

Española Valley Low-cost Do-it-Yourself Solar Collector



Instruction Packet with Materials List

Version 4.30.2015

BUILD YOUR OWN SOLAR COLLECTOR

This packet is being created to tap into the beautiful and abundant sunshine of the Española Valley to help us heat our homes and save money on heating costs. It was first developed in the frigid San Luis Valley of Colorado, about 100 miles north of here, back in the 1980's by a building contractor, a scientist and some do-it-yourselfers, and was so successful that it spawned a whole bunch of collectors around Alamosa and surrounding area which are still running today. It produced a snowball effect and we think it might do the same thing here!

The problem of paying astronomical costs for heating our homes in the winter needs to be addressed, and this is a super way of addressing it.

We got the idea to design an updated collector, using our experiences over the recent decades, to capture the sunlight and convert it to heat air, and then blow that air under the floor of any structure, a house, a trailer, or other building. We wanted to do this for the least cash possible, while creating a collector that would last for many years out of durable materials, and in such a way that almost anyone could put it together, and reap the benefits.

This packet tells you how to build the collector, using new materials that were not even available back in the '80's. We also "discovered" that patio glass doors can be recycled for the glass, and really make the collector more economical to build than ever. Check your local glass shop, or your backyard, for used doors for free or cheap!

We hope you will enjoy putting together a collector, and helping others to do so also. Please contact us to find out about upcoming community workshop events and barn-raising-style get-togethers, with neighbors helping neighbors. We think you will have so much fun and produce so much heat you won't be

able to stop yourself! These collectors produce about 900-1,000 BTU's per square foot of collector on a sunny day in Española. You will be hooked.

We want to get feedback on ways to improve this collector, as well as questions or suggestions for improving the packet, and better and more economical sources of materials. You may also have leftover pieces of Paint Lock or fiberglass ductboard from your project you could pass on to others, through us. If you want to modify these plans and build a bigger or alternative collector, request the Supplemental Information packet. Also, if you want to be on a mailing list for further updates/ improvements/ corrections to this packet, and better sources for materials, please give us your contact information. Looking forward,

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BUILD YOUR OWN COLLECTOR

Let's get started:

First, try to locate a used patio glass door. Check with an ohmmeter if you suspect it has a low-e coating. The coatings are conductive. A glass supplier may be able to help you determine this also. Low-e means poor light transmission. We want high light emission. If it has low-e, find a different door. Low-e is almost impossible to remove. This is also why we use only one pane of glass for the glazing. Take the door apart; it usually consists of two sheets of tempered glass, and you only need one, per collector. Usually they come in either 34 or 46 inch widths, by 76 inches high. Since tempered glass cannot be cut, you will be using the size of your glass to size your collector. You can also buy sheets of tempered glass for a lot more money per square foot, and order them to the dimensions you prefer, so that is always an option. Or you might plan to build two collectors, using two panes.

Plan to install your collector vertically on the south wall of your home, if it gets full sun in the winter. This is the most efficient installation possible, but we can talk about other possibilities (See our Supplemental Info Packet). Then, consider blowing warm air into your crawlspace where the warmth will be stored and radiate up through your floor and reduce your fossil fuel heating bill. It can also help protect any plumbing you have down there from freezing! If the

crawlspace has a dirt floor, you should line it with a sturdy plastic sheet to prevent dirt from being circulated through your collector and keep the area dry and clean. This plastic should be sealed to the perimeter insulation to create a “balloon” of heated air under the floor of your home.

[Figure 1]

And by the way, installing the collector vertically, at 90 degrees to the ground, you will have no problems in the summer. The collector will not even turn on in the summer, due to the angle of the sun at that time of year.

Now plan your layout for ductwork and fan, including wiring for fan and thermoprobe into collector. Electrical work should be done by a qualified electrician. Fan should be installed so that it pulls air from the collector. It should pull air through the collector and push it to the delivery point.* Check your fan instructions. Some are permanently sealed and never need lubrication. Others will need lubricating twice a year, so just to be sure, locate the fan where you can reach it easily. (Oil it when it first turns itself on in the fall, and again around New Year’s. Use SAE20 or 10/40 motor oil. Put 2 drops, no more, in each oil port. Do not over-oil.)

*See paragraph 6 of Supplemental Info Packet for information on collector design.

The thermostat will automatically turn on the fan when the collector reaches the temperature you indicate. A remote probe inserted into the air channel of the collector senses the temperature within the collector. When the collector cools below this set temperature (as, for example, in the summer, due to shading or the angle of the sun), the fan automatically turns off.

[Figure 2]

We recommend pushing this air with the fan into the coldest corner of your crawlspace, or farthest distance possible from the collector, where the warmth will be stored and will radiate heat up through your floor. We include 60 feet of stovepipe in the materials list to carry the warm air from the fan just as we are suggesting here. You may need more, or less.

If you live in a trailer you will want the crawlspace area insulated to hold the solar heat as it warms up the floor above. We recommend an excellent product

called Prodex which can be ordered from Amazon.com. (Rated R value is 16) We are also testing Radiant Barrier with an R rating of 3 but with similar performance ratings for bouncing radiant heat back into crawlspace. Information on these products is in the materials list. There are other brands of thin radiant barrier insulation, if interested, with varying degrees of insulative values and cost. Foil-faced insulation bounces back into the heated area 97% of the area's radiant heat!

Now review the materials list. We provide information on where to buy the materials at the best price we have found so far. Please let us know if you discover better and/or more economical sources.

You will need the following tools and materials:

Saw horses, caulking gun, rubber gloves, putty knife, box cutter, serrated knife, 4" drywall knife, jigsaw, circular saw, screwgun with drill bits and screw driver bits, tools for wiring fan to house current, tools and materials for mounting blower, and wire or strapping for suspending stovepipe ductwork from floor joists.

Gather your materials and tools. Plan to install the ductwork and wiring in advance, if possible.

See wiring instructions near end of this document. There are certain other tasks which should

be done in advance of the actual construction and installation of the collector, because they need time to dry or cure the caulk and paint. As follows:

Do this at least 2-3 hours ahead of installing ductboard in the collector (Step No. 7 below):

Lay your 4'x10' ductboard on supports (such as sawhorses) with the fiberglass side upward. **Coat the fiberglass completely with high temperature silicone caulk**, using the 4" drywall knife, drywall spatula or similar device to spread it around. This will provide a very durable heat-resistant surface for the inside of the hot air chamber. You might wear rubber gloves to do this as it can get messy. The coating does not have to be thick, just make sure it's thoroughly covered. Let this dry at least 2-3 hours before handling.

Do this at least 1 hour ahead of installing collector plate in collector (Step No. 13 below):

Lay your 26 gauge sheet of Paint Lock flat in a good location with lots of ventilation (outside is best). **Spray it with the high temp flat black paint**, coating it evenly and just enough to darken it. Avoid coating it any thicker than necessary. Heat from the sun will transfer through the paint and Paint Lock plate to the air chamber on the backside of this Paint Lock absorber plate. The thinner the paint is applied, the better the transmission of heat. Let dry at least one hour before handling.

Now you are ready to start building.

1. Clean your tempered glass sheet, especially the side which will be inside the collector and permanently sealed. Make sure to remove any film.

Measure and cut your OSB backing. Make it also 1" wider and 1" longer than your glass. Example: 46"x76" glass = 47"x77" OSB. Attach OSB to the south wall of the house at this time. You may wish to attach the collector with wood screws long enough to secure the OSB to the south wall. If the wall is wood frame, then screw into the vertical studs. The collector will be assembled in the vertical position. (If assembled horizontally, the collector would be mounted, after assembly, to a framework or a wall with perimeter supports such as brackets. See our Supplemental Info Packet)

2. Determine placement of 6" diameter holes in OSB for stovepipe, depending on where air should enter and leave collector, and taking into account where pipe will connect to the fan and where you have room to run ducts. You can put both holes in one end of collector, or one in each end. In this packet we show both holes in one end. The hot air stovepipe leaving the fan should be run under the floor to the coldest area of the house (usually the northeast). The stovepipe can be hung under floor using strapping or wire. The cold air intake or "return" should be from ground level and enter directly into the cold air intake port of the collector. Trace holes on OSB no closer than 3" from edges of OSB. You will need this clearance for stovepipe flanges. Please read step # 10.
[Figures 5 and 7]

3. Cut out 2 stovepipe holes in OSB. Use ¼ " drill bit to start holes, then cut with jigsaw.
[Figure 5]

4. **Build your collector box.** First measure and cut perimeter channel track pieces as follows, using example above. Cut 2 – 120” lengths and 1 – 14” length.

[Figure 4]

5. **Cut notches in channel track and bend at the notch to form 4 corners.** See Figure 4 which shows corners on ten foot track. The example shows two ten foot tracks with a third section of track 20 inches long, to connect them. Shorter lengths of track can be used, but do not try to have two tracks connect at a corner. Too hard to seal. We want the corners to be airtight.

[Figures 3 and 4]

6. **Line up channel track** exactly along the outer edges of the plywood. The open side of the C channel faces inward. **Screw C channel to the top surface of the plywood.** Place screws every 6” or so, screwing thru C channel into plywood with 3/4” hex head self-drilling screws. Form the frame per diagram by overlapping at as few points as possible to minimize potential air leaks to outside. Our design shows 2” overlaps to best utilize 10 foot C channel. Do not overlap any less than 2”. Now you have a framed collector box. If you could look at back side of collector all you would see is OSB. The C channel does not show at all on back side.

[Figure 4]

7. **Measure and cut the rigid ductboard insulation,** now coated, so that it is 1” longer and 1” wider than your sheet of glass. Put aside your scrap, you'll need it later. Mark location of stovepipe holes on the ductboard, so you can cut through after installing. Place ductboard down inside your box, with the caulked coating facing you and the foil side down against the plywood, hidden from view. Push until snug. This insulates the backside of the collector’s air channel or chamber.

8. **Cut holes through ductboard** where you know each of the two holes are in the plywood. Cut around ductboard holes with serrated knife to match plywood holes. Now your holes are ready for the stovepipe.

[Figure 5]

9. Use your leftover scrap of coated ductboard to cut strips to **insulate the inside edges of the channel track frame.** These strips should be cut so that

when installed the caulked side will be facing inward toward the airspace. For channel track which is 3 ¾" deep, these strips will be 2 ¾" deep. Push them into the open side of the perimeter metal frame, with the siliconed side facing you (inside of the collector). Now the collector frame is insulated also.

[Figure 6]

10. Figure 7 illustrates how to prepare two 6" stovepipes to serve as "sleeves" for the hot and cold air stovepipes. Get your hot air output and cold air return stovepipes ready by crimping the ends that will be inserted into the sleeves. The hot air stovepipe section should connect to an uncrimped section and the cold air pipe should connect to a crimped section to insure good suction.

[Figure 7]

Attach the flanges on the collector side over the ductboard insulation, through the insulation and to the OSB beneath it. Insert the smooth stovepipe end into the crawlspace for direct attachment to the fan and to the cold air return pipe from the ground level.

11. Now install your absorber plate support channel all around the inside perimeter. Do this by measuring inside dimensions carefully and cut lengths of support channel to fit your inside dimensions, sliding one tip inside the other where they meet at each corner. The material will be flexible enough to allow this and this will form stronger corners. Some trimming may be necessary. Screw them through the ductboard and into the OSB backing with 1 5/8" black panhead framing screws. Don't tighten the screws through the baffles too tight, so they don't compress the ductboard much.

[Figures 3 and 6]

12. Measure and cut a length of this same absorber plate channel to create a baffle to direct air flow inside the air chamber and also to support the absorber plate at the mid section of the air channel. The air channels should add up to the same number of square inches as the area of the stovepipe to guarantee the air flow is balanced throughout.

[see Figures 6]

Center the baffle lengthwise and screw into the middle of the collector, through ductboard and securing to plywood, using 1 5/8" black pan head framing screws. In the crawlspace heating design of this packet, the hot and cold air ports are on the same end of the collector. Leave the 14" opening on the opposite end of the collector.

[Figure 5]

*Note: For a collector with ports on opposite ends of the collector:
In a 76" long collector, for example, where there is one air port on each end, this baffle would be 48" long. (76" minus 14" minus 14" = 48"). In this case, remember to leave 14 square inches at each end for air flow. See our Supplemental Info Packet)*

13. **Drill the hole for the thermoprobe**, the diameter of the tube you have. Locate this hole in the lower part of the air channel so that the thermoprobe connection from the thermostat will reach. Drill the hole from the outside through perimeter channel track and into hot air chamber area behind where absorber plate will go.

14. **Install absorber plate.** Measure inside dimensions to size the absorber plate. It should be cut about one inch shorter and one inch less wide than the plywood backing and try pushing it in to make sure it fits snugly up to the ductboard insulation all the way around. (Save the absorber plate scrap for future applications!) Take it out. **A bead of caulk should be placed on the absorber plate support channel** around the inside perimeter before installing the plate. **Mark carefully where the center baffle runs below the plate**, so you can know exactly where to screw to hold plate firmly to the baffle. Now place absorber plate into collector so it rests evenly on support channel all around, and on baffle track. Before screwing into place, **apply silicone caulk to the top of the perimeter absorber plate support channel and the top of the central air baffle** (which also serves to support the absorber plate). This will seal the absorber plate tightly when it is screwed down. Now screw down the absorber plate by placing pan head screws #7 7/16" every 6" or so around entire edge and on baffle track.

15. **To seal the plate**, caulk all around edges of plate where it rests on support channel and touches ductboard insulation in frame. Let dry for an hour or two before installing glass cover.

[see Figure 6]

16. Place the glass with the bottom edge of the glass resting on two temporarily installed support screws **padded with soft metal strips** obtained, for example, from an aluminum can. These support screws are placed in the extra ½ inch space below the glass. **Be sure no metal touches the edge of the tempered glass**, to prevent its shattering.

[Figure 6]

The weight of the glass is being held up by these two (temporarily installed) padded screws. A wedge may not be necessary to separate glass from the channel to insert caulk. Be sure the glass is ½ inch inside collector perimeter all the way around. Using braces and/or tape to hold glass against the track, allow the caulk to set up at least overnight before removing the support screws. [Figure 6]

17. Wire up the blower. Use extension cord cut in two to run from collector to blower and from blower to outlet. One of the two main wires should be cut to wire in the thermostat. Use connectors to join wires inside rectangular electrical box, and one connector installed at blower. Test everything with power before closing up. [Figure 2]

18. Insert the tube in the hole for the thermoprobe attached to the thermostat. Hook up fan to test the probe before inserting probe into air channel of collector. Thread probe through this hole, leaving an inch or so of wire inside. Once probe is inserted, seal the probe tube with silicone caulk to hold it firmly in place once the caulk has dried.

Thermostat will now kick the blower on automatically every time the air in the collector reaches your set temperature. **The temperature setting for the thermostat to turn on can be adjusted.** Efficient collectors run cool. Feel the glazing on your operating collector at noon on a sunny day. If it is hot (above 120 degrees) you are losing too much heat from the collector and it is operating inefficiently. Turn thermostat to a lower temperature for it to kick on sooner. We have tested the blower listed in the materials list with this size collector, and are sure it should work well. In our Supplemental Info Packet we have a fan sizing formula if you want more information on adequate air flow and temperatures.

Please help us improve these instructions

Call or write us at dunsmorebobjulie@yahoo.com or 575-582-4224.

HAVE FUN AND STAY WARM!

Patio Glass Door Collector Parts

Price List with Supplier Information

Part	Qty	Source	Unit cost	Total
OSB 5/8"x4x8	1	Lowe's		12.97
Ductboard 4 x 10' OR 4 sheets 2x4' from Grainger's →	1	Cisneros Sheet Metal shop in Taos 575-758-9271 OR Grainger's including shipping from Albuquerque 505-472-4643	90.05	90.05
Absorber plate 4x10' s	1	26 gauge Paintlock from Cisneros in Taos, OR Hercules 877-601-8259 in Albuquerque but you must go get it to get this price	32.09	32.09
Perimeter channeltrack 3 3/4"x1"x1 1/2"x1/4" 3 -10 footers , PLUS Absorber plate support channel and baffle track - 1/2"x1"x1 1/2" 3 10 footers	60 ft	Galvalume from SLV Building Components, Taos 575-758-7055, "Mike" will fabricate this for you. OR buy one sheet of 24 gauge Paintlock 4x8 from Meyer's Steel, Espanola, for \$27.50, 753-1886	1.34/ft	80.40
Part	Qty	Source	Unit cost	Total
Silicone I caulk -black color- Acytoxy (NOT Silicone II) -Dble chk expiration	10	Cook's ----TruValue SKU no. 159532	5.84	58.40

date on tubes				
Black high temp spray paint in cans	4 cans	Cook's 753-2145	\$6.30	25.2
Screws for absorber plate - ProTwist 1 lb. black pan head framing screws #7 7/16"	250	Lowe's		6.5
Screws for channel track 3/4" hex head self-drilling	50	Lowe's		5.8
Screws for baffles 3/4" self-drilling Phillips or hex-head		Cook's	5.00	5.0
Screws for attaching absorber plate, 1 5/8" black panhead framing screws (or sheetrock)		Cook's	5.00	5.0
½ inch metal tube x 4 inches long (sensor)		find a scrap such as on old café curtain rod; cut off 4" piece		
Patio Glass Door Insert 46"x76" tempered glass—without low-e coating- you need just one pane	1	Habitat Restore, Espanola, recycled OR Matt's has some used ones OR for new glass, Matt's Glass (747-3345) OR R&E Glass, Rudy 753-963		10.0 70.0
Thermostat with high-end temperature range, from 30-110° C	1	Amazon	6.18	6.1
Part	Qty	Source	Unit cost	Total
¼" Hex shank nut	1	Lowe's	1.98	1.9
1 - 8' outdoor extension cord	1		.68	7.2
3/8" elect connectors			.40	.8
Rectangular Electrical Box	2			3.5
Box cover				2.9

	1			
	1			
Blower - Dayton brand Model 1 TDV2 squirrel cage fan	1	Grainger's, Albuquerque 505-345-8631		147.9
Galvanized ductwork 6" stovepipe single wall	60 ft	Cook's	\$6.56/5'	78.7
6" galvanized elbows	2	Lowe's	5.37	10.7
Romex wiring for wiring blower or extension cord				5.0
Metal strapping or wire to hang stovepipe				10.0
Duct tape for sealing under floor area.		Lowe's		7.9
Roll of plastic 3.3 mils 10x100 ft to lay on ground		Lowe's		26.8
TOTAL COST materials for collector, using cheapest options listed				\$572
Sales tax 8.56%, <u>if we must!</u>				49.0
TOTAL COST COLLECTOR MATERIALS WITH TAX --VERSION 4.27.2015				621.0

CONCERNS WE ARE STILL EXPLORING TO IMPROVE THIS PARTS LIST AND
REDUCE COSTS EVEN FURTHER

1) How could we possibly get around 8.56% sales tax, for a significant savings, if we can use some nonprofit, Cougar, Inc., Owl Peak, or govt entity to avoid?

- 2) Our sheet metal comes in only 4x10 sheets, so could be used to cover more than one collector, or coordinate with another builder. For example if you build collector sized to patio glass door dimensions such as 46x76, you would only use 25.6 sq ft, so you would be have extra 13 sq feet on absorber plate material.....This extra could be used to patch together on another collector..See supplemental information for how to attach two sheets of absorber material.
- 3) The estimate above is based on installation of 60 running feet of ductwork under the trailer or house.
- 4) Reflective or insulative skirting and caulk for a trailer would be an additional cost and well worth the investment if skirting is not in prime condition, well sealed, etc.. Radiant Barrier trailer skirting from Amazon costs \$159 for a roll 250 ft x 4 ft. Prodex, also available from Amazon: 17 5 ft x 4 ft=\$370.00 (including shipping), or \$2.12/running foot. [They need 12 to 28 days advance notice to get it to us by a certain date.]
- 5) If you would like to go in on a group order for some materials, we may be able to get quantity discounts. Please call us for more information.
- 6) You would want to calculate fuel costs to drive to Albuquerque or Taos if you have to pick up parts. We are exploring sources closer to Espanola and will update in future packets.

SOME MISTAKES TO AVOID WHEN BUILDING YOUR OWN SOLAR COLLECTOR

Not seeking advice: The single biggest mistake most solar do-it-yourselfers make is not seeking expert advice before starting construction. Don't try a new idea of any kind without talking to at least two people who know the basics. If your a building a simple system, an "expert" can be anybody who has built two or more similar systems and you can usually find free advice. If you are planning a complex system, consult a professional and plan on spending money for the help. Don't build a \$7,000 mistake.

Avoiding the sheet metal shop: It is very difficult to build a collector without at least one trip to the sheetmetal shop to have items specially made. The sheetmetal shop is a tremendous resource - don't avoid going. Find a friendly owner who likes working with do-it-yourselfers and take his advice. He may not know about collectors, but he certainly knows about moving air.

Not oiling the Blower: The motor on most squirrel cage blowers (except those who are permanently sealed – see your blower instructions) requires oiling once or twice a year. Be sure to locate the blower so this is easy to accomplish.

Heat Storage: Take our advice and never attempt rock storage without consulting a professional. There are many common and expensive mistakes to be made in building rock storage units. The suitable rocks mostly give off Radon.

NOTE: FOR INFORMATION ON DESIGNING A COLLECTOR WITH MORE THAN ONE GLASS PANEL AND/OR LARGER ABSORBER PLATE DIMENSIONS:

Contact Bob and Julie Dunsmore at dunsmorebobjulie@yahoo.com and we will gladly send you our supplemental addendum to the packet. The supplemental information includes how to calculate blower size, collector angle, absorber plate mounting, glass mounting, etc. for custom sizing your own collector.

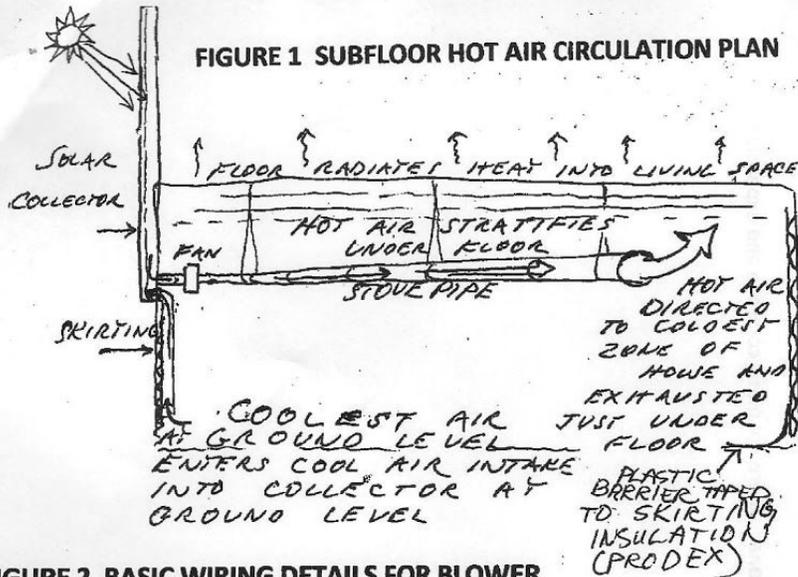


FIGURE 2 BASIC WIRING DETAILS FOR BLOWER

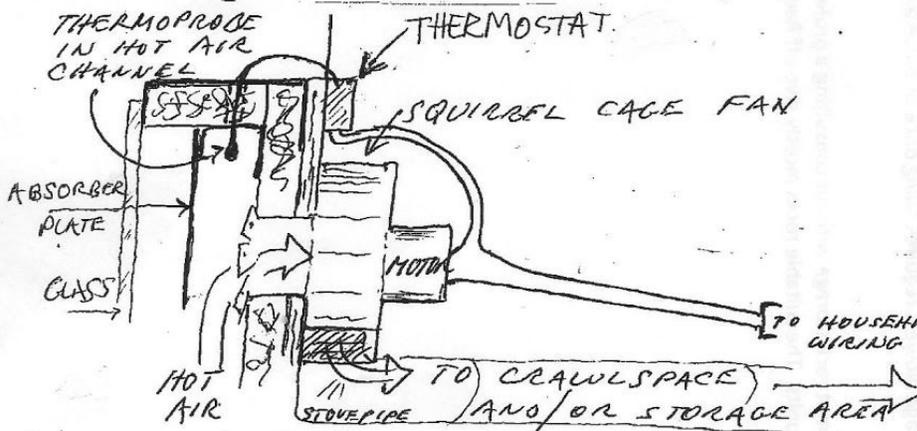


FIGURE 3 CUTTING AND ASSEMBLING THE PERIMETER TRACK

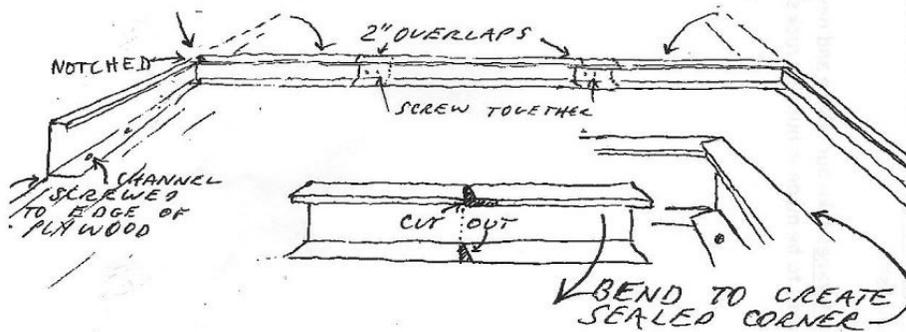
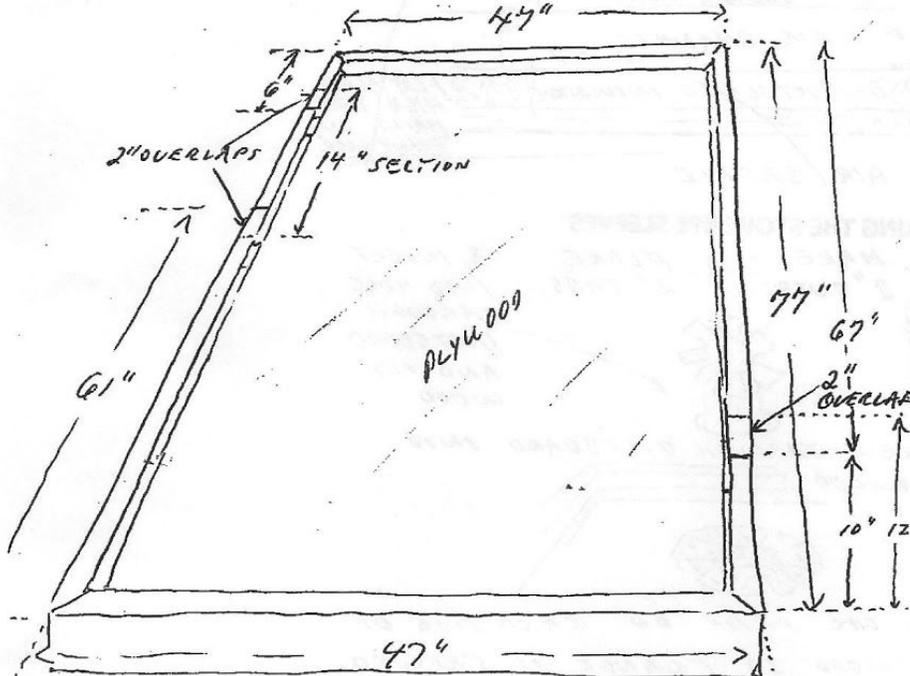


FIGURE 4 ASSEMBLING THE PERIMETER OF COLLECTOR

OVERLAPS ARE 2" LONG
(GLASS IS 46" X 76")



PLYWOOD IS CUT 1" LONGER THAN
GLASS AND 1" WIDER THAN GLASS
CHANNEL IS FLUSH WITH OUTSIDE EDGE

FIGURE 5 SAMPLE LAYOUT FOR STOVEPIPE HOLES AND BAFFLES

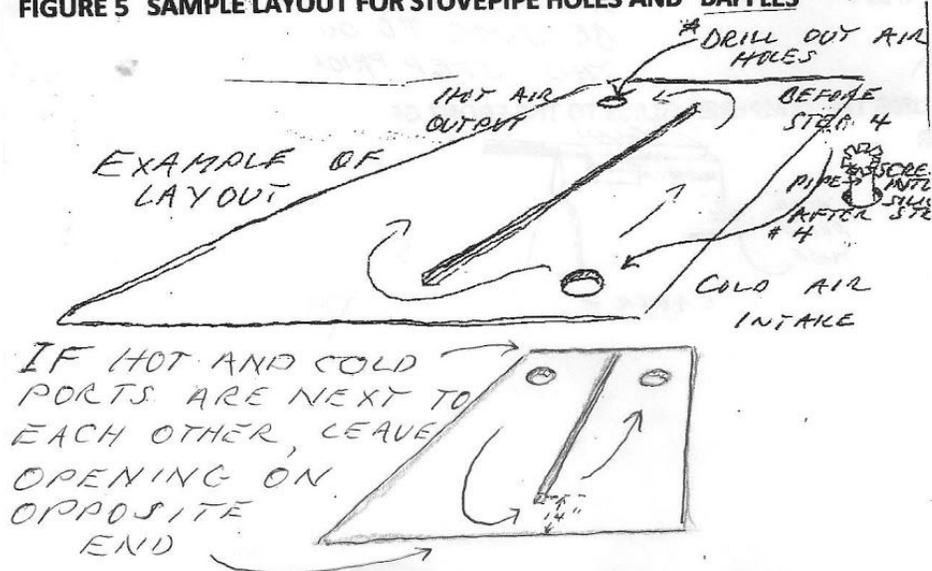


FIGURE 6 ABSORBER PLATE SUPPORTS AND AIR BAFFLES

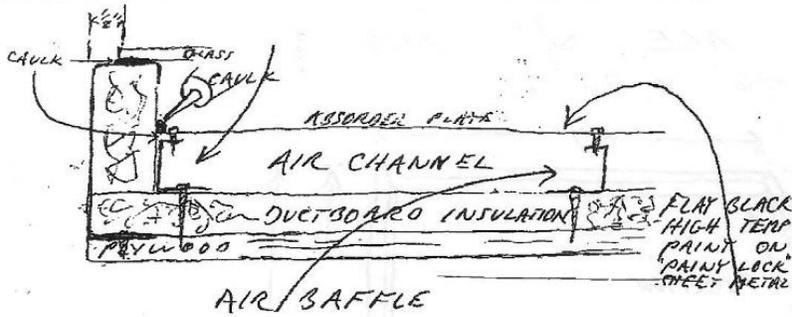


FIGURE 7 MAKING THE STOVEPIPE SLEEVES

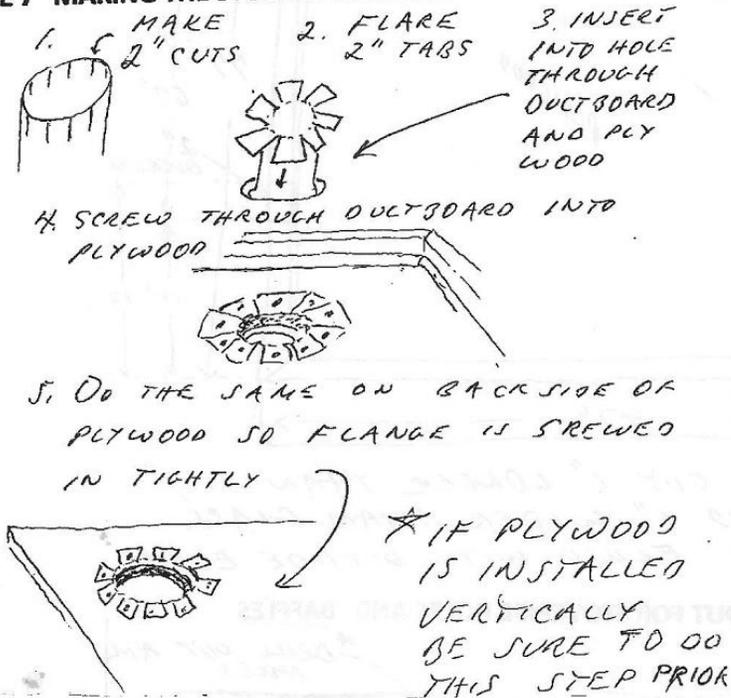


FIGURE 8 SEALING THE TEMPERED GLASS TO THE FRONT OF THE COLLECTOR

