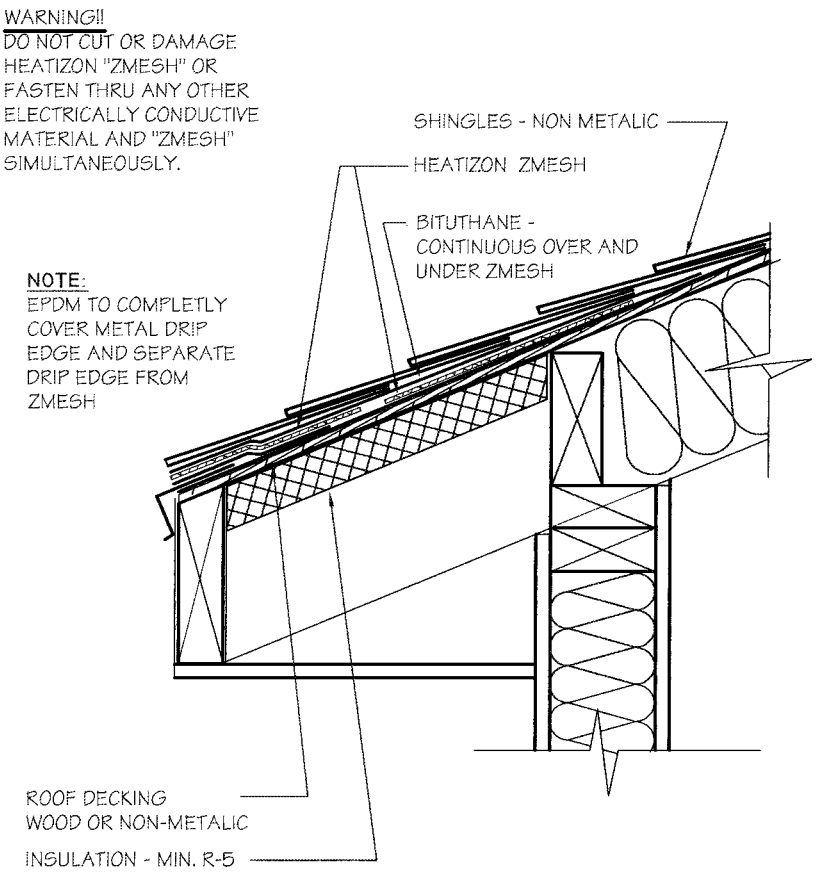


Illustration 2.58
Z Mesh under non-metallic roof



Step 3

TRANSFORMER & CONTROL BOX

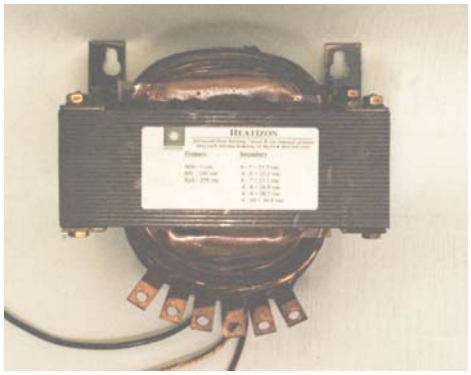


Illustration 3.1
Transformer - Similar to S050 - S106

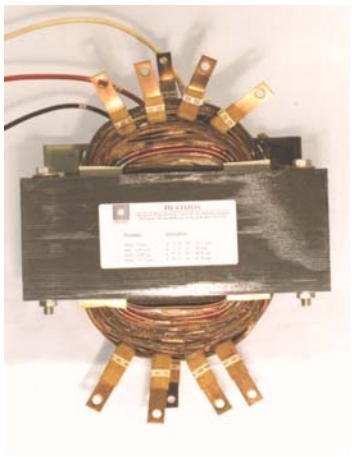


Illustration 3.2
Transformer - Similar to S202 - S203

Note: All Heatizon Systems Transformers require one pair of Cold Leads (except for S202 -- 2X2kVA and S203--2X3kVA Transformers which require *two sets of Cold Lead pairs*). One of the Cold Leads from any given pair connect to the common tap located at the back of the Transformer and the other Cold Lead connects to one of the voltage taps at the front of the transformer.

Note: The length of the Tuff Cable or Z Mesh and Cold Lead you received are compatible with the Transformer Heatizon Systems shipped. Prior to installing the Transformer, Heatizon Systems recommends that you make certain the Transformer you have is the proper size given the actual length of Cold Lead and either Tuff Cable or Z Mesh heating element that you have installed. The sizing of the Transformer can be accomplished using either the System Operating Tables or formulas in the “Useful Information” section of this manual.

Note: The second “Heatizon Systems After Installation Element Test” must be taken and recorded either now, or immediately following the completion of Step 3. See the Heatizon Systems After Installation Test portion of the Installation Manual for details.

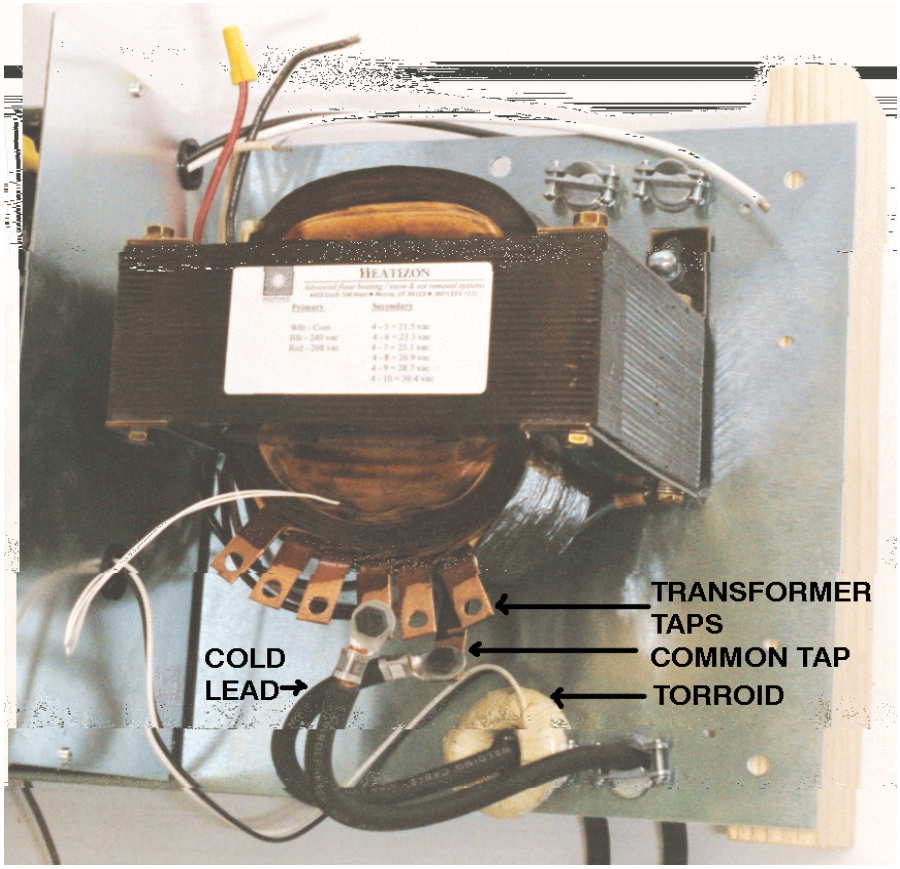


Illustration 3.3
Transformer.

A. Installation of Transformer

1. Install the (2) 1/4-20 x 3/4" slotted round head transformer mounting screws provided in the hardware kit into the pemnuts attached to the upper right hand portion of the backplate (Back Plate should have been installed – see Rough-In section). DO NOT FULLY INSTALL TRANSFORMER SCREWS AT THIS TIME. Leave a gap between screw head and Back Plate large enough to accommodate the transformer mounting bracket.

2. Hang the Transformer from transformer mounting screws via keyed mount holes on the transformer mounting bracket, tighten transformer screws completely.

3. Cut each Cold Lead (#2 THHN) to the length necessary to have one lead of each pair reach the common tap at the back of the Transformer and the other lead long enough to reach all of the voltage taps at the front of the Transformer.

4. Strip ½ inch of insulation from each Cold Lead and install crimp lugs. Attach crimp lugs provided in hardware kit to each Cold Lead with appropriate crimping tool.

5. Before connecting one of the Cold Leads from each pair to the common tap(s), remove the Torroid from the Control Box and slip it over that Cold Lead.

Note: For S202 and S203 Transformers, repeat above for top voltage and common taps and bottom voltage and common taps.

NOTE: Procedures for attaching Cold Leads on dual secondary transformers (S202 & S203 Transformers) must be repeated for both sets of windings using the special dual Torroid provided. These Torroids must be installed “in Phase” with each other to provide proper feedback signal to the Control Box. This can be accomplished by installing each Torroid in the same direction using the black and white wires as a guide. For example, keep the white wire to the left as you slip it over the Cold Lead. Improperly installed dual Torroids will make adjustment of Control Board impossible at system start-up.

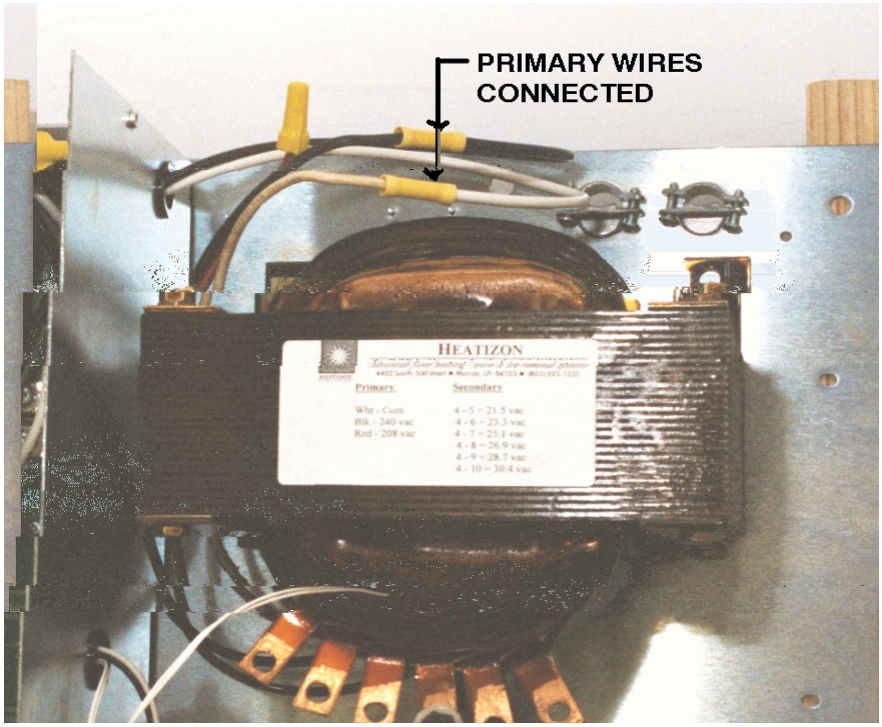


Illustration 3.4
Transformer primaries connected to Control Box leads.

6. Attach one Cold Lead from each pair to the appropriate voltage tap, and the other Cold Lead from each pair to the common tap located at the back of the transformer (use System Operating Tables or "Useful Information" sections to select appropriate voltage tap). Connect each Cold Lead to the appropriate tap using 1/4 inch hex head bolt, nut & lock washer provided.

7. Reconnect Torroid plug to the proper connector (see Illustration 3.10) on the Control Box Mother Board.

NOTE: In order to avoid Transformer damage, do not attach Cold Leads without using a lock washer and tightening the nut completely.

NOTE: If the appropriate voltage tap cannot be determined prior to installation of the Transformer, connect one of the Cold Leads from each pair to the lowest value voltage tap (transformer tap voltages are listed on the transformer body). Once the Control Box is energized, the actual voltage of the voltage tap connected to one of the Cold Leads can be measured and adjusted during system start-up.

Note: Refer to the diagram on the Transformer to connect primary wiring. Wiring configuration will change with Transformer size and supply voltage.

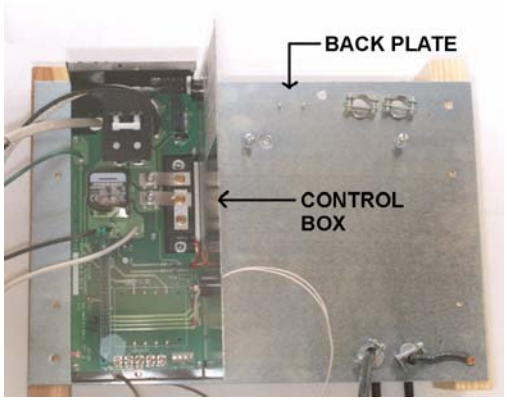


Illustration 3.6
Control Box mounted to Back Plate.

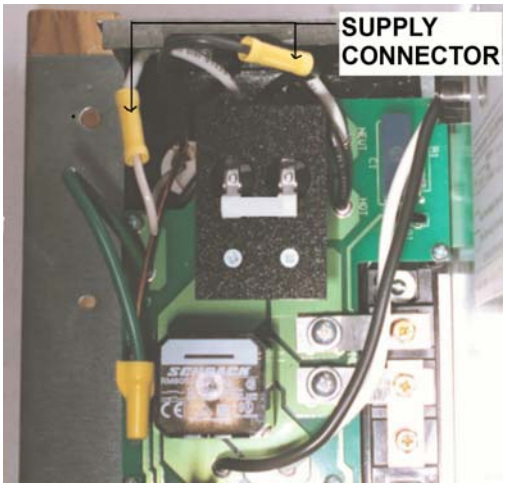


Illustration 3.7
Supply wiring to Control Box.

B. Installation of Control Box- CBX6, CBX6T, CBX23, & CBX23T

1. Run the power supply conductor through the round hole in the upper left corner of the Control Box. Run the Thermostat Wire through the round hole in the lower center of the Control Box.

2. Mount the Control Box to the Back Plate using two (2) #6-32x3/8" screws provided in Hardware Kit. Make certain that the power supply conductor and Thermostat Wire pass through access holes in the Control Box and are not behind it **(see Illustration 3.6).**

3. Cut incoming power supply conductors to desired length and strip ½ inch of insulation from end of each wire. Connect the power supply conductor to the Control Box according to the table below. Use the provided #10 insulated Butt Splice Connectors or wire nuts. It is not necessary to make these connections (**see Illustration 3.7).**

4. Connect the primary wiring of Transformer to orange Transformer primary wires in the Control Box with the provided #10 insulated Butt Splice connectors or wire nuts. It is not

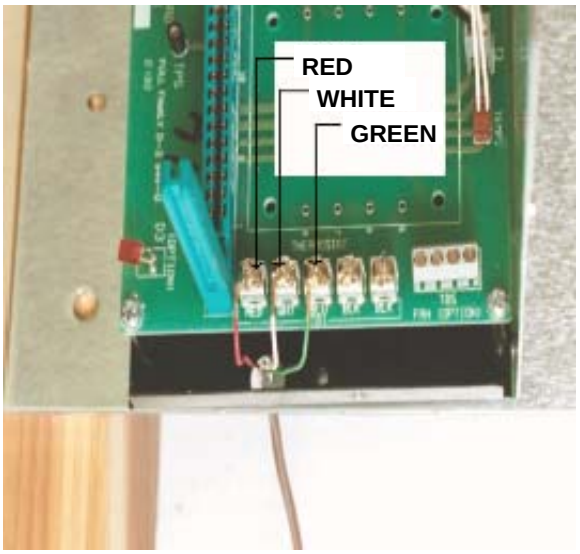


Illustration 3.8
Thermostat Wire connection.

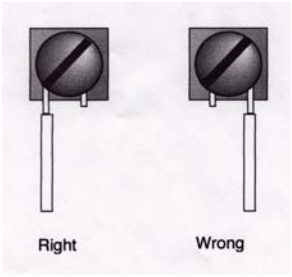


Illustration 3.9
Control Cable Termination.

necessary to observe polarity when making this connection. Use the label information on the transformer to select the proper wiring for the supply voltage you are using. Cap off unused wires individually with a provided wire nut.

POWER SUPPLY VOLTAGE CONNECTIONS

120 VAC	Hot & Neut Hot with Ground
208 & 240 VAC	Two Hots with Ground
277 VAC	Hot & Neut Hot with Ground

5. Cut the Thermostat Wire to desired length. Strip about 2 inches of outer jacket from end of cable. **USE CAUTION WHEN STRIPPING OUTER JACKET. DO NOT CUT OR NICK INDIVIDUAL WIRES**. Strip 3/4 inch of insulation from each of the Red, White, and Green wires in the cable and connect them to the terminals labeled R, W, and G located in the lower left-hand section of the Control Box Mother Board (see **Illustration 3.8)**. If you have a CBX6T or CBX23T and use an Activation Device that requires 24VAC power, strip 3/4 inch from the Blue and Yellow wires, and connect them to the terminals labeled B and Y. Place wire under screw in a clockwise direction and tighten **(see Illustration 3.9)**.

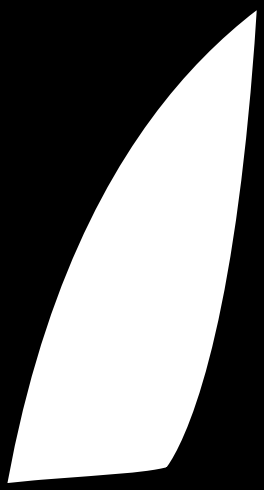
WARNING: Anytime the Blue and Yellow wires are connected to the B and Y terminals, and the Control Box is energized, the other ends of the Blue and Yellow wires must be insulated (isolated) from one another and all other conductive material in order to avoid damage to the Control Box Mother Board.

6. Pass the black bulb end of overtemp thermistor, connected to P2 on the Mother Board through bushing in side of Control Box panel and into the transformer cavity. Insert the black bulb of the thermistor into the space between the laminations and the belly of the Transformer.

NOTE: Control Boxes CBX6T or CBX23T are identical to the CBX6 and CBX23 Control Boxes in every respect except for one: The CBX6T and CBX23T Control Boxes are equipped with 24VAC to power an activation device that requires 24VAC power. Terminals for load are located in the lower left section of the Control Box Mother Board and are labeled B and Y.

NOTE: Any time CBX6T or CBX23T Control Boxes are operating at 120VAC, the Jumper on connection J1 (directly above 24vac transformer) must be moved to the J2 position. For 208/240VAC powered CBX6T or CBX23T, leave the Jumper on connection J1. Do not use CBX6T or CBX23T with 277VAC power **(See Illustration 3.10).**

NOTE: Control Boxes CBX6F and CBX23F that feature a cooling fan option, connect fan harness wires to pins 1 & 4 (two outside terminals) at the “fan option” terminal block located at the lower right-hand portion of the Control Box Mother Board.



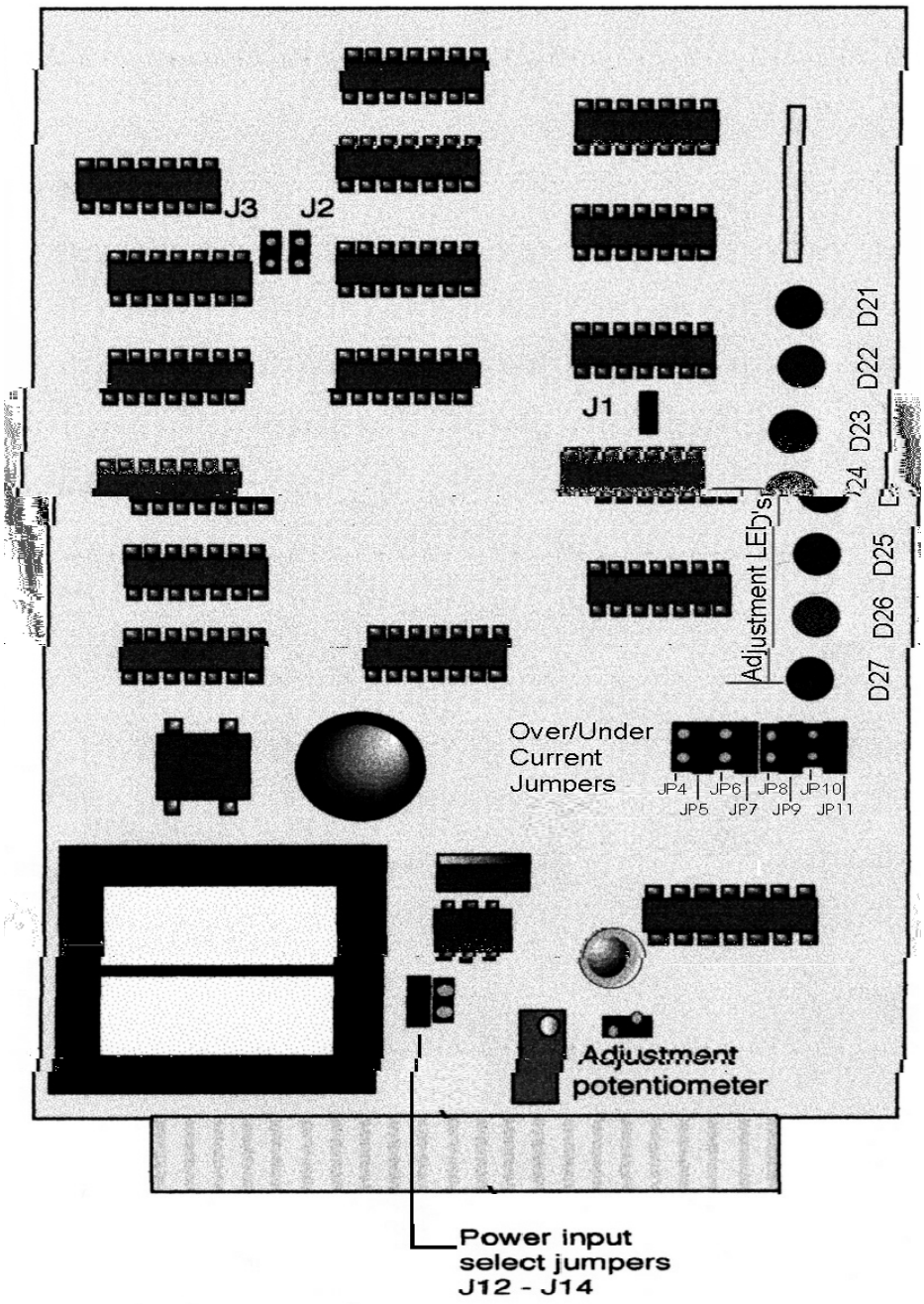


Illustration 3.11
Control Box Schematic

WARNING:
DO NOT INSTALL OR REMOVE CONTROL BOARD WHEN THE CONTROL BOX IS ENERGIZED. INSTALLING BOARD UNDER POWER WILL CAUSE SIGNIFICANT DAMAGE TO MOTHER BOARD AND/OR CONTROL BOARD.

WARNING:
INSTALL CONTROL BOARD WITH COMPONENTS FACING LEFT, INSTALLING BOARD IMPROPERLY WILL CAUSE PERMANENT DAMAGE TO MOTHER BOARD AND/OR CONTROL BOARD.

7. CHECK ALL CONNECTIONS AT THIS TIME FOR TIGHTNESS AND PROPER LOCATION. CHECK SCREWS ON THE SCR AND TIGHTEN AS NEEDED.

8. Set the JP12, JP13, and JP14 jumpers on the Control Board before installing Control Board into the Mother Board using the following tables. Refer to Input Voltage Select Table below for jumper locations on the control board.

9. Verify that all jumpers are installed on the appropriate settings for your specific application before inserting Control Board into the Control Unit.

Control Boards have been preset at the factory on the JP13 208/240V incoming power setting, and the JP5, JP7, JP9, and JP11 settings for Tuff Cable Heating Element.

If your application uses 120VAC or 277VAC incoming powers and/or Z Mesh Heating Element is being used, the jumpers may need to be repositioned. If using 240VAC incoming power and Tuff Cable heating element, verify that the factory installed jumpers are on appropriate settings.

Input Voltage Select Table

120VAC	**JP12**
208/240VAC	**JP13**
277VAC	**JP14**

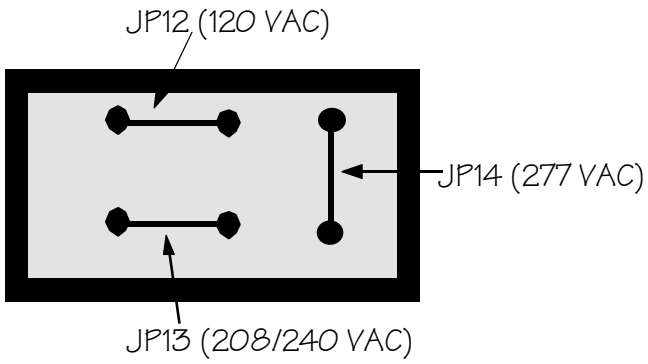


Illustration 3.12
Incoming Power Select Settings.

Over/Under current settings

Zmesh Screen	**(5%)**	**JP4**	**JP6**	**JP8**	**JP10**
Tuff Cable	**(15%)**	**JP5**	**JP7**	**JP9**	**JP11**

10. Make certain that the primary power to the Control Box is off, and then install the Control Board. Make certain that the components on the Control Board are facing left, and then insert the Control Board fully into the edge connector.

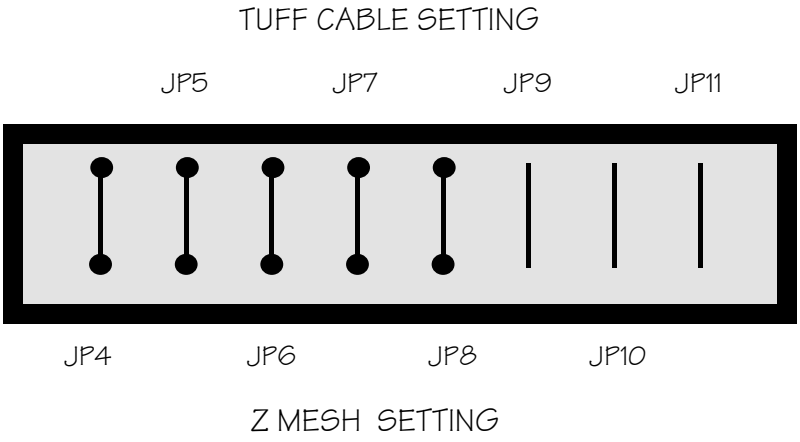


Illustration 3.13
Over/Under Current Settings.

C. START-UP PROCEDURES

When energized, Heatizon Systems Control Boxes turn the primary power On and Off to a step-down, low-voltage Transformer that provides power to the Heatizon Tuff Cable or Z Mesh. The Control Box can be activated by many different types of activation devices. Examples of activation devices include simple timers and thermostats, temperature and moisture sensors and telephone computer activators (see your Heatizon Systems supplier for details).

All of Heatizon System's CBX6 series and CBX23 series Control Boxes employ "soft turn" circuits that turn the Transformer on without a high in-rush current from the power source. If there is a problem, the primary power to the Control Box must shut OFF. The following five safety circuits monitor the output power to contribute to safe operation:

A. Shorting and Arcing: Monitors for loose connections between the Cold Leads and both the Transformer and the Tuff Cable or Z Mesh heating element. In addition, this circuit monitors shorts and arcing on the Tuff Cable or Z Mesh heating element.

B. Overtemp Sensors: Monitors the temperature of the transformer; in the event of the transformer overheating, it will shut off the Transformer until it cools down, then turn it back on.

C. Over current: If the current is increased by more than 5% on Z Mesh systems and more than 15% on Tuff Cable systems, the Control Box should shut off.

D. Under current: If the current decreases by more than 5% on Z Mesh Systems and 15% on Tuff Cable Systems, the Control Box should shut off.

E. Automatic Check. The Heatizon Systems CBX Control Boxes automatically shut off every 30 minutes to check the power circuit for problems. If the Control Box detects a power problems, it should shut off and keep it off.

Starting up the system.
The adjustment potentiometer on the Control Board for the high and low current fault circuits must be set for the exact length of Tuff Cable or Z Mesh heating element and Transformer voltage. Before this can be done, the secondary current on the Transformer must be set. To do this, attach a clamp-on amp meter around one of the two Cold Leads on the Transformer. Set the amp meter for AC amps with a range of at least 200 amps.

1. After all equipment is installed and electrical connections have been made system is ready to energize and test.

   Switch on activation device. System will turn on (transformer will "hum" upon activation, this is normal), check amp meter to see that system is running at less than 96 amps (see System Operating Tables). System will shut down in approximately 5 seconds, this will be long enough to get an amperage reading from the system (LED's will indicate either under or over current prior to system shut down, this is normal). If system is not running at the expected amperage, turn the circuit breaker and activation device off, select a different transformer tap to achieve the proper operating amperage, and connect the Cold Lead to the newly selected tap.

2. To repeat amperage measurement procedure, switch the breaker and activation device on. System will run for another 5 seconds allowing you to re-check the amperage measurement. Repeat this procedure until the proper operating amperage is achieved.

3. Once the proper amperage readings have been verified you may adjust the Control Board adjustment potentiometer using the following procedure. Turn the circuit breaker and activation device off and then back on. When the Control Box starts operating, LED's D24 through D27 on the Control Board become adjustment indicators. The Control Box is in the center of its operating tolerance for the exact amps that your system is running when LED's D25 & D26 are equally lit.

WARNING: IF THE PROPER OPERATING AMPS CANNOT BE ACHIEVED, THIS COULD INDICATE A FAULT IN THE INSTALLATION OF THE HEATING ELEMENT OR OTHER PROBLEM WITH THE SYSTEM. CONSULT YOUR HEATIZON DEALER OR HEATIZON SYSTEMS FOR FURTHER ASSISTANCE.

4. The Control Box will not stay running until the Control Board is properly adjusted. Adjustment of the potentiometer must be done with the system turned on and calling for heat. The Control Box will operate for approximately 5 seconds if not properly adjusted. Once the 5 seconds have lapsed, the control Box will shut down unless the potentiometer is properly adjusted. When the Control Box shuts down, it may be reset by switching off the activation device and the Control Box switch circuit breaker; adjustment procedure can resume.

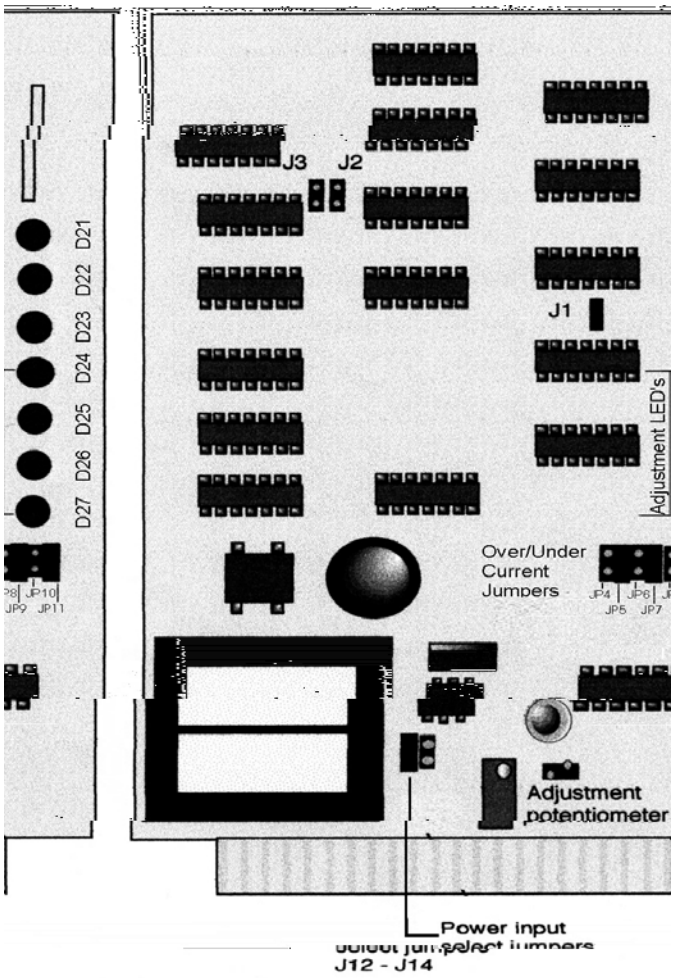


Illustration 3.14 Control Board

5. Set the activation device to the off position (no call for heat).

6. Switch on panel circuit breaker that feeds Control Box. Switch breaker in the front of the controller to the on position. LED's D24 & D25 should be illuminated, this indicates line power is on with no call for heat.

NOTE: LED's are designated from front to back as D21 through D27 (under current indication is # D21). LED functions are indicated on the side of the Control Box cover. Also a status indicator is located near the other LED's on the right-hand side of the control unit. This indicator mimics the function of the status indicator LED on the activation device.

7. If LED's D27 and/or D26 come on when system is activated, turn adjustment potentiometer clockwise until D25 & D26 are equally lit. If D24 and/or D25 are on when the system is activated, turn adjustment potentiometer counterclockwise until D25 & D26 are equally lit. Let Control Box run for approx. 10 minutes then perform a <u>final</u> adjustment to the potentiometer while the heating element is warm. If the Control Board cannot be adjusted correctly after several attempts, turn the power off and refer to the troubleshooting section of the install manual.

NOTE: On cold start-up, the system will be slightly out of adjustment and will "drift" into its proper adjustment as it reaches operating temperature. Amperage will lower slightly during this warm up period, this is a normal function of the system.

CAUTION: NEVER READJUST CONTROL BOARD AFTER FINAL ADJUSTMENT HAS BEEN MADE.

8. Before installing the Control Box cover, record system information in the spaces provided on the foil tag located on the Control Box front cover and on the form "Heatizon Systems After Installation Element Test" found in the Heatizon Systems After Installation Element Test section of this manual.

9. After system has been properly adjusted and is running normally, the covers should be installed. Turn system power off to reduce the risk of electrical shock while installing covers.

WARNING: DANGER OF SHOCK! EXTREME CARE SHOULD BE USED TO POSITION TRANSFORMER TAPS SO THAT THEY ARE CLEAR OF THE COVER OR OTHER TAPS ON THE TRANSFORMER. CAREFULLY BEND COPPER TAPS AS NEEDED TO ENSURE PROPER CLEARANCE ON BOTH USED AND UNUSED TAPS.

10. Install right side transformer side plate using two #6 screws provided.

11. Install transformer cover plate (fan grill to the top), using five #6 screws.

12. Install Control Box cover using two #6 screws (cover is shipped installed, use same hardware). Energize system and activate call for heat using thermostat. System should operate normally.

13. Check status indicator on side of the Control Box or activation device for solid red condition. If status LED indicates other than solid red, refer to the trouble shooting section of the install manual.

OPERATING CAUTIONS

A. Air flow around the Control Box and Transformer is critical and must be maintained. If the Transformer overheats the Control Box will shut the system down until the Transformer cools.

B. The owner of the system must be given a copy of the owners manual and the warranty card to be completed and returned to Heatizon Systems upon completion of the installation.

Step 4

ACTIVATION DEVICES

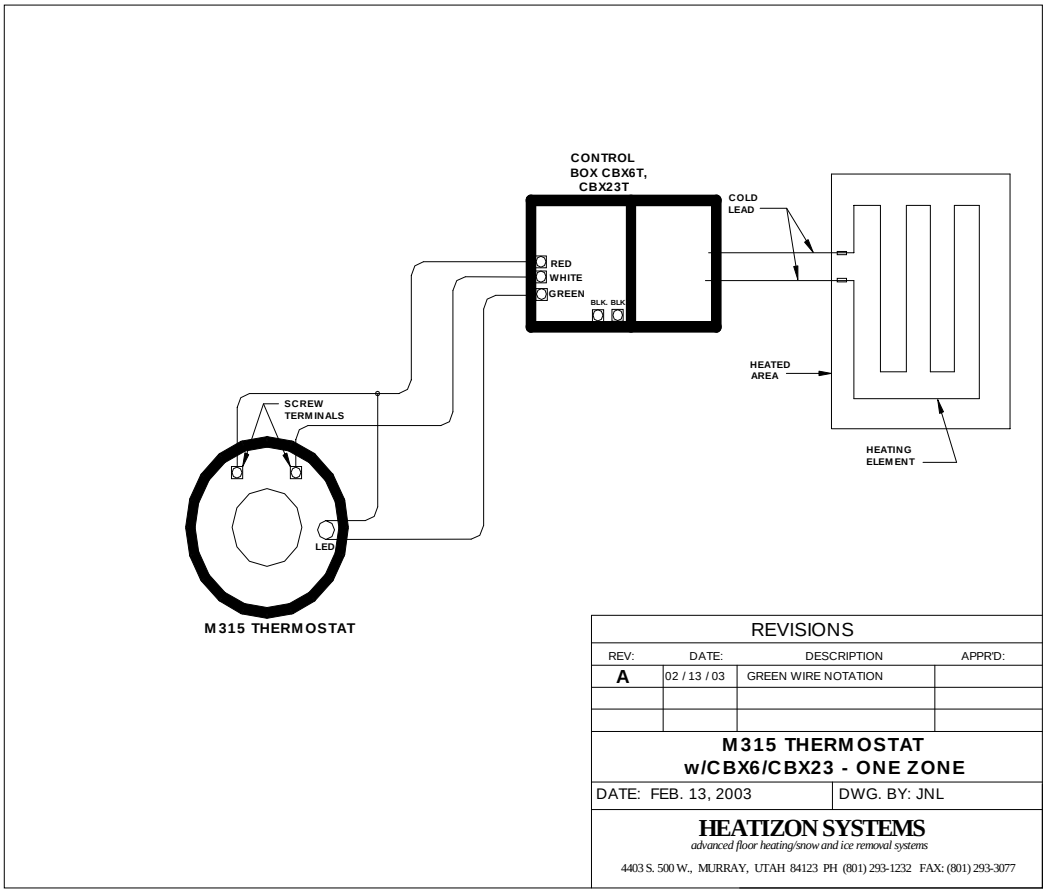
Many different types of activation devices are currently available from Heatizon Systems or its dealers. Heatizon Systems offers activation devices that range from simple switches to temperature/moisture sensors, and telephone or computer activators.

Power requirements for the different devices Heatizon Systems offers vary based upon the device selected. Some devices are battery operated or mechanical, and require no line power at all. Other activation devices operate on 120/240VAC line power or 24VAC. Wiring instructions are included with each activation device that shows the proper wiring method for that activation device.

M315H
Thermostat - White

Features:
- Dial temperature setting
- Has LED indicator light
- Range 48°F to 85°F
- No power required

Applications:
- Space Heating



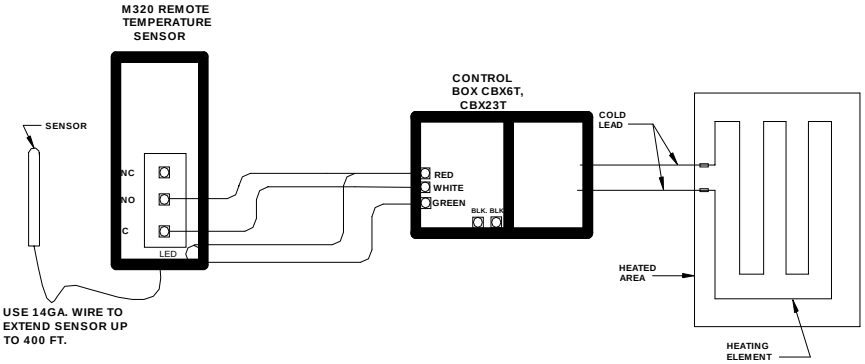
REVISIONS			
REV:	DATE:	DESCRIPTION	APPR'D:
A	02 / 13 / 03	GREEN WIRE NOTATION	

M315 THERMOSTAT
w/CBX6/CBX23 - ONE ZONE

DATE: FEB. 13, 2003 | DWG. BY: JNL

HEATIZON SYSTEMS
advanced floor heating/snow and ice removal systems
4403 S. 500 W., MURRAY, UTAH 84123 PH (801) 293-1232 FAX: (801) 293-3077

HEATIZON
SYSTEMS



REVISIONS			
REV:	DATE:	DESCRIPTION	APPR'D:
A	02 / 26 / 03	GREEN WIRE NOTATION	

M320 REMOTE SENSOR w/CBX6/CBX23 - ONE ZONE

DATE: FEB. 26, 2003 | DWG. BY: JNL

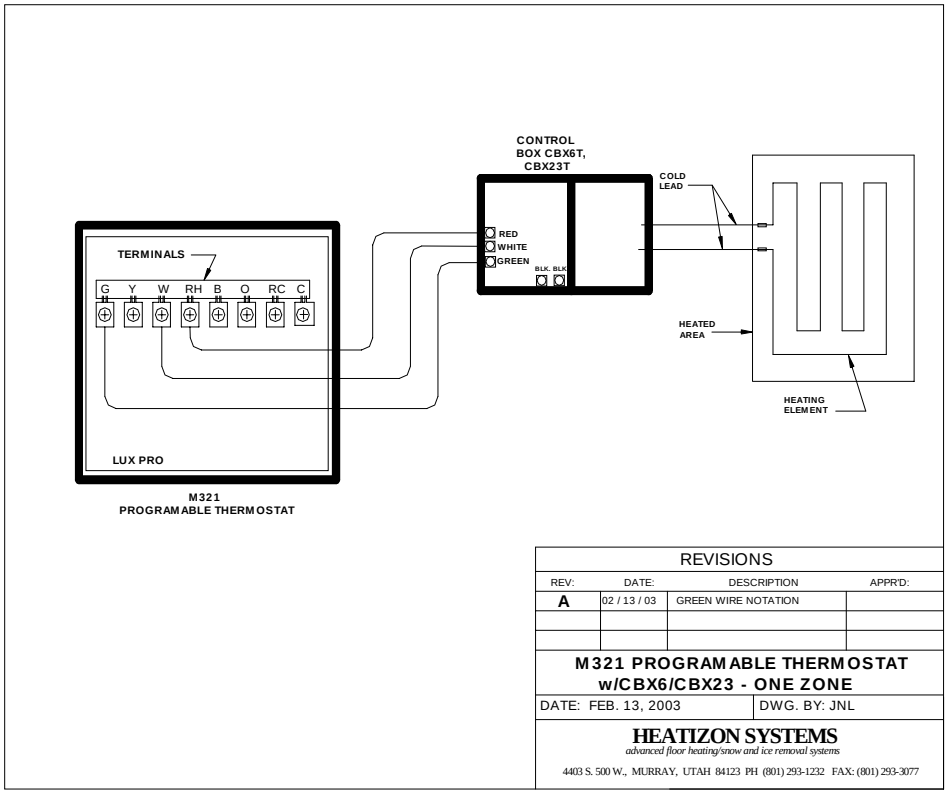
HEATIZON SYSTEMS
advanced floor heating/snow and ice removal systems
4403 S. 500 W., MURRAY, UTAH 84123 PH (801) 293-1232 FAX: (801) 293-3077

Heatizon Systems
4403 South 500 West
Murray, U

M321
Programmable Thermostat

Features:
- LCD display
- Has LED indicator light
- Four programmable periods per day
- Separate programs for weekdays and weekends
- Battery powered

Applications:
- Space Heating
- Floor Warming



REVISIONS			
REV:	DATE:	DESCRIPTION	APPR'D:
A	02 / 13 / 03	GREEN WIRE NOTATION	

M321 PROGRAMABLE THERMOSTAT w/CBX6/CBX23 - ONE ZONE

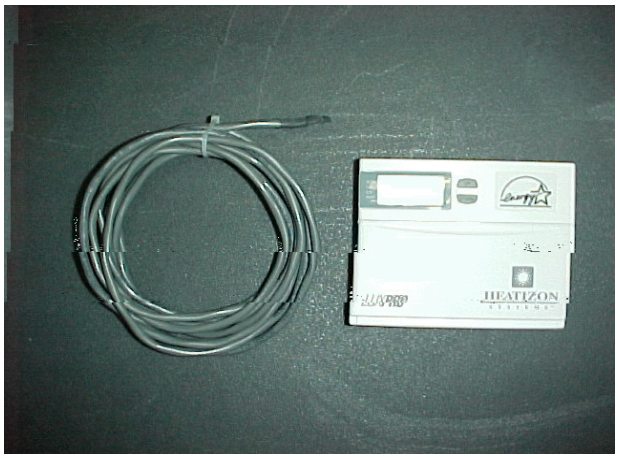
DATE: FEB. 13, 2003 | DWG. BY: JNL

HEATIZON SYSTEMS
advanced floor heating/snow and ice removal systems
4403 S. 500 W., MURRAY, UTAH 84123 PH (801) 293-1232 FAX: (801) 293-3077

Heatizon Systems
4403 South 500 West
Murray, UT 84123
www.heatizon.com

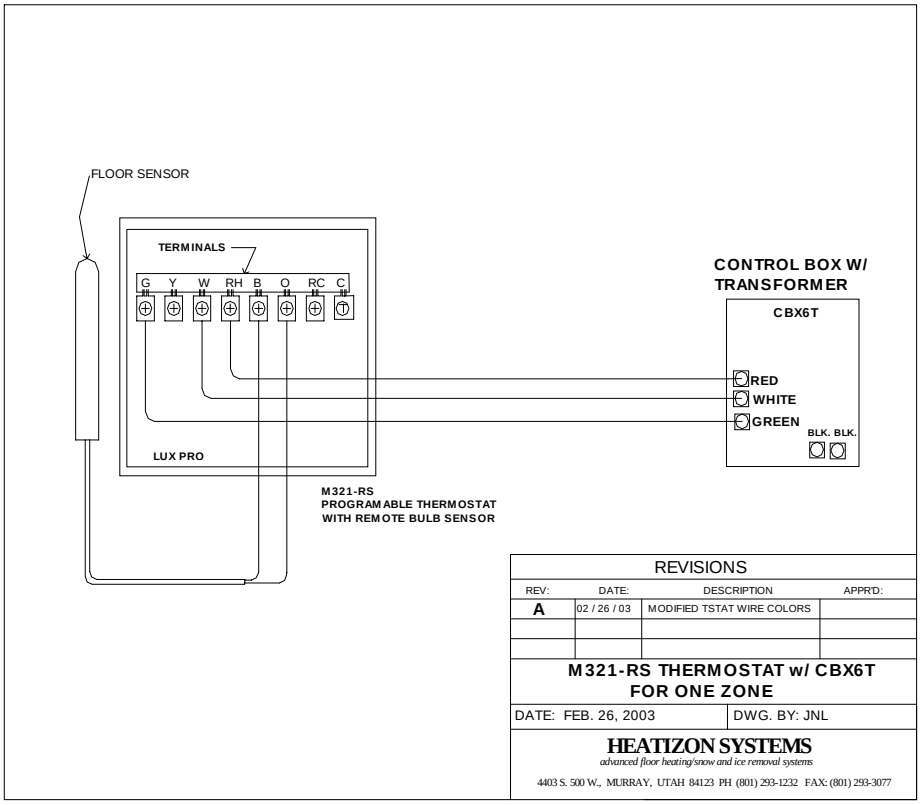
Phone (801) 293-1232
Fax (801) 293-3077
Toll Free (888) 239-1232

M321RS
Programmable Thermostat
With Remote Sensor



Features:
- LCD display
- Four programmable periods per day
- Separate programs for weekdays and weekends
- Battery powered
- Comes with remote bulb sensor and 10' of cable

Applications:
- Space Heating
- Floor Warming



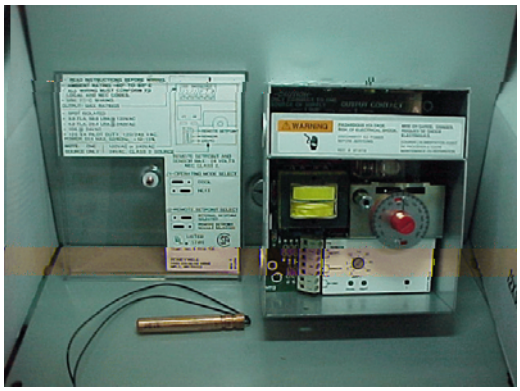
Heatizon Systems
4403 South 500 West
Murray, UT 84123
www.heatizon.com

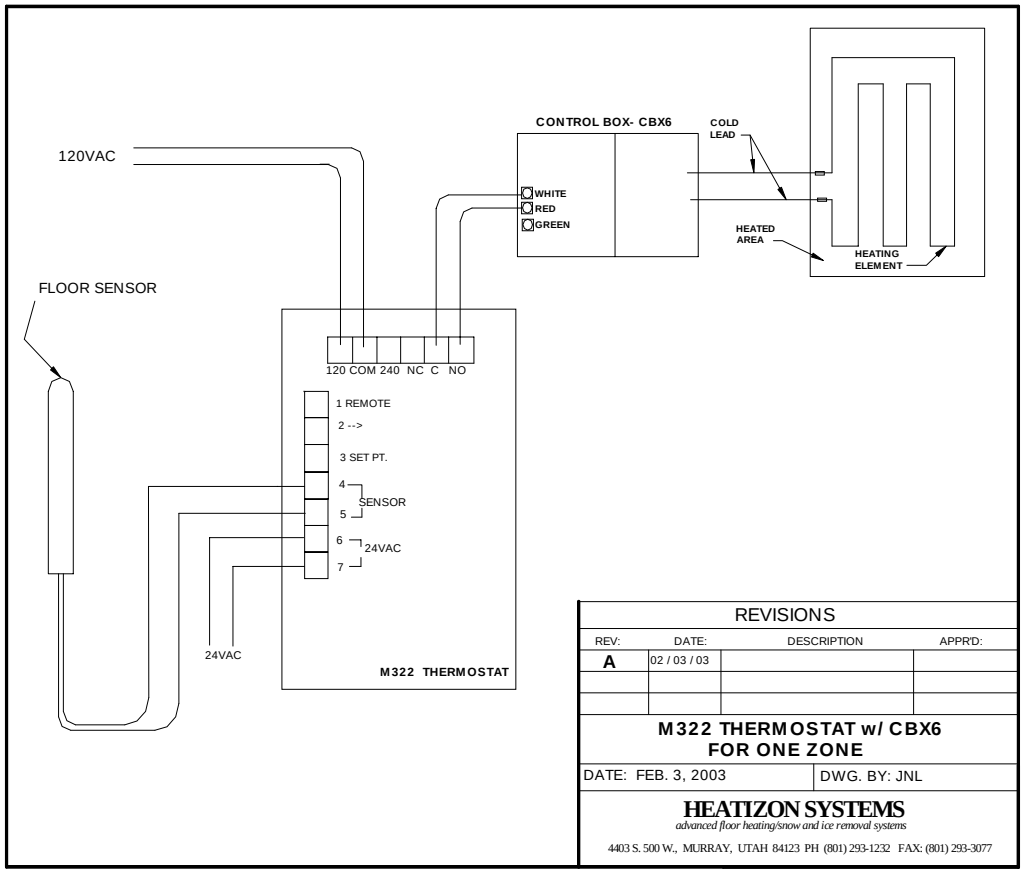
Phone (801) 293-1232
Fax (801) 293-3077
Toll Free (888) 239-1232

M322
Remote Temperature Controller

Features:
- Electronic floor temperature control
- Remote set-point capability
- Sensor lead lengths up to 1,000 feet
- Requires 120 VAC or 240 VAC to operate

Applications:
- Floor warming
- Snow melting
- Roof de-icing





REVISIONS			
REV:	DATE:	DESCRIPTION	APPR'D:
A	02 / 03 / 03		

M322 THERMOSTAT w/ CBX6 FOR ONE ZONE

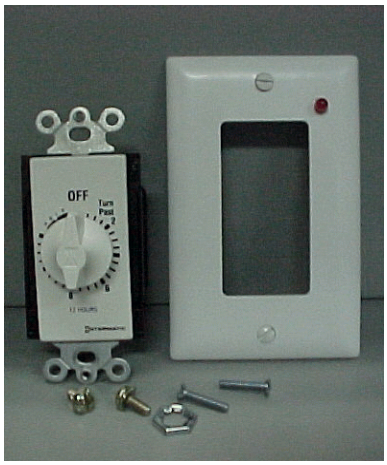
DATE: FEB. 3, 2003 | DWG. BY: JNL

HEATIZON SYSTEMS
advanced floor heating/snow and ice removal systems
4403 S. 500 W., MURRAY, UTAH 84123 PH (801) 293-1232 FAX: (801) 293-3077

Heatizon Systems
4403 South 500 West
Murray, UT 84123
www.heatizon.com

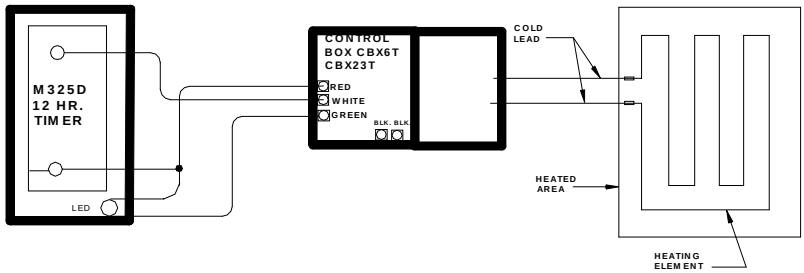
Phone (801) 293-1232
Fax (801) 293-3077
Toll Free (888) 239-1232

M325D
Timer - 12 Hour With LED



Features:
- Operation of system from 0 to 12 hours
- Has LED indicator light
- Has “Hold” position
- No power required

Applications:
- Snow melting
- Roof de-icing
- Floor warming



REVISIONS			
REV:	DATE:	DESCRIPTION	APPR'D:
A	02 / 13 / 03	GREEN WIRE NOTATION	

M325D TIMER w/CBX6/CBX23 - ONE ZONE

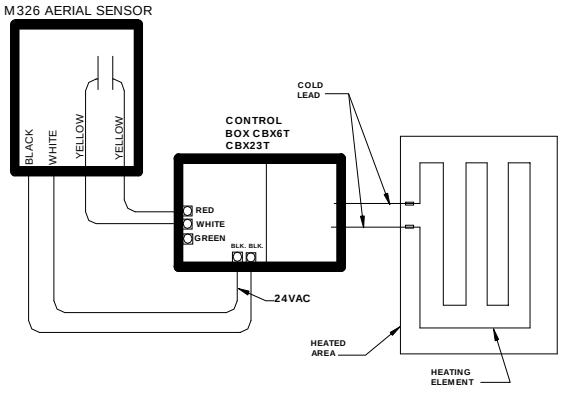
DATE: FEB. 3, 2003 | DWG. BY: JNL

HEATIZON SYSTEMS
advanced floor heating/snow and ice removal systems
4403 S. 500 W., MURRAY, UTAH 84123 PH (801) 293-1232 FAX: (801) 293-3077

Heatizon Systems
4403 South 500 West
Murray, UT 84123
www.heatizon.com

Phone (801) 293-1232
Fax (801) 293-3077
Toll Free (888) 239-1232

HEATIZON
SYSTEMS



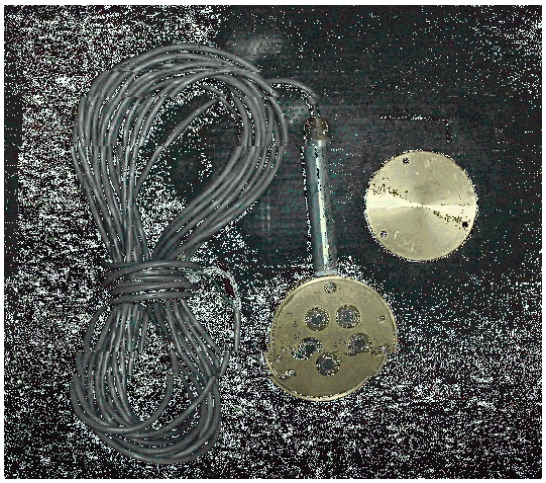
REVISIONS			
REV:	DATE:	DESCRIPTION	APPRD:
A	02 / 03 / 03	MODIFIED TSTAT WIRE COLORS	

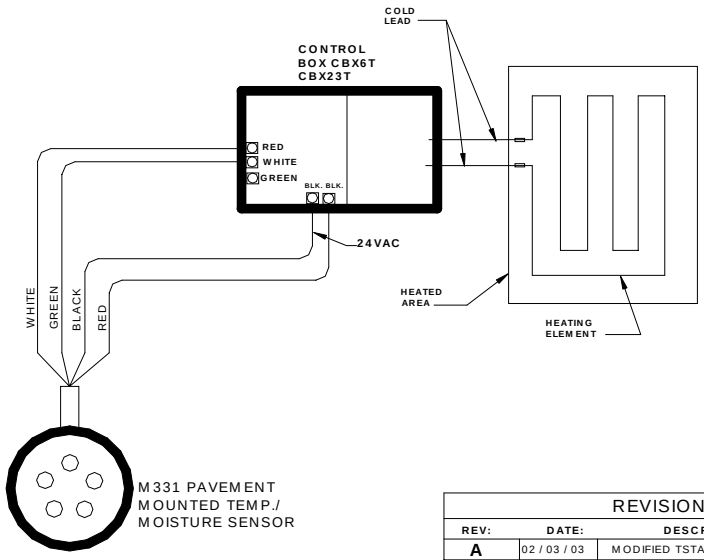
advanced floor heating/snow and ice removal systems
4403 S. 500 W., MURRAY, UTAH 84123 PH (801) 293-1232 FAX (801) 293-3077

HEATED AREA
HEATING ELEMENT
COLD LEAD
CONTROL BOX
RED
WHITE
BLUE

1232
077
-1232

HEATIZON
SYSTEMS





REVISIONS			
REV:	DATE:	DESCRIPTION	APPR'D:
A	02 / 03 / 03	MODIFIED TSTAT WIRE COLORS	

M331 PAVEMENT MOUNTED SNOW SENSOR w/CBX6T

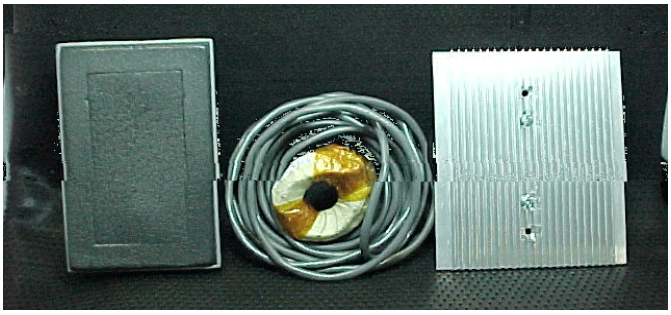
DATE: FEB. 7, 2003 | DWG. BY: JNL

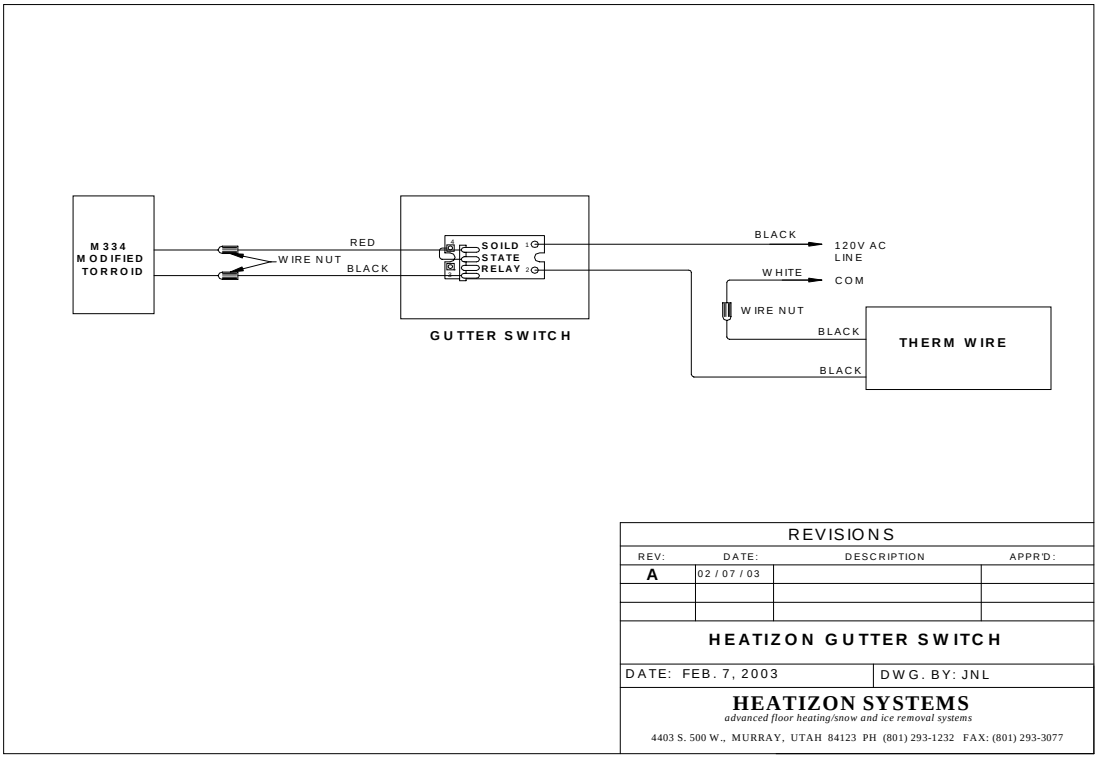
HEATIZON SYSTEMS
advanced floor heating/snow and ice removal systems
4403 S. 500 W., MURRAY, UTAH 84123 PH (801) 293-1232 FAX: (801) 293-3077

Heatizon Systems
4403 South 500 West
Murray, UT 84123
www.heatizon.com

Phone (801) 293-1232
Fax (801) 293-3077
Toll Free (888) 239-1232

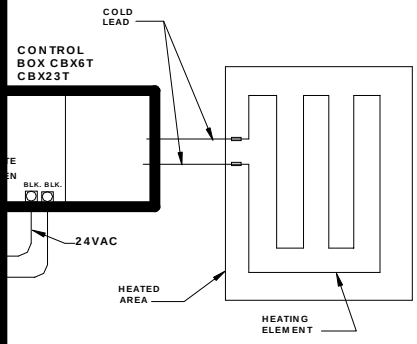
HEATIZON
SYSTEMS





Heatizon Systems
4403 South 500 West
Murray, UT 84123
www.heatizon.com

Phone (80



REVISIONS

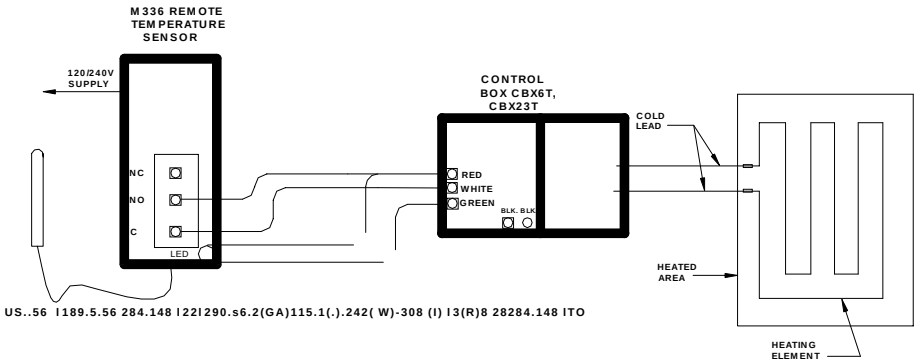
REV:	DATE:	DESCRIPTION	APPR'D:
A	02 / 03 / 03	MODIFIED TSTAT WIRE COLORS	

M335 GUTTER & AERIAL MOUNTED SNOW SENSOR w/CBX6T

DATE: FEB. 7, 2003 | DWG. BY: JNL

HEATIZON SYSTEMS
advanced floor heating/snow and ice removal systems
4403 S. 500 W., MURRAY, UTAH 84123 PH (801) 293-1232 FAX: (801) 293-3077

HEATIZON SYSTEMS



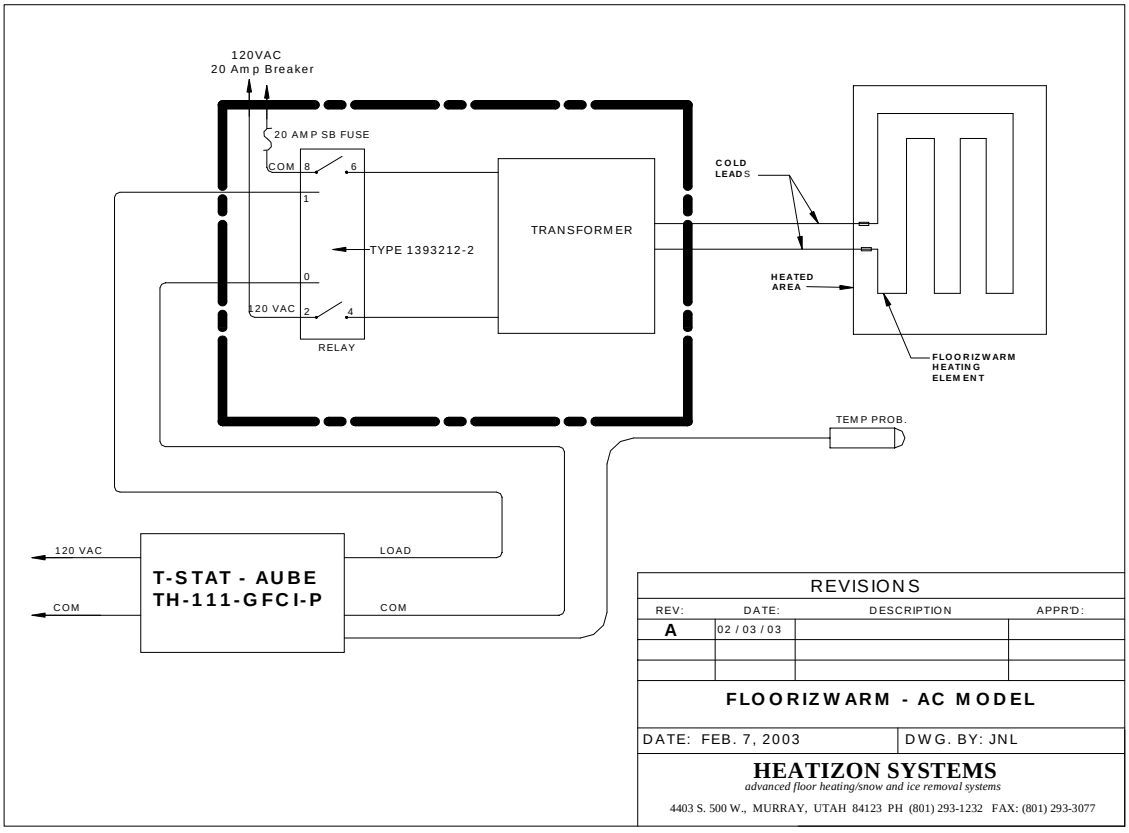
REVISIONS			
REV:	DATE:	DESCRIPTION	APPR'D:
A	02 / 13 / 03	GREEN WIRE NOTATION	

M336 REMOTE SENSOR w/CBX6/CBX23 - ONE ZONE

DATE: FEB. 3, 2003 | DWG. BY: JNL

HEATIZON SYSTEMS
advanced floor heating/snow and ice removal systems
4403 S. 500 W., MURRAY, UTAH 84123 PH (801) 293-1232 FAX: (801) 293-3077

HEATIZON
SYSTEMS



REVISIONS			
REV:	DATE:	DESCRIPTION	APPR'D:
A	02 / 03 / 03		

FLOORIZWARM - AC MODEL

DATE: FEB. 7, 2003 | DWG. BY: JNL

HEATIZON SYSTEMS
advanced floor heating/snow and ice removal systems
4403 S. 500 W., MURRAY, UTAH 84123 PH (801) 293-1232 FAX: (801) 293-3077

Heatizon Systems

Phone (8

Comforming
to UL Standard 1693

HEATIZON
SYSTEMS™

Phone: 801-293-1232
Fax: 801-293-3077
Toll Free: 888-239-1232

www.heatizon.com • 4403 South 500 West • Murray, Utah 84123

SYSTEM OPERATING TABLES
AND
USEFUL INFORMATION

The following tables list Transformer sizes and the amperage/wattage values that they will operate at using varying lengths of Tuff Cable or Z Mesh element. These tables may be used as a general guide in selecting the proper voltage tap for use with the specific length of heating element that your particular installation requires. It is important to note that the System Operating Tables DO NOT include any resistance for Cold leads. As a result, it is recommended by Heatizon Systems that the helpful formulas (on the "Useful Information" page) be used to more accurately estimate the total resistance you have, the Transformer tap you should use, and the amperage and watts you will experience.

NOTES:
YOUR HEATIZON SYSTEM MAY BE PRE-DESIGNED BY HEATIZON OR ONE OF ITS DEALERS TO MATCH YOUR HEATING REQUIREMENTS WITH THE PROPER LENGTH OF ELEMENT & TRANSFORMER SIZE / VOLTAGE. PROPER DESIGN OF THE SYSTEM BEFORE INSTALLATION WILL GREATLY REDUCE THE NEED FOR MODIFICATIONS OF SYSTEM COMPONENTS. CONTACT HEATIZON SYSTEMS OR ONE OF ITS DEALERS FOR ADDITIONAL INFORMATION.

THE LENGTH OF THE COLD LEAD MAY DECREASE THE LENGTH OF THE Z MESH OR TUFF CABLE THAT IS ACCEPTABLE TO USE.

THE LENGTH OF THE COLD LEAD HAS A MORE SIGNIFICANT IMPACT ON SMALLER SIZED TRANSFORMERS.

System Operating Tables
12" Z Mesh

Length of Element: 50 Feet or Less
(SCRKIT50)

Transformer Size	Tap Number	Tap Voltage	15 feet		20 feet		25 feet		30 feet		33 feet		36 feet		39 feet		42 feet		45 feet		48 feet	
			Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts
.25kVA	1	1.68	89	10	67	6																
.25kVA	2	2.51					80	8	66	6												
.50kVA	1	3.40							90	10	82	8	75	7	69	6	64	5	60	5		
.50kVA	2	4.10											90	10	83	9	77	7	72	7	68	6
.50kVA	3	5.00															94	11	88	10	83	9

Length of Element: 55 to 100 Feet
(SCRKIT75 or SCRKIT100)

Transformer Size	Tap Number	Tap Voltage	55 feet		60 feet		65 feet		70 feet		75 feet		80 feet		85 feet		90 feet		95 feet		100 feet	
			Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts
.50kVA	3	5.00	72	7	66	6	61	5														
1kVA	1	6.60	95	11	87	10	80	8	75	7	70	6	65	5	62	5						
1kVA	2	7.70					94	11	87	10	81	8	76	7	72	7	68	6	64	5	61	5
1kVA	3	8.80									93	11	87	10	82	8	77	8	73	7	70	6
1kVA	4	10.00													93	11	88	10	83	9	79	8
2kVA	1	11.90																			94	11

Note: Wattage values are given in watts per linear foot of element.
To calculate watts per square foot, multiply watts per linear foot by the following factors:
2" spacing x .857; 4" spacing x .750; 6" spacing x .666

Wattage on these System Operating Tables are calculated using 0 feet of Cold Lead.
Please use formulas in “useful Information” section to determine exact wattage.

System Operating Tables
12" Z Mesh

Length of Element: 110 to 200 Feet
(SCRKIT150 or SCRKIT200)

Transformer Size	Tap Number	Tap Voltage	110 feet		120 feet		130 feet		140 feet		150 feet		160 feet		170 feet		180 feet		190 feet		200 feet	
			Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts
1kVA	4	10.00	75	7	71	6	66	5														
2kVA	1	11.90	86	9	79	8	73	7	67	6	63	5										
2kVA	2	13.40			88	10	82	8	76	7	71	6	66	6	62	5						
2kVA	3	14.80					90	10	84	9	78	8	73	7	69	6	65	5	62	5		
2kVA	4	16.30							92	11	86	9	81	8	76	7	72	6	68	6	65	5
2kVA	5	17.80									94	11	88	10	83	9	78	8	74	7	71	6
2kVA	6	19.30											96	12	90	10	85	9	80	8	76	7
3kVA	1	21.40															94	11	89	10	85	9
3kVA	2	23.20																			92	11

Length of Element: 210 to 375 Feet
(SCRKIT250, SCRKIT300, SCRKIT350+)

Transformer Size	Tap Number	Tap Voltage	210 feet		225 feet		240 feet		255 feet		270 feet		285 feet		300 feet		330 feet		350 feet		375 feet	
			Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts
2kVA	5	17.80	65	5																		
2kVA	6	19.30	70	6	65	5																
3kVA	1	21.40	81	8	75	7	71	6	66	6	63	5										
3kVA	2	23.20	88	10	82	8	77	7	72	7	68	6	65	5	61	5						
3kVA	3	25.00	94	11	88	10	83	9	78	8	73	7	70	6	66	6	60	5				
3kVA	4	26.80			94	11	88	10	83	9	79	8	75	7	71	6	64	5	61	5		
3kVA	5	28.60					94	11	89	10	84	9	80	8	76	7	69	6	65	5	60	5
3kVA	6	30.30							94	11	89	10	84	9	80	8	73	7	69	6	64	5

Note: Wattage values are given in watts per linear foot of element.
To calculate watts per square foot, multiply watts per linear foot by the following factors:
2" spacing x .857; 4" spacing x .750; 6" spacing x .666

Wattage on these System Operating Tables are calculated using 0 feet of Cold Lead.
Please use formulas in “useful Information” section to determine exact wattage.

System Operating Tables
12" Z Mesh

Length of Element on Each Side of Double Sided Transformer: 120 to 250 Feet (SCRKIT150, SCRKIT200, SCRKIT250)

Transformer Size	Tap Number	Tap Voltage	120 feet		130 feet		140 feet		150 feet		160 feet		170 feet		180 feet		210 feet		230 feet		250 feet	
			Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts
2x2kVA	1	14.8			90	10	84	9	78	8	73	7	69	6	65	6						
2x2kVA	2	16.6					94	11	88	10	82	9	77	8	73	7	63	5				
2x2kVA	3	18.5									92	11	86	9	81	8	70	6	64	5		
2x2kVA	4	20.3											95	11	89	10	77	7	70	6	64	5

Length of Element on Each side of Double Sides Transformer: 190 to 400 Feet (SCRKIT200, SCRKIT250, SCRKIT300, SCRKIT350)

Transformer Size	Tap Number	Tap Voltage	190 feet		210 feet		220 feet		235 feet		250 feet		270 feet		295 feet		325 feet		360 feet		400 feet	
			Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts
2x3kVA	1	23.2	95	11	88	10	84	9	78	8	74	7	68	6	62	5						
2x3kVA	2	26.2					94	11	88	10	83	9	77	7	70	6	64	5				
2x3kVA	3	29.1									92	11	85	9	78	8	71	6	64	5		
2x3kVA	4	32.0											94	11	86	9	78	8	70	6	63	5

Note: Wattage values are given in watts per linear foot of element.
To calculate watts per square foot, multiply watts per linear foot by the following factors:
2" spacing x .857; 4" spacing x .750; 6" spacing x .666

Wattage on these System Operating Tables are calculated using 0 feet of Cold Lead.
Please use formulas in “useful Information” section to determine exact wattage.

System Operating Tables
9" Z Mesh

Length of Element: 15 to 60 feet
(SCRKIT50-9, SCRKIT100-9)

Transformer Size	Tap Number	Tap Voltage	15 feet		20 feet		25 feet		30 feet		35 feet		40 feet		45 feet		50 feet		55 feet		60 feet	
			Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts
.25kVA	1	1.68	82	9	61	5																
.25kVA	2	2.51			92	12	73	7	61	5												
.50kVA	1	3.40							83	9	71	7	62	5								
.50kVA	2	4.10									86	10	75	8	67	6	60	5				
.50kVA	3	5.00											91	11	81	9	73	7	66	6	61	5
1kVA	1	6.60																	88	11	80	9
1kVA	2	7.70																			94	12

Length of Element 65 to 100 feet
(SCRKIT100-9, SCRKIT250-9)

Transformer Size	Tap Number	Tap Voltage	65 feet		70 feet		75 feet		80 feet		85 feet		90 feet		95 feet		100 feet		105 feet		110 feet	
			Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts
1kVA	1	6.60	74	8	69	7	64	6	60	5												
1kVA	2	7.70	87	10	80	9	75	8	70	7	66	6	63	5	59	5						
1kVA	3	8.80			92	12	86	10	80	9	76	8	72	7	68	6	64	6	61	6	58	5
1kVA	4	10.00							91	11	86	10	81	9	77	8	73	7	70	7	66	6
2kVA	1	11.90													91	11	87	10	82	9	79	9
2kVA	2	13.40																			89	11

Note: Wattage Values are given in watts per linear foot of element.
To calculate watts per square foot, multiply watts per linear foot by the following factors:
2" spacing x 1.09; 4" spacing x .923; 6" spacing x .800

Wattage on these System Operating Tables are calculated using 0 feet of Cold Lead
Please use formulas in “Useful Information” section to determine exact wattage.

Note: Wattage Values are given in watts per linear foot of element.
To calculate watts per square foot, multiply watts per linear foot by the following factors:
2" spacing x 1.09; 4" spacing x .923; 6" spacing x .800

Wattage on these System Operating Tables are calculated using 0 feet of Cold Lead

System Operating Tables
9" Z Mesh

Length of Element on each side of Double Sided Transformer: 115 to 235 feet (SCRKIT250-9)

Transformer Size	Tap Number	Tap Voltage	113 feet		130 feet		140 feet		150 feet		160 feet		170 feet		180 feet		190 feet		210 feet		235 feet	
			Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts
2x2kVA	1	14.80	95	12	83	9	77	8	72	7	67	6	63	6	60	5						
2x2kVA	2	16.60			93	12	86	10	80	9	75	8	71	7	67	7	63	6	57	5		
2x2kVA	3	18.50							92	11	84	10	79	9	75	8	71	7	64	6	57	5
2x2kVA	4	20.30									92	12	87	10	82	9	78	8	70	7	63	5

Length of Element on each side of Double Sided Transformer: 177 to 380 feet (SCRKIT250-9)

Transformer Size	Tap Number	Tap Voltage	177 feet		195 feet		210 feet		225 feet		240 feet		255 feet		270 feet		290 feet		350 feet		380 feet	
			Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts
2x3kVA	1	23.20	95	12	86	10	80	9	75	8	70	7	66	6	62	5	58	5				
2x3kVA	2	26.20					91	11	85	10	79	9	75	8	71	7	66	6				
2x3kVA	3	29.10							94	12	88	11	83	9	78	8	73	7	60	5		
2x3kVA	4	32.00											91	11	86	10	80	9	66	6	61	5

Note: Wattage Values are given in watts per linear foot of element.
To calculate watts per square foot, multiply watts per linear foot by the following factors:
2" spacing x 1.09; 4" spacing x .923; 6" spacing x .800

Wattage on these System Operating Tables are calculated using 0 feet of Cold Lead
Please use formulas in “Useful Information” section to determine exact wattage.

System Operating Tables
Tuff Cable

Length of Element: 15 to 60 feet
(CABKIT100)

Transformer Size	Tap Number	Tap Voltage	15 feet		20 feet		25 feet		30 feet		35 feet		40 feet		45 feet		50 feet		55 feet		60 feet	
			Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts
.25kVA	1	1.68	95	11	71	6	57	4	47	3												
.25kVA	2	2.51					85	9	71	6	61	4	53	3	47	3	43	2				
.50kVA	1	3.40							96	11	82	8	72	6	64	5	58	4	52	3	48	3
.50kVA	2	4.10											87	9	77	7	69	6	63	5	58	4
.50kVA	3	5.00													94	10	85	8	77	7	71	6

Length of Element: 65 to 110 feet
(CABKIT100, CABKIT200)

Transformer Size	Tap Number	Tap Voltage	65 feet		70 feet		75 feet		80 feet		85 feet		90 feet		95 feet		100 feet		105 feet		110 feet	
			Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts
.50kVA	3	5.00	65	5																		
1kVA	1	6.60	86	9	80	8	75	7	70	6	66	5	62	5	59	4	56	4	53	3		
1kVA	2	7.70			93	10	87	9	82	8	77	7	73	6	69	6	65	5	62	5	59	5
1kVA	3	8.80							93	10	88	9	83	8	79	7	75	7	71	6	68	5
1kVA	4	10.00											94	10	89	9	85	8	81	8	77	7
2kVA	1	11.90																			92	10

Note: Wattage values are given in watts per linear foot of element.
To calculate watts per square foot, multiply watts per linear foot by the following factors:
2" spacing x 6; 4" spacing x 3; 6" spacing x 2;

Wattage on these System Operating Tables are calculated using 0 feet of Cold Lead.
Please use formulas in “Useful Information” section to determine exact wattage.

System Operating Tables
Tuff Cable

Length of Element: 120 to 210 feet
(CABKIT200, CABKIT300)

Transformer	Tap Number	Tap Voltage	120 feet		130 feet		140 feet		150 feet		160 feet		170 feet		180 feet		190 feet		200 feet		210 feet	
			Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts
2kVA	1	11.90	84	8	78	7	72	6	67	5	63	5	59	4	56	4	53	3	50	3	48	3
2kVA	2	13.40	95	11	87	9	81	8	76	7	71	6	67	5	63	5	60	4	57	4	54	3
2kVA	3	14.80			96	11	90	9	84	8	78	7	74	6	70	6	66	5	63	5	60	4
2kVA	4	16.30							92	10	86	9	81	8	77	7	73	6	69	6	66	5
2kVA	5	17.80									94	10	89	9	84	8	79	7	75	7	72	6
2kVA	6	19.30											96	11	91	10	86	9	82	8	78	7
3kVA	1	21.40															95	11	91	10	86	9
3kVA	2	23.20																			94	10

Length of Element: 225 to 365 feet
(CABKIT300, CABKIT400)

Transformer	Tap Number	Tap Voltage	225 feet		240 feet		255 feet		270 feet		285 feet		300 feet		320 feet		335 feet		350 feet		365 feet	
			Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts
3kVA	1	21.40	81	8	76	7	71	6	67	5	64	5	60	4	57	4	54	3	52	3		
3kVA	2	23.20	87	9	82	8	77	7	73	6	69	6	66	5	61	4	59	4	56	4	54	3
3kVA	3	25.00	94	10	88	9	83	8	78	7	74	7	71	6	66	5	63	5	61	4	58	4
3kVA	4	26.80			95	11	89	9	84	8	80	8	76	7	71	6	68	5	65	5	62	5
3kVA	5	28.60					95	11	90	10	85	9	81	8	76	7	72	6	69	6	66	5
3kVA	6	30.30							95	11	90	10	86	9	80	8	77	7	73	6	70	6
4kVA	1	32.80											93	10	87	9	83	8	79	7	76	7
4kVA	2	35.00													93	10	89	9	85	8	81	8
4kVA	3	37.20															94	10	90	10	86	9
4kVA	4	39.40																	95	11	91	10

Note: Wattage values are given in watts per linear foot of element.
To calculate watts per square foot, multiply watts per linear foot by the following factors:
2" spacing x 6; 4" spacing x 3; 6" spacing x 2;

Wattage on these System Operating Tables are calculated using 0 feet of Cold Lead.
Please use formulas in “Useful Information” section to determine exact wattage.

System Operating Tables
Tuff Cable

Length of Element:850 to 1300 feet

Transformer	Tap Number	Tap Voltage	850 feet		900 feet		950 feet		1000 feet		1050 feet		1100 feet		1150 feet		1200 feet		1250 feet		1300 feet	
			Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts
6kVA	1	52.60	52	3	50	3	47	3														
6kVA	2	55.80	56	4	53	3	50	3	47	3												
6kVA	3	59.10	59	4	56	4	53	3	50	3	48	3										
6kVA	4	62.30	62	5	59	4	56	4	53	3	50	3	48	3								
6kVA	5	65.50	65	5	62	4	58	4	56	4	53	3	50	3	48	3	46	3				

Length of Element on each side of Double Sided Transformer: 130 to 350 feet (CABKIT 200, CABKIT 300, CABKIT400)

Transformer Size	Tap Number	Tap Voltage	132 feet		140 feet		150 feet		165 feet		180 feet		200 feet		225 f3et		250 feet		300 feet		350 feet	
			Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts
2x2kVA	1	14.80	95	11	90	9	84	8	76	7	70	6	63	5	56	4	50	3				
2x2kVA	2	16.60					94	10	85	9	78	7	70	6	63	5	56	4	47	3		
2x2kVA	3	18.50							95	11	87	9	87	7	70	6	63	5	52	3		
2x2kVA	4	20.30									98	11	88	9	78	7	61	5	59	4	51	3

Length of Element on each side of Double Sided Transformer: 200 to 550 feet CABKIT 200, CABKIT 300, CABKIT400, CABKIT500, CABKIT600)

Transformer Size	Tap Number	Tap Voltage	206		225		250		275		300		350		400		450		500		550	
			Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts
2x3kVA	1	23.20	95	11	87	9	79	7	71	6	66	5	56	4	49	3						
2x3kVA	2	26.20			95	11	89	9	81	8	74	7	63	5	56	4	49	3				
2x3kVA	3	29.10					95	11	90	9	82	8	70	6	62	5	55	4	49	3		
2x3kVA	4	32.00							95	11	90	10	77	7	68	5	60	4	54	4		

Note: Wattage values are given in watts per linear foot of element.
To calculate watts per square foot, multiply watts per linear foot by the following factors:
2" spacing x 6; 4" spacing x 3; 6" spacing x 2;

Wattage on these System Operating Tables are calculated using 0 feet of Cold Lead.
Please use formulas in “Useful Information” section to determine exact wattage.

USEFUL INFORMATION

Resistance of Heating Element

9" Z Mesh Resistance = 0.001367 ohms / l.f.
12" Z Mesh Resistance = 0.001262 ohms / l.f.
Tuff Cable Resistance = 0.00118 ohms/ l.f.
Cold Lead Resistance = 0.000129 ohms / l.f.

Helpful Formulas

V = Volts C = Cold Lead, Total Feet
I = Amps Z = Z Mesh Element, Total Feet
R = Resistance T = Tuff Cable Element, Total Feet

RZ = Resistance of Z Mesh
RZ = Total Resistance - (C x 0.000129)

RT = Resistance of Tuff Cable
RT = Total Resistance - (C x 0.000129)

V = I x R: Volts (V) = Amps (I) x Resistance (R)
W = V x I: Watts (W) = Volts(V) x Amps (I)
I = V ÷ R: Amps (I) = Volts(V) ÷ Resistance (R)
R = V ÷ I: Resistance (R) = Volts(V) ÷ Amps (I)

Determining Length of 12" Z Mesh Used:

(When Volts and Amps are known)

Total Resistance (R) = Volts (V) ÷ Amps (I)
RZ = R - (C x 0.000129)
Z = RZ ÷ 0.001262

Example: 3kVA Transformer on Tap #6
V = 30.3
I = 94
C = 50 feet
R = 30.3 ÷ 94
RZ = 0.32234 - (50 x 0.000129)
Z = 0.31589 ÷ 0.001262 = 250 l.f. 12" Z Mesh

Determining Operating Amperage of Z Mesh or Tuff Cable Heating Element:

(When Volts and lineal footage of Heating Element are known)

Amps (I) = Volts (V) ÷ Resistance (R)
R = Z or T x R per linear foot of Z Mesh or Tuff Cable element

Example: 3kVA Transformer on Tap #6, 12" Z Mesh
V = 30.3
Z = 250 l.f. of 12" Z Mesh
C = 50 feet
I = 30.3 ÷ (250 x 0.001262 + 50 x 0.000129)
I = 94

Determining Operating Costs

Watts = Volts (V) x Amps (I)
Kilowatts/hour (KWH) = W ÷ 1000
Operating Cost/hour = KWH x Cost per KWH

Example: 3kVA Transformer on tap #6

V = 30.3
I = 94
Cost Per Kilowatt Hour = $0.06

W = 30.3 x 94
KWH = 2848 ÷ 1000
Operating Cost/hour = 2.85 x $0.06 =
$0.17 per continuous hour of operation

Determining Length of Tuff Cable Used:

(When Volts and Amps are known)

RT = R - (C x 0.000129)
T = RT ÷ 0.00118

Example: 6kVA Transformer on Tap #3
V = 59.1
I = 90
C = 50 feet
R = 59.1 ÷ 90
RT = 0.656666 - (50 x 0.000129) = 0.65021
T = 0.65021 ÷ 0.00118 = 551 l.f. Tuff Cable

Determining Watts Per Square Foot

(When Volts and Amps are known)

W = V x I
Watts/ft^2 **=** Watts ÷ Square feet

Example: 6kVA Transformer on Tap #3
V = 59.1
I = 90
$Feet^2$ = 278
W = 59.1 x 90
Watts/ft^2 **=** 5319 ÷ 278
Watts per Square Foot = 19.13

Conversions

BTU's = Watts x 3.412
Calorie/hour = BTU/hour x 252
Degree F = Degree C x 1.8 + 32
Degree C = (Degree F - 32) x 0.556
Meters = Feet x 3.281
Feet = Meters x 0.3048

Note: Volts and amps readings should be taken on secondary taps on the transformer.

Comforming
to UL Standard 1693

HEATIZON
SYSTEMS™

Phone: 801-293-1232
Fax: 801-293-3077
Toll Free: 888-239-1232

www.heatizon.com • 4403 South 500 West • Murray, Utah 84123

A Few Concrete Suggestions

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' high quality 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.

Jumpers: It does not matter what kind of joint is in the asphalt or concrete, Tuff Cable should never be allowed to run through it. Always use a Heatizon Systems jumper under any and all joints. Remember, if it is a joint of any kind it must be jumpered under with a jumper kit.

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.

COMPARATIVE R-VALUES OF FLOORING AND SUBFLOORS

Material	Typical R-Value	R-Value Per Inch	Typical Thickness
Plywood	0.825	1.10	0.750
OSB	1.050	1.40	0.750
Softwood	0.825	1.10	0.750
Sheet Vinyl	0.200	1.60	0.125
Vinyl Composition Tile (VCT)	0.200	1.60	0.125
Linoleum	0.400	1.60	0.250
Linoleum	0.200	1.60	0.125
Dense Rubber Flooring	0.250	1.30	0.325
Recycled Rubber Flooring	1.100	2.20	0.500
Cork	1.125	3.00	0.375
Cork/MDF/Laminate	1.175	2.35	0.500
Brick	3.375	2.25	1.500
Marble	0.400	0.80	0.500
Ceramic Tile	0.250	1.00	0.250
Thinset Mortar	0.050	0.40	0.125
MDF/Plastic Laminate	0.500	1.00	0.500
Laminate Floor Pad	0.300	1.92	0.160
Engineered Wood	0.250	1.00	0.250
Engineered Wood	0.375	1.00	0.375
Engineered Wood	0.625	1.00	0.625
Engineered Wood	0.750	1.00	0.750
Engineered Wood Flooring Pad	0.200	1.60	0.125
Engineered Bamboo	0.720	0.96	0.750
Oak	0.638	0.85	0.750
Ash	0.750	1.00	0.750
Maple	0.750	1.00	0.750
Pine	0.975	1.30	0.750
Fir	0.900	1.20	0.750
Carpet Pad/ Slab Rubber 33 lb.	0.320	1.28	0.250
Carpet Pad/ Slab Rubber 33 lb.	0.480	1.28	0.375
Carpet Pad/ Slab Rubber 33 lb.	0.640	1.28	0.500
Carpet Pad/ Waffle Rubber 25 lb.	0.620	2.48	0.250
Carpet Pad/ Waffle Rubber 25 lb.	1.240	2.48	0.500
Hair Jute	1.940	3.88	0.500
Hair Jute	1.250	3.88	0.325
Prime Urethane	1.400	4.30	0.325
Prime Urethane	2.150	4.30	0.500
Bonded Urethane	1.350	4.20	0.325
Bonded Urethane	2.100	4.20	0.500
Carpet	0.700	2.80	0.250
Carpet	1.050	2.80	0.375
Carpet	1.400	2.80	0.500
Carpet	1.750	2.80	0.625
Carpet	2.100	2.80	0.750
Wool Carpet	15.75	4.20	0.375
Wool Carpet	2.100	4.20	0.500

R-Values are approximate. Check with manufacturer for individual products.
Excerpted from Radiant Panel Association *Radiant Flooring Guide.*

TROUBLE-SHOOTING PROCEDURES

WARNING: HIGH VOLTAGE PRESENT! TROUBLE- SHOOTING PROCEDURES AND MEASUREMENTS MUST BE PERFORMED WITH THE SYSTEM ENERGIZED AND THE COVERS REMOVED. ALWAYS MAKE CERTAIN THAT THE PERSON PERFORMING THESE PROCEDURES IS FAMILIAR WITH SAFE PRACTICES REQUIRED FOR WORKING WITH HIGH VOLTAGE EQUIPMENT. A QUALIFIED TECHNICIAN OR ELECTRICIAN SHOULD PERFORM THE FOLLOWING PROCEDURES!

NOTE: Always turn power off prior to removing or reinstalling covers.

NOTE: Never install or reinstall the Control Board with the primary power in the “ON” position.

NOTE: Prior to trouble-shooting the system, check for obvious problems such as loose connections, cut or broken wires, etc.. Check the jumpers on the printed circuit board for proper settings (see Step 3, and Illustrations 3.11, 3.12, and 3.13 in this Installation Manual).

STATUS INDICATOR

The CBX series Control Boxes are equipped with a status indicator LED on both the activation device and the controller itself. This indicator monitors whether the unit is heating or not heating and gives other vital diagnostic information.

Indication	**Status**
-On -Solid	System heating - normal heating mode
-Off	System not heating - no call for heat
-Slow Blink	Under/Over Current
-2 Blinks - Pause	Transformer over temperature
-3 Blinks - Pause	Arcing or Shorting of heating Element
-Rapid Blink	SCR Failure--Actions required when a diagnostic signal is given by the status indicator are listed in the troubleshooting section below.

TROUBLESHOOTING PROCEDURES

The following procedures cover most problems that can be encountered when installing or servicing Heatizon Systems products with CBX6 and CBX23 Series Control Boxes. If your Heatizon Systems product cannot be repaired using the following procedures, contact Heatizon Systems for further assistance.

A. **System shuts off every 30 minutes for one minute.**

1. It is normal for the Control Box to shut the system off every 30 minutes to perform a diagnostic test of the system's safety features.

B. **No power to control unit** (no LED indication on control board)

1. Test for input power.

2. Check panel circuit breaker, reset or turn on as necessary.

3. Check controller circuit breaker, reset or turn on as necessary.

4. If power is measured at the input but the Control Board indicates no power is present, the problem could be within the Control Box itself. Contact Heatizon for technical assistance.

C. **"Hard starting" or breaker trips when thermostat is activated**. Under normal conditions the controller incrementally powers up the transformer during the first one second of operation. Failure of the controller to do this properly will result in a "hard start", (hard starting is characterized by a noticeable "bang" or shaking in the transformer and/or conduits upon start-up).

1. Check for proper wiring of the transformer primary for the supply voltage you are using. Improper wiring of the primary will possibly trip circuit breaker. Improper primary wiring can also damage the transformer if allowed to run for any length of time.

2. Check for continuity of the heating element. Heating element may be damaged, broken or shorted out to something metal or electrically conductive.

D. **Power to Control Unit, but system will not activate**

1. LED indicators #D24 and #D25 on the Control Board should be lit when system is energized (but not activated). Check voltage select jumpers on control board, (JP12 - JP13 - JP14). Jumper settings must be set for the supply voltage. Control Board will not operate properly if voltage is set incorrectly and **will be damaged if set for a value lower than the supply voltage.**

2. Test the Control Box by jumpering Red and White terminals for the activation device, Control Box should start. If system starts, fault is in the activation device or Thermostat Wire.

3. Check the installation and wiring of the Activation Device. To test Activation Device, connect an ohm meter to the Thermostat Wire terminals (the "R" & "W" terminals) of the Control Box. The ohm meter should read continuity when the device is adjusted to call for heat, and should read open when the device is set for no heat. Repair or replace Activation Device or Thermostat Wire as necessary.

4. Check to see if LED #D23 ("Overtemp") is illuminated. Check connection and placement of thermistor on the Control Board. If thermistor is missing or not installed properly, system will not operate.

E. **System starts when power is turned on, but will not turn off via activation device.**

1. Remove red or white wire from control box at activation terminals. If control unit shuts off, test activation device as described above.

F. **System starts, but won't stay running; LED's #D24 through #D27 won't change status when potentiometer is adjusted.**

1. Check that the torroid is properly installed over one of the Cold Leads and plugged into the proper connector in the Control Box

2. Attach clamp-on amp meter around a Cold Lead and activate the system. Check for the presence of current in the secondary circuit during the 5-second period prior to system shut down (current should be 40 to 100 amps). If there is no current present in the secondary, check the Transformer for voltage on the taps you are connected to 1.6 to 66 VAC depending on Transformer size). The presence of voltage on the Transformer taps but no current on the Cold Leads indicates no continuity in the heating element or Cold Lead. To check for continuity in the heating element and Cold Lead, remove one of the Cold Leads from the Transformer and place an ohm meter across the Cold Leads. Normal resistance should be less than 1 ohm.

3. If there is current present and the unit will not adjust, check for a feedback voltage using a voltage meter connected to TP3 and TP4 while system is running. Normal volts should be approximately 3 to 4 volts. If none is detected, replace the torroid.

4. CBX23 and CBX23T Control Boxes are a special case. If a CBX23 Control unit will not adjust, the problem could be the result of improperly installed dual torroids. To solve this, check the feedback voltage at test points TP3 and TP4. If there is current and the voltage at TP3 and TP4 is zero, turn power off, remove one of the two torroids from its cold lead, reverse direction and reinstall torroid back on the cold lead.

G. **System starts, but will not stay running. LED # D21 (undercurrent) or #D22 (overcurrent) turns on and status LED blinks slowly.**

1. Verify secondary voltage and amperage is the same as those taken when heating element was originally installed. If they are the same, return the Control Box to Heatizon Systems. If they are different, then call Heatizon Systems Technical Support Department at (801) 293-1232.

2. Open heating element. Test for continuity as described in previous section.

WARNING. An out of adjustment potentiometer may be caused by shorted or damaged heating element or Cold Lead which may result in a danger of fire and risk to property or life. Shorted or damaged heating element or Cold Lead must be repaired prior to energizing the Control Box and/or any adjustment to the potentiometer.

H. **System starts and runs, but Transformer is operating at greater than 200°F.**

1. Check thermistor for proper location and connection.

I. **System may start and run, but shuts down after a period of time. LED # 23 (overtemp) lights and status indicator flashes a pattern of two blinks and a pause. This is transformer overtemp fault.**

1. Check to see if the Transformer is operating at a temperature less than 200°F. If it is operating at less than 200°F, then:

2. Check Cold Lead operating amperage. If higher than original Amperage measured when the Control Box was originally installed, see Trouble Shooting Guide, Section F.

3. Check for restricted air flow to the transformer. Correct as necessary.

4. Check for air temperature where the Control Box is mounted. Make certain it is 72°F or less. Correct as necessary.

5. Check that thermistor is properly installed on the controller, (if thermistor is missing or not installed properly system will not operate).

J. **System may or may not start, but shuts down and status LED blinks three times then pauses, LED #D21 & D22 will light. This is an arcing or shorting fault**.

1. Turn primary power off. Check for loose connections at the transformer. Correct as necessary.

2. Check for loose connections at the Control Box, (power input and transformer primary). Correct as necessary.

3. If Control Box connections are found to be good, the problem could be in the cold leads or heating element, or the connections between them at the transition plate or butt splice. Check for poor solder or crimp connections. Repair as necessary.

4. Check for anything that could be shorting between adjacent runs of heating element or cold leads, such as nails that pass through the heating element into air ducts below the floor, metal carpet strips or thresholds, a frayed wire from the screen element, a foil candy wrapper, etc. Correct as necessary.

5. An erratic power source may also cause an erroneous arcing detection in the system. Check for defective panel circuit breakers or loose connections at these breakers. Correct as necessary. If primary power to the breaker panel is the source of the problem, contact your electrician or your power company for technical assistance.

K. **System shuts down immediately upon call for heat, status LED flashes rapidly. This indicates SCR has failed.**

1. Turn the power to the Control Box OFF. Contact Heatizon Systems.

L. **System will stay in adjustment. After running a given period of time, an overcurrent or undercurrent fault occurs.**

1. Check jumpers on control board for proper over/under current tolerance settings. If the system is using Tuff Cable heating element set for 5% tolerance, set it for 15% tolerance (JP5, JP7, JP9 and JP11). If the system is using Z Mesh screen element and is set for 15% tolerance, set it for 5% tolerance (JP4, JP6, JP8, and JP10). These adjustments are made on the Control Board.

2. Check for poor connections, burnt or damaged heating element. Correct as necessary.

M. Television Screen or Computer Monitor interference occurs only when Heatizon System is on.

1. Change the distance from the Heatizon heating element and the television or computer monitor, and/or change the location of the television or computer monitor in the room.

2. Turn the Heatizon system thermostat to the off position when watching the affected television or when using the affected computer monitor.

3. Contact your Heatizon Systems Dealer and discuss whether the purchase of one of Heatizon systems DC products may solve your problem.

4. Replace the affected television or computer monitor with one that utilizes Plasma Display Panel or Liquid Crystal Display technology.

Note: Prior to returning anything to Heatizon Systems, 4403 South 500 West, Murray, UT 84123, call (801) 293-1232 for a Return Materials Authorization form.

Heatizon Systems After Installation Element Test

WARNING: Danger of Fire. This test will not detect cuts in Z Mesh, Tuff Cable, or Floorizwarm Heating Element.

Attached please find three forms titled "Heatizon Systems After Installation Element Test." Heatizon Systems recommends that the measurements be taken and the attached forms be completed on all zones on three different occasions. The First Element Test should be conducted immediately after the Cold Lead and Z Mesh, Tuff Cable, or Floorizwarm Heating Element has been installed and before it has been covered up with floor covering, roofing material, concrete, etc. The Second Element Test is to be conducted following the covering of the heating element and immediately prior to installing the Control Box. The third Element Test should be conducted immediately following the energizing of the system. All of these tests may be conducted by using either the Control Box and Transformer provided as part of your Heatizon Systems Product, or by using Heatizon Systems Element Tester (Part Number NI113). It is important that the same source be used to energize the Z Mesh, Tuff Cable and Floorizwarm Heating Element for all tests taken.

It is Heatizon Systems recommendation that each test be completed by the party responsible for the installation and witnessed by a representative of the party which contracted for the installation. It is essential that all of the blanks on each "After Installation Element Test" form be completely filled out and that the form be signed by both the party completing the test and the party witnessing the test.

Conducting these tests will help insure that a third party or an unknown event has not adversely impacted the heating element. In addition the results of these tests may help you in any troubleshooting that must be performed on the system(s).

Warning: In the event any of the measurements taken during the three After Installation Element Tests are different, a problem may exist. Do not energize your Heatizon Systems product, and call Heatizon systems Technical Support at (801) 293-1232 to discuss the options available.

Element Tester Instructions

Part Number NI113

1. Connect one of the welding cable leads from the Element Tester to one of the Cold Leads near the point where the Cold Leads will eventually connect to the transformer.
(Note: Cold leads are the Number 2 wires extending from the heating element to the transformer).

2. Connect the other welding cable lead from the Element Tester to the other Cold Lead near the point where the Cold Leads will eventually connect to the transformer.

3. Plug the Element Tester power cord into a 120 VAC power source.

4. Turn the Tester to the "on" position.

5. Using an Amp meter, read the amperage (Amps) and Voltage (Volts) and record them on the form titled "Heatizon Systems After Installation Element Test." The voltage is to be read at the connection of one of the Cold Leads and the welding cable lead from the Element Tester. Amperage can be read anywhere along either Cold Lead.

5. Continue taking the amperage and voltage readings every five (5) minutes or until the readings remain the same. (Note: At the point where the readings remain the same, the temperature of the element should be stabilized.)

6. Read and record the temperature of the area where the heating element is located.

7. Using the numbers recorded on the form titled Heatizon Systems after Installation Element Test and the form titled Calculation of Element Length, the length of the heating element can be calculated or verified.

Note: When using the Control Box and Transformer provided as part of your Heatizon product to conduct the "Heatizon Systems After Installation Element Tests," the entire product must be installed per this manual. Once installation is complete, conduct three Element Tests by following steps 4 through 7 above.

Heatizon Systems After Installation Element Test #1

Date: _____

Time Test Began: _____AM/PM

Time Test Ended: _____AM/PM

Zone Number:_____ Direction:_____ Area Covered: _____

Primary Input Power _____Amps _____ Volts

Length of Element: _____ Feet

Type of Element: 12" Screen 9"Screen Tuff Cable Floorizwarm

Total Length of Cold Leads Including Jumpers: _____ Feet

Surface Temperature of Heatizon Heated/Snowmelt Area at the Beginning of Test: _____E F

At Beginning of Test: Amps _____ Volts _____

After 5 Minutes: Amps _____ Volts _____

After 10 Minutes: Amps _____ Volts _____

After 15 Minutes: Amps _____ Volts _____

After 20 Minutes: Amps _____ Volts _____

Surface Temperature of Heatizon Heated/Snowmelt Area at the End of Test: _____ EF

Communication tested with: drip edge valley metal other metal

Other metal described: _____

Test Completed by: _____ Daytime Phone # _____
(Please Print)

_____
(Signature)

Test Witnessed by: _____, on this ____ Day of _____, 200__
(Please Print)

_____
(Signature)

Heatizon Systems After Installation Element Test #2

Date: _____

Time Test Began: _____AM/PM

Time Test Ended: _____AM/PM

Zone Number:_____ Direction:_____ Area Covered: _____

Primary Input Power _____Amps _____ Volts

Length of Element: _____ Feet

Type of Element: 12" Screen 9"Screen Tuff Cable Floorizwarm

Total Length of Cold Leads Including Jumpers: _____ Feet

Surface Temperature of Heatizon Heated/Snowmelt Area at the Beginning of Test: _____E F

At Beginning of Test: Amps _____ Volts _____

After 5 Minutes: Amps _____ Volts _____

After 10 Minutes: Amps _____ Volts _____

After 15 Minutes: Amps _____ Volts _____

After 20 Minutes: Amps _____ Volts _____

Surface Temperature of Heatizon Heated/Snowmelt Area at the End of Test: _____ EF

Communication tested with: drip edge valley metal other metal

Other metal described: _____

Test Completed by: _____ Daytime Phone # _____
(Please Print)

_____
(Signature)

Test Witnessed by: _____, on this ____ Day of _____, 200__
(Please Print)

_____
(Signature)

Heatizon Systems After Installation Element Test #3

Date: _____

Time Test Began: _____AM/PM

Time Test Ended: _____AM/PM

Zone Number:_____ Direction:_____ Area Covered: _____

Primary Input Power _____Amps _____ Volts

Length of Element: _____ Feet

Type of Element: 12" Screen 9"Screen Tuff Cable Floorizwarm

Total Length of Cold Leads Including Jumpers: _____ Feet

Surface Temperature of Heatizon Heated/Snowmelt Area at the Beginning of Test: _____E F

At Beginning of Test: Amps _____ Volts _____

After 5 Minutes: Amps _____ Volts _____

After 10 Minutes: Amps _____ Volts _____

After 15 Minutes: Amps _____ Volts _____

After 20 Minutes: Amps _____ Volts _____

Surface Temperature of Heatizon Heated/Snowmelt Area at the End of Test: _____ EF

Communication tested with: drip edge valley metal other metal

Other metal described: _____

Test Completed by: _____ Daytime Phone # _____
(Please Print)

_____
(Signature)

Test Witnessed by: _____, on this ____ Day of _____, 200__
(Please Print)

_____
(Signature)

Dear Installer:

Heatizon Systems welcomes and appreciates any and all comments and suggestions that you may have regarding our products, installation instructions and techniques, and applications. Please take a few minutes to share your comments and suggestions with us.

Thank you in advance for the time you will spend in helping us improve our products in the future.

Warm Regards,

Heatizon Systems
4403 South 500 West
Murray, UT 84123
Phone: (801) 293-1232
Fax: (801) 293-3077
Email: sales@heatizon.com

In the event additional space is needed, please use any lined paper.

Name: _____

Address: _____

City: _____ State: _____ Zip Code: _____

Telephone: _____ Fax: _____

Email Address: _____

Project Name and Location: _____