Rural Renewable Energy Alliance

SPF Installation Manual

Rural Renewable Energy Alliance (RREAL)
2330 Dancing Wind Road SW, Suite 2
Pine River, MN 56474, USA
info@rreal.org  218-587-4753   www.rreal.org
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The following installation manual provides general guidelines for how to install the Solar Powered Furnace. It is not specific to your site or application. Differences between homes, businesses, and applications will require each installation to have its own set of appropriate methods. Each installation is unique—that point cannot be emphasized enough. Certain installations may require specific fasteners or materials. Any substitutions or equivalents to the materials specified in this document must be approved by RREAL prior to the installation process. Always consult local building codes and professionals for appropriate installation methods, permits and regulations. The Rural Renewable Energy Alliance is not responsible for errors in your installation. The Solar Powered Furnace must be installed appropriately according to this installation manual and must meet local mechanical, electrical and all other relevant building codes. Appendix E provides some relevant selections from the 2006 International Residential Code, these sections are referenced when applicable in the installation instructions. This is not a complete list of code that may apply to your unique installation. RREAL is not responsible for ensuring that your installation meets all relevant local, state, federal, international, mechanical, electrical and other code.

**REMEMBER Safety First!!!**

Installing a solar air heat panel can result in serious injury or even death. Construction of any sort can pose life-threatening risks to your health and personal safety. The installation of a solar air heat panel is no exception. Always practice safety first!

Always use personal protection equipment such as fall protection, safety glasses, gloves, and all other necessary equipment to ensure the safe completion of the project. Do not use inappropriate tools, safety gear or hardware. Do not rush. Follow all relevant safety rules and regulations.

The Rural Renewable Energy Alliance is not responsible for injuries or incidents that occur during the installation process.

Prior to beginning any installation it is important to ensure that the selected panel location is adequate and that all the steps of installation can be met (M2301.2). Read through the entire installation manual and confirm that your project plan will meet all installation steps. Also, review the following considerations and requirements:

- Double check the solar resource at the selected site. In the northern hemisphere, the panels should be located on the southern face of the building.
- The SPF must be mounted vertically and cannot be mounted at any angle whatsoever.
- The SPF should be mounted a minimum one foot above grade to ensure proper protection from the environment.
- The SPF should be mounted flush to the exterior building wall. Often this requires the removal of siding in the selected installation area. If your installation will not allow for the panel(s) to be mounted flush, contact RREAL prior to beginning your project.
- Ensure that the desired location has sufficient structural material to which the SPF can be fastened. If mounting directly to wall framing studs, ensure the stud’s structural integrity, especially on retrofits.
- Ensure that supply and return penetrations can be made into the building appropriately. Locate all studs, water and electrical lines and other infrastructure prior to beginning the project. Avoid straddling the transition from rim joist to foundation or concrete basement wall. Straddling this transition presents additional challenges with flush mounting and flashing the panel(s).
- When handling collectors, no load should be placed on the Array Interconnect. Collectors should not be lifted by the Array Interconnect ports. The Array Interconnect ports are not designed to be used as a hand hold to grab or lift collectors. Collectors should not be lifted by the glass alone using tools such as glass suction cups. The glass is not designed to support the load of the collector.
- Unconventional installations may require additional engineering, contact RREAL for additional information.
- If unsure of any procedure in this installation process, contact
**Parts Definitions**

**Fan or Blower**
RREAL recommends CFM inline fan units. For a fan sizing chart, see Appendix B.

**Back Draft Damper**
Also called, “check-valves,” these components should be installed as close to the collectors as possible. They close to prevent unwanted heat or cold from traveling backwards into the building. They should be mounted with the vane vertically aligned.

**Starter Collar**
Starter collars are inserted into the back of the SPF panels to create supply and return ports.

**Ducting**
Most systems use 6” or 8” ducting. Joints, elbows and boots may also be required depending on the system.

**High Temperature Silicone**
Must be used in connecting:
- the starter collar to the collector,
- the ductwork to the starter collar,
- the high-temp insulation to the back of the collector,
- connection between stints and receivers,
- connections between collectors,
- any other connections that come in contact with the side of the collectors.

**High-Temperature Duct Insulation**
High Density fiberglass covered with Teflon.

**Receiver**
SPF will be delivered with these receivers already installed in the ports between collectors. Used in conjunction with the receivers, these parts make an air tight seal for interconnecting multiple panels.

**Stint**
The stints work in connection with the receivers to make connections between multiple panels in an array.

**Return-Air Grille with Filter**
RREAL typically uses return air grilles that allow a filter size that is easily available locally. If the filter gets dirty and is not replaced, the efficiency of the fan will be compromised.

**Supply Grille**
For distribution of warm air from the SPF panels to the desired space.

**1”x2” Aluminum Mounting Rail**
RREAL’s SPF’s were specifically designed to mount onto 1”x2”x0.125” 6063-T5 Aluminum Rectangular Tubing or 6063-T5 Aluminum Architectural Channel. This is a common aluminum extrusion.

**Structural Screws**
GRK Fasteners Rugged Structural Screw. Used for attaching mounting rails to most structures. Certain buildings may require lag bolts or other specialized fasteners. Note, some installations may require unique hardware, contact RREAL.

**Self-tapping Screws**
ITW Buildex TEKS® Self-Drilling Metal Fasteners. Used for attaching the SPF panels to the aluminum mounting rails. Note, some installations may require unique hardware, contact RREAL.

**Pre-Bent Aluminum Flashing**
Used to prevent water from penetrating behind the SPF panels.

**Thermal Differential Controller, thermostat and thermistor**
Eagle 2 differential controller can be used to control the system and to convey different temperature readings to residents. (Ex. Input and output temperatures, collector temperature, building temperature).
**Bill of Materials**

<table>
<thead>
<tr>
<th>Qty</th>
<th>Item</th>
<th>Source</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any</td>
<td>SPF Panel</td>
<td>RREAL</td>
<td>Various sizes available</td>
</tr>
<tr>
<td></td>
<td>Minimum of 8 feet per panel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1&quot;x2&quot;x0.125&quot; 6063-T5 Aluminum Rectangular Tubing OR 6063-T5</td>
<td>RREAL</td>
<td>Additional rail may be required depending on array orientation and mounting configuration. See Appendix D</td>
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<tr>
<td></td>
<td>Aluminum Architectural Channel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Eagle 2: Thermal Differential Controller</td>
<td>RREAL</td>
<td>Manufactured by IMC Instruments</td>
</tr>
<tr>
<td>1</td>
<td>Eagle 2: Differential Control Thermostat</td>
<td>RREAL</td>
<td>Manufactured by IMC Instruments</td>
</tr>
<tr>
<td>1</td>
<td>Thermistor</td>
<td>RREAL</td>
<td>Manufactured by IMC Instruments. High temperature wire</td>
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<tr>
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<td>CFM Aeroflow Inline Fan</td>
<td>RREAL</td>
<td>Manufactured by CFM. Various sizes available to match ducting size</td>
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<tr>
<td>Any</td>
<td>Array Interconnect Stints</td>
<td>RREAL</td>
<td>Quantity dependent on array size, type and orientation. Array Interconnect Receivers come installed in SPF</td>
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<tr>
<td>Varies</td>
<td>Pre-bent Metal Flashing</td>
<td>RREAL</td>
<td>Length dependent on array size and orientation</td>
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<tr>
<td>Varies</td>
<td>Thermostat Wire, 22 gauge minimum, shielded</td>
<td>RREAL or Available Locally</td>
<td>Length dependent on site and system</td>
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<td>2</td>
<td>Spring Loaded Back Draft Dampers</td>
<td>RREAL</td>
<td>Matching duct size</td>
</tr>
<tr>
<td>Varies</td>
<td>Knauf 1000° Fiberglass Pipe Insulation</td>
<td>RREAL</td>
<td>Manufactured by Knauf. Matching duct size length dependent on site and system</td>
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<td>Varies</td>
<td>High Temperature Silicone</td>
<td>RREAL</td>
<td>Manufactured by Durasil rated to a 450°F</td>
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<td>2+</td>
<td>Starter Collars</td>
<td>RREAL or Available Locally</td>
<td>Quantity dependent on system type and size</td>
</tr>
<tr>
<td>Varies</td>
<td>Ducting (straight sections and joints, elbows and boots)</td>
<td>RREAL or Available Locally</td>
<td>Size, length and quantity dependent on site and system size</td>
</tr>
<tr>
<td>Varies</td>
<td>GRK Fasteners Rugged Structural Screw, 5/16” Climatek coated some installations may require unique hardware</td>
<td>RREAL or Available Locally</td>
<td>Manufactured by GRK Fasteners. Quantity and size dependent on site and system. Some installations may require unique hardware</td>
</tr>
<tr>
<td>Varies, minimum of 6 per panel</td>
<td>ITW Buildex TEKS® Self-Drilling Metal Fasteners, 12-24x1-1/4 HWH TEKS 5</td>
<td>RREAL or Available Locally</td>
<td>Manufactured by ITW. Quantity dependent on system size and orientation. See Appendix D</td>
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<tr>
<td>1</td>
<td>Filtered Return Air Grill</td>
<td>RREAL or Available Locally</td>
<td>For return air into panel</td>
</tr>
<tr>
<td>1+</td>
<td>Filter for Return Air Grill</td>
<td>RREAL or Available Locally</td>
<td>Size matching return air grill, additional required to maintain cleanliness</td>
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**Additional Materials**

<table>
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<tr>
<th>Item</th>
<th>Reason</th>
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</thead>
<tbody>
<tr>
<td>Tar Paper or Vapor Barrier</td>
<td>Lay behind panels in areas where siding has been removed</td>
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<tr>
<td>Plastic or Metal Strapping</td>
<td>Hanging or mounting duct work</td>
</tr>
<tr>
<td>Flex Duct</td>
<td>Substitute for rigid duct in certain circumstances</td>
</tr>
<tr>
<td>Aluminum Foil Tape</td>
<td>Sealing duct joints</td>
</tr>
<tr>
<td>Sheet Metal Screws</td>
<td>Connecting duct sections</td>
</tr>
<tr>
<td>Sheet Metal</td>
<td>Back sheet for return air grill</td>
</tr>
<tr>
<td>Duct Wrap Insulation</td>
<td>Insulating duct runs in non-conditioned space</td>
</tr>
<tr>
<td>Supply Registers or Boots</td>
<td>Registers for supplying air into building</td>
</tr>
<tr>
<td>Silicone or Spray Foam</td>
<td>Filling gaps between panel and building. Dark Bronze color to match collector extrusion</td>
</tr>
<tr>
<td>Window Flashing Roll Tape</td>
<td>Used to seal behind flashing and around SPF array</td>
</tr>
</tbody>
</table>

Version 1.10
1) Select and mark out an appropriate location for the SPF collectors

1a) Mark out the collector location on the exterior wall and double check that the location is appropriate (1602.2). It is required that a minimum of 6 inch clearance of any eaves, overhangs or other large protruding objects is allowed around the perimeter of the selected panel location for ease of fastening collectors to mounting rails. For overall collector dimensions, see Table 1.

| SPF 40  | 48 1/8" x 122 1/8" |
| SPF 32  | 48 1/8" x 98 1/8" |
| SPF 26  | 48 1/8" x 78 1/8" |

Table 1: Overall dimensions of SPF panels

1b) Prepare surface for flush mount (M2301.2.7). In many cases, this may require the removal of siding in the selected panel area. It is recommended that an additional 1 inch of space is allotted around the perimeter of the panels for ease of flashing, sealing and trimming. If unsure if siding removal is required or how to remove specific siding materials, contact a contractor licensed in your area for recommendations.

2) Hang mounting rails

2a) Review Appendix D for appropriate mounting rail layout and dimensions for specific system configurations. If hanging an array of multiple SPF panels, see Appendix C for directions on how to hang multiple SPF panels on one set of rails.

2b) Pre-determine the wall stud spacing. Mark the locations of wall studs on the aluminum mounting rails. Fasteners should be used at each available stud and should be spaced no more than 24 inches apart

2c) Drill holes in the aluminum mounting rail at the location of wall studs or where mounting hardware will be located. If using aluminum rectangular tube, as opposed to aluminum c-channel, one side will have to be opened up with a step drill bit to accommodate hardware and drivers.

2d) Fasten aluminum mounting rails securely through the wall sheathing into the supporting structure, see Figure 1 for an example. Mounting rails should be flat to ensure proper fastening of SPF. Mounting rails should always be hung plumb and level. Use only building appropriate fasteners for hanging mounting rails.

Figure 1: Example of using 6063-T5 aluminum c-channel mounting rail fastened to wall stud using GRK Fasteners RSS Structural Screws.
3) Make supply and return penetrations

3a) Determine the location of the supply and return penetrations in both the wall cavity and the SPF panel (M1602.2). Ensure proper alignment of wall cavity and SPF penetrations. See Figure 2 for available locations for supply and return penetrations on SPF panels. The entire penetration must be contained within the designated area in Figure 2.

3b) Ensure that selected locations are within the designated area on the back of the SPF panel and that the selected locations in the wall are not obstructed by building framing, electrical lines, water lines or other obstructions or hazards.

3c) Make circular penetrations into the SPF panels and the wall at the selected locations. SPF penetrations should match the size of the ducting to be used. Wall penetrations should allow for an additional 2 inches in diameter to accommodate high temperature insulation.

![Figure 2: Allowable area in SPF panel for penetrations to be made](image)

*Note: All units are given in inches*
4) Prepare to mount SPF

4a) Remove all debris from inside collector that may have accumulated as a result of the cutting of supply and return penetrations.

4b) Apply high temperature silicone to panel and starter collar. See Figures 3 and 4 for proper high temperature silicone locations.

4c) Bend starter collar tabs to 90° angle and insert starter collars into the supply and return penetrations on SPF and cover tabs with high temperature silicone. See Figure 4.

4d) Insert thermistor into the supply side of the SPF panel using a sheet metal screw. Separate thermistor from duct floor using high temperature silicone to prevent corrosion. Run the thermistor wires out a small penetration made near the starter collar and seal this penetration with high temperature silicone. See Figure 5.

4e) Drill 1/4 inch holes in the aluminum frame rails around the perimeter of the collector at the locations where the ITW Buildex TEKS® self tapping metal screws will be inserted. See Appendix D for ITW Buildex TEKS® locations.

**Figure 3:** Proper location for high temperature silicone beads on starter collar

**Figure 4:** Proper installation of starter collar into SPF penetration

**Figure 5:** Proper installation of thermistor into SPF panel [View of collector cutaway]

*Note: Parts and Dimensions Not Drawn to Scale*
5) Hang first SPF panel

5a) Lift the first SPF panel onto the mounting rails and into position. Ensure proper alignment of building and panel penetrations.

5b) Secure SPF to mounting rails with ITW Buildex TEKS® self tapping metal screws. See Figure 6. For proper location of ITW Buildex TEKS® see Appendix D.

6) Hang additional SPF panels

If only hanging one SPF panel, omit this step

6a) Properly prepare the additional SPF panel(s) following step 4 of this manual. Note, not all additional SPF panels will require installation of starter collars and thermistors. A typical array uses one thermistor, one supply penetration and one return penetration. Omit any irrelevant substeps of step 4.

6b) Apply two beads of high temperature silicone to Array Interconnect stint. See Figure 7 for proper high temperature silicone location.

6c) Insert stint(s) into already mounted collector. Ensure that stint is completely seated in receiver.

6d) Lift additional SPF onto mounting rails and slide into place. Ensure that stint(s) is appropriately seated in both SPF receivers before the SPF panel is secured. It is recommended that pressure is applied to push the collectors together, there should be minimal gap of 0 to 1/8 inches between collectors.

Figure 6: Installation of SPF panel on mounting rails using ITW Buildex TEKS®

First panel of a portrait parallel array hung on new construction

Single SPF installation in landscape orientation

ITW Buildex TEKS Self Tapping Screw
12-24x1 1/4"

6063-T5 Aluminum Architectural Channel or Approved Equivalent

Figure 7: Application of high temperature silicone to AI stint

[Right] Array Interconnect stint installed receiver

[Left] First panel hung with stints installed

Location of Silicone Beads on AI Stint
7) Flash, trim and seal around the SPF array

7a) Apply the appropriate siding-specific flashing to the top of the SPF array. Flashing should be made of aluminum (M2301.2.7, R903.2).
7b) Seal any seams between SPF collectors in multiple collector arrays.
7c) Trim and seal around the perimeter of the array.

It is important to ensure a weather tight seal between the SPF array and the building. Improper flashing and sealing can result in damages to the SPF panels and/or the building.

8) Insert back draft dampers and high temperature insulation

8a) Insert high temperature insulation into wall cavities from the inside of the building. This insulation must be sealed to the backside of the collectors using high temperature silicone to prevent heat loss into wall cavities. See Figure 8.
8b) Install back draft dampers into ducting sections and insert ducting into high temperature insulation. Back draft dampers should be placed as close to the supply and return penetrations in the panel as possible and orientated with the hinges vertically. See Figure 8. Ensure proper airflow alignment of back draft dampers.
9) Run additional ducting, hang fan and mount supply and return air grills

**WARNING!**
Contract with a qualified licensed HVAC contractor to complete ducting properly. Ducting must be connected and sealed according to code and by a qualified individual. Attempting to run ducting without proper credentials can result in system malfunctioning, indoor air quality problems, and structural damage.

9a) Run additional ducting from supply and return penetrations on SPF panel as desired (N1103.2, M1601.1, M1601.3).
9b) Install air handling unit (fan) following manufacturer’s specification. Air handling unit can be installed on either the supply or return side of the system to create either a negative or positive pressure system. If the fan is located on the supply side of the system, use a thermal break to isolate the fan from the ducting to avoid unwanted heat conduction and possible damage to the fan. Air handling units hung in unconditioned space should be hung vertically to avoid moisture accumulation and must be well insulated.
9c) Install supply and return air grilles as desired. All return air grilles should be filtered to avoid debris buildup inside the SPF panel.
9d) Insulate all duct sections not in conditioned space to avoid heat loss (N1103.2.1, M1601.2.1, M1601.3).

If running duct work through non-conditioned space, insure that the proper precautions are taken to avoid condensation from collecting in the duct work. RREAL does not recommend using flexible duct work in unconditioned space. RREAL recommends installing a third back draft damper at the point of transition between conditioned and unconditioned space for all duct runs that travel through non-conditioned space.

10) Contract with a licensed electrician

**Warning!**
Contract with a qualified licensed electrician to complete wiring properly. Connections must be made according to code and by a qualified individual. Attempting to wire a system without proper credentials can result in injury, death and, destruction of property.

10a) Hang the IMC Instruments Eagle 2: Thermal Differential Controller.
10b) Hang the IMC Instruments Eagle 2: Differential Control Thermostat in a proper location well away from any heat sources (N1103.1).
10c) Have a qualified individual properly install and wire the IMC Instruments Eagle 2: Thermal Differential Controller following the wiring diagram in Figure 9. See additional attached documents pertaining to controller installation.

![Figure 9: IMC Instruments Eagle 2: Thermal Differential Controller Wiring Diagram](image-url)
Limited Warranty

Full Ten Year Warranty on the Solar Powered Furnace Series Solar Collectors manufactured by Rural Renewable Energy Alliance

1. Scope of Coverage
This warranty applies to a new solar collector purchased by the end user. The warranty covers the collector as a whole including all of its components and parts. It extends to the first buyer of the collector for a total of ten (10) years from the date of purchase.

2. Warranty on the Collector
Rural Renewable Energy Alliance fully warrants its solar collectors to be free from defects in both material and workmanship for a total period of ten (10) years from date of installation acceptance by the original owner. If a failure does occur during the warranty period, Rural Renewable Energy Alliance will provide a new part, or at Rural Renewable Energy Alliance’s option, have repaired any part of the collector. A new warranty shall apply to any replacement part, but shall be limited in time to the remainder of the original warranty period. This warranty applies to collectors installed for use as a heat collector to provide energy for use in medium temperature range applications (110 to 210 degrees Fahrenheit) only.

3. Service Labor Responsibility
This warranty covers labor expenses for removal and reinstallation. Rural Renewable Energy Alliance will pay up to seventy-five dollars ($75.00) per collector for such expenses.

4. Absorber Surface
Rural Renewable Energy Alliance warrants fully for a period of ten (10) years against any degradation of the absorber surface which would significantly affect the collector performance.

5. Warranty Exclusions
A. This Warranty will not apply to the following exclusions:
   1) To defects or malfunctions resulting from failure to properly install, operate or maintain the collector.
   2) To damage from abuse, accident, fire, flood, hail, wind or other Acts of Nature.
   3) To glass breakage.
   4) To collector failure which occurs due to damage caused by heat transfer fluids.
   5) If the collector is moved from the original installation location.
   6) To damage from when the collector is not installed directly against a building.
   7) To damage from when the collector is installed at any angle other than 90 degrees from the ground, or vertical to the ground.

B. Limitation on Exclusion from Coverage
Conditions that may occur in the normal operation of the collector shall not be invoked by Rural Renewable Energy Alliance to reduce the coverage of this warranty.

6. Other Rights and Remedies
A. Consequential and Incidental Damages
Rural Renewable Energy Alliance shall not be liable for:
   (1) Consequential damages to the system in which the improperly functioning collector is installed, (2) Consequential or Incidental damages to the system in which the collector is improperly installed, and (3) Incidental expenses incurred to replace, as necessary, any other obligations or liability in connection with the collector.

B. No Other Expressed Warranties
Unless otherwise explicitly agreed to in writing, it is understood that these are the only written warranties given by Rural Renewable Energy Alliance, and Rural Renewable Energy Alliance neither assumes nor authorizes anyone to assume for it any other obligations or liability in connection with the collector.

C. Implied Warranties
This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

D. Right to Arbitration
Any dispute between the buyer and Rural Renewable Energy Alliance, pertaining to this warranty may, at the option of the buyer, be resolved by arbitration in the state installed according to the rules of the American Arbitration Association.

E. Right to Indemnity
Rural Renewable Energy Alliance will fully indemnify a licensed contractor who installs the collector and gives a written warranty in the amount of any liability to the buyer under such warranty to a breach that is also a breach of the Manufacturer’s warranty to the buyer.

F. Filing a Claim
All claims should be filed with the contractor or dealer from whom the collector was purchased. If unable to do so, please contact: Rural Renewable Energy Alliance (RREAL), at rreal.org.
Appendix A: Panel Configurations

Sufficient airflow is crucial for the efficient operation of solar air heat systems. Under-sizing the fan or ducting WILL result in efficiency loss. Use the chart below to select the correct size fan and ducting.

**SERIES** - Collectors are connected end to end, or in U-series where all air flows through all collectors.

**PARALLEL** - Collectors are connected side by side. A particular air molecule will travel through the middle of only one collector.

When the building allows, parallel configuration is preferable, although series works well when properly sized.

Systems in series require more fan power than parallel systems since the air needs to be pushed twice as far. Due to the increased fan power required, we do not recommend series configuration for an array of more than 2 collectors. For systems larger than covered in this chart, you may need more than one fan. Please call RREAL for additional sizing information.

Appendix B: Fan Sizing Chart

When selecting a fan for your solar system, it is important to ensure that the fan is sized properly. Improperly sized fans can cause systems to function incorrectly or not at all.

Note: Continental Fan Manufacturing has updated their line of AXC fans. All fans in the AXC line are now Energy Star qualified. As a result, some fan characteristics have changed. These changes have resulted in some changes to the fan sizing chart and recommended duct size for various system configurations. Please ensure that you are selecting the proper fan and duct size for your system.

In certain applications the AXC fans may not be desirable due to their sound level. In applications where a quieter fan is needed, RREAL recommends the WhisperLine™ fans from Panasonic. This line of fans is also all Energy Star qualified.

Fan sizing charts are given in the tables on the following page for both lines of fan. For technical specifications regarding these fans please contact the fan manufacturer. If you have questions about selecting an appropriate fan for your system please contact RREAL.
## CFM AXC Fan PARALLEL CONFIGURATION

<table>
<thead>
<tr>
<th># Collectors</th>
<th>SPF40</th>
<th>SPF32</th>
<th>SPF26</th>
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<tbody>
<tr>
<td>1</td>
<td>6&quot; Duct</td>
<td>5&quot; Duct</td>
<td>5&quot; Duct</td>
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<tr>
<td>CFM/ft²</td>
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<td>6&quot; Duct</td>
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<td>CFM/ft²</td>
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<td>10&quot; Duct</td>
<td>8&quot; Duct</td>
</tr>
<tr>
<td>CFM/ft²</td>
<td>3.5</td>
<td>3</td>
<td>3.3</td>
</tr>
<tr>
<td>Fan</td>
<td>AXC300A-ES</td>
<td>AXC250-ES</td>
<td>AXC200B-ES</td>
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<tr>
<td>Electrical Consumption</td>
<td>206W</td>
<td>197W</td>
<td>188W</td>
</tr>
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</table>

## CFM AXC Fan SERIES CONFIGURATION

<table>
<thead>
<tr>
<th># Collectors</th>
<th>SPF40</th>
<th>SPF32</th>
<th>SPF26</th>
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<tbody>
<tr>
<td>2</td>
<td>8&quot; Duct</td>
<td>8&quot; Duct</td>
<td>6&quot; Duct</td>
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<tr>
<td>CFM/ft²</td>
<td>3.5</td>
<td>3.3</td>
<td>3.4</td>
</tr>
<tr>
<td>Fan</td>
<td>AXC200B-ES</td>
<td>AXC200A-ES</td>
<td>AXC150B-ES</td>
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<tr>
<td>Electrical Consumption</td>
<td>188W</td>
<td>85W</td>
<td>89W</td>
</tr>
<tr>
<td>3</td>
<td>Not Recommended</td>
<td>Not Recommended</td>
<td>Not Recommended</td>
</tr>
</tbody>
</table>
Appendix C: Cut SPF extrusion for multiple panel arrays

In multiple SPF panel arrays it often makes sense to hang multiple panels on the same set of rails. This will help ensure that panels are properly aligned and provide easier installation of the array interconnect system.

1) After determining the desired system configuration (see Appendix A), verify the proper mounting rail layout and dimensions in Appendix D.
2) Mark the appropriate areas where material needs to be removed. See Figure 10 for proper cut dimensions. Location of cuts will vary depending on the array size and configuration, refer to mounting rail layouts in Appendix D.
3) Using an angle grinder, or other appropriate tool, remove material from the aluminum extrusion.
4) Using a grinding wheel or file, smooth all rough edges resulting from the cuts made in step 2. This is done to ensure that the mounting rails will sit properly in the extrusion and for safety purposes.
5) Lay a piece of aluminum mounting rail in the removed notch to ensure proper fit.
6) Repeat this process for the other collectors in the array.

**WARNING!**
The use of an angle grinder or other metal cutting tools can be extremely dangerous. Only operate such tools with the proper training and always wear personal protection equipment.
Appendix D: Portrait Orientation

Table 2: Portrait orientation dimensions

<table>
<thead>
<tr>
<th></th>
<th>SPF 26</th>
<th>SPF 32</th>
<th>SPF 40</th>
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<tbody>
<tr>
<td>A</td>
<td>77 3/8</td>
<td>97 3/8</td>
<td>121 3/8</td>
</tr>
<tr>
<td>B</td>
<td>73 3/8</td>
<td>93 3/8</td>
<td>117 3/8</td>
</tr>
<tr>
<td>C</td>
<td>47</td>
<td>47</td>
<td>47</td>
</tr>
</tbody>
</table>

Note: All dimensions are given in inches

ITW Buildex TEKS are shown to illustrate where the mounting hardware is placed when mounting SPF Panels to Mounting Rails. It is recommended that ITW Buildex TEKS are placed at least 3 inches from the edge of any panel.

Figure 11: Mounting rail locations for portrait orientation installations

*Note: Parts and Dimensions Not Drawn to Scale*
Appendix D: Landscape Orientation

Table 3: Landscape orientation dimensions

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>A</td>
<td>47 5/16</td>
<td>47 5/16</td>
<td>47 5/16</td>
</tr>
<tr>
<td>B</td>
<td>43 5/16</td>
<td>43 5/16</td>
<td>43 5/16</td>
</tr>
<tr>
<td>C</td>
<td>77</td>
<td>97</td>
<td>121</td>
</tr>
</tbody>
</table>

Note: All dimensions are given in inches

ITW Buildex TEKS are shown to illustrate where the mounting hardware is placed when mounting SPF Panels to Mounting Rails. It is recommended that ITW Buildex TEKS are placed at least 3 inches from the edge of any panel.

*Note: Parts and Dimensions Not Drawn to Scale

Figure 12: Mounting rail locations for landscape orientation installations
Appendix D: Multiple Panels in Landscape

Table 4: Multiple panels in landscape dimensions

<table>
<thead>
<tr>
<th></th>
<th>SPF 26</th>
<th>SPF 32</th>
<th>SPF 40</th>
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</thead>
<tbody>
<tr>
<td>A</td>
<td>77</td>
<td>97</td>
<td>121</td>
</tr>
<tr>
<td>B</td>
<td>95 1/4</td>
<td>95 1/4</td>
<td>95 1/4</td>
</tr>
<tr>
<td>C</td>
<td>47 5/16</td>
<td>47 5/16</td>
<td>47 5/16</td>
</tr>
<tr>
<td>D</td>
<td>69</td>
<td>89</td>
<td>113</td>
</tr>
<tr>
<td>E</td>
<td>24</td>
<td>24</td>
<td>24</td>
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</tbody>
</table>

**Note:** All dimensions are given in inches

ITW Buildex TEKS are shown to illustrate where the mounting hardware is placed when mounting SPF Panels to Mounting Rails. It is recommended that ITW Buildex TEKS are placed at least 3 inches from the edge of any panel.

Bottom SPF is hung on two horizontal rails with attached 24 inch connection pieces (E). Top SPF is hung on one horizontal top rail and attached to 24 inch connection piece. 24 inch connection piece is not mounted to wall framing, only used to connect two SPF together.

*Note: Parts and Dimensions Not Drawn to Scale

Figure 13: Mounting rail locations for multiple panels in landscape
International Residential Code - SPF Installation Method Compliance

This appendix contains only selections from the 2006 International Residential Building Code. This is not a complete list of all code that may apply to your installation and is only to be used as a reference. You must ensure that all relevant local, state, federal, international and other codes, whether listed in this appendix or not, are met during your installation. RREAL is not responsible for ensuring that your installation meets all applicable code.


Chapter 3: Building Planning

R309.1.1 Duct Penetration
Ducts in the garage and ducts penetrating the walls or ceilings separating the dwelling from the garage shall be constructed of a minimum of No. 26 gage (0.48mm) sheet steel or other approved material and shall have no openings into the garage.

R324.1.5 Protection of Mechanical and Electrical Systems
Electrical systems, equipment and components, and heating, ventilating, air conditioning and plumbing fixtures, duct systems and other service equipment shall be located at or above the design flood elevation. If replaced as part of a substantial improvement, electrical systems, equipment and components, and heating, ventilation, air conditioning, and plumbing appliances, plumbing fixtures, duct systems, and other equipment shall meet the requirements of this section. Systems, fixtures a, and equipment and components shall not be mounted on or penetrate through walls intended to break away under flood loads.

Exception: Electrical systems, equipment and components, and heating, ventilating, air conditioning and plumbing appliances, plumbing fixtures, ducting systems, and other service equipment are permitted to be located below the design flood elevation provide that they are designed and installed to prevent water from entering or accumulating within the components and to resist hydrostatic and hydrodynamic loads and stresses, including the effects and buoyancy, during the occurrence of flooding to the design flood elevation in compliance with the flood-resistance construction requirements of the International Building Code. Electrical wiring systems are permitted to be located below the design flood elevation provided they conform to the provisions of the electrical part of this code for wet locations.

R602.8 Fireblocking Required
Fireblocking shall be provided to cut off all concealed draft openings (both vertical and horizontal) and to form an effective fire barrier between stories, and between a top
story and the roof space. Fireblocking shall be provided in wood-frame construction in the following locations.

1. In concealed spaces of stud walls and partitions, including furred spaces and parallel rows of studs or staggered studs; as follows:
   1.1 Vertically at the ceiling and floor levels.
   1.2 Horizontally at intervals not exceeding 10 feet (3048mm)
2. At all interconnections between concealed vertical and horizontal spaces such as occur at soffits, drop ceilings and cove ceilings.
3. In concealed spaces between stair stringers at the top and bottom of the run. Enclosed spaces under stairs shall comply with Section R311.2.2
4. At openings around vents, pipes, ducts, cables and wires at ceiling and floor level, with an approved material to resist the free passage of flame and products of combustion.
5. For the fireblocking of chimneys and fireplaces, see Section R1003.19
6. Fireblocking of cornices of a two-family dwelling is required at the line of dwelling unit separation.

Chapter 9: Roof Assemblies

R903.2 Flashing
Flashing shall be installed in a manner that prevents moisture from entering the wall and roof through joints in copings, through moisture permeable materials and at intersections with parapet walls and other penetrations through the roof plane.

Chapter 11: Energy Efficiency

N1103.1 Controls
At least one thermostat shall be installed for each separate heating and cooling system.

N1103.2 Ducts
N1103.2.1 Insulation
Supply and Return ducts shall be insulated to a minimum of R-8. Ducts in floor trusses shall be insulated to a minimum of R-6. (EXCEPTION: Ducts or portions thereof located completely inside the building envelope.)

N1103.2.2 Sealing
Ducts, air handlers, filter boxes and building cavities used as ducts shall be sealed.

N1103.2.3 Building Cavities
Building framing cavities shall not be used as supply ducts.

Chapter 16: Duct Systems

M1601.1 Duct Design
Duct systems serving heating, cooling, and ventilation equipment shall be fabricated in accordance with provisions of this section and ACCA Manual D or other approved methods.
M1601.1.1 Above-ground Duct Systems

Above-ground duct systems shall conform to the following:

1) Equipment connected to a duct system shall be designed to limit discharge air temperature to a maximum of 250°F (121°C).
2) Factory-made air ducts shall be constructed of Class 0 or Class 1 materials as designed in Table M1601.1.1(1).
3) Fibrous duct construction shall conform to the SMACNA Fibrous Glass Duct Construction Standards or NAIMA Fibrous Glass Duct Construction Standards.
4) Minimum thickness of metal duct material shall be as listed in Table M1601.1.1(2). Galvanized steel shall conform to ASTM A653.
5) Use of Gypsum products to construct return air ducts or plenums, provided that the air temperature does not exceed 125°F (52°C) and exposed surfaces are not subject to condensation.
6) Duct systems shall be constructed of materials having a flame spread index not greater than 200.
7) Stud wall cavities and the spaces between solid floor joists to be used as air plenums shall comply with the following conditions:
   7.1 These cavities or spaces shall not be used as a plenum for supply air.
   7.2 These cavities or spaces shall not be part of a required fire-resistance-rated assembly.
   7.3 Stud wall cavities shall not convey air from more than one floor level.
   7.4 Stud wall cavities and joist-space plenums shall be isolated from adjacent concealed spaces by tight-fitting fire blocking in accordance with Section R602.8.

<table>
<thead>
<tr>
<th>Table M1601.1.1(1)</th>
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<tr>
<td>CLASSIFICATION OF FACTORY-MADE AIR DUCTS</td>
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<table>
<thead>
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<th>Table M1601.1.1(2)</th>
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</thead>
<tbody>
<tr>
<td>GAGES OF METAL DUCTS AND PLENUMS USED FOR HEATING OR COOLING</td>
</tr>
<tr>
<td>TYPE OF DUCT</td>
</tr>
<tr>
<td>-------------</td>
</tr>
<tr>
<td>Round ducts and enclosed rectangular ducts</td>
</tr>
<tr>
<td>Exposed rectangular ducts</td>
</tr>
</tbody>
</table>
M1601.1.2 Underground Duct Systems
Underground duct systems shall be constructed of approved concrete, clay, metal, or plastic. The maximum duct temperature for plastic ducts shall not be greater than 150°F (66°C). Metal ducts shall be protected from corrosion in an approved manner or shall be completely encased in concrete not less than 2 inches (51 mm) thick. Non-metallic ducts shall be installed in accordance with the manufacturer's installation instructions. Plastic pipe and fitting materials shall conform to cell classification 12454-B of ASTM D or ASTM D 1784 and external loading properties of ASTM D 2412. All ducts shall slope to an accessible point for drainage. Where encased in concrete being poured. Metallic ducts having an approved protective coating and non-metallic ducts shall be installed in accordance with the manufacturers' installation instructions.

M1601.2 Factory Made Ducts
Factory-made air ducts or duct material shall be approved for the use intended, and shall be installed in accordance with the manufacturer's installation instructions. Each portion of a factory-made air duct system shall bear a listing and label indicating compliance with UL 181 and UL 181A or UL 181B.

M1601.2.1 Duct Insulation Material
Duct insulation materials shall conform to the following requirements:

1) Dust coverings and linings, including adhesives where used, shall have a flame-spread index not higher than 25, and a smoke-developed index not over 50 when tested in accordance with ASTM E 84, using specimen preparation and mounting procedures of ASTM E 2231.

2) Duct coverings and linings shall not flame, glow, smolder, or smoke when tested in accordance with ASTM C 411 at the temperature to which they are exposed in service. The test temperature shall not fall below 250°F (121°C).

3) External duct insulation and factory-insulated flexible ducts shall be legibly printed or identified at intervals not longer than 36 inches (914 mm) with the name of the manufacturer; the thermal resistance R-value, at the specified installed thickness; and the flame spread and smoke-developed indexes of the composite materials. All duct insulation product R-values shall be based on insulation only, excluding air films, vapor retarders, or other duct components, and shall be based on tested C-values at 75°F (24°C) mean temperature at the installed thickness, in accordance with recognized industry procedures. The installed thickness of duct insulation used to determine its R-value shall be determined as follows:

3.1 for duct board, duct liner, and factory-made rigid ducts not normally subjected to compression, the nominal insulation thickness shall be used.

3.2 for duct-wrap, the installed thickness shall be assumed to be 75% (25% compression) of nominal thickness.
3.3 For factory-made flexible air ducts, the installed thickness shall be determined by dividing the difference between the actual outside diameter and the nominal inside diameter divided by two.

M1601.2.2 Vibration Isolators
Vibration isolators installed between mechanical equipment and metal ducts shall be fabricated from approved materials and shall not exceed 10 inches (254mm) in length.

M1601.3 Installation
Duct installation shall comply with Sections M1601.3.1 through M1601.3.6

M1601.3.1 Joints and Seams
Joints of duct systems shall be made substantially airtight by means of tapes, mastics, gasketing, or other approved closure systems. Closure systems with rigid, fibrous glass ducts shall comply with UL 181A and shall be marked "181 B-M" for pressure-sensitive tape, "181 A-M" for mastic, or "181 A-H for heat-sensitive tape. Closure systems used with flexible air ducts and flexible air connectors shall comply with UL 181B and shall be marked "181B-FX" for pressure-sensitive tape or "181B-M" for mastic. Duct connections to flanges of air distribution system equipment or sheet metal fittings shall be mechanically fastened. Mechanical fasteners for use with flexible nonmetallic air ducts shall comply with UL 181B and shall be marked "181B-C." Crimp joints for round metal ducts shall have a contact lap of at least 1-1/2 inches (38 mm) and shall be mechanically fastened by means of at least three sheet-metal screws or rivets equally spaced around the joint.

M1601.3.2 Support
Metal Ducts shall be supported by 1/2-inch (13 mm) wide 18-gage metal straps or 12-gage galvanized wire at intervals not exceeding 10 feet (3048 mm) or other approved means. Nonmetallic ducts shall be supported in accordance with the manufacturer's installation instructions.

M1601.3.3 Fire-blocking
Duct installations shall be fire-blocked with Section R602.8

M1601.3.4 Duct Insulation
Duct insulation shall be installed in accordance with the following requirements:

1) A vapor retarder having a maximum permeance of 0.05 perm \([2.87 \text{ ng/}(s \text{ m}^2 \text{ Pa})]\) in accordance with ASTM E 96, or aluminum foil with a minimum thickness of 2 mils (0.05 mm), shall be installed on the exterior of insulation on cooling supply ducts that pass through non-conditioned spaces conducive to condensation.
2) Exterior duct systems shall be protected against the elements.
3) Duct coverings shall not penetrate a fire-blocked wall or floor.
M1601.3.5 Factory-Made Air Ducts
Factory-made air ducts shall be installed in or on the ground, in tile or metal pipe, or within masonry concrete.

M1601.3.6 Duct Separation
Ducts shall be installed with at least 4 inches (102 mm) separation from earth except where they meet the requirements of Section M1601.1.2.

M1601.3.7 Ducts Located in Garages
Ducts in garages shall comply with the requirements of Section R309.1.1.

M1601.3.8 Floor Hazard Areas
In areas prone to flooding as established by Table R301.2(1), duct systems shall be located or installed in accordance with Section R324.1.5.

M1602.2 Prohibited Sources
Outdoor and return air for a forced-air heating or cooling system shall not be taken from the following locations:

1) Closer than 10 ft (3048 mm) to an appliance vent outlet, a vent opening from a plumbing drainage system, or the discharge outlet of an existing fan, unless the outlet is 3 ft (914 mm) above the outside air inlet.

2) Where flammable vapors are present; or where located less than 10 ft (3048 mm) above the surface of any abutting public way or driveway; or where located at grade level by a sidewalk, street, alley, or driveway.

3) A room or space, the volume of which is less than 25 percent of the entire volume served by such system. Where connected by a permanent opening having an area sized in accordance with ACCA Manual D, adjoining rooms or spaces shall be considered as a single room or space for the purpose of determining the volume of such rooms or spaces.

3.1 Exception: The minimum volume requirement shall not apply where the amount of return air taken from a room or space is less than or equal to the amount of supply air delivered to such room or space.

4) A closet, bathroom, toilet, kitchen, garage, mechanical room, furnace room, or other dwelling unit.

5) A room or space containing a fuel burning appliance where such room or space serves as the sole source of return air.

5.1 The fuel-burning appliance is a direct-vent appliance or an appliance not requiring a vent in accordance with Section M1801.1 or Chapter 24

5.2 The room or space complies with the following requirements:

5.2.1 The return air shall be taken from a room or a space having a volume exceeding 1 cubic foot for each 10 Btu/h (9.6 L/W) of combined input rating of all fuel-burning appliances therein.
5.2.2 The volume of supply air discharged back into the same space shall be approximately equal to the volume of return air taken from the space.

5.2.3 Return air shall not be located within 10 ft (3048 mm) of any appliance firebox or draft hood in the same room or space.

5.3 Rooms or spaces containing solid-fuel burning appliances, provided that return-air inlets are located not less than 10 feet (3048 mm) from the firebox of such appliances.

Chapter 23: Solar Systems

M2301.2 Installation
Installation of solar energy systems shall comply with Sections M2301.2.1 through M2301.2.9.

M2301.2.1 Access
Solar energy collectors, controls, dampers, fans, blowers, and pumps shall be accessible for inspection, maintenance, repair, and replacement.

M2301.2.2 Roof-Mounted Collectors
The roof shall be constructed to support the loads imposed by roof-mounted solar collectors. Roof-mounted solar collectors that serve as a roof covering shall conform to the requirements for roof coverings in Chapter 9 of this code. Where mounted on or above the roof coverings, the collectors and supporting structure shall be constructed of noncombustible materials or fire-retardant-treated wood equivalent to that required for the roof construction.

M2301.2.7 Roof and Wall Penetrations
Roof and wall penetrations shall be flashed and sealed in accordance with Chapter 9 of this code to prevent entry of water, rodents and insects.
SOLAR AIR HEAT ATTACHMENT METHOD
DETAIL B

- ALUMINUM FLASHING
- DEEP BROMZE POWDER COATED
- ALUMINUM FRAMES
- MINIMUM SLOPE OF 5 TO 12 ODD EYES
- TO ALLOW FOR WATER SHEET
- COLOR MATCH TO BUILDING
- SLEEVED WASHER (TYP)
- HEX SCREW WITH BONDED SILICONE BETWEEN BUILDING AND FLASHING (TYP)
- FLANGE MATERIAL TO PREVENT FILTER MATERIALS TO COMPRESSIBLE AND FLASHING WITH COMPRESSIBLE
- FLANGE MATERIAL TO PREVENT FILTER MATERAIL TO COMPRESSIBLE AND FLASHING WITH COMPRESSIBLE

NOTE: THIS DOCUMENT IS FOR REFERENCE PURPOSES ONLY. ACTUAL INSTALLATION MAY DIFFER.
Diagram of Wiring Instructions for EAGLE 2 Warm Air System.

- **FAN UNIT**
  - Cool Air Inlet
  - Fan plugs into bottom of controller

- **HEATED AIR**
  - Collected by Collector Sensor

- **OPTIONAL AUXILIARY INLET**
  - Optional auxiliary inlet

- **COLLECTOR SENSOR**
- **Sensor**

- **WARM AIR DIFFERENTIAL TEMPERATURE CONTROL**
  - Relays
  - #1, #2, #3, #4

- **EAGLE 2**
  - Warm Air Differential Temperature Control

- **NEC CLASS 2 CIRCUIT**
  - Differential Control
  - TST, HSE, COL, SHLD

- **CONTROLLER**
  - Plugs into wall outlet

*Optional auxiliary sensor used for data logging, not included*
EAGLE 2 WARM AIR DIFFERENTIAL TEMPERATURE CONTROL WIRING INSTRUCTIONS

1. ATTACH SENSOR IN COLLECTOR, PREFERABLY TO MATERIAL THAT IS A GOOD CONDUCTOR.
   IF COLLECTOR MATERIAL IS NOT COPPER, USE SILICONE OR OTHER SPACER TO PREVENT CORROSION.
2. PLACE CONTROLLER AS CLOSE TO FAN AS POSSIBLE FOR EASE OF WIRING.
3. USING 22/3 WIRE, CONNECT SENSOR WIRES TO DIFFERENTIAL CONTROLLER AS ILLUSTRATED IN DIAGRAM.
4. PLACE THERMOSTAT IN LOGICAL LOCATION IN THE BUILDING INTERIOR.
5. USING 22/5 WIRE, CONNECT CONTROLLER TO THERMOSTAT AS ILLUSTRATED IN DIAGRAM.
6. PLUG CONTROLLER IN TO WALL OUTLET.

EAGLE 2 WARM AIR DIFFERENTIAL TEMPERATURE CONTROL SET POINT INSTRUCTIONS

THE CONTROLLER HAS 4 CONTROLS:
1. OFF-ON-AUTO SWITCH
2. ON DIF
3. LO LIM
4. THERMOSTAT

1. THE “OFF-ON-AUTO” SWITCH (#1) CAN BE USED TO TEST THE FUNCTION OF THE FAN, ETC. MAKE CERTAIN THAT THE SWITCH IS SET TO “AUTO” PRIOR TO ATTACHING COVER PLATE.

2. IN RESIDENTIAL APPLICATIONS, RECOMMENDED “ON DIF” (#2) SETTING IS 16. FOR COMMERCIAL OR UNHEATED SPACE APPLICATIONS, THE SETTING CAN BE LOWERED TO 8 FOR MAXIMUM HEAT HARVEST. This functions as follows: when the temperature difference between the sensor in the solar collector and the sensor in the building exceeds the dialed temperature difference setting, the fan relay will actuate after a 30-second delay. When the temperature difference decreases 4 degrees F below the set point, the fan will turn off without delay.

3. IN RESIDENTIAL APPLICATIONS, RECOMMENDED “LO LIM” (#3) SETTING IS 90. FOR COMMERCIAL OR UN-HEATED SPACE APPLICATIONS, THE SETTING CAN BE LOWERED FOR MAXIMUM HEAT HARVEST. This feature prevents the system from operating the fan when the collector temperatures are too low and could result in cold drafts in the heated space. If the collector sensor temperature is below the LO LIM setting, the controller differential function (#2) will be disabled and the power relay will be kept in the off position. If the collector sensor rises above the LO LIM setting PLUS 10 degrees, the controller will be enabled and return to normal operation.

4. IN RESIDENTIAL APPLICATIONS, RECOMMENDED “THERMOSTAT” (#4) SETTING IS 85 DURING THE HEATING SEASON. WHATEVER THE SETTING, IT MUST BE HIGHER THAN THE BACKUP HEAT THERMOSTAT IN ORDER FOR THE SYSTEM TO FUNCTION PROPERLY. FOR COMMERCIAL OR UNHEATED SPACE APPLICATIONS, THE SETTING CAN BE INCREASED TO MAXIMUM, 105, FOR INCREASED HEAT HARVEST. When the building temperature rises 3 degrees above the THERMOSTAT setting, the fan will turn off without delay. When the space temperature decreases below the THERMOSTAT setting, the controller will check to see if there is heat in the collector. If the collector is hot enough, the fan will turn on.
Wiring Diagram

INSTALLATION

MOUNTING- The Eagle line of SOLAR controllers are designed to be mounted indoors, protected from rain and condensing moisture. Use two #10 screws in the enclosure "keyholes" for mounting.

POWER WIRING- Hard wired models are designed for 120 vac operation unless special ordered. If relay is wired to switch any voltage other than 120 vac then the "20 AMP RELAY JUMPER" MUST BE REMOVED. Use solid wire in 16 or 18 ga. and stranded (19 max) in 12 or 14 ga. Same gage and stranding must be used under both sides of each clamping washer. All wiring must be done in accordance with local codes. Models supplied with line cords and receptacies are to be connected directly to power outlets without the use of extension cords. Line and power wires should not be bundled with or placed in the same conduit with sensor or data cables.

SENSOR INSTALLATION AND WIRING- Sensor installation should be in a manner as to permit proper sensor contact of the areas to be measured. Shield and/or insulate the sensors to prevent them from being affected by the surrounding ambient temperatures. Sensor wiring installed outdoors must be rated for OUTDOOR use. All connections exposed to the weather must be made with waterproof "outdoor" rated connectors.

It is recommended in today’s Radio interference “RICH” environment that all sensor wiring be shielded. Listed below are a few suggested wire part numbers. Wire selected must also meet local codes and be rated for indoor/outdoor use by its manufacturer.

1) "PLTC" Belden # 9322 (22ga) or 9320 (20ga) 
Best specifications
2) "Control" Belden #8761 (22ga) or 8752 (20ga) 
Better specifications
3) "Audio" Belden #9451-19 Black (22ga) 
Acceptable specifications

The cable SHIELDS must be brought to the shield grounding terminal that is the rightmost position on the GREEN terminal block. See controller layout diagram. For ease of shield installation, insert one short wire in the shield terminal labeled “SHLD” and connect all the shields together with a “wire-nut” or other reliable means. Ungrounded shields may result in damage to the Solar controller circuits. The shield requires grounding at the controller side ONLY. DO NOT attempt to ground the collector panel with the sensor shield.

For efficient and reliable wire connections, strip 3/8” (slightly shorter than block width) of insulation from an undamaged wire end. Use a stripped tool that will not nick the conductors. If wire is solid, make sure that the tip is NOT pinched or deformed so that it will fit into the terminal hole easily. If the wire is stranded, make sure the strands are tightly twisted. Using a 1/8” (3mm) wide blade screwdriver, select the appropriate screw and turn CCW to open the terminal hole fully. Then guide the wire into the terminal hole and hold while tightening (turn CW) the screw to clamp the wire. WARNING- If a 5/32” (4mm) wide screwdriver blade is used, the screw retaining edge of the hole will be scraped off allowing the screw to fall out. DO NOT reverse the screw turning directions and place the wire outside the metal CAGE creating an unreliable connection. DO NOT slip off the screw and damage any circuit components. If the wire is stranded, make sure that ALL the strands are properly clamped in the terminal.

COLLECTOR GROUNDING- The Solar collector panel array “must be GROUNDED” directly to an earth ground line. This is necessary to prevent damage from nearby lightning strikes which induce very DAMAGING high voltages in all nearby ungrounded metallic surfaces. Please consult local, state and federal codes for proper grounding.

DATA LOGGING TO A COMPUTER- All the EAGLE Solar controllers can be connected to the serial port of a PC or Laptop computers. An IMC DATA PORT/RS232 adapter is required. The maximum recommended adapter cable length is 500 feet. All Windows operating systems have a communications programs such as “Terminal” or “Hyper Terminal” which are used to receive and/or CAPTURE data from the PC’s serial port. This feature is “EXTREMELY” valuable in starting up newly installed SOLAR systems. Long-term data logging is now possible which can be very useful in service and diagnostics of intermittent malfunctions. Complete “system status” including temperature is presented in a line by line format including timer information. In applications were the computer’s interface is going to be permanent it is recommended that the EAGLE WEB model be used in order to protect the connecting computer from electrical surges.

Please visit our website for news or more detailed instruction at "www.solar.imc-instruments.com".
**EAGLE 2 - CONTROLLERS FOR WARM AIR APPLICATIONS**

**MAIN FEATURES**
- Microprocessor accuracy and dependability with ambient operation from -10 to 120°F
- Large easy-to-read 40 character (20x2) backlit LCD display showing every parameter measured and controlled by the microprocessor.
- DATA port with transmitter that allows optional adapter to interface with computers using up to 500 feet of cable, for easy startup and remote diagnostics. Or, for adding an Optional large 80 character (4x20) backlit LCD display. Remote-mount up to 150 feet away with a CAT-5 cable.
- Long-term diagnostics and data logging is possible with communications software that is included in Windows’ OS or with our optional charting software.
- Fault LED indicators for quick servicing and diagnostics
- Easy access to wiring compartment for quick installation.
- Electrostatic discharge protected
- One HP or 20 AMP high reliability relay
- Polyester coated 16 gage rugged steel enclosure
- Model available with receptacle & power cord or with 1/2” conduit holes for permanent wiring rated for highest current.

**INSTRUMENTATION WITH QUALITY ENGINEERING**
Attention Solar enthusiasts,
Below please find an application note that we included in past Emails. This is a Reminder that in today’s SERIOUSLY CONGESTED AIR WAVES you should take all recommended precautions to protect your SOLAR INSTALLATIONS !!! Radio interference is now present every were you go in the form of YFIY networks, Cell phones, wireless telephones and other types of transvers. The attached recommendations will minimize their effect in SOLAR INSTALLATIONS. We hope that you follow the recommendations we have outlined in the attached PDF wiring application Notes.

Best Regards Louis Frias IMC Instruments

NOTICE

The manufacturer of the Eagle line of controllers strongly recommends that sensor wiring be done with proper shielding. Sensor wiring should be shielded so that the signal quality remains high while also protecting the microcircuits from damage by low energy electrical disturbances.

All spliced connections exposed to the weather must be made with waterproof “outdoor” rated connectors.

Listed below are a few suggested wire part numbers. Wire selected must also meet local codes and be rated for indoor/ outdoor use by its manufacturer.

1) “PLTC” Belden # 9322 (22ga) or 9320 (20ga) Best
2) “Control” Belden # 8761 (22ga) or 8762 (20ga) Better
3) “Audio” Belden # 9451-10 Black (22ga) Pass

Check for availability from your control supplier or any of these sources: Anixter, Graybar Electric or Newark Electronics.

Revised 10/08/10

* Manufactured in U.S.A by - IMC INSTRUMENTS, INC.
Solar Powered Furnace Installation Technical Specifications Sheet

I. General

1.1 Summary -- Provide and install vertical wall mounted Solar Powered Furnace (SPF) systems including the panels, ducting, high temperature insulation, fan, controller unit, thermostat and wiring

1.2 References

A. Complete installation in accordance with all applicable building standards and local ordinances
B. Complete installation in accordance with ASTM Standard fixed designation E683
C. Complete installation in accordance with all applicable ANSI and NEC standards
D. It is the responsibility of the installer to follow the appropriate health and safety standards

1.3 Submittals

A. Appropriate energy efficiency improvements completed prior to solar deployment
B. SPF Site Assessment form completed by qualified Rural Renewable Energy Alliance (RREAL) staff or certified SPF dealer
C. Solar Pathfinder site reading
D. Floor plans, drawings and/or photos detailing site

1.4 Quality Assurance

A. All panels shall be verified using the QA/QC inspection checklist
B. All panels shall be inspected by RREAL manufacturing plant before entering inventory
C. All panels shall bear a label containing information as required by the third party certifying body, Solar Rating and Certification Corporation (SRCC)

1.5 Delivery, Storage and Handling

A. Materials and panels to be delivered to the job site in good condition
B. Any open ports on SPF panels will be sealed for transport
C. Panels shall be stored as recommended by manufacturer until deployment date

1.6 Project Conditions

A. For all components, maintain manufacturer’s recommended environmental conditions; do not install components outside of recommended conditions
B. Ensure correct dimensions and project plan prior to beginning project
II. Products

2.1 Manufacturing

A. All SPF panels to be manufactured by RREAL, Rural Renewable Energy Alliance, 2330 Dancing Wind Rd SW, Suite #2, Pine River, MN 56474, 218-587-4753.

B. Eagle 2 controller and thermostat to be manufactured by IMC Instruments

2.2 Materials

A. SPF collectors are the only allowable solar air heat collector for installation, manufactured by RREAL, Rural Renewable Energy Alliance, 2330 Dancing Wind Rd SW, Suite #2, Pine River, MN 56474, 218-587-4753. Collector substitutions not allowed.

B. Ducting
   1. Use ducting for job-specific requirements, as detailed by RREAL in attached drawings and specifications
   2. Use Aluminum or galvanized steel starter collars, elbows and joints as detailed by RREAL in attached drawings and specifications
   3. Filtered return air grille as detailed by RREAL in attached drawings and specifications
   4. Seal penetrations, ducting and high temperature insulation in accordance with Chapter 16 of the International Residential Code and all other applicable building standards and local ordinances

C. Fan Unit -- Use fan/blower appropriate to the installation as detailed by RREAL in attached drawings and specifications

D. Mounting Rails
   1. 6063 Aluminum 1”x2”x0.125” Rectangular Tubing
   2. Or 6063 Aluminum 1”x2”x0.125” Architectural Channel

E. Controller and Thermostat
   1. Eagle 2 Controller manufactured by IMC Instruments
   2. Eagle 2 Thermostat manufactured by IMC Instruments
   3. Thermistor with high temperature wire manufactured by IMC Instruments
   4. Thermostat wire

F. Array Interconnect (AI) System
   1. Silicone (AI) receivers from RREAL
   2. Silicone (AI) stints from RREAL
G. Fasteners
   1. GRK Fasteners Rugged Structural Screw 5/16” Climatek coated
   2. ITW Buildex 12-24x1-1/4 HWH TEKS®/5 Climaseal Self-Drilling Fasteners

H. Pipe Insulation – Knauf 1000° Fiber Glass Pipe Insulation

I. Sealant - ChemLink DuraSil Low VOC silicone sealant

2.3 Fabrication
   A. SPF Panels to be manufactured in RREAL manufacturing plant in accordance to RREAL manufacturing standards and protocol
   B. Any array interconnect (AI) ports to be cut in RREAL manufacturing plant and receivers installed

III. Execution

3.1 Preparation
   A. Prepare surfaces in accordance with SPF Wall Mount installation method
   B. Ensure adequate space for SPF panel to mount flush
   C. Ensure proper vapor barrier is installed according to local building code
   D. All panels to be mounted plumb and level

3.2 Installation
   A. Install in accordance with SPF Wall Mount installation method
   B. Ensure that ducting is properly fitted and insulation properly installed in wall cavities
   C. Ensure that panel is properly flashed and trimmed

3.3 Protection
   A. Protect product in a manner that ensures no damage to product through project completion
   B. Ensure that all ports or holes cut in SPF panel are covered or sealed until ready to install to prevent debris from entering system
   C. Repair or replace damaged products as a result of transport or installation processes, do not install damaged or compromised components
**Recommended Installation Tools**

This list of tools is intended to be a recommendation only. Every installation is unique, not all tools on this list may be applicable in all cases. Some installations will require tools not shown on this list. It is the responsibility of the installer to make sure all the necessary tools are present to complete the job in a safe and code compliant manner. RREAL takes no responsibility for contractor tools, use and maintenance of tools, or insuring the all necessary tools to complete the project are present.

**Hanging Collectors**

- Personal Protection Equipment
- Drills, bits (metal and wood), drivers (tork, hex, other)
- Saws (keyhole, reciprocating, other, metal and wood blades)
- Long pipe clamp (at least 8’4”, longer may be required for larger systems)
- Rubber mallet and hammer
- Extension ladder
- Scaffolding
- Right angle drill
- Angle grinder (cutoff wheel, grinding wheel)
- Hole saws (various sizes)
- Long pilot bit
- Hammer stapler
- Stud finder
- Tape Measure
- Level (4’ or 6’ recommended)
- Chalk line
- Vacuum
- Caulk gun
- Work Light(s)
- General and miscellaneous hand tools

**Electrical**

Warning: Contract with a licensed electrician and insure that all applicable code is met.

- Wire stripper and cutter
- Wire splices and crimper, wire nuts
- Wiring screwdriver (various sizes)

**Ducting**

- Duct crimpers
- Tin snips
- Duct Seamer
- Duct Notcher