

SECTION 23 8326

RADIANT UNDERFLOOR HEATING SYSTEMS

This section includes editing notes to assist the user in editing the section to suit project requirements. These notes are included as hidden text, and can be revealed or hidden by one of the following methods:

Microsoft Word 2007: Click the OFFICE button, select WORD OPTIONS, select DISPLAY, then select or deselect the HIDDEN TEXT option.

Microsoft Word (earlier versions): From the pull-down menus select TOOLS, then OPTIONS. Under the tab labeled VIEW, select or deselect the HIDDEN TEXT option.

Corel WordPerfect: From the pull-down menus select VIEW, then select or deselect the HIDDEN TEXT option.

1. GENERAL

1. SUMMARY

A. Section Includes:

1. Radiant floor warming system.
2. Radiant underfloor heating system.
3. Earth storage system.
4. Thermostat controls.
5. Connection to power supply.

B. Related Sections:

1. Division 01: Administrative, procedural, and temporary work requirements.
2. Section [03 3000 - Cast-In-Place Concrete:] [____ - ____:] Concrete subfloor.
3. Section [06 1100 - Framing and Sheathing:] [____ - ____:] Wood floor framing and decking.
4. Section [09 3000 - Tiling:] [____ - ____:] Tile setting bed and floor finish.
5. Section [09 6340 - Stone Flooring:] [____ - ____:] Stone setting bed and floor finish.
6. Section [31 2300 - Excavation and Fill:] [____ - ____:] Subgrade preparation and fill placement.

2. REFERENCES

- A. Canadian Standards Association (CSA) - Canadian Electrical Code
- B. National Fire Protection Association (NFPA) 70 - National Electrical Code.
- C. Underwriters Laboratories, Inc. (UL) - Product Directories.

3. SUBMITTALS

A. Submittals for Review:

1. Shop Drawings: Include plans with heating [panel] [cable] layout, [panel sizes,] and power supply locations.
2. Product Data: Manufacturer's descriptive data for [panels] [cables] and accessories, including electrical characteristics.

4. QUALITY ASSURANCE

- A. Installer Qualifications: Minimum [2] [] years [documented] experience in work of this Section.
- B. Electrical Products: Tested by Underwriters Laboratories, Inc.
 1. Bear UL Listing Mark.
 2. Listed in UL Product Directory.

**** OR ****

C. Electrical Products: Certified by CSA.

**** OR ****

D. Electrical Products: Certified by an independent laboratory approved by authorities having jurisdiction.

5. DELIVERY, STORAGE AND HANDLING

A. Deliver, store, and handle products in manner to prevent damage.

6. WARRANTIES

A. Furnish manufacturer's [5] [10] [20] year warranty providing coverage against defects in materials and workmanship.

2. PRODUCTS

2.1. MANUFACTURERS

A. Contract Documents are based on products by Therma-Ray (www.thermaray.com).

B. Substitutions: [Under provisions of Division 01.] [Not permitted.]

2.2. COMPONENTS

A. Radiant Floor Warming Cable System:

1. Factory fabricated electrical heating cables.
2. Utilize alloy resistance wire element, electrically insulated, rated to 250 degrees C.
3. Factory-made waterproof splice connections for each non-heating lead to resistance wire.
4. Complete heating element covered with stainless steel braid over entire length.
5. Produce two watts per linear foot when energized on design voltage.
6. Model: No. [____], 240 VAC, [] watts, [] feet long x [] inches wide.
7. Spacing strips: Manufacturer's standard.
8. Controls: No. SR-240/120 SmartRooms Comfort Controller, 240/120 volts, with sensors and built-in GFCI.

**** OR ****

B. Radiant Heating Panels:

1. Product: Therma-Ray Radiant Heating Panels.
2. Utilize alloy resistance wire element, electrically insulated, rated to 250 degrees C, uniformly distributed over panel face, embedded in 1/2 inch thick gypsum board.
3. Model: No. [____], [208] [240] [277] VAC, [] watts, [] feet long x [] inches wide.
4. Connectors: No. 3M567.
5. End caps: No. PC-1.
6. Controls: [No. SR-LV SmartRooms Comfort Controller, low voltage, with sensors and SRDP distribution panel.] [No. SR-240/120 SmartRooms Comfort Controller, 240/120 volts, with sensors.]

**** OR ****

C. Earth Storage Panels:

1. Product: SmartRooms Earth Storage System.
2. Factory fabricated electrical heating cables.
3. Utilize alloy resistance wire element, electrically insulated, rated to 250 degrees C.
4. Watt density range of 40 to 50 watts per square foot when energized on design voltage.
5. Model: No. [____], [208] [240] [277] [347] VAC, [] watts, [] feet long x [] inches wide.
6. End caps: No. PC-1.
7. Connectors: No. 3M567.
8. Gelcaps: No. PC-3.
9. Sensor: No. SR.

10. Relay panel: No. SRDP SmartRooms Relay Panel.
11. Controls: [No. SR-LV SmartRooms Comfort Controller, low voltage, with sensors and SRDP distribution panel.] [No. SR-240/120 SmartRooms Comfort Controller, 240/120 volts, with sensors.]

2.3. ACCESSORIES

- A. Setting Bed: Specified in Section [09 3000.] [09 6340.] [____.]

3. EXECUTION

3.1. INSTALLATION

- A. Install cables and accessories in accordance with manufacturer's instructions, approved Shop Drawings, and [NFPA 70.] [Canadian Electrical Code.]
- B. Lay out system to locate cables:
 1. 1/2 to 1 inch from undersides of counters, steps, bathtubs, showers and other fixed objects.
 2. 2 inches from walls and partitions.
 3. 6 inches from toilets and faucets.
 4. 8 inches from other heating systems installed at base of walls and partitions or in floor.
- C. Attach cable to floor using spacing strip starting at connection box.
- D. Attach green clip from S.I.D. to steel braid; leave on during installation. Attach black and red clips to non-heating lead wire.
- E. Place cables with manufacturer's recommended distance between cables; apply slight tension to cable to ensure that cable is parallel.
- F. Secure cable with staples or construction adhesive when required to prevent shifting during mortar placement.
- G. Install all heating portions of cable on floor.
- H. Allow sufficient space for cable return to connection box.
- I. After all cable has been installed, test cable to verify ohms and for grounding.
- J. Install controller probe wire between cables at 1 to 2 foot intervals within heating zone. Secure probes with glue, staples, or tape. Do not cross probe wires over warming cables.
- K. Embed cables in full mortar bed.
- L. Locate thermostat controls [where indicated.] [____.]
- M. Ground stainless steel braid to the electrical ground wire.
- N. Connect to power supply and control wiring.
- O. Test system after mortar bed is applied, after tiles are installed but before grouting, and after grouting at rated voltage using ammeter. Ensure that ammeter values are same as calculated for heating load.

**** OR ****

3.2. INSTALLATION

- A. Install panels and accessories in accordance with manufacturer's instructions, approved Shop Drawings, and [NFPA 70.] [Canadian Electrical Code.]
- B. Place panels between floor joists in open, unobstructed floor joists.

- C. Secure panels in place using wires spaced 24 inches on center maximum in holes drilled through joists.
- D. Place sufficient panels to fill floor joist spaces in area to be heated.
- E. Do not install panels below cabinets, appliances, or other fixed objects.
- F. After panels are in place, secure wires to nails or hooks.
- G. Locate controllers [where indicated.] [____.]
- H. Drill holes in joists near lead wires of panels.
- I. Wire panels to branch circuits in parallel.
- J. Connect to power supply and control wiring.

**** OR ****

3.3. INSTALLATION

- A. Do not begin installation until below-grade plumbing and electrical work is roughed in and subgrade has been placed and compacted.
- B. Install panels and accessories in accordance with manufacturer's instructions, approved Shop Drawings, and [NFPA 70.] [Canadian Electrical Code.]
- C. Position panels to layout indicated. Do not place panels partly on structural components and partly on subsoil.
- D. Run branch circuits in concrete in nonmetallic conduit.
- E. Do not place conduits across expansion or construction joints.
- F. Protect conductors entering or leaving slab with conduit.
- G. Install branch circuits with amp rating equal to 125 percent of connected panel load.
- H. Run branch circuits to pick up connections at each panel.
- I. Connect panels parallel to branch circuit using 3M No. 567 self-tapping connectors. When using USE wire, use No. 12 AWG. When using RWU wire, use 10 AWG or 12 AWG.
- J. Insert connected cables into endcap gel; draw endcap tight using strap, then affix strap using screw.
- K. Conduct final test of panels and connections and record test readings.
- L. Conduct additional tests after backfilling and compacting, after slab is poured, and before connecting branch circuit to distribution panel; record readings and compare to first set of values.
- M. Read resistance between two branch circuit conductors using ohmmeter. If circuit is connected to distribution panel, turn circuit breaker off.
- N. Install conduits for in-slab temperature sensor.
- O. Install conduits for cut-outs.
- P. Do not energize panels until slab is fully cured.

END OF SECTION

ES Panels

Earth (Thermal) Storage System



Applications

- Manufacturing Facilities
- Hospitals
- Schools
- Warehouses
- Assisted Living Facilities
- Basements
- Garages
- Townhouses
- Off-Peak electric rates



Transform the ground **below** your concrete slab into an efficient thermal mass of stored energy.

ES panels are ideal for taking advantage of off-peak electric rates thus reducing operating costs. Areas can be zoned to match needs for present and future use. Installed 6 - 8 inches **under** the concrete floor, the ES system eliminates the problem of hydronic floor heating systems springing leaks in the event there is damage to the concrete floor.

Radiant Heat: Radiant energy travels in straight lines and is absorbed by objects in the room, warming the space. Air quality is maintained because no forced air movement occurs with radiant heating.

Maintenance Free: Radiant panels have no moving parts, so they are maintenance free and can provide years of quiet, safe and clean operation.

Warranty: 10 years on the heater.

Standard Construction Features

Heating Element – High quality alloy resistance wire is dielectrically insulated with a PTFE compound rated for 250°C (482°F).

Panel Design – Panel is made of 1/2 inch thick gypsum with a wire embedded within.

Electrical – 2 non-heating lead wires are connected in parallel to a direct burial wire using 3M567 self tapping connectors and a gel cap resulting in a water tight connection.

Watt Density Range - 40 to 50 watts per square foot when energized on design voltage

Installation Requirements – Heaters are installed on the ground before the concrete is poured.

No insulation below the heaters is required. Perimeter insulation is required.

Do not begin installation until below-grade plumbing and electrical work is roughed in and subgrade has been placed and compacted.

Fill - 6-8 inches of sand are placed on top of the heaters and compacted.

Once panels are connected and verified using ohm meters, the concrete floor can be poured as normal.



ES Series

Earth (Thermal) Storage System

Control Options

All SRDP models are rated for the following voltages:
120V, 208V, 240V 277V, 347V

Catalog Number	Description
SR-LV	Low Voltage thermostat c/w plaster ring. Floor or remote limit sensor(s) must be ordered at the same time. Requires connection to the SRDP2 (Distribution Panel)
SR-LV-B	Same as the SR-LV but with a box ring for double gang electrical box instead of the plaster ring
SR Sensor	15' (4.5 m) Long. Longer lengths available
SRDP2-10-10	Distribution Panel with 10 RJ 45 ports for thermostats and 10 - 20 amp relays
SRDP2-10-20	Distribution Panel with 10 RJ 45 ports for thermostats and 20 - 20 amp relays
SRDP2-20-20	Distribution Panel with 20 RJ 45 ports for thermostats and 20 - 20 amp relays

SRDP2-20/20



Field Installed Options

(shipped loose for field installation)

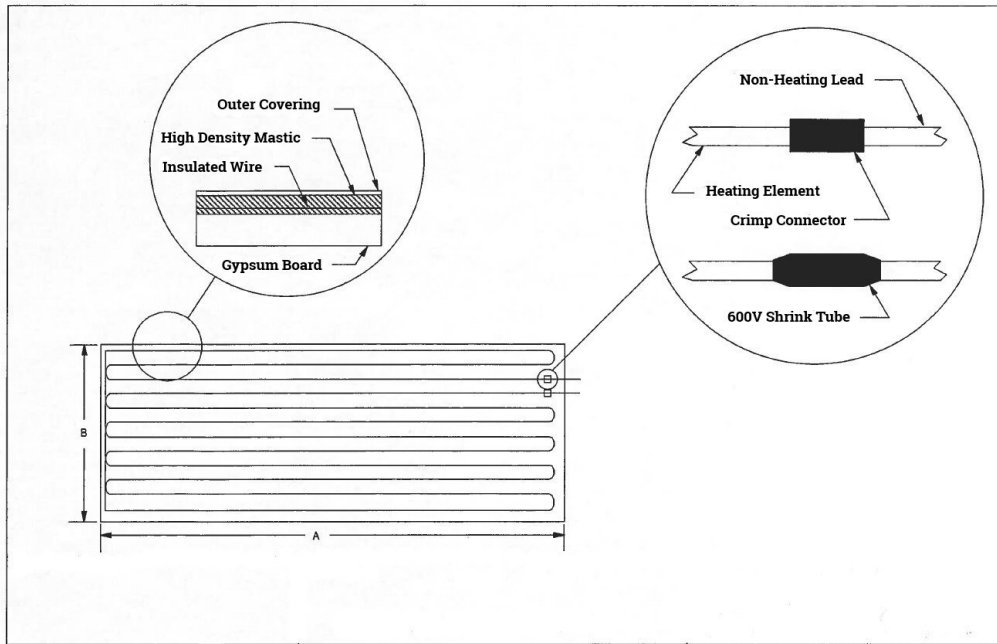
Catalog Number	Description
3M567	Self-tapping connector for use with 12 AWG direct burial wire.
PC-3	Gel endcap that the direct burial wire (feed wire) and 3M567 connectors are inserted. Cover on the endcap is closed making a watertight connection



Gel Cap getting placed on the 3M567 Connectors.

ES Series

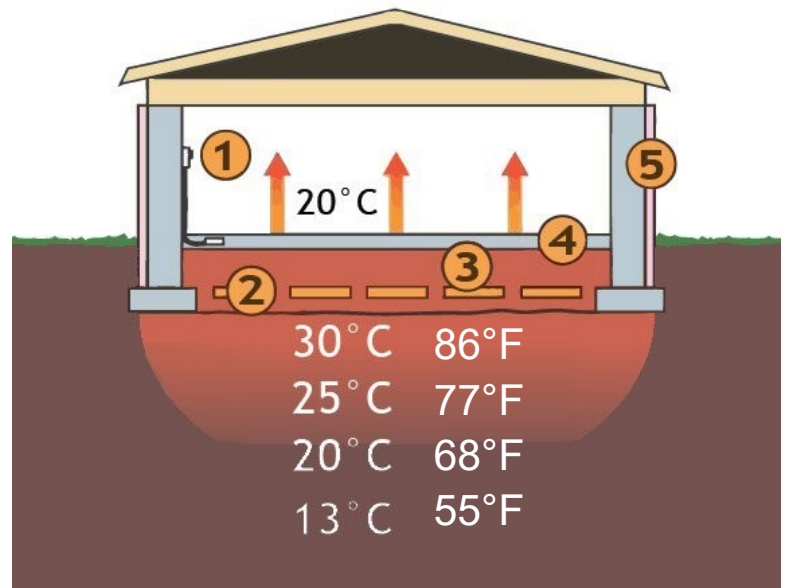
Earth (Thermal) Storage System



Cutaway view of Earth Storage Panel

Earth Thermal Storage System

1. Thermostat
2. ES Panels
3. Fill
4. Slab Building Foundation
5. Styrofoam Insulation—2 inches (5 cm)

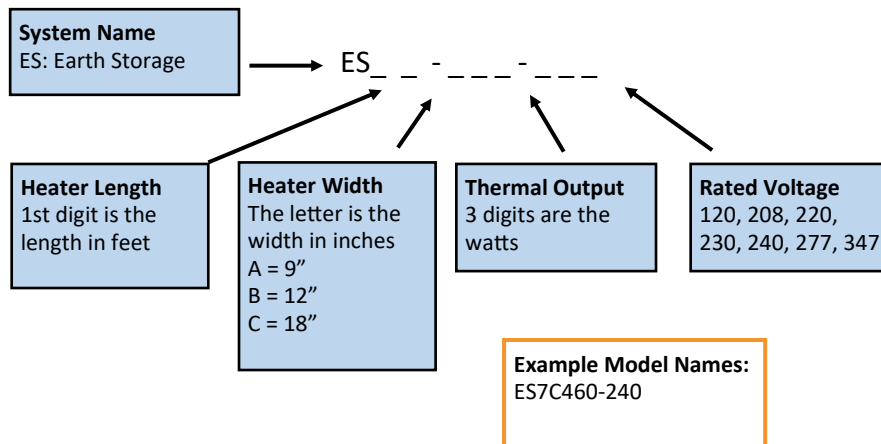


ES Panels

Radiant Ceiling Panels

ES—Earth (Thermal) Storage Panels

VOLTAGE	WATTS	LENGTH (feet)	WIDTH (inches)	CATALOGUE #	WEIGHT lbs
208	565	8	18	ES8C565-208	20.1
208	515	7	18	ES7C515-208	17.5
208	405	6	18	ES6C405-208	15.3
208	300	5	18	ES5C300-208	12.9
208	225	4	18	ES4C225-208	10.3
208	200	3	18	ES3C200-208	7.7
240	600	8	18	ES8C600-240	20.1
240	460	7	18	ES7C460-240	17.5
240	320	5	18	ES5C320-240	12.9
240	280	4	18	ES4C280-240	10.3
240	230	3	18	ES3C230-240	7.7
277	540	8	18	ES8C540-277	20.1
277	460	7	18	ES7C460-277	17.5
277	300	5	18	ES5C300-277	12.9
347	480	7	18	ES7C480-347	17.5
347	335	5	18	ES5C335-347	12.9
347	260	4	18	ES4C260-347	10.3
347	200	3	18	ES3C200-347	7.7





EARTH STORAGE SYSTEM

Installation Guide

Whether you're a contractor, architect, builder or homeowner, creating the perfect indoor environment has always been a challenge. **ThermaRay**, the world's #1 name in thermal comfort systems introduces you to the ultimate Thermal Storage solution. Please take the time to read this installation guide carefully before you begin. Remember, accurate measurements are the key to success for a proper installation

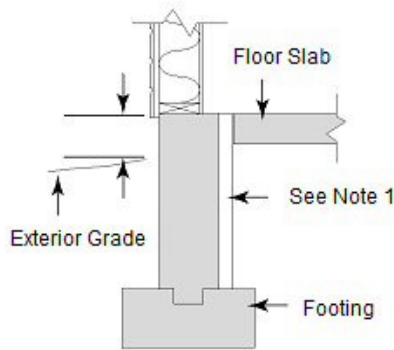


Diagram 1 Note 1. All insulation shown is 2 inch thick closed cell polystyrene type SB. Installed from top of slab to top of footing or 4 ft. horizontally from inside of foundation.

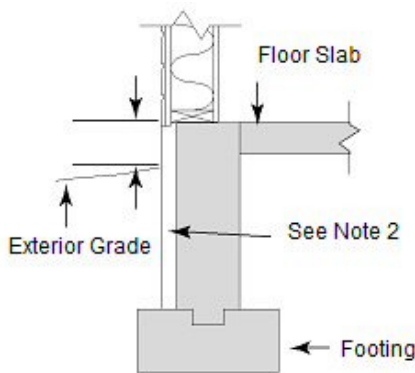


Diagram 1 Note 2. If more than one foot of foundation wall is exposed above grade, the insulation thickness should be increased to 4 inches.

PLANNING AND LAYOUT

Primary Heating Systems – When the **ThermaRay** Earth Storage System is the main heat source for the building a detailed heat loss calculation must be performed to ensure a successful installation. Consult your **ThermaRay** representative.

A scale layout or sketch should be provided, showing the placement and type of panels, junction box locations and thermostat type & locations. All below-grade construction, such as footings, column bases, drains, plumbing & electrical lines, which might affect the location of the panels, should be indicated on the layout.

Inspection upon arrival of the panels should be made for any damage that may have happened in transit. If delivered by common carrier, immediately report damage or missing materials to the trucking company. For problems with other means of delivery, contact your **ThermaRay** distributor. Check the operating voltage marked on the panels to make sure it matches the building supply voltage.

Outside storage of the panels is permitted, provided that the protective moisture-proof plastic cover and tarp is intact and the panels are protected from physical damage.

INSTALLATION IN OR ON TOP OF SAND FILL

Site Preparation – Ground water conditions will cause problems if there is moving water present within the building area. Should moving water exist at the site, a soil engineer should be consulted as to the feasibility of using footing drains or other drainage methods to correct the problem. A high water table that is NOT MOVING or changes very slowly with the seasons is generally not a problem. In such cases a vapour barrier should be installed.

Perimeter insulation must be installed to ensure an efficient heating system. Failure to insulate the slab correctly may cause difficulty in maintaining the desired building temperature and/or cause excessive heating costs. Insulation that will be in contact with the ground should be a type SB foamed, closed-cell polystyrene. Other types of insulation, such as foamed urethane or polystyrene bead-board, will absorb a certain amount of ground moisture that will reduce its effectiveness. Refer to **Diagram 1** of this installation guide for the proper methods of installing the perimeter insulation for various slab configurations. Consult your **ThermaRay** Representative for alternate configurations if necessary.

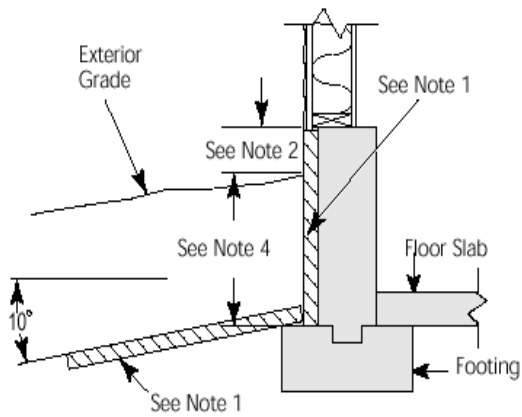


Diagram 1 Note 3. If top of footing is a minimum of 6 ft. below exterior grade, insulation may be installed to a depth of 4 ft. below grade. Otherwise the insulation should be installed to top of footing.

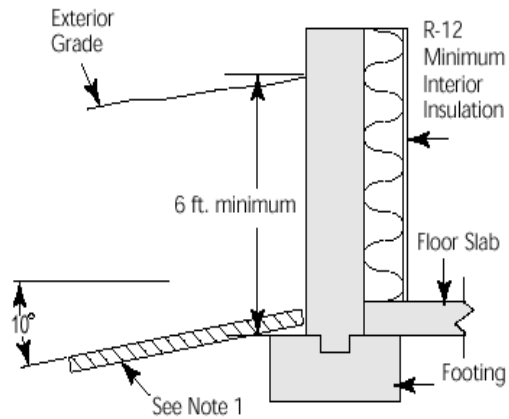


Diagram 1 Note 4. All footings must be below the frost line.

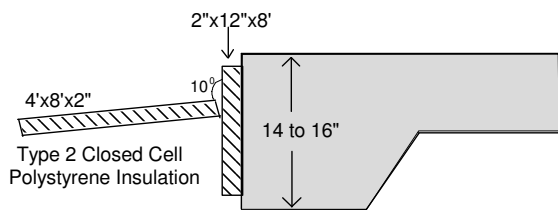


Diagram 1 Note 5 – Floating Slab

Filling and grading may be started after all below-grade insulation is installed. Any under slab plumbing or electrical lines should be roughed in before filling to avoid disturbing compacted fill or damaging panels. Good practice requires a minimum of 4 to 6 inches of compacted granular fill to provide adequate drainage if slab moisture problems are to be avoided. When panels are used to provide an OFF-PEAK STORAGE SYSTEM, they are usually installed with additional sand fill above them. If design specifications require fill above panels, DO NOT FILL TO FINAL GRADE until panels are installed. If need be, spread a minimum of two inches of sand as protection against sharp stones in the subsoil before placing panels and to protect supply wiring. **Refer to Diagram 2.**

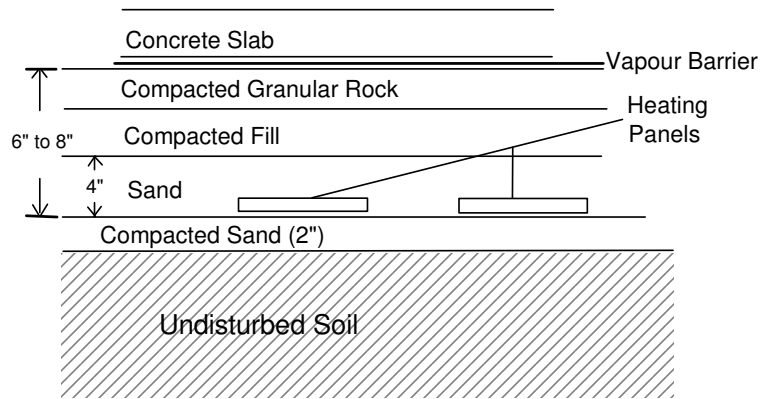


Diagram 2

Fill material should be granular material with good compaction qualities to provide drainage and a stable base for the slab. Materials such as unwashed, unscreened bank run gravel or sand are preferred. If there is any doubt about the acceptability of the fill contact your **ThermaRay** representative. Any large stones, which would interfere with or damage the panels, or wiring should be removed.

A vapour barrier should be installed according to local building codes. An approved vapour barrier at least 6 mil thick should be used and placed on the fill directly under the slab. If panels are to be placed in contact with the slab, the vapour barrier may be installed on top of the panels.

Panel Installation

1. All work done under this section must comply with any national or local building codes.
2. To avoid damage by other trades, all below-grade plumbing and electrical work must be roughed in before positioning panels. If floor area is large enough to require screeds or forms, locate the screed stake line and avoid placing the panels in this area.
3. Position panels as designed. To prevent damage to panels due to possible settling of the sand, panels should not be placed partly on column bases and partly on the sand.
4. Branch circuits run in concrete must have the conductors installed in non-metallic conduit. Conduits must not cross expansion or construction joints. The use of conduit may be avoided if conductors feeding the panels are placed in the sand fill under the slab. Wire approved for direct burial must be used. Single conductor USE or 2-conductor RWU wire is recommended. Conductors entering or leaving the slab must be protected with conduit.

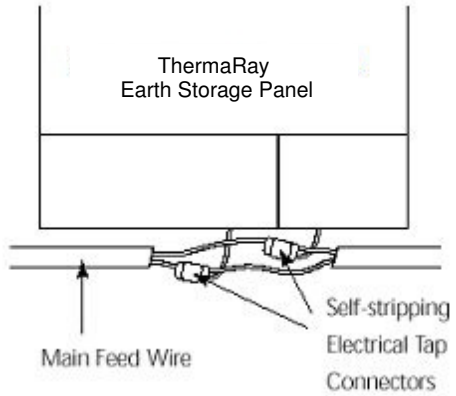


Diagram 3. Connecting the main feed to the individual panel is easily done using tap-on connectors. Note that ONLY the outer insulation jacket of the main feed is removed.

3M567 Self Stripping Electrical Tap Connectors

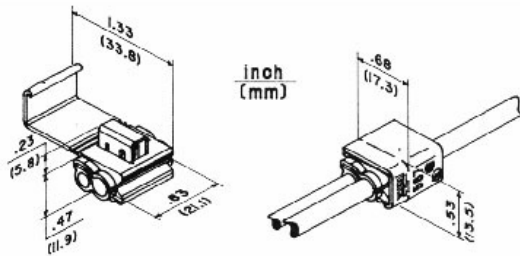


Diagram 3 – Note 3

The 3M connectors are inserted into the gel and can be easily removed from the gel if required for inspection or testing.

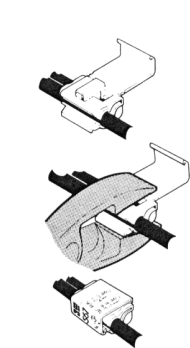


Diagram 3 – Note 2

INSTRUCTIONS
Use only with insulated wire. Do not strip insulation.

1. Slip circuit (run) wire into side slot. Insert fixture (tap) wire up to stop.
2. Make connection with 9" electrician's (lineman's) pliers, by driving "U" contact down flush with top of connector.
3. Close hinged cover until it locks.

5. Branch circuits must have an amp rating equal to 125 percent of the connected panel load per N.E.C. Run branch circuits to pick up connections at each panel. Refer to **Diagram 3** for panel connection procedure. Connect panels parallel to the branch circuit using 3M No.567 self-tapping connectors. When using USE wire, only #12 AWG should be used. When using RWU wire, #10 AWG or #12 AWG may be used. Refer to **Diagram 3-Note 2**. Insert the now connected cables into the endcap gel. Using the strap, draw the endcap as tightly as possible to the panel, then affix the strap using the supplied screw. Refer to **Diagram 3- Note 3**.
6. It is highly recommended to use ½" flexible conduit with a glued cap for the high limit sensor. This is to be placed on top of one of the ES heaters and runs from the panel back to the thermostat location (maximum 15').
7. A final test of the panels and connections is required at this point. Although all panels are fully tested at the factory, a test of the field-connected system should be performed. Record test readings made during this step. After back fill and tamping another reading must be taken and recorded. This reading must match the first reading.
8. A second ½" flexible conduit with glued cap for the floor sensor may be tied to the mesh (maximum 15'). After slab is poured and before connecting branch circuit to distribution panel, another set of readings should be recorded and compared with the first set of values. Failure to record the readings as outlined will void the warranty.

Read the resistance between the two branch circuit conductors with an ohmmeter. If circuit is connected to the distribution panel, make sure circuit breaker is "off" or reading may include the resistance of other branch circuits. If the reading agrees with the value calculated using the formula below, then circuit is OK.

Example: For branch circuit of 1500 watts and rated panel voltage of 240V, the resistance is 38.4 ohms.

$$\text{Formula: } \frac{\text{voltage} \times \text{voltage}}{\text{wattage}} = \text{resistance in ohms, Example: } \frac{240 \times 240}{1500} = 38.4 \text{ ohms}$$

Recheck connections to any suspect panel. If connections are OK, then replace unit and recheck readings. Should **ThermaRay** LOADCHECK sheets be provided with the job, they must be completed per their attached instructions.

Preparation for pouring floor

9. If sand fill over panels is specified, fill to final grade. Fill must be well compacted.
10. If required, install vapour barrier. If there is no fill above panels, it may be installed on top of the panels.
11. If screeds will be used, screed stakes should only be driven in areas designated by electrical contractor to avoid damaging panels and branch circuit wiring.
12. Install conduits for in-slab temperature sensor. Refer to control installation (**Diagram 4**). If high temperature cut-outs are required, install conduits for cut-outs. (High temperature cut-outs are required whenever panels are not in contact with the concrete slab.) Refer to the thermostat instruction sheet for installation details.

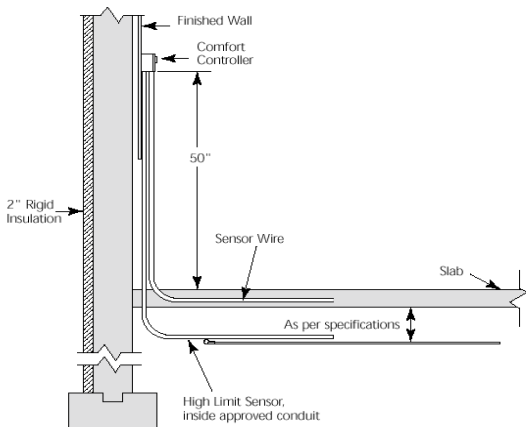


Diagram 4

ThermaRay Inc.

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 Fredericton, NB Canada E3B 7K4
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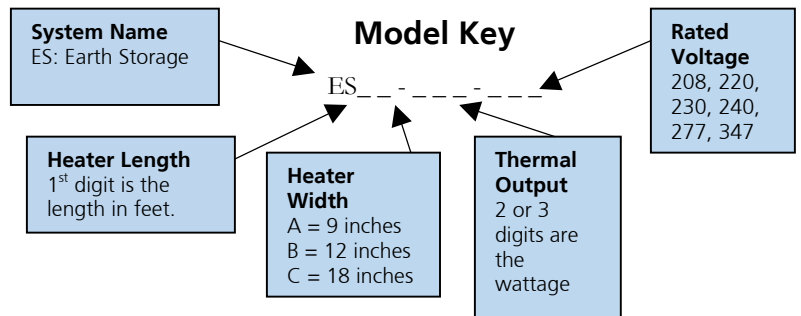


Pouring concrete

13. The slab and foundation must be installed in accordance with state and local codes.
14. All workers should be cautioned to use care with shovels, rakes and other equipment, to avoid damaging panels and branch circuit wiring.
15. When large floor areas are involved, consideration should be given to the method of pouring concrete, i.e. pumping, truck chute, etc. It may be advisable to lay panels one or two bays at a time. This will allow equipment to use adjacent bays to deliver concrete to bay being poured.
16. DO NOT ENERGIZE PANELS until slab is fully cured. Slab strength may be affected by rapid curing. Contact **ThermaRay** for proper procedures.

EARTH STORAGE SYSTEM

CATALOGUE #	VOLTAGE	WATTS	WIDTH "	LENGTH '	WEIGHT LBS
ES7C515-208	208	515	18	7	17.5
ES6C405-208	208	405	18	6	15.2
ES5C300-208	208	300	18	5	12.9
ES4C225-208	208	225	18	4	10.3
ES3C200-208	208	200	18	3	7.7
ES7C460-240	240	460	18	7	17.5
ES5C320-240	240	320	18	5	12.9
ES4C280-240	240	280	18	4	10.3
ES3C230-240	240	230	18	3	7.7
ES7C460-277	277	460	18	7	17.5
ES5C300-277	277	300	18	5	12.9
ES7C480-347	347	480	18	7	17.5
ES5C335-347	347	335	18	5	12.9
ES4C260-347	347	260	18	4	10.3
ES3C200-347	347	200	18	3	7.7



ACCESSORIES

- PC-3 ENDCAP** Gel Endcap
- 3M567** Connector for #12 wire
- SR-LV** Low voltage **ThermaRay** Controller with plaster ring to be used with an SRDP2 Distribution Panel
- SR-LV-B** Low voltage **ThermaRay** Controller with box ring to be used with an SRDP2 Distribution Panel
- SR SENSOR** Sensor 15' long
- THERMARAY DISTRIBUTION PANELS**
- SRDP2-10-10** 10 communication ports for controls & 10 relays
- SRDP2-10-20** 10 communication ports for controls & 20 relays
- SRDP2-20-20** 20 communication ports for controls & 20 relays

NOTE: Heaters are available in 208, 220, 230, 240, 277 and 347 volts. (example: ES7C460-240). Other size panels and voltages may be available upon request.