LOWER YOUR EXPENSIVE BILLS AND RAISE YOUR EXPECTATIONS

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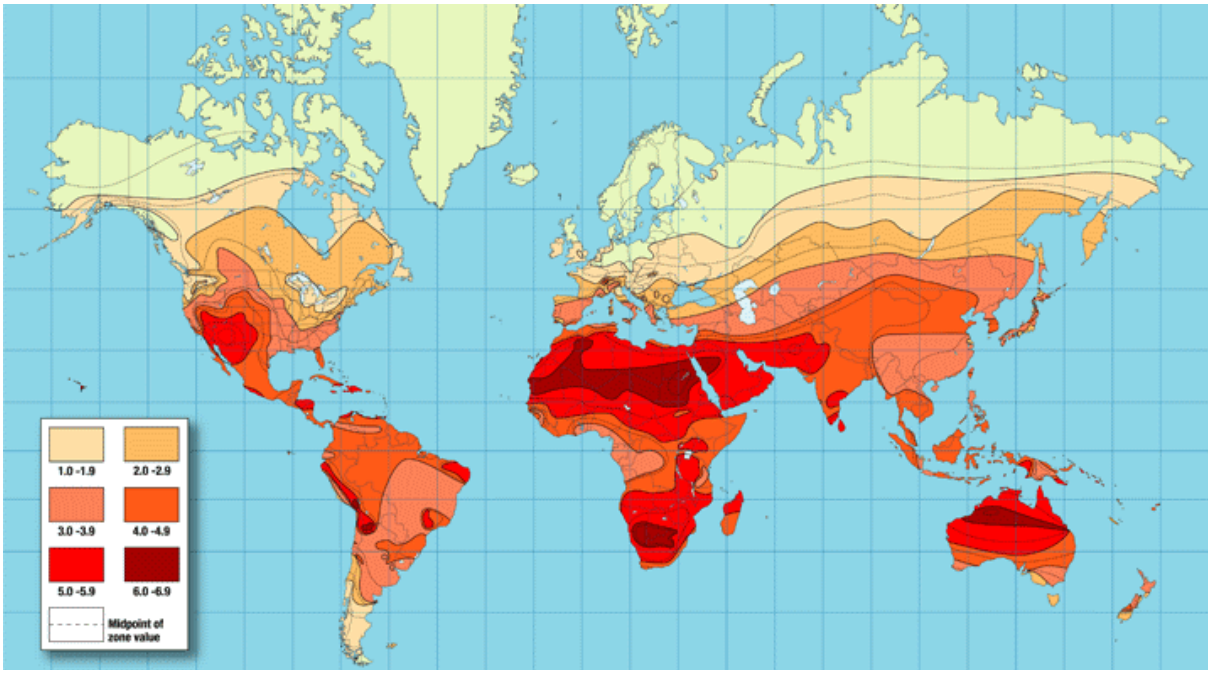
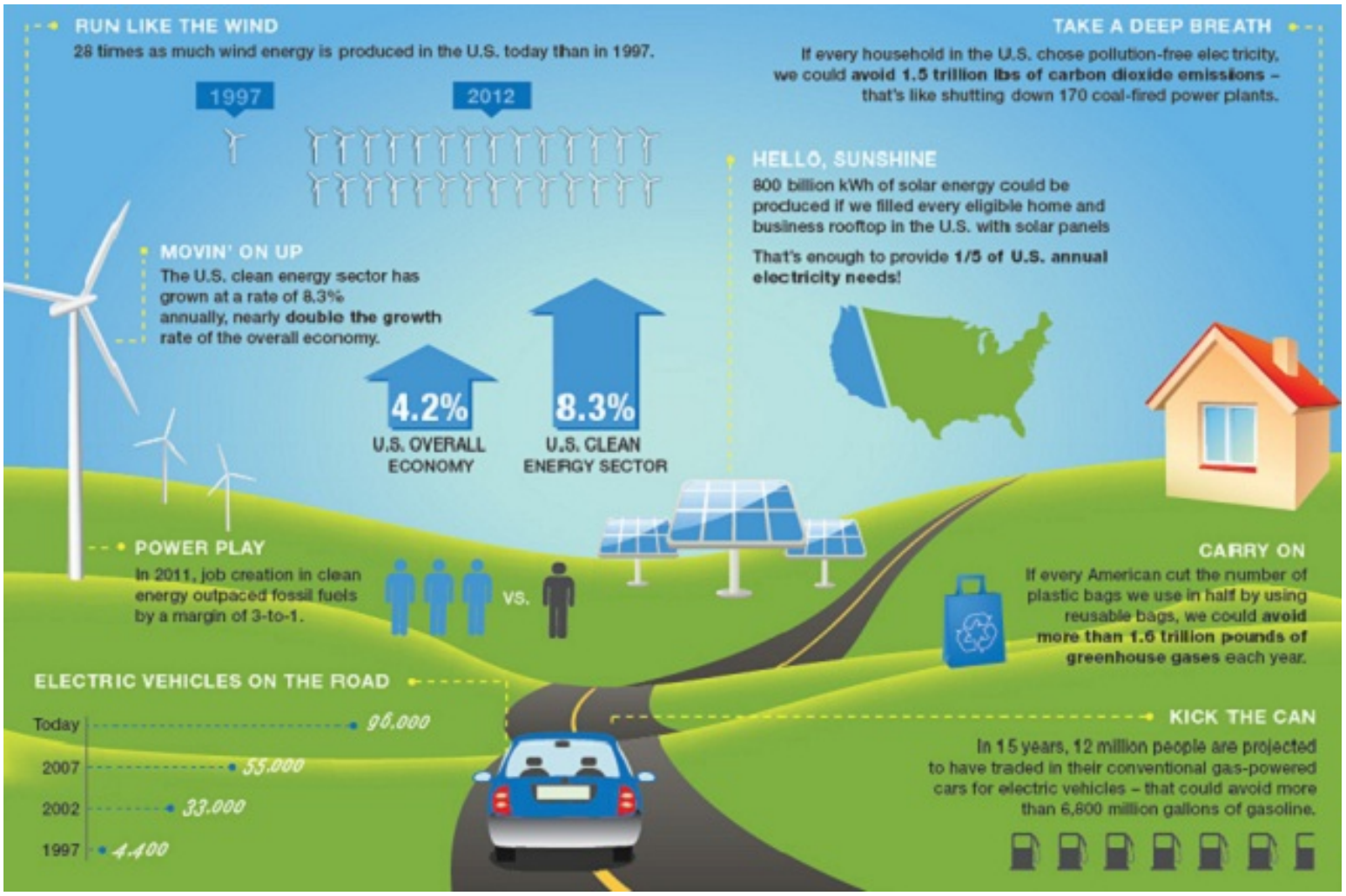
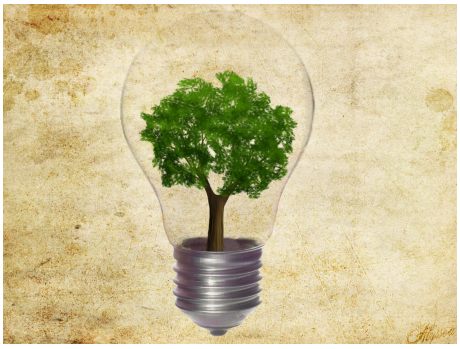


Lower your electric bills by turning green
And help the earth by doing so



Solar Energy Advantages

We can't change the world but we could hurt it a little less



Solar energy advantages and consequently its drawbacks are very important, merely because setting up solar technology is really a great (and quite often, pricey) action.

The main benefit of solar power will be the cash you can expect to conserve in time to come.

The common home utilizes a large amount of power and a lot of them pay out large sums of money every month for just heating and also supplying power to their very own house.

The moment its already put up, Photovoltaic energy is basically free of charge; all you've got to do will be obtain the rays from the sun.

It is a chief benefit for most people in terms of solar technology. Photovoltaic Energy Advantages could wipe out the energy expenses.

The actual sum of money you will end up keeping using solar technology stands out as the most potent drive for any individual to check in the probability of switching to solar power.

A lot of Photovoltaic energy advantages work on a universal range.

Solar power generates little if any toxins , won't produce carbon dioxide or even demand burning as well as polishing, just like some other power sources.

By interpolating Photovoltaic power into human use, carbon dioxide degrees and even greenhouse emissions are generally anticipated to decline substantially.

This cannot just boost soil, air, as well as water level of quality , but in addition helps control the wave of climate change.

If you're at a loss for the up-front fees and even installment prerequisites of huge solar systems, you can think about utilizing solar power in a tinier point.

It is possible to harness the sun's rays and use solar power without spending a huge amount of funds.

Solar hot water heaters and even passive solar heating are wonderful choices for any individual enthusiastic about utilizing solar energy, however , not prepared for big solar heating system installation.

Yet another of the most basic solar energy advantages is the fact that escalating utilization of solar energy is likely to generate new work opportunities.

Since homes and also companies are retrofitted or even meant to yield solar energy, construction and also contracting work opportunities could possibly expand.

To start employing solar power as being a main power source,scientists, inventors and researchers are essential to generate a new as well as improved ways of creation, maintenance, and usage.

Of all of the solar facts which anyone can understand, the most crucial solar energy fact rotate throughout the advantages solar can present.

Solar energy facts are generally appealing. All these facts are typically useful which are essential to mankind for the accomplishment for decades ahead.

Because the energy from the sun is really an endless power source, most likely we could keep the following generation with sufficient electrical power to enable them to live pleasantly for a longer period .

And due to the fact solar power will not discharge carbon as well as methane, operating the home appliances that use this certain solar energy won't promote climate change.

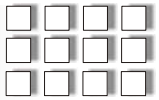
Of all of the solar power facts the most important is to become aware of what the solar energy advantages are.

These would be the primary explanations why it is worth the cost to make the switch and start utilizing solar energy power rather than fossil-based source.

LEARN HOW TO MAKE YOUR OWN SOLAR CELLS

We will show and demonstrate in this plans how can you make your own homemade Solar Cells.

The future is in our hands!



Thank you for buying these plans. It will help us in our research efforts and to tell the world about this suppressed technology.

Included is 3 different ways to make a home made solar cell

The 1996 japan Patent is by far the best and the most powerful. The japan patent uses a simple process that has been used for centuries, You simply screen print the negative and positive layers and the contact layers on to a piece of glass plate, it does not matter how thick the glass is. The layers can be sprayed on with a spray gun and a air compressor, but it is best to Screen print it. Screen printing each layer will make your solar cells last longer and they will be more efficient

If you do not know what screen printing is, you can learn about this very simple process from the Library. Also lots of info and supplies can be purchased at your local hobby store or art supply store. You can also buy supply's such as screens and such at a local Screen printing shop. or they can screen print it for you. Screen printing is very simple and cheap to do for you self right in your own home. It may take a little studying but it will be worth it. you can print up as many Solar Cells as you want for just pennies. (Cover your entire roof with them. You will have more energy than you will ever need. You can then make money selling electricity back to the electric company which should pay for it self in one to two years. The most expensive part is the deep cycle marine batteries and your inverters. Many are making a nice income every year from this, just by selling electricity back to the electric company, ask to see if your electric company has that type of program in your area. most states I heard do.

The Japan method is new and it is not limited to just a glass surface, you can also apply it right onto aluminum or copper sheeting. Look at the 1 st page, see the N type layer #2 this is what the Patent says to Print first. But if you want to print onto a metal surface the metal surface would be #5 then the 1 st print would be #4 then let it air dry and then bake at 600 degrees for 3 to 5 minutes.
(Each printed layer can be done this way.) Then your 2nd print would be #3, then you let air dry, then bake, then Print #2 Air dry/bake. Then you must print a Metal grid over #2 then let air dry, (you don't have to bake the metal print.) This will be your negative contact, #5 will be your Positive Contact, so what your doing is just simply reversing the printing layer steps. If you have never seen a solar cell the metal grid is like a metal door screen but with bigger spacing. You can buy a special metal printing ink or mix it your self as the patent says. The ink is simply made up of nickel or silver. Nickel is the cheapest and will work just fine.

Please Notice: You can not manufacture and sell the Japan Solar Cells with out there permission If you want to leam about Screen Printing we sell a VHS Video for only $29.95
Please send $4 for shipping.

The chemicals that are mentioned in the patent are very easy to get. You can buy them in any QTY from any Chemical supply company look one up in your yellow page phone book. Or check online, search for Chemical Supply Shops or companies.

About Photovoltaics

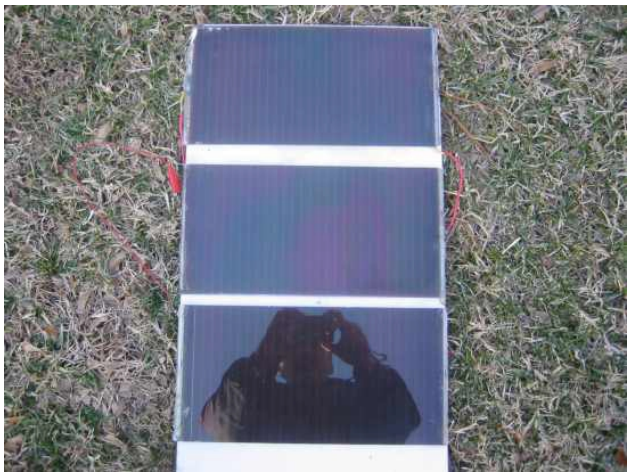
Photovoltaic (or PV, Solar Cells) systems convert light energy into electricity. The term "photo" is from the Greek "phos" which means light. "Volt" is named from Alessandro Volta (1745-1827, He was a pioneer in the study of electricity. So you could say that" Photo-voltaics is basically light electricity! And is most commonly known as Solar Cells. Solar cell systems are already a very important part of our lives. The simplest systems power many of the small calculators and wrist watches we use everyday. PV power is the cheapest form of electricity for powering these small devices. There are many ways to make solar cells, and one of the cheapest ways is to screen print them. There are many companies in the USA that are doing this. Many US Patents have been issued for screen printing solar cells and there are many different chemical inks that can be used. The Japanese Patent is one of many.

Homemade Solar Cells

Turning Sunlight Into Electricity!

Solar Cells convert light energy into electricity at the atomic level. It was rst discovered in 1839, the process of producing electric current in a solid material with the aid of sunlight wasn't truly understood for more than a hundred years.

Throughout the second half of the 20th century, the science has been rened and process has been more fully explained. As a result the cost of these devices has put them into the mainstream of modem energy producers. This was caused in part by advances in technology, where PV conversion eciencies have been improved.

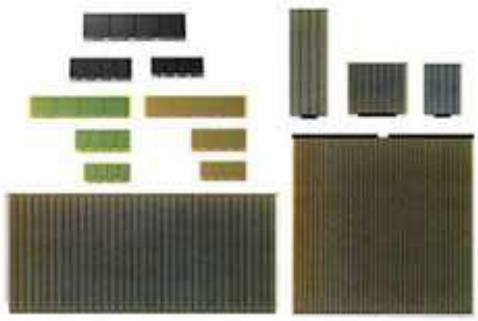


12” x 18” 12 vdc
Screen Printed Solar Cells

Solar Cell Materials

The most important parts of a solar cell are the semiconductor layers, this is where the electron current is created. There are a number of dierent materials available for making these semiconducting layers, and each has benets and drawbacks. Unfortunately, there is no one ideal material for all types of cells and applications.

In addition to the semiconducting materials, solar cells consist of a top metallic grid or other electrical contact to collect electrons from the semiconductor and transfer them to the external load, and a back contact layer to complete the electrical circuit. Then, on top of the complete cell is typically a glass cover or other type of transparent encapsulant to seal the cell and keep weather out, and a anti-reective coating to keep the cell from reecting the light back away from the cell. A typical solar cell consists of a cover glass, a anti-reective layer, a front contact to allow the electrons to enter a circuit and a back contact to allow them to complete the circuit, and the semiconductor layers where the electrons begin to complete there voyages!



Homemade Solar Cells

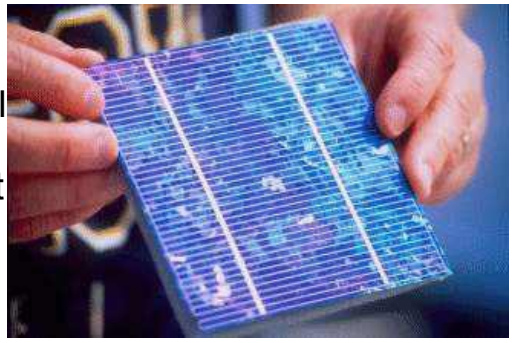
Scientists in Arizonaare using screen-printing, a technique developed for printing fabrics, paper and to produce plastic, glass and metal solar cells.

The basic materials of a photovoltaic cell (solar cell) are inexpensive. The organic manufactured by Ghassan Jabbour and colleagues at the University of Arizona in Tucson have about 11/4 of the efficiency of commercial silicon solar cells, which turn 10-20 per cent of light energy into electricity. But, being cheap to produce, they can make up the loss in quantity what they lack in quality. Now the Japan screen printed solar cells are even better than that!

For more info contact: Matsushita Electric Industrial co. LTD, Osaka. Japan

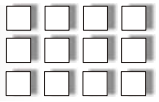
A Screen printing press, the wood frame is the screen

In conventional Screen - printing, a taut piece of screen mesh fabric is stretched over a wood frame, you can buy the screens already made and the material from any screen printing shop or screen printing supply company in your area or on the internet. Also you might want to check with your local art store, sometimes they have full kits etc...



An example of a Silicon cell

The screen is then masked off using masking tape, For example: a 5" x 5" square area. the screen outside of the masking tape is then coated with a block out liquid or paint, this is so when you apply your semiconducting ink that you mixe, it will go through just the area that you masked off when you apply a rubber squeegee to it. The screen can then be placed on any table top and hinges attached to the back of the wood frame and the table, this will insure the screen can move up and down. Then get a small wood paint stick and using a small nail, hammer one end to the front side of wood frame. This will be your kick leg and will help keep your screen in an upward position when needed. Take a 5" x 5" piece of glass and place it right under the open 5" x 5" area of the open screen mesh. When the leg is flipped back the screen comes down and you grab your rubber and wood handled squeegee and with the ink in front of your rubber squeegee pull toward you applying pressure so ink will go through screen, once you have passed by the 5" x 5" area then flip the screen back up and reverse squeegee to flood the screen for the next print.

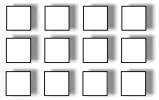


The Research group mentioned earlier , Jabbour's group, print very flat, thin cells, onto glass in a similar way. First they coat the glass with a transparent electrically conducting material (metal ink) that acts as one of the solar cell's electrodes. On top of this, they lay down a thin film of a polymer, which helps to gather current from the photovoltaic material. Finally they deposit a blend of two organic compounds that convert light into electricity. One is a carbon-based molecule called a fullerene, it produces charged particles that carry an electrical current when light shines onto the molecules. The other is a polymer, it ferries the current to the electrodes on the top and the bottom of the solar cell.

Under blue light, these screen-printed solar cells have an efficiency of 4.3 per cent. And the Japanese cells are much greater than that! Many of the flexible solar cell panels that you see today are screen printed.

Now lets take a look at what The Dupont Company is doing with there solar cells. Dupont is involved in the development of solar cell metallisation since the 1970's. Although all PV cell manufacturers use different processes to make there solar cells, the metallisation of the rear and front sides is in many cases DONE BY SCREEN PRINTING! Which has shown itself to be one of the most economic way to produce solar cells.

Recently, Dupont achieved a real breakthrough in the formulation of front-side contacts for silicon solar cells that has resulted in customers, such as photowatt, to realize the screen printing efficiency by changing their anti-reflection technology from Titanium dioxide to silicon nitride. This came at just the right time for the Photowatt solar cell company, Because they have been using there own past material for the front side metallisation since it first started manufacturing solar cells. The development of the metallisation from Dupont for the back side, (p-side). These pasty inks are either silver pastes containing Al, or pure Al pastes to secure a good ohmic contact with the p-side of the solar cell. We have told you all this to help you better understand and leam the screen printing solar cell process and what others are doing.



The Japan Solar Cell Patent

Note: You can Use an outside Grill to bake the Screen Printed layers. It is a good idea to make small cells, 8" x 10" or what ever. It is easier to fit into the Grill, We suggest Baking in side a large roasting pan and then put the roasting pan inside the preheated grill and shut the lid. It is suggested that you try and make 3 prototype cells first, Work out all the details, Test them, and then start on a large production of Solar Cells. It will all get much easier once you have done it. It is also suggested that you bake them out side. You don't want any fumes in the house, an outside grill is the best and most readily available oven there is and propane is cheap. I hear you may be able to make them without a Nitrogen atmosphere if not try special gas companies or make some yourself, it is supposed to be nonflammable.

Screen Printing: You start with a small 14" x 14" wood frame 2x2". Then a plastic or clothe screen is stretched over the frame tightly one side at a time, and then stapled down on all 4 sides, we suggest buying a yellow 200 mesh screen from a screen printing supplier, Then you put an image of what ever you want to print into the screen by photo emulsion or by cutting a lacquer or water film with an exacto knife. (see our Screen Printing Video) Once you have your image you place the finished screen onto a flat smooth table top, attach it to a 14" long 2" x 4" with 2 door hinges. using wood screws, then you attach the 2" x 4" on to the table so it and the screen will not move. the screen should only go up or down.
you then put your 8" x 10" glass under the screen, register it, then lay the screen down over the glass and apply your ink and then with a small 12" rubber Squeegee, You pull the ink over the image and it is pushed thru the screen mesh and thru the image that you cut and smoothly is printed onto the glass.

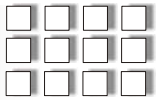
SUPPLIERS;

Screen Printing Books and supplies; NDS 1-800-783-3883 Indianapolis, IN.
(See also Art Store's, Hobby Shop's, Arts and Crafts, Screen printing company's.) They also sell copper sheeting.

Solar Cell Screen Print Chemicals: Search the web, simply type in the chemical you are looking for and many suppliers will pop up. Example: Cadmium Sulphide Supplier..... We have checked and you can find all the chemicals and info on them free on the web.

The Stanford Materials Company

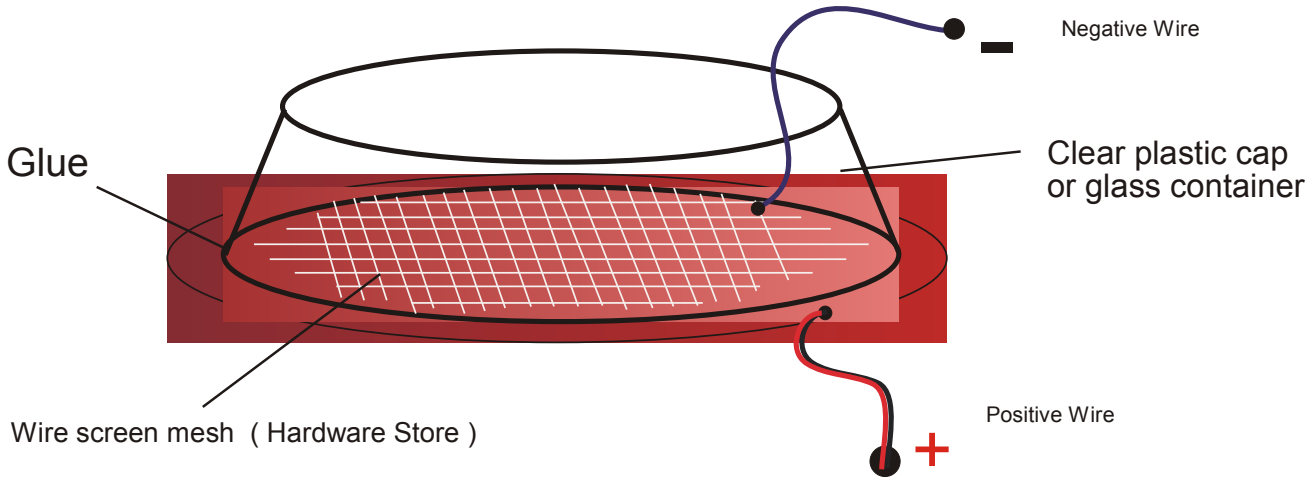
1. Cadmium Sulphide in powder form = Cds (or if already thick liquid or ink OK.)
2. Cadmium Chloride + Cdcl 2 (Powder or liquid form)
3. Propylene glycol + pg in liquid form
4. Carbon Powder, if you can not find none make your own wood carbon powder?
5. Cadmium = Cd
6. Tellurium = Te



THE COPPER CHLORINE SOLAR CELL: Buy a roll of Thin Copper sheeting, cut a 1.5" diameter piece out with a pair of cutters, then sand polish the copper on both sides with some fine grade steel wool. then by using a propane torch heat the copper while griping it with rubber handled pliers, and let the copper get red hot, until it glows, move the copper over the flame evenly for about 3 minutes then allow to cool slowly. Then once it is cooled dip it down in an acid solution of 1/2 water and 1/2 acid,
WARNING!
Never pour water into acid always pour acid into water. The acid that you can use is MURIATIC ACID (Hydrochloric Acid) you can buy it at any hardware store, or you can use a solution of nitric acid. REMEMBER TO WEAR PROTECTIVE GOGGLES OR OTHER SUITABLE EYE PROTECTION, AND WORK IN A WELL VENTILATED AREA. DO NOT SMELL THE FUMES OR MAKE CONTACT WITH YOUR SKIN, WEAR RUBBER GLOVES. THESE ACIDS CAUSE SEVERE BURNS. KEEP OUT OF THE REACH OF CHILDREN.
NOTICE: WE ARE NOT RESPONSIBLE FOR ANYTHING IN THESE PLANS , YOU BUILD AND EXPERIMENT AT YOUR OWN RISK.
Keep it in the acid for only a half a minute or longer, the idea is to keep it dipped in the acid long enough for the black oxide to come off of the top layer, under that is the photo sensitive red cuprous oxide. Remember you should only have a dark bright red layer left. Note: do not leave it in to long it will eat away the red. once you have done that then it's O.K. to wash off the acid with water, do all of this outside or in your garage, make sure all of the acid is off. wash no less than 3 minutes, now look at the copper disk on one side you will have bright copper, this is the positive side, and on the other side you will have red this the negative side the side you face toward the sun. now mix a small solution of 95 water and 5 Clorox bleach, now take the red side and look for scratches if there are any you must paint them with enamel oil base paint, apply paint to any where on that side where copper is showing through, now glue a plastic lid on to red side, let it dry them drill a small hole in the top pour in Clorox bleach and water solution and then place a copper or steel wire through the hole and onto the bottom, wire must be submerged in the solution, now tape or glue the hole up with the wire in it. now tape Solar cell out into the sun and using a DC volt meter attach + to the copper back, and - to the steel wire coming out of hole. you will see the meter move showing a voltage, now block the sun with your hand and watch the voltage drop.
make many of these for just pennies and put them in series or parallel to increase your voltage or amperage. These type of cells are only 5 of the japan cells.

I have heard that the Japanese cells are about 95 of the American made silicon cell that is a very expensive process. Screen printing them is the cheapest way to go and is easy, once you get the hang of it.
Chemicals: needed:1. Cadmium Sulphide = cds2. Cadmium Chloride == cdcl 2 (These can be in powder form) 3.Propylene Glycol = this is used to mix the pg powders into a pasty but screen printable liquid ink type. 4. Carbon powder If you can not find it make some yourself out of burnt wood etc..5. Cadmium = cd
6. Tellurium = Te

Copper Chorline Solar Cell



There are many different ways to construct these home made cells, the above drawing shows a wire screen mesh that you can buy at any hardware store. Using wire mesh makes a much more powerful cell, than just using one strand of wire. before assembly, attach the wire mesh to the red copper side. use a small weight in the center of the wire mesh and using clear silicon, glue down the edges, (make sure you don't get any glue in the area where the plastic cap is going to sit.) now let that sit over night, then glue on your clear plastic cap on to the red copper side of cell.

These also makes a great science fair project as well as providing free Electricity to your home.

It's going to take some practice if you do any of these projects.

But will be able to make your own FREE Electricity force us out of the closet so they could shut us down.

Knowledge is Power! Study this Patent well and read all you can from the free info on the internet as well about screen printing solar cells and the many different chemicals that can be used! The Japan Solar Cells are better to make and will last a long time!

A More Simplified Copper

Solar Cell

The fabrication of Modern modem solar cell is very complicated and a delicate process. In most cases, a large silicon ingot is grown from a small crystal in an extremely clean and sterile environment. Any dust or particle contamination even down to the atomic level during the growing process can completely ruin the ingot. Impurities must typically be kept to one part per billion.

The growing process itself is slow, and the very pure materials required are extremely costly. Because of this, a single ingot which is later sliced into thin cells approximately 0.05 centimeters thick often costs thousands of dollars to produce.

This fact coupled with the general inefficiency (7-14 typically) of even these modem cells has kept the price of photoelectric cells too high to be competitive with other sources of power.

Someday, lower cost production techniques together with higher efficiency will make widespread use of clean, renewable solar energy possible. Someday solar cells will be a very common Source of energy, the idea of deriving Electricity directly from sunlight will continue to excite the Inventor and experimenter.

It is well known that if even 1 of the Sahara desert were covered with the solar cells just described, it would more than supply our worlds current energy needs. We will briefly outline some of the processes and materials that are now being researched for converting the use of solar energy into electricity.

You should have no trouble building the cells that will be described in the following pages. Be cautious. Use good judgement and common sense in handling the chemicals and heating processes described. You'll find that a simple solar cell can be constructed by a persistent student, Solar cells that can make outstanding science fair projects.

The electrical output from the homemade copper cells in this article will be well below that of modern commercial cells, but the materials cost is also very low. Often a cell can be literally produced for pennies! The loss in efficiency is probably more than made up in the reduction of their price.

But again the Screen printed solar cells are far more powerfull than the copper type solar cells.

COPPER SOLAR CELLS

A small, carefully made solar cell of approximately 2 1/2" diameter will produce around 5 milliamperes of current in direct sunlight. This is enough to drive a sensitive light meter or extremely sensitive relay. Banks of these cells have even been used to run small electric motors.

Experiment with the procedures described. You may stumble onto a method of producing even more efficient cells than we have. Just be sure to be very careful. The chemicals described can be dangerous if abused or mishandled.

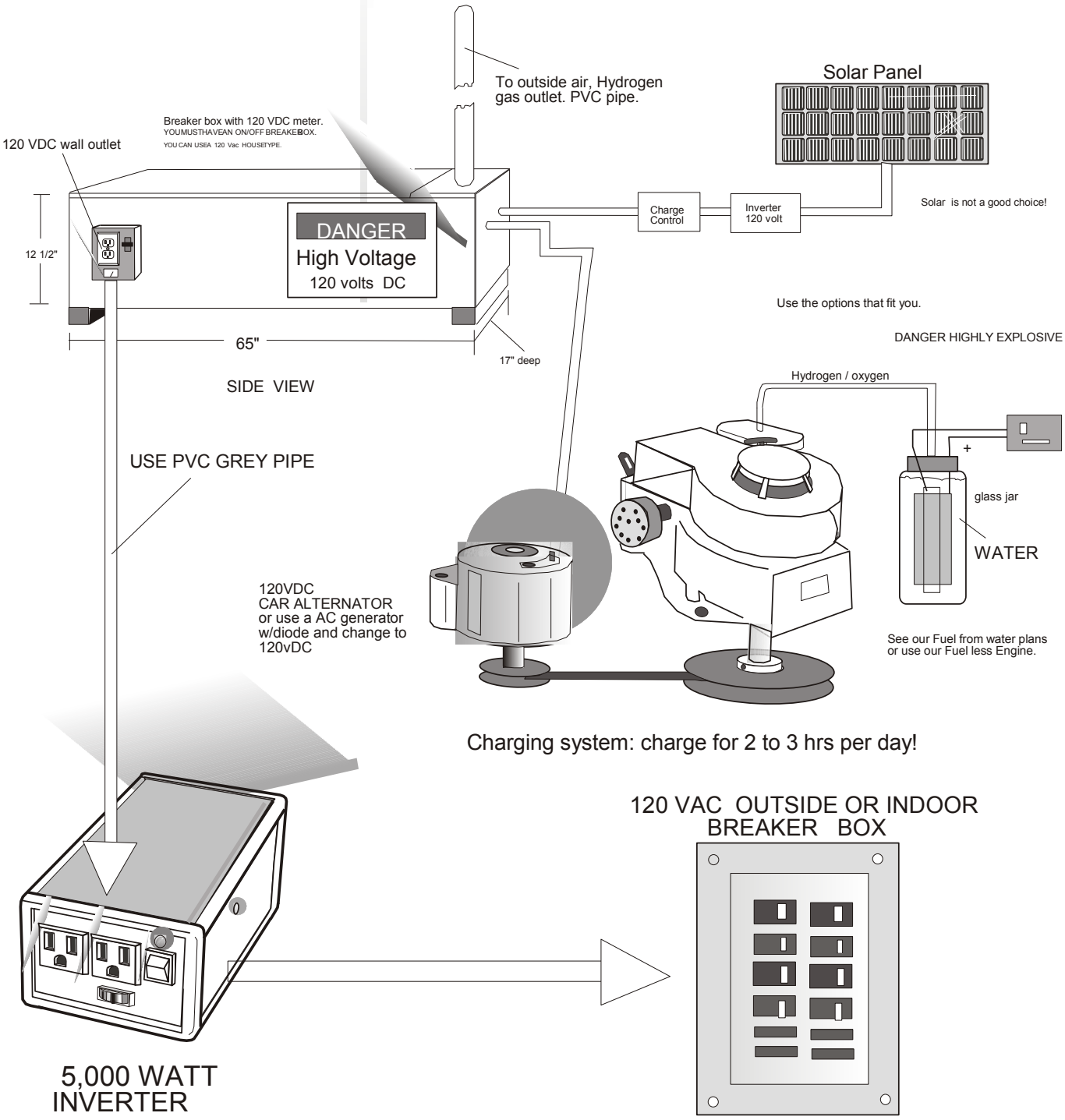
There are an estimated 80 trillion kilowatts of solar electrical energy available in the northern hemisphere.

Many Different types of Chemicals Have Photoelectric Properties!

There are a number of elements and chemical compounds that can be used to produce photoelectric power. They include titanium, selenium, thorium, cuprous oxide, and metals of the alkali group including sodium, potassium, rubidium, lithium, cesium and francium.

The two best substances for a homemade cells are, selenium and cuprous oxide.

An example of a complete Free Energy System, Using Solar cells in series and parallel to charge 12 volt deep cycle batteries, which in turn runs our 5,000 watt inverter to run your home on 120 vac x 60 Hz. We recommend replacing the solar panels with our Fuel less Engine connected to a 12 volt car alternator to keep up batteries. The lawn mower motor we use as a back up.



Homemade Copper Solar Cells

Selenium was extensively used in the production of commercial solar cells before silicon. Although it can be a somewhat difficult to find a supplier and it is a toxic heavy metal, it is relatively inexpensive and can often be found in old model radio sets, where it was used in the rectifier of the power supply.
A selenium photocell is made from a metal plate(usually iron) with one side being covered with a layer of selenium. A very thin layer of silver or gold is spattered over the selenium layer forming a layer of current-carrying material that allows light to pass through it. This layer is called a transparent electrode. A metal electrode called a collector, rests on the gold or silver near the edge of it.

Wires are attached to the collector and the iron plate to deliver the electric current to the load. Although not as great an output as more modern cells, a selenium photocell can produce as much as eight milliamperes for each square inch of surface area exposed to bright sunlight.

Cadmium sulfide is probably the most promising low-cost solar cell second only to silicon.

If you have an interest in electronics, you will undoubtedly recognize cadmium sulfide (the common "CDS" cell) as the material used in light detecting circuits. Although inventors have realized for some time that a number of materials such as cadmium sulfide change their electrical resistance in the presence of light, it has only been in fairly recent times that it was realized they could also be used to generate power also.

The most important attribute of cadmium sulfide is that it could be mass-produced efficiently using a thin-film procedure wherein very thin layers of its photosensitive components are evaporated onto a base metal or screen printed.

Cadmium cells are fairly efficient (3-5 typical) making them a good rival for amorphous silicon cells.

An Experimental Cell With Cuprous Oxide

The best cell by far for the you to start with, is a cell made with cuprous oxide (Cu^O). Copper actually has two oxides, a red

oxide called cuprous oxide, and a black oxide called cupric oxide (CuO).

The dark red cuprous oxide has photoelectric properties but black cupric oxide does not. The black oxide that forms on the outside of your cell must be removed because it is opaque and will not allow light to reach the cell's active surface.

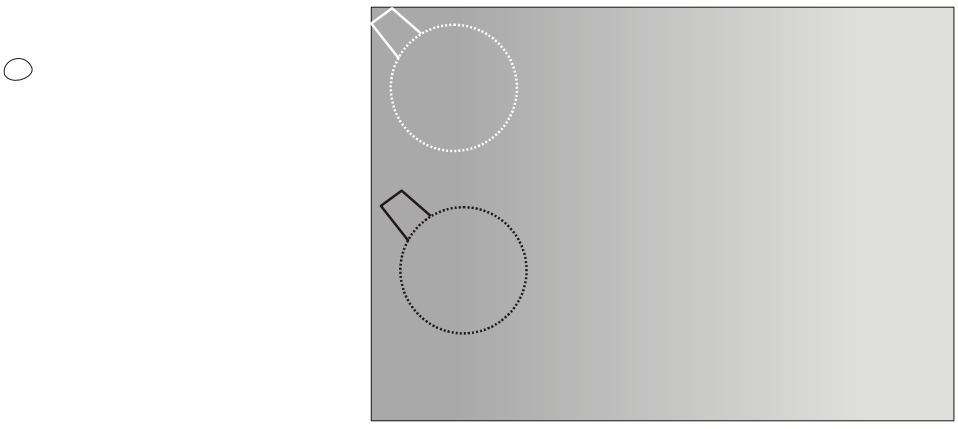
Building your solar Cell

Step 1. Cut a piece sheet copper into the size and shape you wish for your cell. Although .025 inch thick copper was used for the cells described here, just about any thickness will do.

Copper is a soft metal and can be cut with tin snips or even with an old pair of scissors.

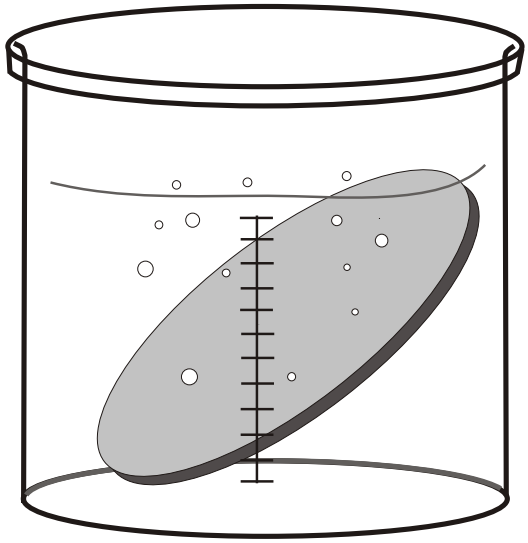
Cut your cell with a diameter of 1 1/2 inches, we strart with a smaller cell because it is much easier to work with. The larger the heat source the bigger the size copper you can use to create your solar cell. After you get the hang of it you can then build larger cells..

As you cut the copper, be sure to leave a "handle" so that you may grip the cell with pliers without marring the cell's active surface.



Thin Copper sheet

Step 2.
the surface of the cell must be made extremely clean. Prepare a solution of nitric acid by carefully mixing 20 parts nitric acid and 80 parts distilled water. Remember towear protective goggles or other suitable eye protection and to work in a well ventilated area whenever you work with chemicals.



Copper disk, scoured & polished and dipped in acid.

IMPORTANT! ALWAYS ADD ACID TO WATER!
NEVER ADD WATER TO ACID!

Begin by carefully polishing the face of the cell with a fine grade of steel wool until it shines brightly. Then place the cell with the shiny side up, in the solution of nitric acid.

Soon, tiny bubbles will form on the copper disk. Stir the solution occasionally. When the disk seems shiny and well cleaned, remove and rinse it under cool running water.

WARNING! Never to allow your skin to touch the acid, and that no acid remains on the cell.

The cell will sometimes work without the acid cleaning if it is simply well polished by the steel wool. However, we strongly recommend the acid cleaning.

Nitric acid and the other chemicals mentioned in the text can be easily ordered from a number of mail-order chemical houses such as found in the classified section of magazines such as Popular Science.

Step 3.Cuprous oxide is now formed on the disk by heating it over a Bunsen burner, or propane torch. A gas stove can be used, but results may be unpredictable.

The time me disk must be heated varies greatly depending on the heat of the torch, and the thickness and size of the copper piece. Using a standard propane torch from the hardware store and a disk of the described size, I found 2 minutes and 40 seconds to be ideal. If you heat it too long, you run the risk of burning off the oxides. Heating for too short a time may prevent the oxides from forming fully.

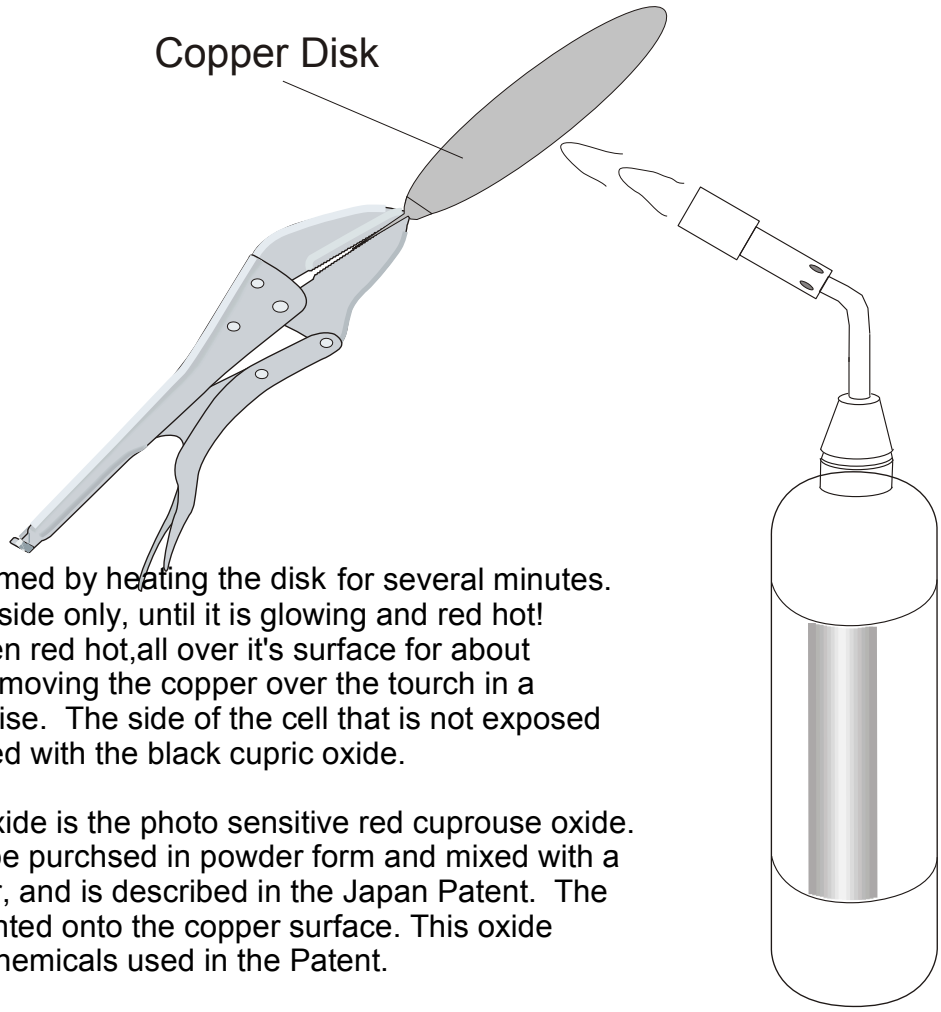


Photo sensitive oxides are formed by heating the disk for several minutes. The Copper is heated on one side only, until it is glowing and red hot! copper must be kept at an even red hot,all over it's surface for about 2 minutes and 45 seconds by moving the copper over the tourch in a round motion. counter clock wise. The side of the cell that is not exposed to the flame will become coated with the black cupric oxide.

Now just beneath this black oxide is the photo sensitive red cuprouse oxide. This red cuprouse oxide can be purchsed in powder form and mixed with a special solvent, which is clear, and is described in the Japan Patent. The Oxide can then be screen printed onto the copper surface. This oxide material is different than the chemicals used in the Patent.

After heating your cell for the prescribed time, it must be carefully cooled. There are two ways to go about this. You can cool the copper quickly by either placing it face down on a flat metal surface, or by waiting a few moments and then quenching it in cool water. The advantage to cooling the cell quickly is that the unwanted black cupric oxide will often flake off the cell due to the difference in contraction rates of the oxides. Unfortunately, I have had bad luck with this method despite extensive experimentation with different temperatures and procedures.

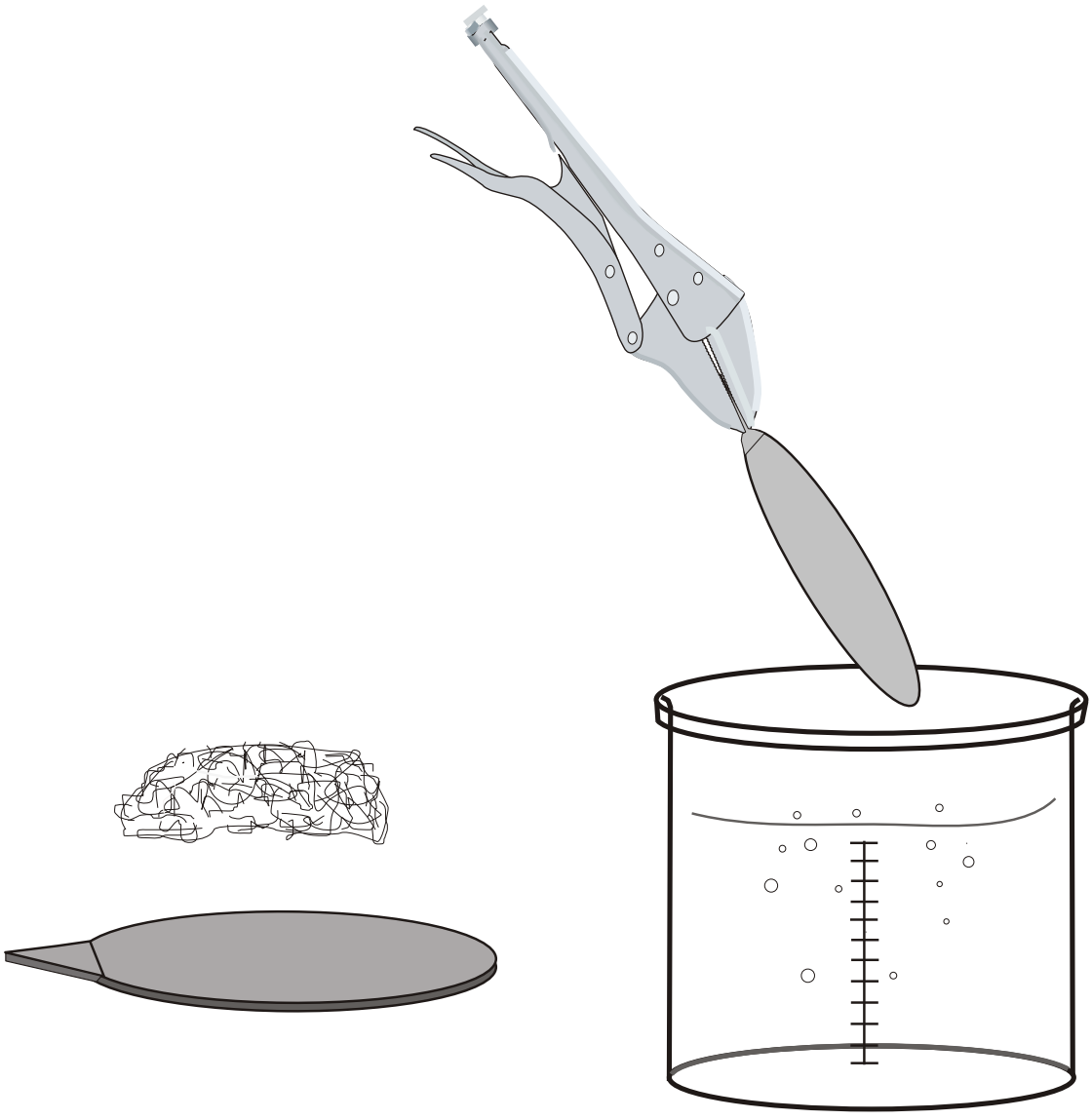
What has worked very well for me is to bring the cell's temperature down as slowly as possible making sure the black oxide does not crack at all. Once completely cool, the cell is immersed in the nitric acid bath. You must wait while the acid begins to dissolve the black oxide. Then you remove and rinse the cell.

A very weak solution of sodium cyanide can also be used with good results. However, you should be extremely careful when using it. Cyanide is an extremely poisonous chemical, and if accidentally mixed with an acid can create deadly fumes. At this point the black oxide covering the cell can be rubbed away with steel wool and a little elbow grease. After all of the Black oxide has been removed, your cell should have a uniform caoting of deep red on one side.

Black oxide has been removed and your cell should have a uniform coating of deep red on one side. Don't worry if the very outside edges of your cell don't have the coating, this is due to uneven cooling and is normal. Keep in mind that the red coating must not be scratched or scraped away to reveal the bare copper plate beneath. If this happens the cell might short in the final step and not work at all.

Testing: There are now several ways that you can test you solar cell even though it is not finished, it can generate power. If you are building the cell for a science fair or other demonstration, you may want to stop and use the cell at this point while the cuprous oxide is still visible. If you hold the cell near a source of bright light, a current will be generated between the cuprous oxide coating and the copper plate. The copper will form the positive terminal and the cuprous oxide the negative.

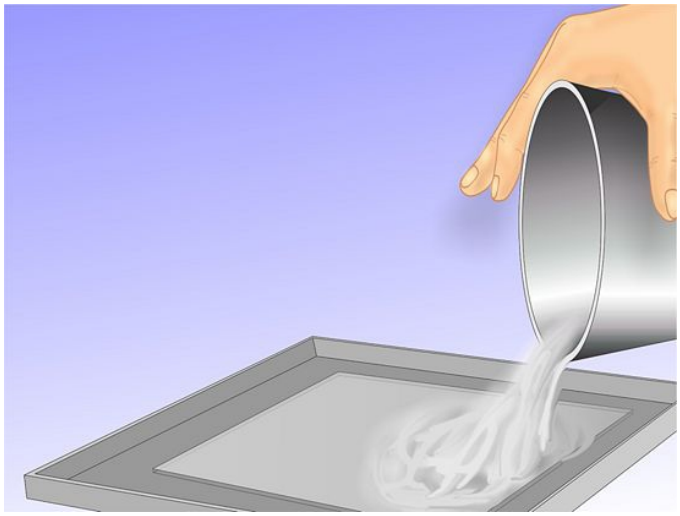
Making contact with the copper portion of the disk is very easy. Simply sand a small bare spot on the back of the solar cell and attach a wire. Attaching the wire and making a good contact with the cuprous oxide is more difficult, it is hard to solder and attach anything, but it can be done by pressure gluing or other.



A better way is to apply a very thin layer of silver or gold called a transparent.
An easily fabricated but temporary transparent electrode can be made from salt water.
Or as seen in our Chlorine cells and a container glued to the cell and the liquid applied.
A soloution of salt or acid will conduct electricity and also pass light to the cell.
Drip a small amount of salt water or your spit, on to the center of the cell.
Make sure that the water rest only on the cuprous oxide and does not touch any of the Solar cell's copper surface or it will short out and will not produce any free electrical energy at all.
Now, attach one wire from a galvanometer, digital voltmeter using the milliamp or low voltage setting to the portion of cell's copper surface. Usually the back or the edges have some exposed copper. Touch the other meter lead to the surface of the water.
The meter will spring to life. Next, bring a bright source of light such as a 100 watt bulb near the cell.
The meter should show a slightly smaller voltage as the light approaches.
Your cell will produce best in sunlight! The cell is changing some of the light into electricity but is having to counteract the current generated by the saltwater, hence the drop in voltage.
The salt water actually acts as an electrolyte and with the oxide generates its own current just as a small battery would.
Another way that you can test your cell is by making a wire electrode for the surface.
This is done simply by coiling some 30 gauge silver-plated wire or aluminum wire and by holding it against the (cells) cuprous oxide surface with a sheet of glass. A good way is to coil the wire around is to use a cone shaped dowel or otherobject first in order to make good even spirals.
Make sure that the wire touches the cuprous oxide only, and none of the bare copper.
You will always have some bare copper around the edges of the cell, so it is best to paint with enamel paint, let dry and then work with the cell.
By simply attaching one wire of your meter to the silver wire, and one to the cell's exposed copper, you will be able to register a small current when a light is brought near.

In this form, the cell can be operated indefinitely and makes an excellent Science Fair Display.

Making The Silvering Solution : The final step in making your own solar cell will be to make a permanent transparent electrode. When properly applied, this will give your cell a beautiful semi-mirrored finish and allow you to make electrical contact with the whole cuprous oxide face of the cell. This step is probably the trickiest in the production of the cell.



But, just as with the last steps, it becomes somewhat easier with practice.

Using distilled water, make ten percent solutions each of ammonia water, potassium hydroxide and potassium sodium tartrate in seperate test tubes.

A ten percent solution can be created by mixing 10 parts by weight of solute in 90 parts of water.

Please remember that the test tubes can become warm or even hot when the water is first added, so be sure to use Pyrex glass test tubes.

Also, make certain you have ample ventilation when mixing the ammonia solution.

Dissolve in 1 oz. water a single crystal of silver nitrate. The crystal should be somewhat larger than the head of a match.

Begin adding drops of the ammonia solution to the dissolved silver nitrate until the water first becomes brown, and then just begins to clear.

Add a drop of potassium hydroxide to this solution.

Then again begin adding drops of ammonia water until the solution just begins to clear. The solution will remain somewhat cloudy.

Too much ammonia in the solution can dissolve the cuprous oxide coating and candamage or ruin the cell.

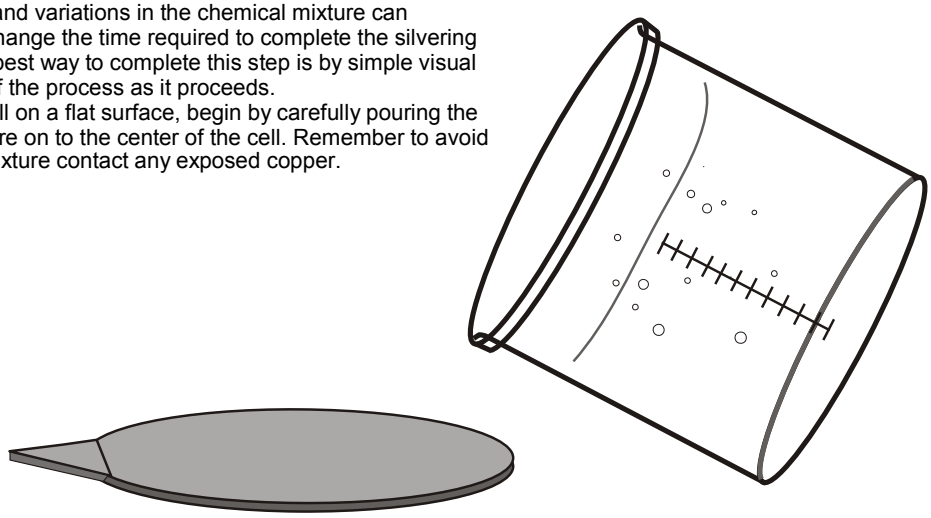
Stir the mixture while adding a single drop of the potassium sodium tartrate solution.

The mixture is now ready and should be used immediately.

Applying The Solution

Temperature and variations in the chemical mixture can dramatically change the time required to complete the silvering process. The best way to complete this step is by simple visual examination of the process as it proceeds.

With the cell on a flat surface, begin by carefully pouring the silvering mixture on to the center of the cell. Remember to avoid letting this mixture contact any exposed copper.



A good trick is to cover with paint or lacquer any exposed copper surfaces on the face of the cell.

Continue pouring until the liquid has covered as much of the surface as you can .

If all the exposed copper on the surface has been properly protected with the lacquer, you can actually pour the solution until it comes right to the edge. Since water has an affinity for itself called "cohesion", it won't spill over the edge.

Very soon, a thin film of silver will begin to form over the cell's surface. The liquid should be poured off when the red oxide is still slightly visible beneath the silver. allow the silvering process to go a little too long rather than not long enough since some of the silver coating can be polished A way.the red oxide is barely visible.

You should now have a smooth silver coating through which

Completing the Cell contact can now be made to the cuprous oxide face of the by means of a ring of lead or silver-coated wire which is slightly smaller in diameter than the disk itself. With the ring held firmly against the disk, a protective coating of thin lacquer can be applied. Make certain the lacquer does not come between the wire and the disk.

With wires attached to the disk's copper back and the lead or silver ring, the cell is complete. The disk can now be housed behind glass, mounted to a sheet of plastic, cast in a clear resin or housed in any other enclosure you desire!

Solar Panels

Types of solar cells

The basic energy producing unit of a photovoltaic power generating system is the photovoltaic or solar cell.Solar cells can be made from a variety of different materials, however the silicon solar cell is the most common, well developed, and readily available, so it is what we will discuss here.

A silicon solar cell is a solid state semiconductor device that produces DC (direct current) electricity when stimulated by photons.The three most readily available types of silicon solar cells are the single crystal cell, the poly crystal cell;and the vapor deposition type, often called amorphous or thin film cell.

Of these three types of silicon cells, the single crystal cell is the most efficient per exposed surface area in producing current.The poly crystalline is the next most efficient, and the amorphous is the least efficient per exposed surface area of the group.Single crystal cells are the most expensive to manufacture, polycrystalline comes next as far as manufacturing costs, and the amorphous type is the least expensive to make of the three. This is, of course, reflected in how much the cells cost to the end buyer.In practice poly crystal cells generate slightly less current than single crystal. Thin film (amorphous cells) produce about half the current of a single crystal cell for the same area.

Solar Panels

Although amorphous cells are the least costly alternative of the three types, they are not a serious consideration for solar hydrogen production as the cost of the added area for panel support structures and extra space needed mitigates some of the savings derived from lower manufacturing and purchasing costs.

Electrical characteristics of solar cells

Each cell, no matter what its size, will produce around .5 volts – some more, some less, depending on the cell.So, if you took a 5" by 5" cell rated at .5 volts and 4 amperes of current, and divided that cell into four separate pieces, each smaller piece would still generate .5 volts.Although the voltage remains the same for each piece, the current output for each would be only about $^{1}/_{4}$ of the original larger section, or about 1 ampere.

This is an important consideration. Using larger area cells in an ESPM allows you to use fewer cells in each string, which saves time and work when constructing panels, as there are fewer tab and bus connects to solder.

Other factors that affect the current output of a cell are the amount of sunlight that stimulates the cell, and the temperature of the cell.The amount of sunlight reaching a solar cell will vary from minute to minute due to particulates in the air, moisture, and cloud cover.Daily variations occur due to the changing position of the sun and the angle of the light striking the cells.

These factors and the seasonal angle variations affect the current output of each cell.Heat also affects cell output.When the temperature of the cells rise, the output decreases.

Elements of photovoltaic panel construction

A single photovoltaic cell does not produce much voltage and the current output is limited by its size.To augment either the voltage or the current output, solar cells can be connected in either series or parallel. Although it is not always the case, usually the sun-facing surface of the solar cell is negative and the back side is positive.

When cells are connected in series to increase voltage, the negative terminal on the face of one cell is connected with tab ribbon to the positive terminal of the next cell's back.This type of connection adds the voltage of each cell.For instance, for five cells that put out .5 volts apiece and are connected in series, the leads at the top and bottom will give a reading on a voltmeter of 2.5 volts.

For parallel, the faces of the cells are connected to each other and the backs of the cells are connected to each other.With this arrangement, the current output of each cell is added, but the voltage remains the same as the output of one cell.Five cells connected in parallel would give a reading of .5 volts at 20 amperes of current if the cells are 4 amps output.

Solar Panels

Connecting two or more cells to each other creates a string.A string is a row of cells connected to each other in either series or parallel.Multiple strings are then connected to each other in series or parallel to form the whole of the solar panel or module.

Two or more solar panels connected together form an array.Arrays can be connected in series, parallel or in series-parallel.

Task specific photovoltaic modules

All photovoltaic modules are classed as some form of TSPM (Task Specific Photovoltaic Module). This means that every solar panel is designed to perform a particular task.

Conventional solar panels are called BSPMs (Battery Specific Photovoltaic Modules).Most panels sold commercially are of this type and are designed solely to charge battery systems.These panels come in 12 volt, 24 volt and 48 volt configurations.Most have short circuit current ratings of from 2 to 10 amperes.

ESPMs (Electrolyzer Specific Photovoltaic Modules) are uniquely designed to match the power requirements of electrolyzer systems.This makes them more energy efficient and economical for their intended use.

Solar Panels

Whereas BSPMs output higher voltages and lower currents, ESPMs output higher current and lower voltages.

Although not always possible, the best engineering practice is to design any power supply to match the specific appliance that will use that power, so that as little energy as possible is wasted.Still, BSPMs can be used efficiently for hydrogen production if they are used to power a bank of electrolyzers rather than just one.

For instance, a two panel BSPM array connected in parallel will sufficiently power three electrolyzers connected in series. For more current you would add more panels in parallel to the array.

Another option is to insert a voltage divider, or DC to DC converter between the BSPM and electrolyzer, which will give the correct current and voltage for the electrolyzer. However, with this configuration there will be some power loss.If that is not a concern for you, then it is a viable option.

Solar Panels

Basic components to build a solar panel

- Solar cells
- Bus ribbon wire
- Tab ribbon wire
- Sheet metal backing (or other rigid material)
- Support frame
- Cover (Plexiglass ®)
- Electrically insulating underlay (if you use a metal backing)
- Screws, bolts
- Power distribution box
- Wire and terminal blocks
- Schottky power diodes with heat sinks (optional)

Designing the ESPM

Since solar cells come in a variety of shapes and sizes, it is not possible to give exact dimensions for the particular panel you will build.Your panel dimensions will depend on what size cells you are going to use, how much power it will generate, and where it is going to be situated.These

Solar Panels

factors dictate the final dimensions and the type of materials used for your particular panel.

I will show you how a panel is designed and constructed. This will show you how to make your own calculations based on the materials you have and your power demands.

The first design consideration is to determine what the power needs of the electrolyzer will be.

Front and back views of the finished panels

I decided on a photovoltaic power supply that would provide somewhere between 10 to 20 amps, at 4 to 6 volts.This would be sufficient to power my electrolyzer.

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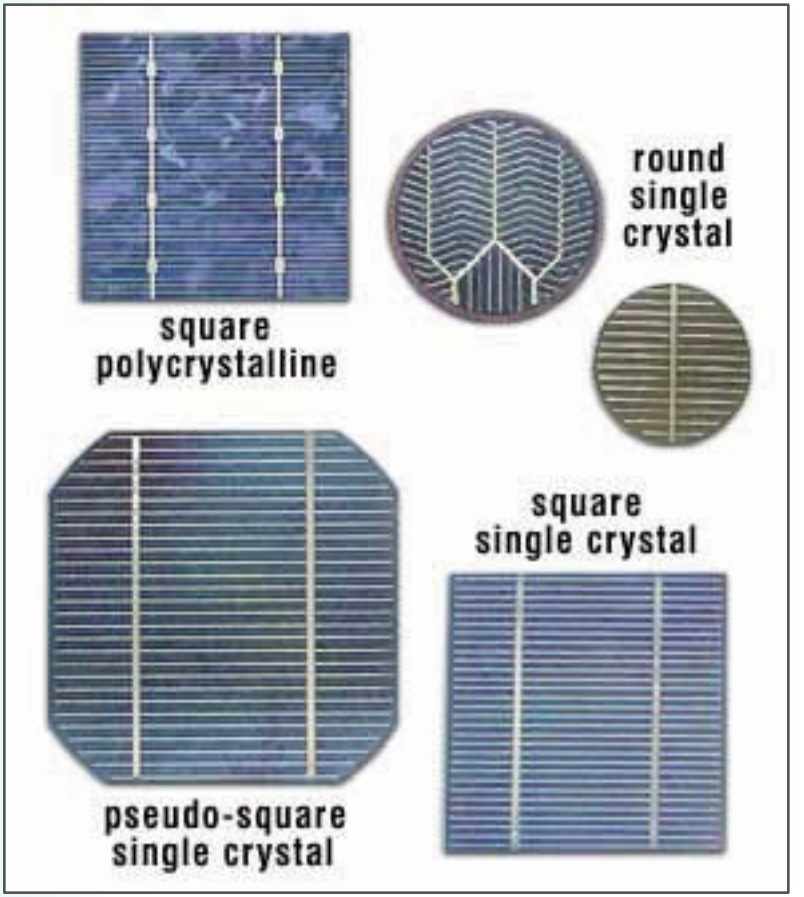
Choosing PVcells

The next choice is the type of solar cells to use.Cells come in a wide variety of shapes and sizes.The most frequently encountered shapes are square, pseudo square (square with angled corners) and round.I chose a pseudo square shaped single crystal cell that was rated at 4 amps at .55 volt per cell. These cells were purchased as cosmetically blemished and off spec (sub standard) thus, they were available at a reduced price. Each cell is 5" in length and width.



As stated earlier, there are three basic types of cells: the single crystal cell, the polycrystalline

type and the amorphous type cell.There are other types of cells such as dye titanium dioxide, ribbon and others.For the most part, the single crystal and polycrystalline are more readily available, and are well suited for building an ESPM.

When shopping for cells, you can purchase new cells with no flaws or new cells with flaws, either cosmetic or those that are off specification.Off spec cells are cells that did not have the expected output when tested at the factory.They are still good cells, but may not provide the current and voltage that would make them suitable for a commercial panel.When considering off spec cells, keep in mind that the lowest output cell on a panel is what the panel's final output will be.So, be sure that the lowest output cell is within your acceptable limits.

Cosmetic flaws can be anything from chips off the sides or corners, discoloration, or lack of reflective coating. Cells can be just cosmetically flawed and putting out full output;or they can be cosmetically flawed and off spec.For instance, a lack of reflective coating on parts of a cell (cosmetic blemish) can reduce their output as they will reflect more and not absorb as much light.

Higher current cells are larger and cost more per cell.However, larger cells mean fewer tab and bus connections to make, and they reduce the number of cells needed to produce a given amount of current.

I have listed solar cell suppliers in the resources section, but you can also call major solar cell manufacturers.Request their prices for cosmetically flawed and off spec cells, and find out what their minimum order is. Popular internet auction sites can also be a possible source for cells, although I recommend these with caution.Take your time, shop around, compare prices, and consider customer service.

Testing solar cells

Each cell should be tested for voltage and current output before you solder the tab ribbon to the cells.Even if you are using up-to-spec new cells, test them before you solder.They might still be flawed or have been damaged in transit and handling.

Solar cell manufacturers use an array of lights that closely mimic solar output to test cells.This gives excellent results, but is expensive and not really necessary.

The most low cost test option is simply to take the cells outdoors on a very sunny day with a multimeter.The good news is that the sunlight testing station is free.The bad news is that if it is not a perfectly clear day, barely perceptible changes in light intensity occur within seconds due to a variety of atmospheric changes.This can easily throw your readings off a

bit.However, this is not a really major concern – ball parking it should be sufficient.A fairly decent sunny day works for this technique.

With the multimeter, measure the open circuit voltage and short circuit current for each cell.Write down the reading for each one.The cells do not have to exactly match each other in voltage and current output.The point is to match the cells so that all of the cells put out voltage and current at or above what your target output is.The lowest single cell output will limit all the others to its output level, so try to match them as closely as possible.

When I was testing the cells for this project, I waited for the first sunny day to get out and test the cells.I tested and selected my cells, and connected them together in a string, The next day, when I performed the second test, I was surprised to find that my current readings were much higher than I had expected.What I thought was a very sunny day for the first test was not as sunny as the day of the second test.I realized that there must have been more particulates and or moisture in the air on the first test day than on the second test day.

The time of the day, season of the year, and atmospheric particulates and moisture will cause changes in the readings.Full output can be tested best in the summer at high noon on a clear day.This doesn't mean that

cells cannot be tested this way at other seasons of the year or times of the day.Just take into account that output variations can occur because of these factors.You will, of course, get lower output readings in the winter than in the summer as the light has more atmosphere to traverse due to the tilt of the earth. Other times than high noon or when the sun is at zenith in your location will give you a lower reading.Despite all these variances, I find this to be an excellent method of testing cells.

If you test cells this way, make some sort of holder that can be tilted at an angle, and that will hold the cell so that you can easily take readings. You should be able to adjust the direction and angle of the device so that it faces the sun as directly as possible.Be sure that when testing that you do not shade part of the cell – it will affect the reading.

Laying a cell on a piece of copper clad circuit board is helpful for taking readings.If you do use a copper clad circuit board, make sure the surface is clean and that the back of the cell is touching the copper clad well.Lack of good contact will give you a false or weak reading.

When you take your cell reading for either open circuit voltage or short circuit current, touch one probe to the solder finger on the top side, and the other probe to the copper clad board that is in contact with the solder finger on the other side.To measure voltage with a multimeter you simply

dial in “voltage,”place the probes on either end, and note the voltage.To measure current move the dial to current measurement and note the reading.For this project you will need a multimeter that can measure at least 20 amps.You could also use a separate voltage meter and ammeter.

Another way to test cells is to take one cell and expose it to sunlight on a very clear day, then test this same cell under an artificial light such as an ELH projector lamp bulb which has similar characteristics to daylight; and/or a daylight photoflood such as a BCA-B1 which has a daylight color temperature of about 4800°Kelvin. Natural daylight has a Kelvin color temperature that varies between 5000°to 6000°Kelvin.

Or, take a reading for one cell (this will be your control) under the artificial light at a specific distance.Then, take the other solar cells and see if they are close in output to the control cell.This will give a relative comparison to a cell which you know has the output that you need.

Solar cell manufacturers test their cells using a xenon light source with filters, under “AM1 conditions.”An AM1 condition is when the sun is directly overhead on a very clear day.AM stands for air mass.The number indicates the amount of air that sunlight has to travel through, and the resulting spectrum and intensity change due to the variations in air mass.The change in spectrum is visible when you see more red during sunrise and

sunset than at midday.The sunlight has more air mass to go through at sunrise and sunset, so the Kelvin color temperature will be different at those times than when the sun is directly overhead.In AM1 conditions, the irradience affecting a surface is considered to be about 1000W/m ^{2} and is called one sun or full sun.

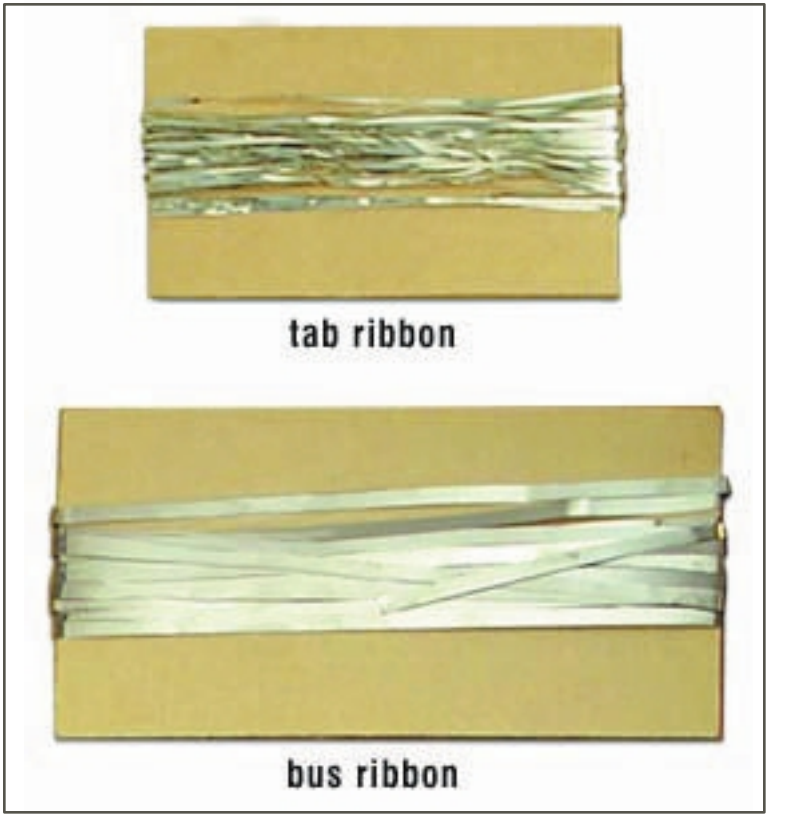
This irradience or insolation (a term that is a shortened version of “incoming solar radiation”) figure is used to size photovoltaic systems.Of course the amount of incoming solar radiation depends on a number of factors such as cloud cover, moisture, and particulate concentration in the atmosphere.Each geographic region has its particular climate characteristics to be considered when calculating the number of panels required for the photovoltaic fuel cell system.

Tab and bus ribbon

When you have decided what type of cell to use for your project, you can move on to purchasing the tab and bus ribbon that will connect the cells and strings of cells. Tab and bus ribbon are made from soft copper that is pressed into a flat wire.This ribbon is tin coated to make it easier to solder. Most tab and bus wire used for BSPMs is .003", .004", and .005" thick.

Solar Panels

For ESPMs, a .005 thick tab ribbon is sufficient to connect the individual cells to the bus ribbon, but the bus ribbon needs to be larger to accommodate the larger current carried. For the panels described here, a 20 amp capacity conductor is needed for the bus wire.Most suppliers of cells do not have bus ribbon in the thicknesses required. Enquire and see what is available.



Tab and bus ribbon can be purchased in the thicknesses required and cut to any width from manufacturers, such as E. Jordan Brookes Co.They cut the ribbon from larger rolls and can provide any width and thickness of tinned wire desirable.Most tab ribbon widths supplied by secondary cell dealers usually run about $^{1}/_{16}$" to $^{1}/_{8}$", and bus ribbon is usually cut at $^{3}/_{16}$" widths.Measure the width of the solder fingers on your cells to see if you can use a larger width cell connect tab

wire.The more surface you cover, the better.These sizes are generally adequate for most cells and solar panels.The 1/16" width is usually fine for most cells.Ask your dealer what thickness the tab ribbon is.

For an ESPM as discussed in this book, use at least a .005 thick ribbon for the cell connects.The bus ribbon needs to be able to carry the current of this ESPM, for instance .010" thick, at 3/8" wide;or a .020" thick at 7/32" wide.

You can make your own tab and bus wire. Copper foil is available in thicknesses from .002 to .021 from McMaster-Carr or another supplier.It can be cut into thin strips to your particular specifications.You can also use flat grounding braid for bus ribbon, as it is made for heavier current carrying capacity.Grounding braid comes in a variety of thicknesses and widths and is usually tinned.Make sure to use Tinnit® to tin the tab and bus if you make your own – it also helps to minimize oxidation.You can use round wire, either solid or stranded, for bus connections as well as cell connects, if you desire, but the flat ribbon is probably easier to work with.

Square mils

It is easy to find the current capacity of round wire in a variety of published tables for the photovoltaic enthusiast, but it is not so easy to find the current capacity of ribbon wire.Not very many people engineer their own PV panels.

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Although the current carrying capacity of a wire is based on factors other than wire diameter (type of insulation, stranded or solid), wire gauge is a general indicator, within limits, of the actual current allowable for a certain area of a conductor.

If you are working with a conductor that is flat and of a certain thickness and width, it is useful to be able to compare its current carrying capacity to round wire conductors.

Wire gauge is usually indicated in what is called AWG or B&S. AWG stands for American Wire Gauge, and B&S stands for Brown and Sharpe gauge. They are one and the same. In the table at right, wire gauges are listed with their rated amp carrying capacity and their area in circular mils and square mils.

Since you will be building a panel that delivers 20 amperes of short circuit current, use the table to see what size wire carries that current adequately.

CIRCULAR TO SQUARE WIRE CONVERSION TABLE

Size AWG	Current carrying capacity / amps	Resistance / ohms per ft.	Circular mils	Square mil equivalent
14	20	0.0026	4,107	3,226
12	30	0.0016	6,530	5,128
10	35	0.0010	10,380	8,152
8	50	0.0006	16,510	12,967
6	70	0.0004	26,250	20,617
4	90	0.0003	41,740	32,783
2	125	0.0002	66,370	52,127
1	150	0.0001	83,690	65,730
0	200	0.0001	105,500	82,860

Values are for copper conductors only.

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Note that #14 gauge will carry 20 amperes, but you now need to know what size of flat ribbon wire will carry that same amount of current.

To get the current carrying capacity of the ribbon wire, simply multiply the thickness in inches by the width in inches.This will give the area in square mils.Take this square mil figure and match it up with one of the wire gauges listed in the table on the preceding page.Then, multiply your square mil figure by .7854 to give the area in circular mils. Whatever gauge the ribbon is close to in circular mils will tell you generally what the current carrying capacity of the bus ribbon is.Note that this table is only correct for copper conductors.

Square mils/current capacity

One square mil equals .001".To find the current carrying capacity of square or rectangular shaped conductors such as bus ribbon, multiply the thickness in inches times the width in inches.The result will be the square mils of the conductor. The table on the previous page gives the carrying capacity based on square mils.

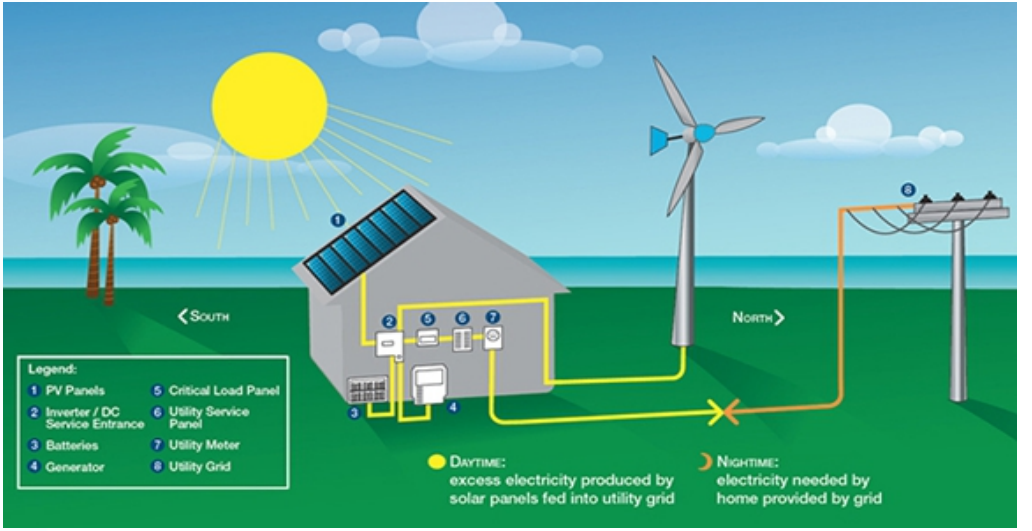
Voltage drop

To find the voltage drop for any length of wire run, multiply the resistance per foot of the particular size conductor, times the number of feet in the run, then multiply this times the current (amps) you will be running through the conductor. The result is the voltage drop.For example, an ESPM with an output of 16 amps at 4 volts and a wire run of 10' to the electrolyzer through a #10 conductor, will give a voltage drop of 0.16v. This means that at the terminals of the electrolyzer the system will be able to deliver 3.8v.

R x Ft.x Amps (resistance x length of run in feet x amps) = voltage drop.

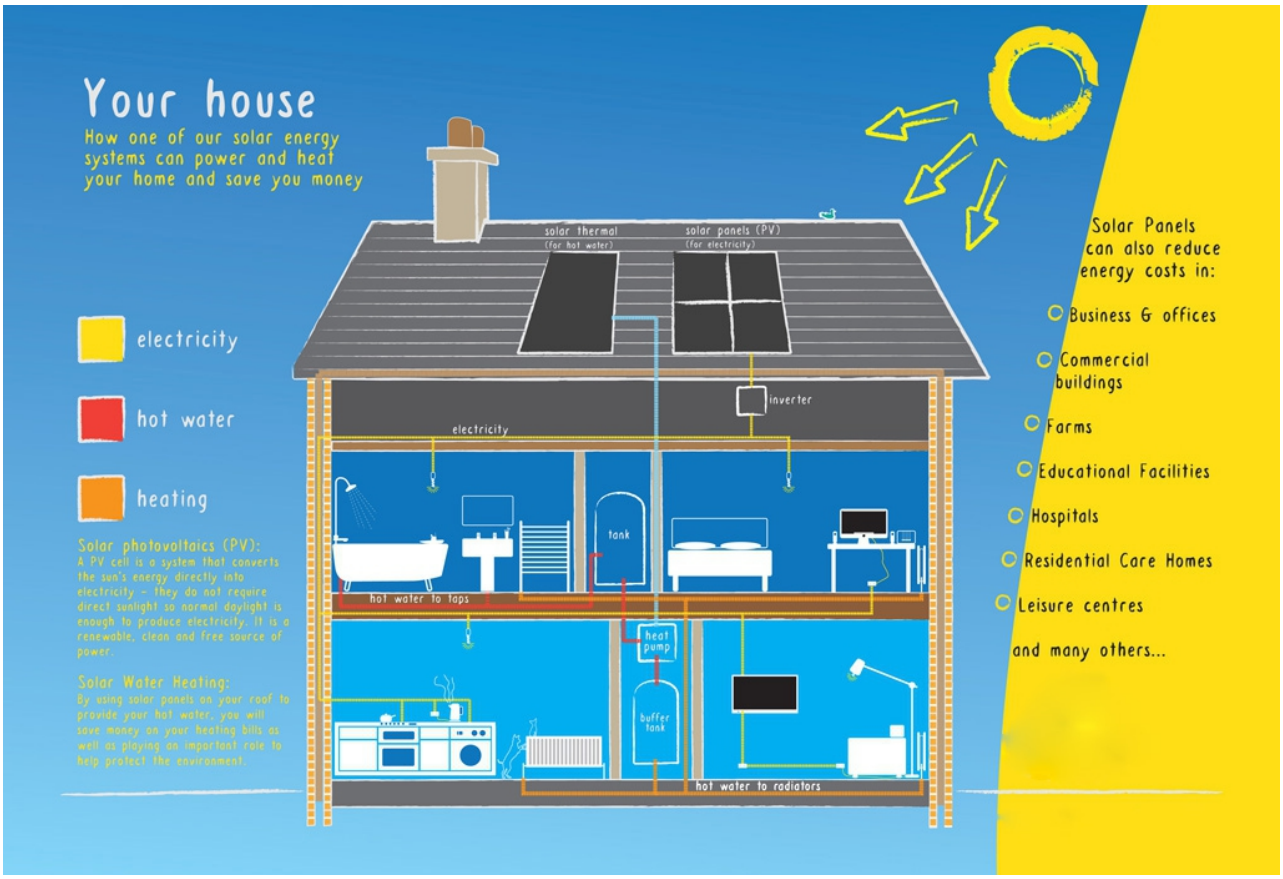
Solar Panels

As an example, consider a bus ribbon .020" thick and $^{7}/_{32}$" wide. Convert $^{7}/_{32}$" into its decimal equivalent (.21875) and move the decimal place to 218.75 because 1 mil = .001". Then multiply 218.75 times 20, which gives you 4375 square mils.Either check the table or convert these square mils to circular mils by dividing 4375 by .7854, which is 5570 circular mils.As you can see from looking at the conversion table, this figure falls between a 14 and 12 gauge, and any wire size within this range would be sufficient to carry 20 amps.



Guide One-On-One:

How you can install Solar Panels



INFORMATION ONLY

SAFETY ICONS

Various safety icons appear in this installation manual and on the products it describes. These icons are categorized in the following manner, according to the consequences of ignoring the icons and handling the products inappropriately.

Make sure that you understand these icons and always read the accompanying text.

⚠WARNIN	This indicates danger of death or serious bodily injury.
⚠CAUTIO	This indicates danger of bodily injury or damage to property.
⃠	This icon indicates something you must never do.

⚠ WARNING

- Do not cut or modify SRS Mounting System. Doing so is dangerous. Safety cannot be guaranteed.
- Stop work during stormy weather. Solar modules can be caught in the wind, causing you to fall.

⚠ CAUTION

- Never step or sit on the glass surface of a solar module. The glass may break, resulting in shock or bodily injury. The module may also stop generating power.
- Always use the supplied parts to attach the solar modules and mounts.

  Use of weaker parts, such as screws that are too short, is dangerous and may cause the solar modules or mounts to fall.
- Always use the specified tools.

  The solar modules or mounts may fall if the installation is not strong enough, for example when parts are not tightened sufficiently.
- Regardless of whether you are working on a new or existing roof, never allow the sheathing to become wet. Protect the sheathing from rain during the installation. Failure to do so may cause leaks.
- Always use the specified materials.

  Use of other materials is dangerous. Materials other than specified can reduce performance and can cause leaks, shock, and so on.
- Do not modify or cut parts.
- Do not install system in a location within 0.3 miles from the ocean or any salt water.
- Do not install in corrosive locations classified C5 by ISO.
- The SRS system and modules are UL listed to standard 1703. The UL 1703 test is performed at 1.5 times the design load of 30 lbs per square foot, or 45 lbs per square foot. The system has been load tested by Sharp to 50 PSF. Do not use in locations subject to higher loads. Building departments often require a design safety factor of 1.5 or greater for structures. The maximum structural loading listed in this guide, does not include an added safety factor.
- Protective earth grounding of the individual photovoltaic modules is achieved by the securement of the modules to the mounting frames. The assembly instructions should be closely followed, in order to ensure a reliable ground connection.
- The framing system has only been evaluated by UL for use with the photovoltaic modules listed in this manual.

UL REQUIRED INFORMATION:

1. Artificially concentrated sunlight shall not be directed on the module.
2. “Rated electrical characteristics are within 10 percent of measured values at Standard Test Conditions of: 1000 W/m^2, 25°C cell temperature and solar spectral irradiance per ASTM E 892 or irradiation of AM 1.5 spectrum.”
3. Under normal conditions, a photovoltaic module may experience conditions that produce more current and/or voltage than reported at Standard Test Conditions. Accordingly, the values of ISC and VOC marked on UL Listed modules should be multiplied by a factor of 1.25 when determining component voltage ratings, conductor capacities, fuse sizes and size of controls connected to the module output. Refer to Section 690-8 of the National Electric Code for an additional multiplying factor of 1.25 which may be applicable.
4. Wiring methods should be in accordance with the NEC.
5. Install wires and cables with appropriate hardware in accordance with applicable electrical codes.
6. Protective earth grounding of the individual photovoltaic modules is achieved by securing the modules to the mounting frames. The assembly instructions should be closely followed, in order to ensure a reliable ground connection.
7. The framing system shall be grounded in accordance with NEC Article 250.
8. #10 AWG copper wire is the minimum size acceptable for the primary protective ground connection to the rails.
9. A UL Listed Grounding terminal constructed of tin-plated copper or stainless steel, or steel provided with a zinc or beryllium coating, and suitable for outdoor use, shall be used with the selected grounding wire (minimum 10 AWG copper wire).
10. All of the Rails in an installation shall be provided with protective earth bonding wires when installed.
11. The framing system has only been evaluated by UL for use with the photovoltaic modules listed in this manual.

1.1 CAUTIONS REGARDING INSTALLATION OF SOLAR POWER SYSTEMS

This manual contains critical information regarding electrical and mechanical installation and safety information which you should know before starting installation.

The information in this manual is based on Sharp's knowledge and experience, however, the information and suggestions do not constitute a warranty.

Sharp Electronics Corporation reserves the right to make changes to the product, specifications, or manual without prior notice.

Do not locate systems near coastal locations or other salt water locations or C5 locations as classified by ISO. Minimum distance is 0.3 miles from the body of water. Do not locate in a corrosion prone area. The modules and system are UL listed to standard 1703. The UL 1703 test is performed at 1.5 times the design load of 30 lbs per square foot, or 45 lbs per square foot. The system has been load tested by Sharp to 50 PSF. Building departments often require a design safety factor of 1.5 or greater for structures. The maximum structural loading listed in this guide, does not include an added safety factor. Check with your local building department for code information.

⚠ CAUTION

1 Do not drill holes in frame. Do not cut or modify parts or rails.

2 Work under dry conditions with dry tools.

3 Do not stand or step on solar module.

4 Do not install near flammable gases.

5 Do not drop or allow objects to fall onto module.

6 Completely cover solar module with opaque materials when wiring to halt production of electricity.

7 Keep the back side of solar module surfaces free of foreign objects.

8 Do not use chemicals on solar modules when cleaning.

9 Do not wear metallic jewelry, which may cause electrical shock.

10 Do not touch cable electrical contacts.

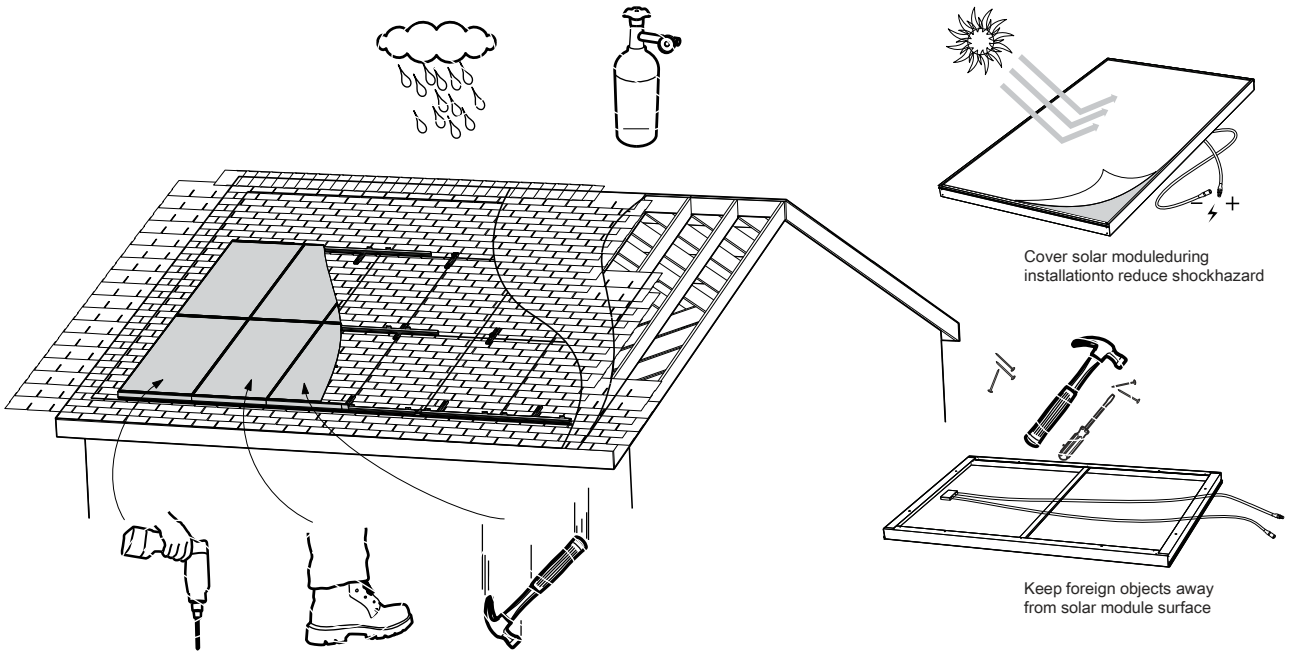
11 Do not expose solar modules to sunlight that is concentrated with mirrors, lenses or similar means.

12 Consult local codes and other applicable laws and statutes concerning required permits and regulations concerning installation and inspection requirements. Install solar modules and systems according to applicable codes.

13 Product should be installed and maintained by qualified personnel. Keep unauthorized personnel away from solar modules.

14 Avoid shadowing cells in order to prevent solar module hot spots and/or reduction in power.

15 Avoid installing modules and mounting system in high corrosion areas.



Cover solar moduleduring installationto reduce shockhazard

Keep foreign objects away from solar module surface

1.2 SRS MOUNTING SYSTEM

Solar modules are installed on rooftops where there is danger of personnel falling off of the roof. Scaffolding, stepladders, and ladders may be dangerous and require caution. The installation of solar modules involves work in high places, take extreme precautions to avoid falling from roof. To prevent accidents, safety regulations must be observed. Always take the following precautions to prevent accidents and injury.

1 Take the following precautions before starting work.

- Plan the job and visit the site before starting work.
- On site, do not work alone. Always work with at least one other person.
- Inspect power tools before using them.

2 When conditions make it necessary, tell workers to stop working.

- When it is raining, or there is a strong probability that it will start raining.
- Immediately after rain, and when work areas are slippery.
- When high wind conditions exist, or are expected, or when a high wind warning has been issued.
- When it is snowing, or when there is snow underfoot.
- When the condition of the scaffolding and ladders are not satisfactory.

3 Wear appropriate work clothes and protective equipment.

- Work clothes for both the upper and lower body should fit well and allow you to move freely.
- Always wear protective equipment such as harnesses and lifelines.
- Wear a helmet and secure it correctly.
- Wear non-slip shoes. Shoes get dirty when worn on a roof, so keep the soles clean.

4 Observe safety regulations for ascending and descending ladders and stepladders.

- Before use, always inspect ladders and stepladders to makes sure they are in good condition.
- Choose a safe spot to anchor ladders and stepladders.
- Always work with a partner. One person should hold the ladder steady.
- Ladders from a first-story roof to a second-story roof are very dangerous. Do not set up a ladder on a roof. When there is no other choice, straddle the ridge and lay down a rubber anchor mat, and secure the ladder to the mat. Always have one person hold the ladder firmly.
- When you use a two-stage ladder, secure it with ropes or stays to prevent it from sliding sideways, and have two persons hold the ladder steady.
- Use ladders with steps broad enough to permit safe work.

5 When working in high places, wear harnesses and use scaffolding.

- When working at heights of 6 ft or more, use scaffolds or other equipment to ensure a stable work platform.
- Scaffolds should be designed and erected by a qualified person.
- When it is difficult to erect a stable work platform, install safety nets, wear harnesses, and take other measures to prevent falls.
- Regulations mandate the use of harnesses. Fasten harnesses securely, and check that the length of lifelines is 6 ft or less.
- Attach the primary support line securely to a metal fixture installed for that purpose on a ridge or beam.

6 Install enclosures and covers.

- Install enclosures, guardrails, or covers at the end of work decks that are 10 ft or more above ground, at openings, and at other dangerous locations.
- When it is extremely difficult to install enclosures, guardrails, or covers, or when they must be removed to work in that location, install a safety net, wear harnesses, and take other measures to prevent falls.

7 Protect against falling objects.

- When objects are thrown down from a height of 6 ft or more, appoint a surveillance person on the ground and warn others about falling objects.
- Do not allow third parties to enter the work area during construction.
- Arrange tools and materials neatly and secure them with ropes, or use bags or other measures to prevent falling objects.

8 Other

- When there are electric power lines near the roof or eaves, request the power utility to take advance measures to prevent shock.
- Check the health of workers before starting work.
- Lift packaged modules by grasping both sides of the package. Do not lift by grasping the band, as the band can break.
- Never step or sit on the glass surface of a solar module.

1.3 PV MODULES

⚠WARNIN Wiring work should be performed according to the provisions of the National Electrical Code. Grounding work and wiring connections to the inverter should be performed by a qualified electrician.

Adhere to all of the NEC. Pay special attention to Article 110, Chapter 2 , Article 250, Chapter 3, Articles 300 & 310, 480 & 690.

The solar array generates electricity whenever it is exposed to sunlight. Be careful when handling it. There is a danger of shock if you touch the connectors or wires of the electric cables.

1 Points to check before wiring.

- The solar modules generate electricity when exposed to light. You will need to wear insulating gloves.
- You will need a multimeter for volts, amps, resistance and continuity capable of measuring DC and AC up to 600V and 40A.
- Make sure your tools are insulated.

2 Wiring the solar modules.

- Never step or sit on the glass surface of the solar modules. The glass may break.
- When you install the solar modules on the mount, never allow an output cable to become caught between the mount and a module frame.
- The solar modules generate electricity when exposed to sunlight, take care not to short circuit the output cables. The cables can become overheated and their cable sheaths can melt.
- Ensure the module connectors are fully inserted. There is a risk of malfunction if they are not pushed in all the way.
- Support output cables so that there is no slack. High winds can blow slack cable against the mount, damaging the cables.

3 Wiring from solar arrays to the inverter (connector box).

- Follow the provisions of the National Electrical Code. Adhere to all of the NEC. Pay special attention to Article 110, Chapter 2, Article 250, Chapter 3, Articles 300 & 310, 480 & 690.
- For wiring through walls, protect the cables with metal conduits, flexible metal conduits, or other protection. Failure to do so can result in shock and short circuits. Always use conduit to protect sections of array output cables that are exposed to sunlight.

  For wiring outdoors, protect cables with PVC conduits, metal conduits or flexible conduits.
- Prevent water from entering or building up in conduit by using waterproof fittings or duct seal.
- To prevent shock, tape and label the cut ends of array output extension cables (the side opposite to the connector side) before connecting to solar module output cables. Further, tape them again after measuring the voltage of each array.
- To prevent shock when you connect the array output cables to the inverter, remove the tape one cable at a time as you connect the cables.

4 Measuring array output voltage

- See the description of how to measure the output voltage for each array.
- Make sure that all solar modules are exposed to sunlight. (Remove lightproof sheets, if present.)
- Set the volt meter measurement range to a DC voltage, greater than the expected measurement (for example 600 VDC).
- Keep the plus (+) solar array output cables away from the ends of the minus (-) cables. Dangerous arcs can occur. (The array output voltage under normal conditions (clear skies) can be very high.)

5 Grounding the mount

- To prevent shock, always connect a ground wire from the mounting hardware to earth.
- Use a minimum #10 AWG ground wire. Run a continuous bond wire to each module and rail in the array. Refer to section on grounding in this manual.
- Follow NEC 690 grounding provisions.

POINTS TO CHECK WHEN SELECTING THE INSTALLATION LOCATION

○ Check the following items before starting installation work.

○ Refer to the inverter installation manual for more information about inverter installation and electrical work.

2.1 CONDITION OF HOUSE WHERE SOLAR POWER SYSTEM IS TO BE INSTALLED

INSPECTION OF ROOF STRUCTURE

It is important to inspect the structural integrity of the roof and the durability of the roof materials. The SRS mounting structure and solar modules require a strong base for durable and reliable operation in local environments. Always wear a safety harness when working on the roof.

Inspect the roof surface in the area of the installation for cracks, water leakage, and roofing material quality and uniformity. This is especially important if the roof is older than 10 years.

Inspect the roof for sags and other abnormalities. A sag or deep depression in the roof may indicate a structural weakness in the support system that may require correction. The following illustrations detail typical roof construction as well as old roof problems.

INSPECTION OF THE ROOF SUPPORT SYSTEM

This may require access to the attic.

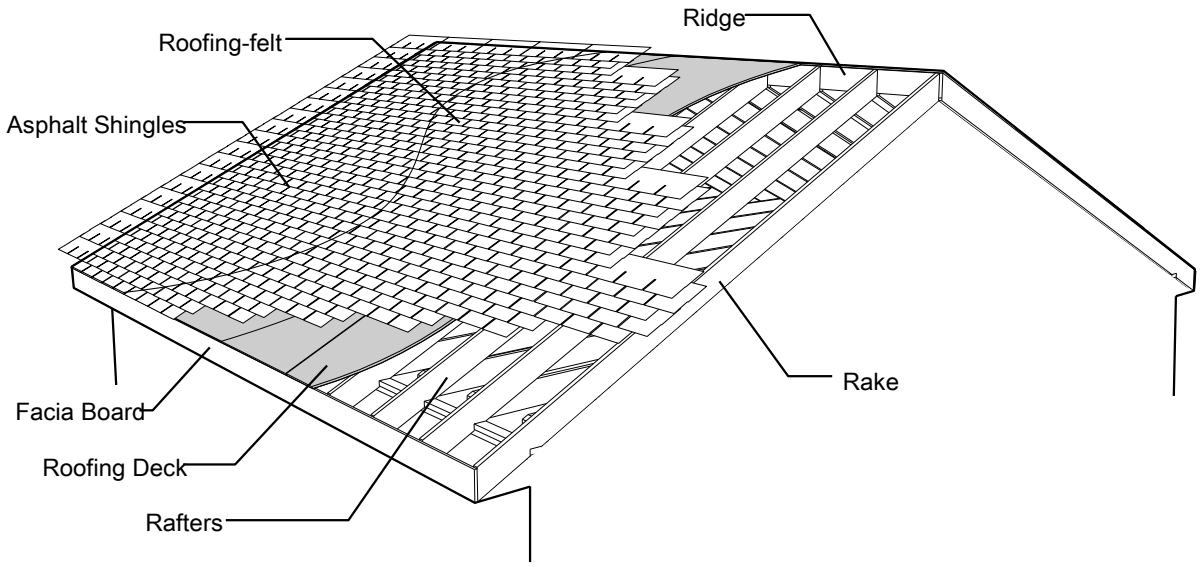
Check that all rafters, trusses and other materials are in good condition.

Check for indication of previous water leaks.

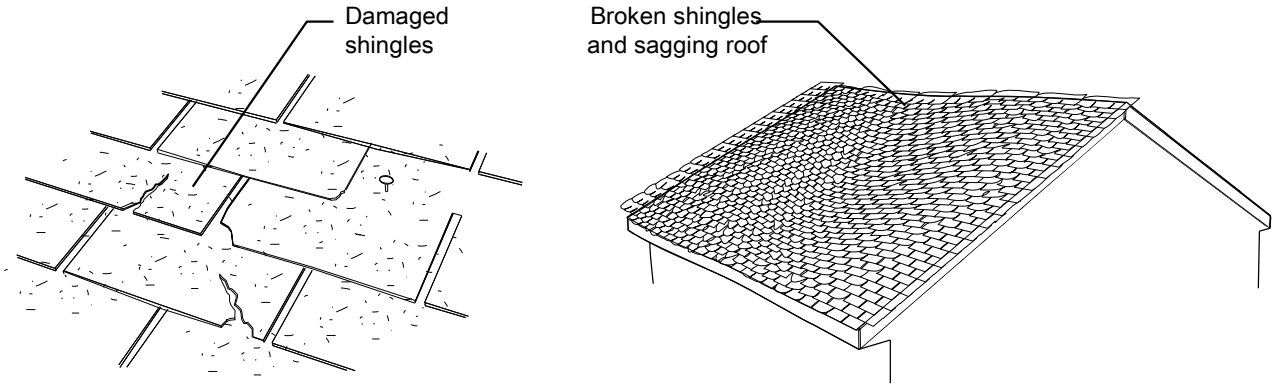
Measure the spacing of the rafters or trusses to confirm the dimensions and prepare for the system layout.

Determine the location of the electrical roof penetration and wire run, if wiring is planned for this area.

EXAMPLE ROOF CONSTRUCTION



EXAMPLES OF POOR ROOF CONDITION



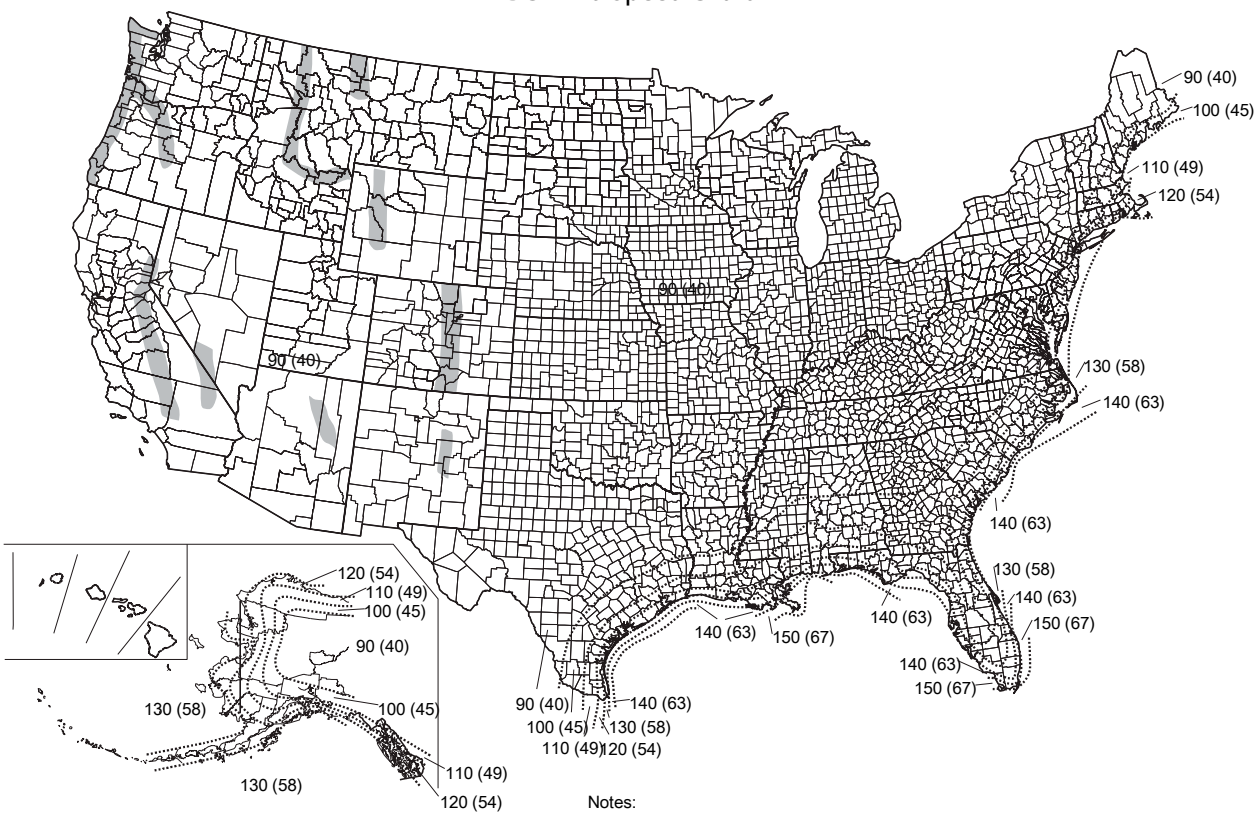
2.2 CHECKING THE SOLAR POWER SYSTEM INSTALLATION LOCATION

CODE COMPLIANT INSTALLATION

1. Determine the wind loads for the installation site. Check with your local building and safety department for the specific requirements.
2. Make certain that the roof structure can support the live and dead loads resulting from the installation of the PV array.
3. Consult with a professional engineer if additional assistance is required.
4. Determine the basic wind speed from the IBC wind speed chart (for US locations).
5. Determine the exposure category A through D (get latest definitions from IBC or local building code).
6. Determine total pressure by compiling basic wind speed, exposure and roof height. Check with Sharp technical support if your total pressure exceeds 45 PSF.
7. Reference the chart wind speeds to determine your design wind pressure (PSF). Determine exposure categories A through D for various roof heights.
8. Based on the loading in step 7, makes certain that the roof structure can support the load.
9. The modules and system are UL listed to standard 1703. The UL 1703 test is performed at 1.5 times the design load of 30 lbs per square foot, or 45 lbs per square foot. The system has been load tested by Sharp to 50 PSF use in locations subject to higher values. Building departments often require a design safety factor of 1.5 or greater for structures. The maximum structural loading listed in this guide, does not include an added safety factor.
10. To achieve maximum loading, use at least the same number of sliders as modules on each rail.

BASIC WIND SPEED SPECIFIED BY IBC

IBC Wind Speed Chart



Location	V mph	(m/s)
Hawaii	105	(47)
Puerto Rico	145	(65)
Guam	170	(76)
Virgin Islands	145	(65)
American Samoa	125	(56)

Notes:
1. Values are nominal design 3-second gust wind speeds in miles per hour (m/s) at 33 ft. (10 m) above ground for Exposure C category.
2. Linear interpolation between wind contours is permitted.
3. Islands and coastal areas outside the last contour shall use the last wind speed contour of the coastal area.
4. Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions.

2006 International Building Code - Basic Wind Speed (3-second gust)

1. Install solar modules facing south, if possible. Installations facing east and west are also possible, although the amount of power generated will be lower. Check the roof from a southern orientation, and check for obstacles that will cast a shadow. These factors will lower the amount of power generated. Explain this to the users and obtain their consen
2. Install in a location that has good sun exposure throughout the year. Less power is generated in shaded locations.
3. Check the following before installation.

   3.1 Solar modules should not be installed within 12" from the ridge or edges of the roof, nor within 16" from the eave.

   3.2 Installation is not possible in regions where the wind pressure exceeds 45 PSF. Check with your local building department to determine if this mounting system is in compliance. Installation is not possible when the roof angle is less that 10 degrees or greater than 45 degrees.

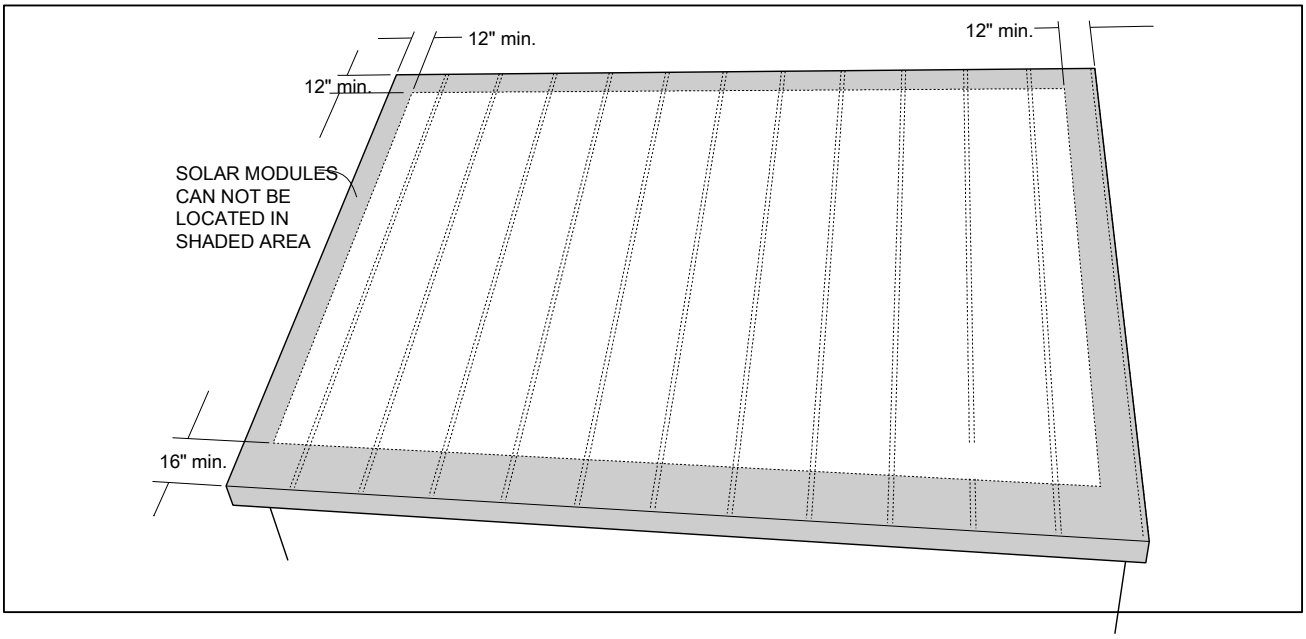
   3.3 Installation is not possible in the peripheral shaded area of the following figure.

   3.4 Do not locate systems near coastal locations or other salt water locations or C5 locations as classified by ISO. Minimum distance is 0.3 miles from the body of water. Do not locate in a corrosion prone area.

   ARRAY LAYOUT

   The array must be installed at least 16" away from the eave of the roof and 12" from the sides of the roof. This border will enhance the wind load resistance of the system.

   Measure the perimeter of the roof surface where the array will be installed.



4. The output of a series string of solar modules is connected to the input of the inverter. Always install solar modules so that all elements of the array receive the same amount of sunlight.

   The amount of power generated declines dramatically if you connect solar modules receiving different amounts of light in a string array, for example, solar modules facing east and solar modules facing south should not be connected in the same string.

   Refer to the inverter installation manual for more information about the number of solar modules connected in series in a single array.
5. It may not be possible to install solar modules in the following areas and under the following conditions. For more information, contact technical support.

   - Regions with heavy snowfall - Installation is not possible in regions where maximum snow accumulation exceeds the maximum allowable load. Contact the building & safety department for more information about maximum snow accumulation.

3.1 SOLAR MODULE AND ARRAY SPECIFICATIONS MODULES: ND-187U1, ND-187U1F, ND-167U1Y

1 Array specifications (typical examples)

Array: Layout of series connected solar modules

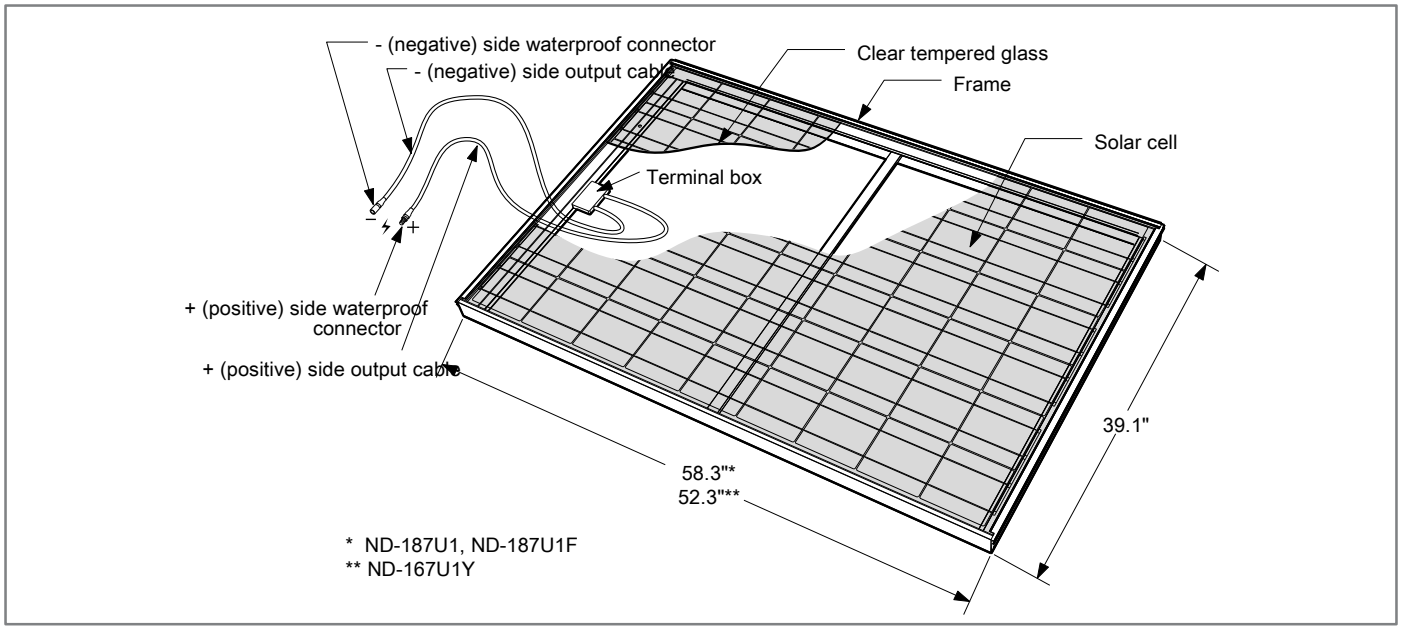
Solar module	ND-187U1				ND-167U1Y			
Solar modules	18	20	24	27	18	20	24	27
Solar power capacity (kW) STC	3.4	3.74	4.5	5.0	3.0	3.3	4.0	4.5
Solar module area (sq.ft.)	284.9	316.6	379.9	427.4	255.8	284.2	341.0	383.7

2 Individual specifications and dimensions

Module model name	ND-187U1	ND-187U1F	ND-167U1Y
Power (W) STC	187	187	167
Max. power voltage (Vmp)	25.6	25.8	22.97
Max. power current (Imp)	7.31	7.25	7.27
Open circuit voltage (Voc)	32.5	32.7	29.04
Short-circuit current (Isc)	8.13	7.99	8.02
Weight (lbs)	39.6	39.6	35.27
Dimensions (in)	58.3 x 39.1 x 2.26		52.3 x 39.1 x 2.26

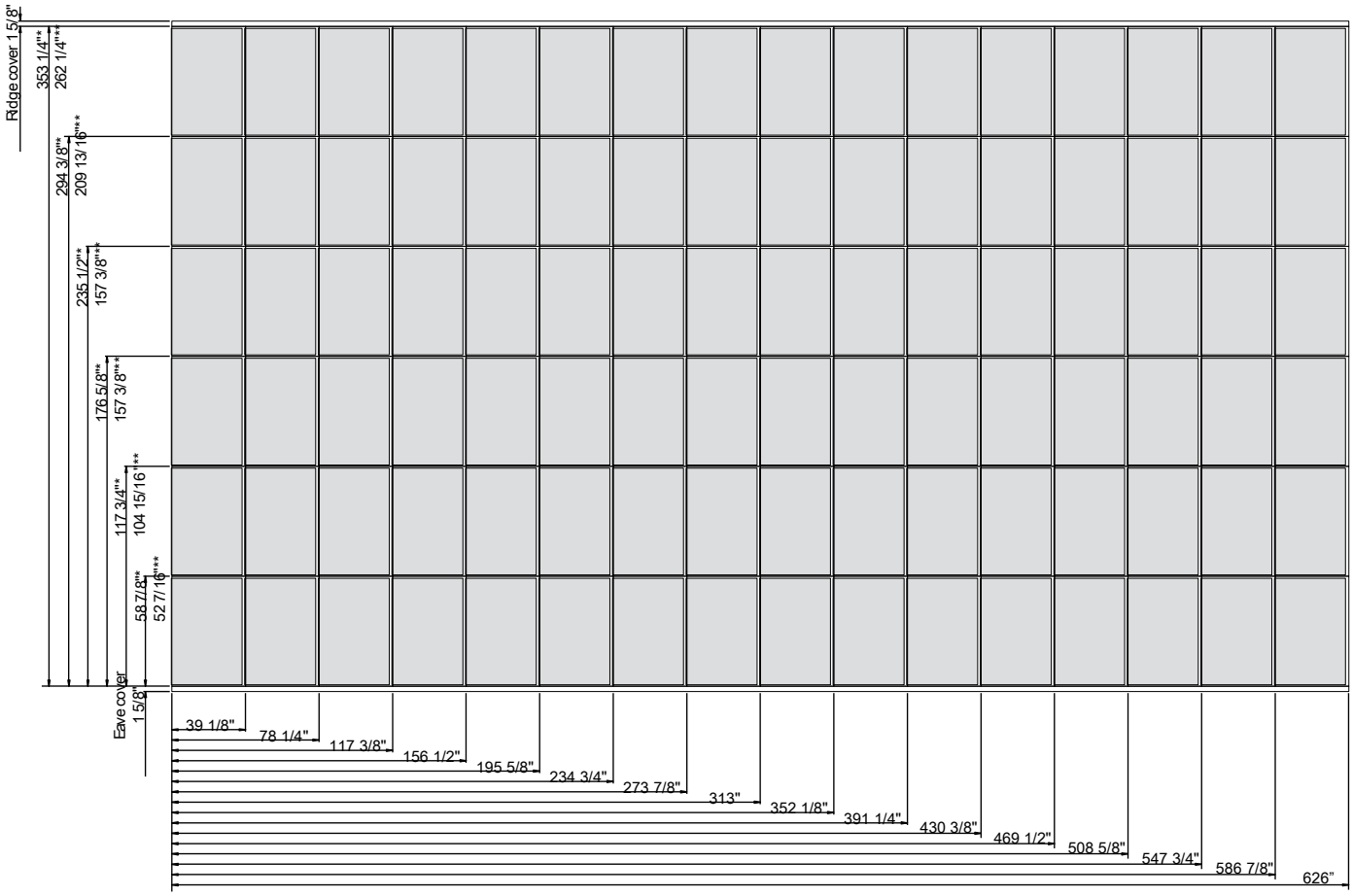
Rated electrical characteristics are within ±10 percent of the indicated values of Isc and Voc and within +10/-5 percent of Pmax under standard test conditions (irradiance of 100 mW/cm^2, AM 1.5 spectrum, and a cell temperature of 25˚C (77°F)). Under normal conditions, a photovoltaic module may experience conditions that produce more current and/or voltage than reported at Standard Test Conditions. Accordingly, the values of Isc and Voc marked on UL Listed modules should be multiplied by a factor of 1.25 when determining component voltage ratings, conductor capacities, fuse sizes and size of controls connected to the module output. Refer to Sec. 690-8 of the National Electric Code for an additional multiplying factor of 125 percent (80 percent of rating) which may be applicable. In the coverage of Canadian UL listing, installation shall be in accordance with CSA C22.1, Safety Standard for Electrical Installations, Canadian Electrical Code, Part 1.

SOLAR MODULE



3.2 ND-187U1, ND-187U1F, ND-167U1Y MODULE ARRAY LAYOUT DIMENSIONS

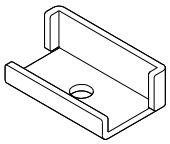
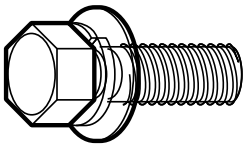
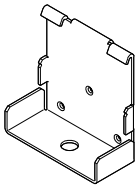
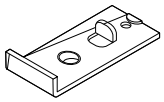
The location of the mounting feet and rails are dependent on the layout of the array. Use the following grid to determine the overall size of the array that will fit on the installation location.

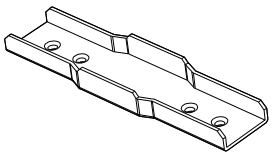
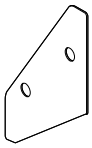
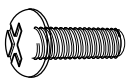


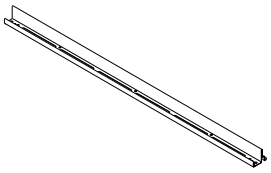
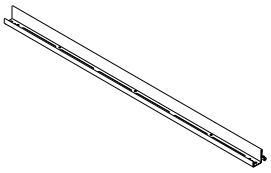
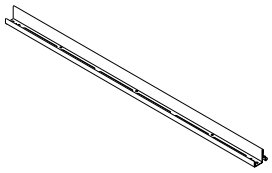
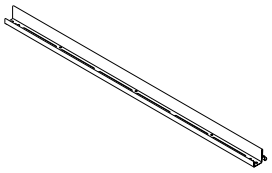
Maximum module layout (shown) is 16 wide x 6 tall. Contact Sharp for other configurations.

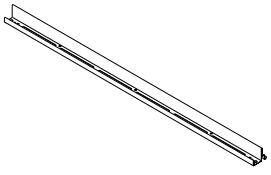
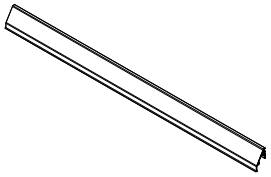
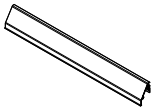
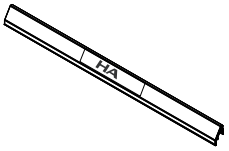
* ND-187U1, ND-187U1F

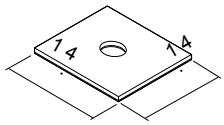
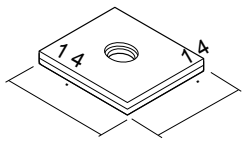
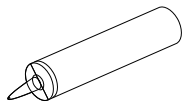
** ND-167U1Y

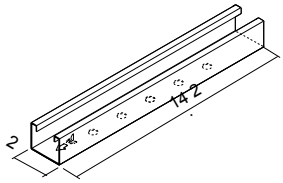
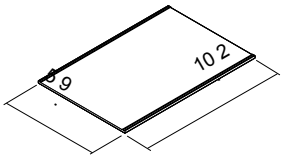
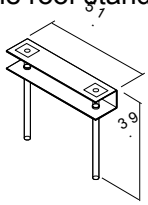
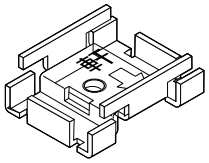
STANDARD PARTS				
Part No.	AD804	XA52	AD801	AD105
Model name	Dock washer	M8 Bolt 20 (shown actual size)	Module mounting clip	Threaded tab
				
Dimensions		M8 x 20 mm		
Material	Anti-corrosion coated steel	Stainless steel	Anti-corrosion coated steel	Anti-corrosion coated steel

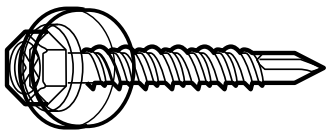
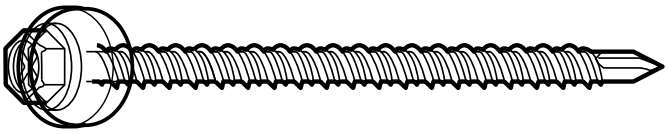
Part No.	AD101	AD802	XA05
Model name	Splice	Side cover	M4 Sidecover screw (shown actual size)
			
Dimensions			M4 x 12 mm
Material	Anti-corrosion coated steel	Aluminum	

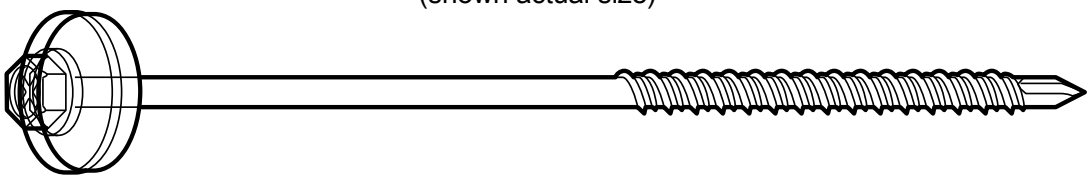
Part No.	AA801	AA802	AA803	AA804
Model name	Rail 1 in 1	Rail 2 in 1	Rail 3 in 1	Rail 4 in 1
				
Dimensions	Length: 35.98"	Length: 75.12"	Length: 114.25"	Length: 153.39"
Material	Anti-corrosion coated steel			

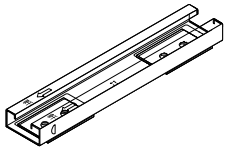
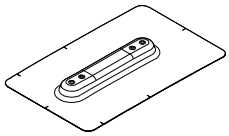
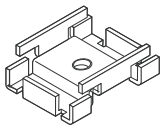
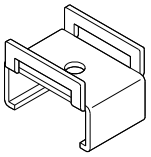
Part No.	AA805	AB801	AB802	AB803
Model name	Rail 1.5 in 1	Front cover	Front cover, half size	Front cover with Sharp logo
				
Dimensions	Length: 55.55"	Length: 39.13"	Length: 19.57"	Length: 39.13"
Material	Anti-corrosion coated steel	Aluminum		

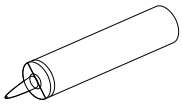
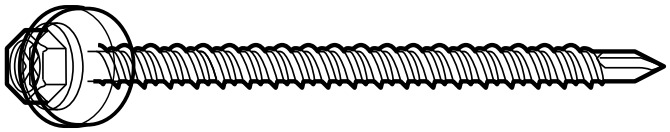
ROOF TILE PARTS				
Part No.	AE112	AE105	AE106	AE107
Model name	Roof tile drill bit per piece (6 pcs/case) 	Tile roof bottom butyl pad 	Tile roof top butyl pad assy 	Silicone caulking 
Material		Anti-corrosion coated steel	Anti-corrosion coated steel	Silicone

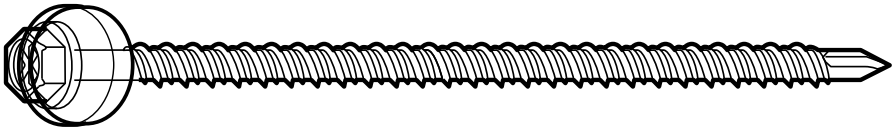
Part No.	AE110	AK111	AE104	AE102
Model name	Tile roof slider 	Support AL plate 	Tile roof stand off 	Tile roof slder bracket 
Material	Anti-corrosion coated steel	Aluminum	Anti-corrosion coated steel	Anti-corrosion coated steel

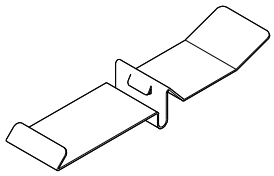
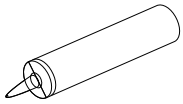
Part No.	XA27	XA02
Model name	Support AL screw 5.5 x 35 (shown actual size) 	Standard slider mounting screw 5.5 x 80 (shown actual size) 
Material	Stainless	

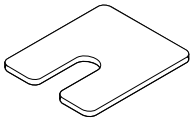
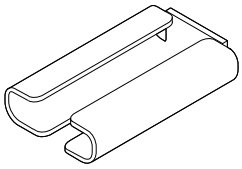
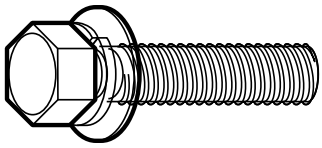
Part No.	XA50
Model name	Tile roof stand off screw 5.5 x 135 (shown actual size) 
Material	Stainless

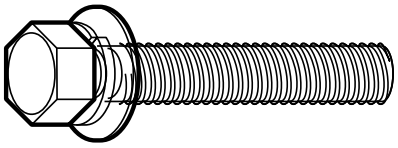
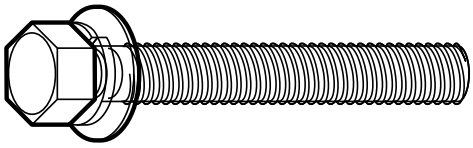
ASPHALT ROOF PARTS				
Part No.	AS801	AS804	AS105	AD805
Model name	Standard slider assembly 	Mounting Flash assembly 	Standard slider bottom bracket 	Standard slider top bracket 
Dimensions	11" x 2" x 1"	14" x 10" x 1.25"		
Material	Anti-corrosion coated steel		Anti-corrosion coated steel	

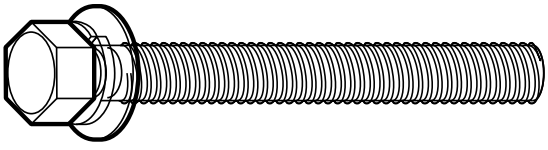
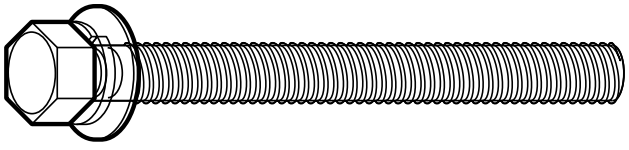
Part No.	AE107	XA02
Model name	Silicone caulking 	Standard slider mounting screw 5.5 x 80 (shown actual size) 
Material	Silicone	Stainless

Part No.	XA58
Model name	Standard slider mounting screw w/ flashing 5.5 x 110 (shown actual size) 
Material	Stainless

OPTIONAL PARTS			
Part No.	AD803	AD806	AE107
Model name	Cable support bar 	Cable clip 	Silicone caulking 
Material	Anti-corrosion coated steel		Silicone

Part No.	AK113	AK114	XA53
Model name	0.1" shim 	0.4" shim 	M8 Bolt 30 (shown actual size) 
Dimensions			M8 x 30 mm
Material	Anti-corrosion coated steel		Stainless Steel

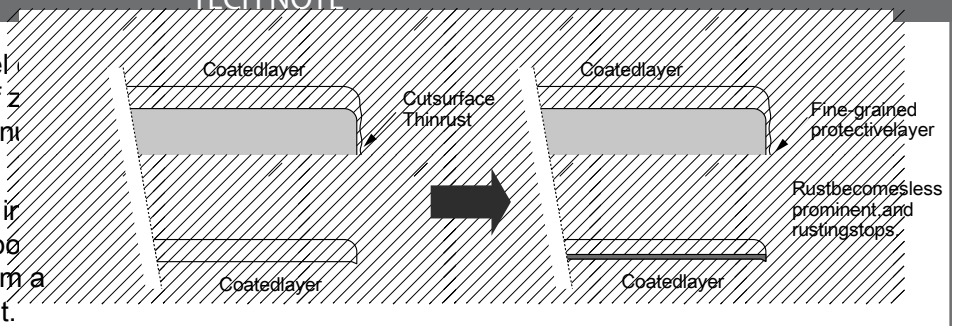
Part No.	XA54	XA55
Model name	M8 Bolt 40 (shown actual size) 	M8 Bolt 50 (shown actual size) 
Dimensions	M8 x 40 mm	M8 x 50 mm
Material	Stainless Steel	

Part No.	XA56	XA57
Model name	M8 Bolt 60 (shown actual size) 	M8 Bolt 70 (shown actual size) 
Dimensions	M8 x 60 mm	M8 x 70 mm
Material	Stainless Steel	

TECH NOTE

Anti-corrosion coated steel is steel with a layer consisting primarily of z plus another metal, such as alumin magnesium.

After it is cut, some rust develops ir the cut surface, but then the compo of the coating layer dissolve to form a stable protective layer over the cut.



POINTS TO CHECK BEFORE INSTALLATION WORK

⚠ WARNING

- The solar modules generate electricity when exposed to sunlight, so be careful not to short circuit the output cables. The cables can become overheated and their cable sheaths can melt.
- Stop working when the surface of the roof is wet. There is a danger of slipping, falling, and shock.

⚠ CAUTION

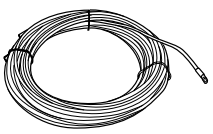
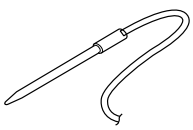
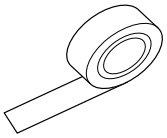
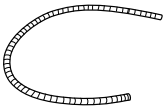
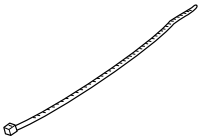
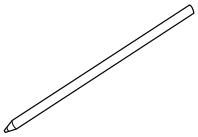
- Never step or sit on the glass surface of the solar modules. The glass may break.
- Do not twist the solar modules when you mount them (twisting should not exceed 0.1" per 4"). Failures and damage can result.
- When you mount the solar modules on the rail, never allow an output cable to become caught between the rail and a module frame. Short circuits and fire can result.

5.1 UNPACKING AND CHECKING PARTS

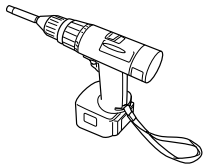
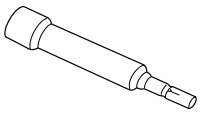
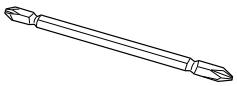
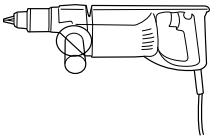
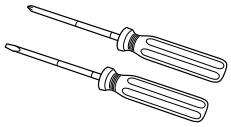
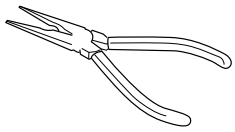
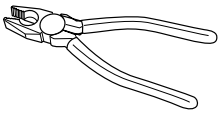
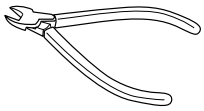
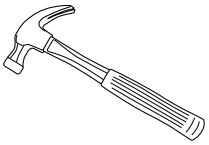
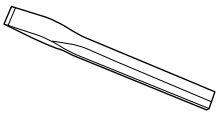
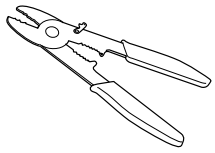
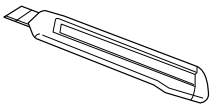
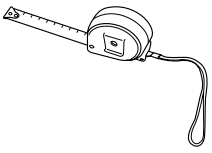
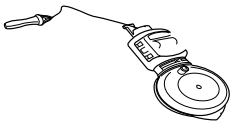
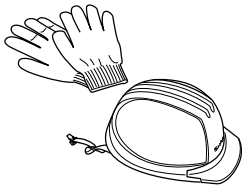
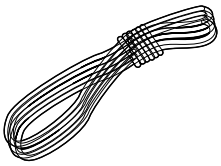
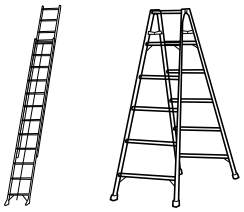
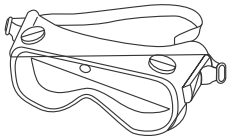
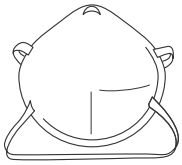
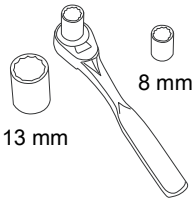
When you unpack the system, check the model names of the components of each system and check to be sure that you have the correct number of parts.

5.2 MATERIALS AND TOOLS YOU WILL NEED

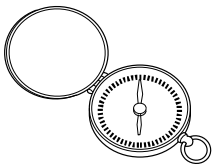
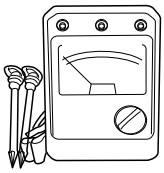
Before starting installation work, make sure you have the following materials and tools on hand (including materials and tools for electrical work).

Materials					
Ground wire	Ground rod	Electrical tape	Flexible metal conduit (to protect electric cables)	Cable ties	Pencil
					

Tools

Cordless drill 	Socket drivers 8 mm & 13 mm 	Phillips driver bits 	Drill 	Screw driver set 
Needle nose pliers 	Line man's pliers 	Wire cutters 	Hammer 	Chisel 
Crimping tool 	Knife 	Tape measure 	Extension cord 	Chalk line 
Gloves & safety helmet 	Rope 	Tool belt 	Ladders 	Safety Harness 
Safety glasses 	Air mask 	Ratchet Wrench 		

Measurement

Compass 	Calculator 	Solar insolation meter 	Digital multimeter 

6.1 PREPARING SHINGLE ROOF FOR INSTALLATION

1. Locate roof rafters or trusses.

   Tip: here are 3 options to finding the locations.

   A. Locate and measure the locations of the rafters in the attic or at the outside eave and transfer measurements to the roof.

   B. Use a rubber or leather mallet to tap the roof and locate the rafters. This will work with a cap sheet or composition roof.

   C. Scan the roof with a high sensitivity stud finder.

2. Once the rafters have been located, snap a chalk line on every rafter to identify the location.

3. Measure up from the eave 16" (400 mm) in at least 3 locations. Snap a chalk line. This marks the location of the bottom edge of the slider feet.

   Note: This line needs to be 0.22" (5.5 mm) away from the nearest front edge of shingles.

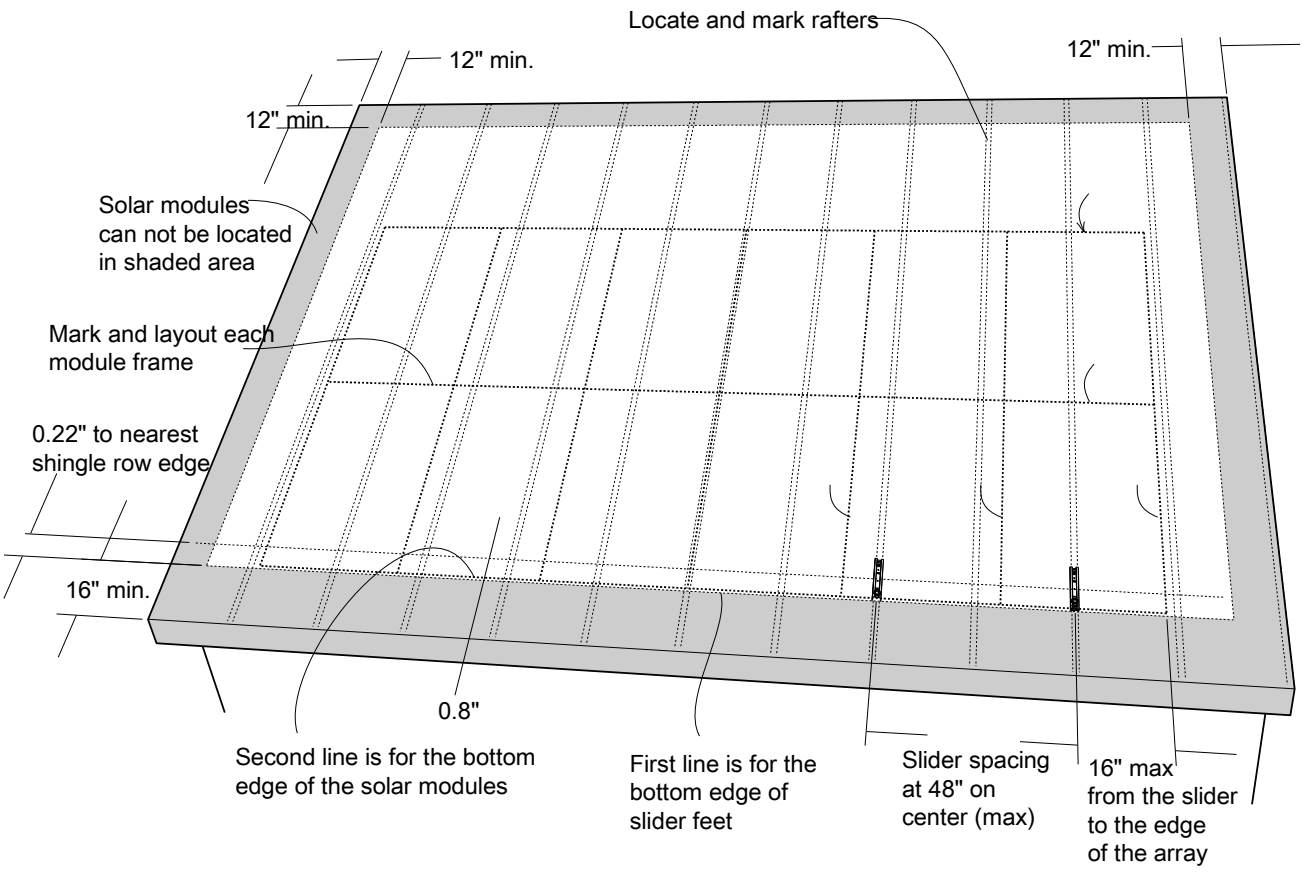
4. Measure up from chalk line 0.8" (20 mm) and snap a new chalk line. This marks the location of the bottom edges of the modules.

5. Measure up from the module chalk line to the desired module length to form the array. Snap horizontal lines at the measured locations.

6. Mark and layout solar module vertical lines.

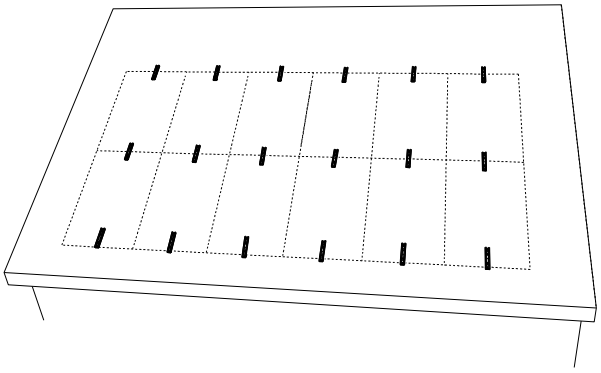
   Note: modules should not fall in shaded areas.

MODULE GABLE ROOF LAYOUT

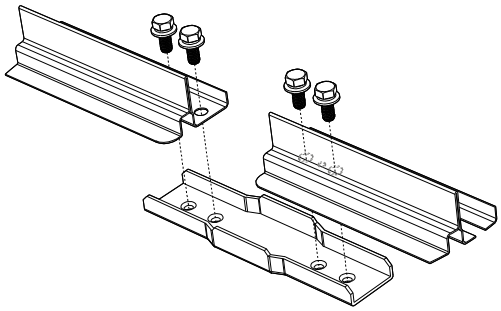


6.2 CHECKING LAYOUT

1. Before installing sliders, check layout of rails and splices.
2. Place all sliders in desired locations.



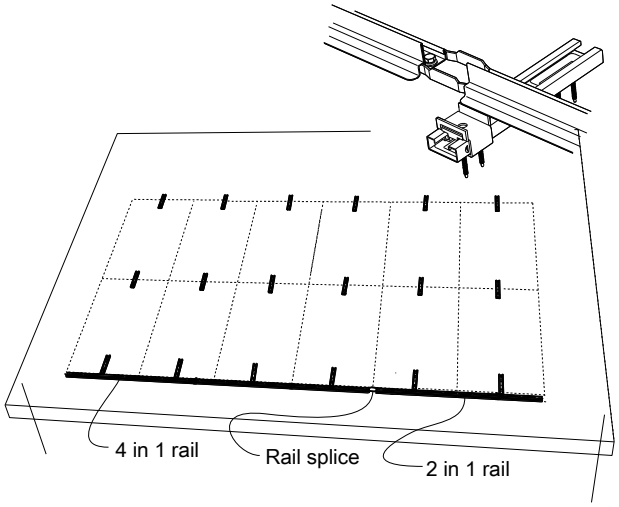
3. Pre-assemble rails and splices.



⚠ CAUTION Bolt Tightening Instructions

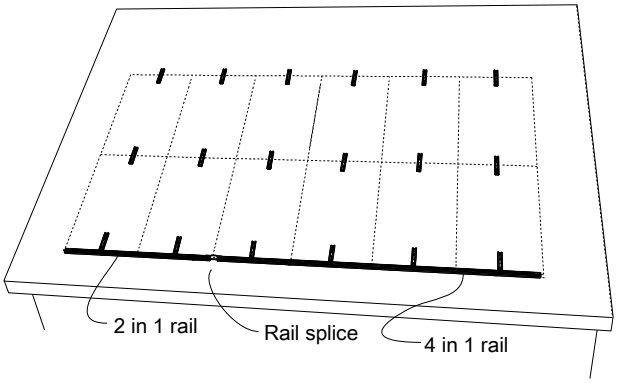
You must begin tightening bolts by hand. After 5 turns by hand, use a socket driver to finish tightening. Proper torque (SI units 12.5 Nm) (USA units 9.3 ft.lb)

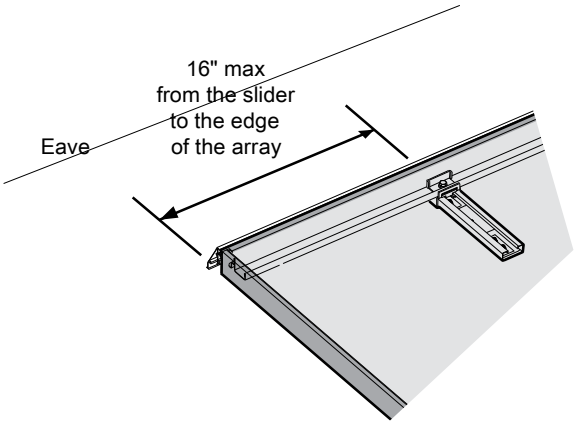
4. Place rails with splices into position. Ensure slider locations do not overlap splices.



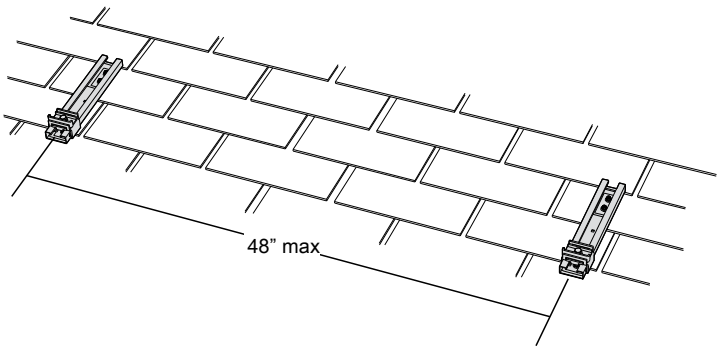
5. If these overlap or seem too close, shift rails horizontally or move sliders to next rafter or remove splices to switch the long and short rails to opposite sides. Reattach splices after rails are switched and recheck for overlap.

⚠ CAUTION The maximum distance from the slider to the edge of the array is 16".





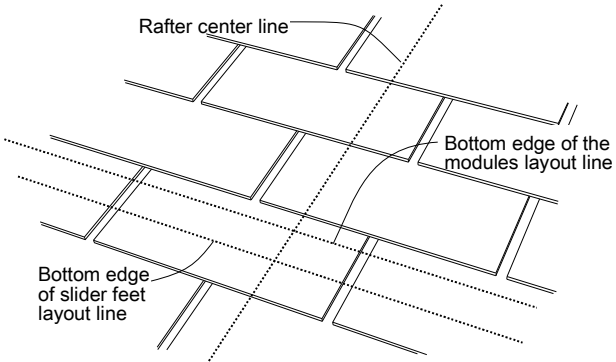
Sliders not to exceed more than 48" on center.



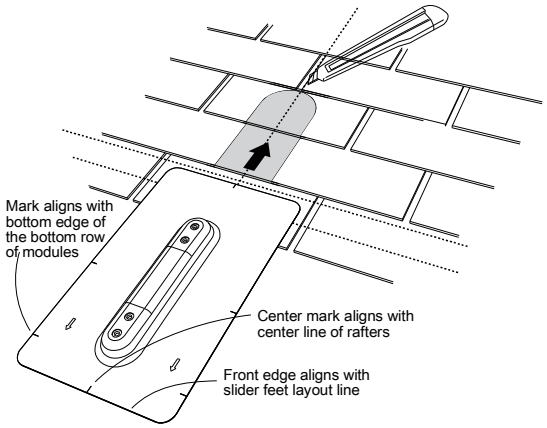
6.3 INSTALLING THE FLASHINGS (OPTIONAL)

Flashings can improve water and ice management on the roof by directing the water around the rail slider assembly. It is ideal for use in new construction, re-roof, and in locations with significant precipitation. The flashings are installed below the standard slider assembly. Each flashing is similar in size to the slider assembly. The flashing has a large flange around it's perimeter to allow for integration with the surrounding shingles. There are 3 alignment marks on the flashing and identification for the orientation of the part.

1. Confirm the locations of each standard slider assembly. Follow the same rules for installation as the slider foot. The flashings located on the bottom rail (close to the eave), should be aligned with the chalk lines created in the roof layout. Flashings used to support the center rails, should be centered on the rail line. The flashings located at the top rail (close to the ridge), should have minimal exposure beyond the rail.

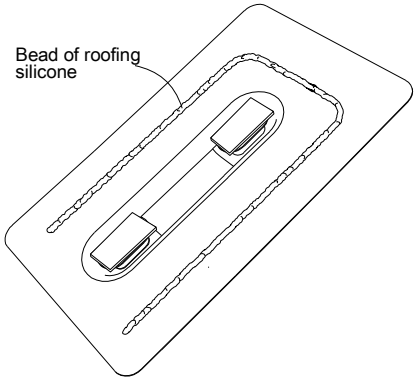


2. Dry fit the flashing in the location marked for installation. Use a utility knife to cut the surrounding shingles to assure a flush and water resistant fit. Install flashing over a layer of shingles to insure water resistance.

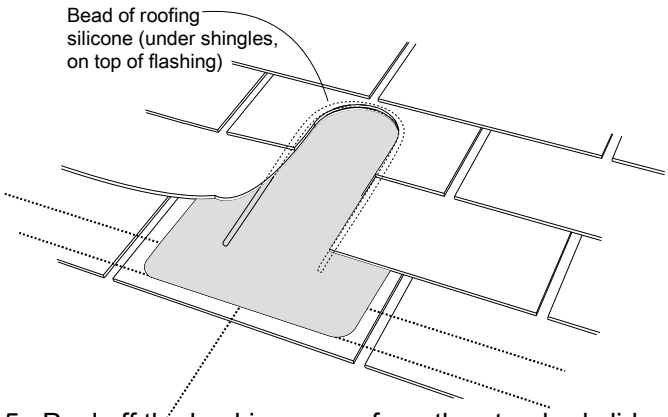


⚠ CAUTION The arrow on the flashing should point to the eave side. Install flashing over a layer of shingles to insure water resistance.

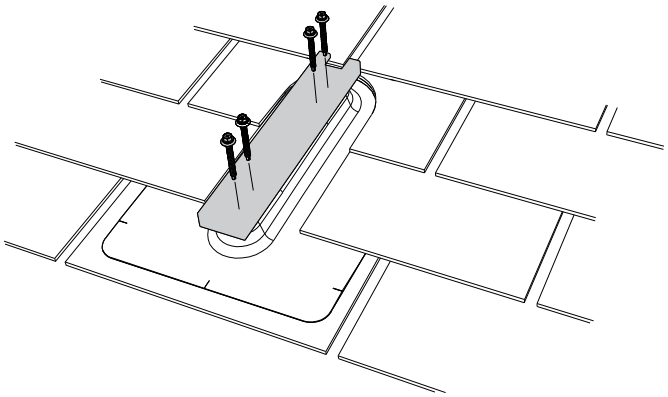
3. Invert the flashing, peel off the protective backing paper and apply a bead of roofing silicone along the top and sides in the flange area. Leave the bottom flange clear for water drainage. Make sure that the shingles are at room temperature, ~68˚F. When shingles are cold, they become brittle and are difficult to work with. Use a putty knife to lift the shingles and slide in the flashing.



4. Apply a bead of silicone on the top and sides of the flange that contact the surrounding shingles. Press the area to create tight seal.

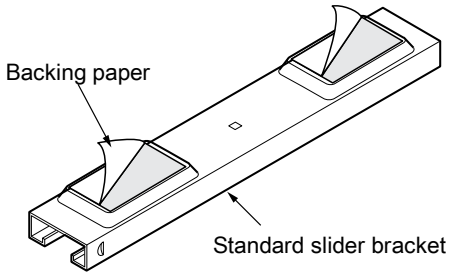


5. Peel off the backing paper from the standard slider. Place the standard slider assembly on the flashing and secure with the supplied flashing screws 110 mm.



6.4 INSTALLING STANDARD SLIDER ASSEMBLY

1. Insert standard slider top and bottom brackets into each standard slider assembly prior to installation. Peel off the backing paper from the standard slider.



Each adjustable slider is equipped with pre-installed butyl sealant pads. A protective cover must be removed prior to installation on the roof.

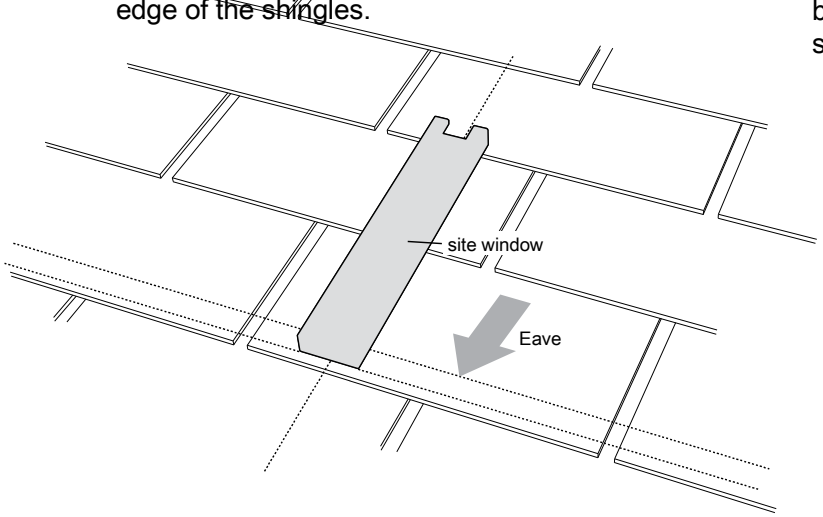
A hole is located at the center point of the slider. It can be used as the site window for locating the slider on the previously snapped chalk line.

There are 2 arrows located at one end of the slider. The arrows should be pointing towards the eave of the roof. The arrows indicate the location of indents on the slider that prevent the standard slider bottom bracket from falling out.

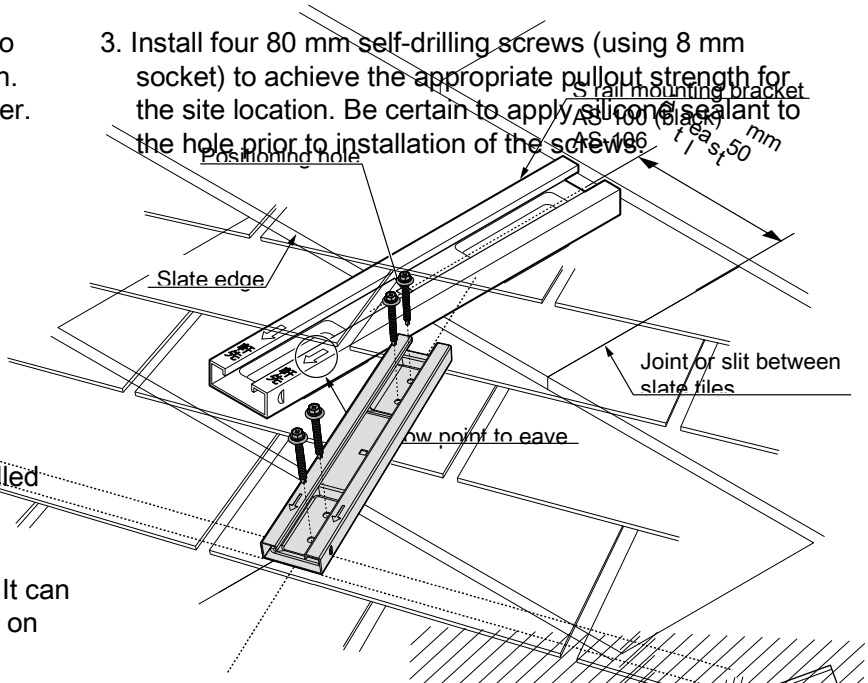
Place the slider assembly in the measured location and install the self-drilling screws at the upper and lower locations.

⚠ CAUTION The arrow on the standard slider assembly should point to the eave.

2. Remove any debris, and press the slider assembly into place. Site window should align with the front edge of the shingles.

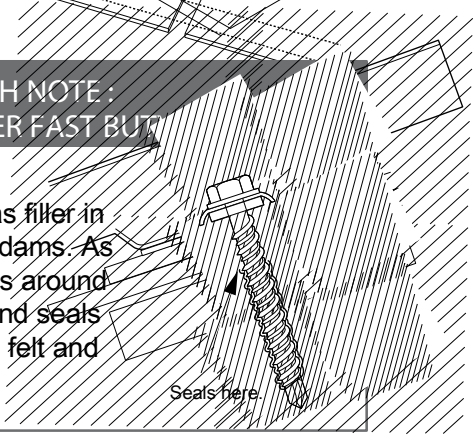


3. Install four 80 mm self-drilling screws (using 8 mm socket) to achieve the appropriate pullout strength for the site location. Be certain to apply silicone sealant to the hole prior to installation of the screws.

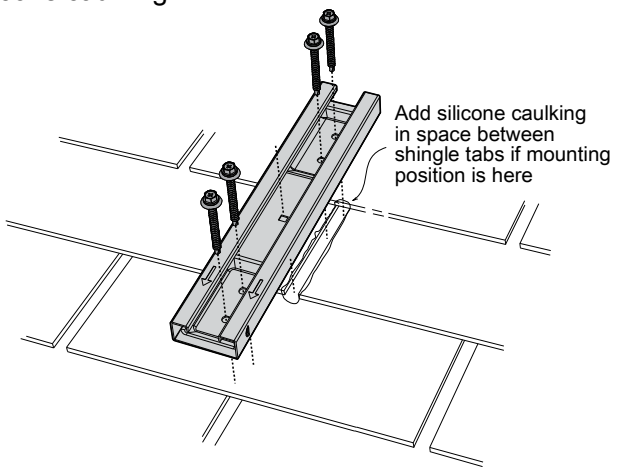


TECH NOTE : DURABLE AND WATER FAST BUTYL

Butyl rubber is used as filler in the concrete joints of dams. As shown at right, it twists around the mounting screw and seals the hole in the roofing felt and sheathing.



⚠ CAUTION If slider is positioned on top of the space between shingle tabs, fill the void with the supplied silicone caulking.



6.5 PREPARING TILE ROOF INSTALLATION

1. Locate roof rafters or trusses.

   Tip: here are 3 options to finding the locations.

   A. Locate and measure the locations of the rafters in the attic or at the outside eave and transfer measurements to the roof.

   B. Use a rubber or leather mallet to tap the roof and locate the rafters. This will work with a cap sheet or composition roof.

   C. Remove a few tiles and scan the roof with a high sensitivity stud finder.

2. Once the rafters have been located, snap a chalk line on every rafter to identify the location.

3. Measure up from the eave 16" (400 mm) in at least 3 locations. Snap a chalk line. This marks the location of the bottom edge of the front cover.

   Note: This line needs to be 8" away from the next row up front edge of tiles. The bottom rail (eave) should be centered in the 2 nd course of tile. Do not install rail in the 1st course of tile, it is too close to the edge.

   When using 167 Watt modules, install the next rails 3 courses higher than previous rail. When using 187 Watt modules, install the next rails 4 courses higher than previous rail.

4. Measure up from chalk line 1" and snap a new chalk line. This marks the location of the bottom edges of the modules.

5. Measure up from the module chalk line to the desired module length to form the array. Snap horizontal lines at the measured locations.

6. Mark and layout solar module vertical lines.

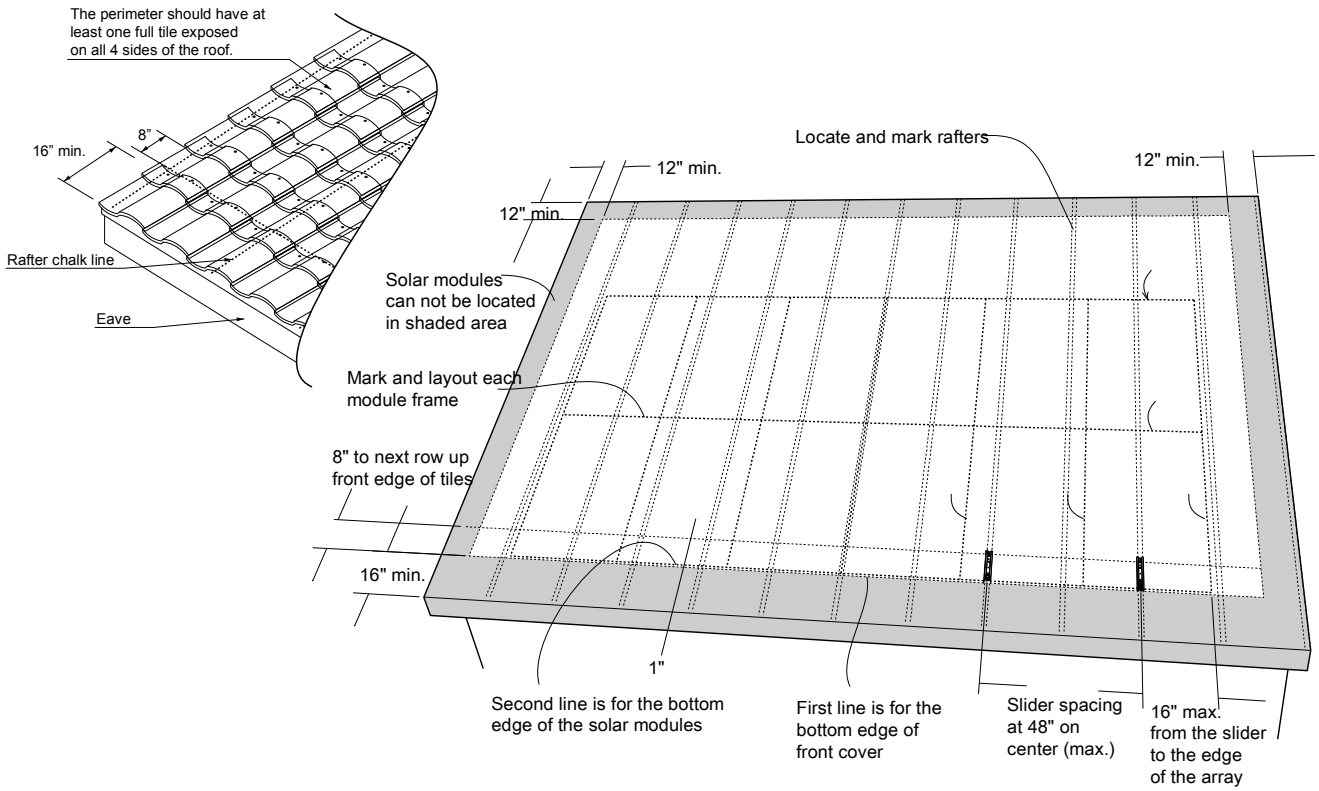
   Note: modules should not fall in shaded areas.

7. Tile attachment is designed for use with a minimum thickness of 15/32" roof deck and minimum rafter thickness of 2 x 4.

8. Tile attachment is designed for use with flat concrete tile, low profile S tile, and medium profile S tile.

9. The roof tiles must be able to fit within the 4 inch gap between the deck and the rail.

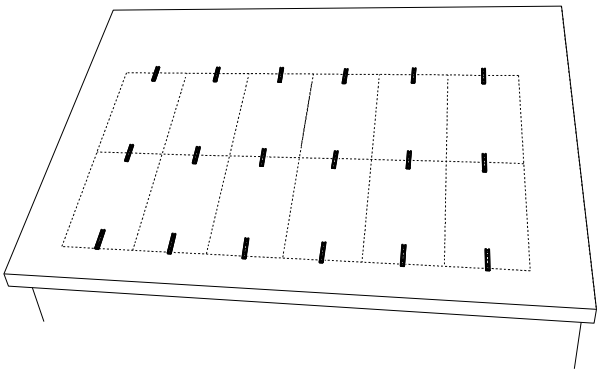
MODULE GABLE ROOF LAYOUT



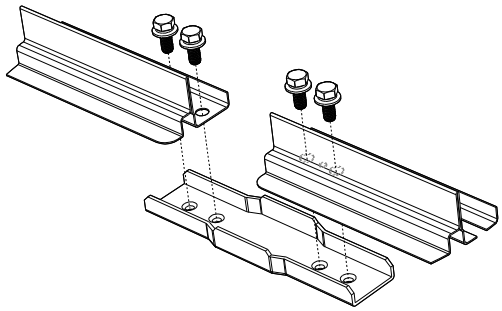
Note: Bottom row of tiles should not to be used to install tile standoff.

6.6 CHECKING LAYOUT

1. Before installing sliders, check layout of rails and splices.
2. Place sliders on all tiles that were identified to be drilled for tile standoffs.



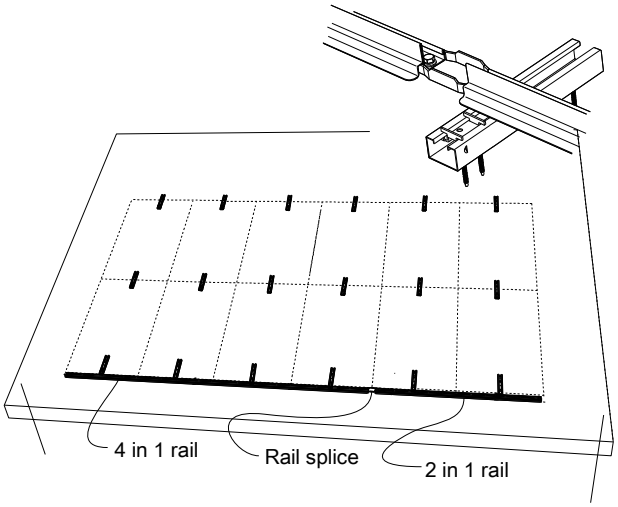
3. Pre-assemble rails and splices.



⚠ CAUTIO Bolt Tightening Instructions

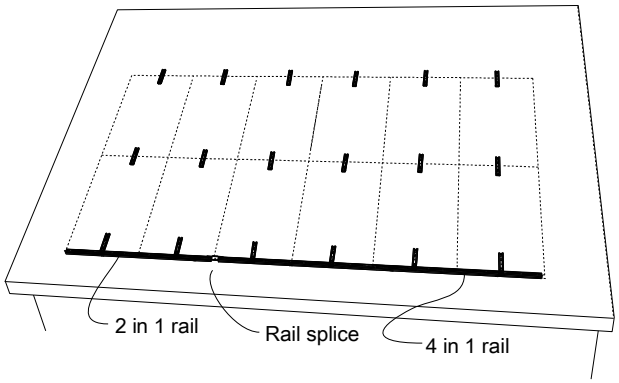
You must begin tightening bolts by hand. After 5 turns by hand, use a socket driver to finish tightening. Proper torque (SI units 12.5 Nm) (USA units 9.3 ft.lb)

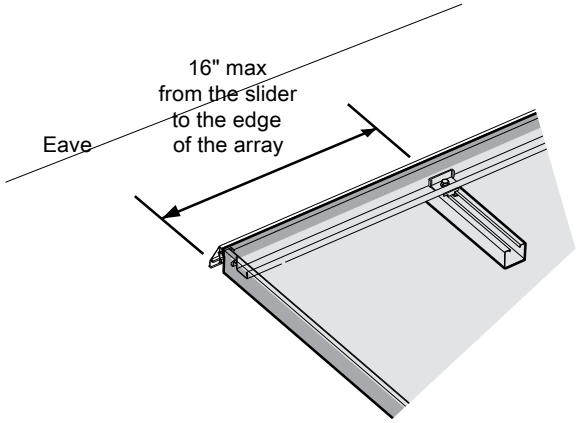
4. Place rails with splices into position. Ensure slider locations do not overlap splices.



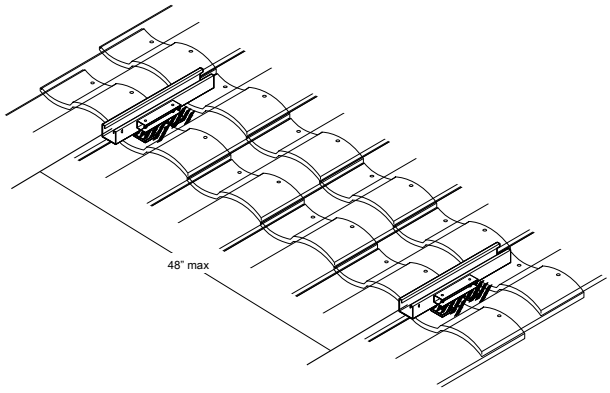
5. If these overlap or seem too close, shift rails horizontally or move sliders to next rafter or remove splices to switch the long and short rails to opposite sides. Reattach splices after rails are switched and recheck for overlap.

⚠ CAUTIO The maximum distance from the slider to the edge of the array is 16".



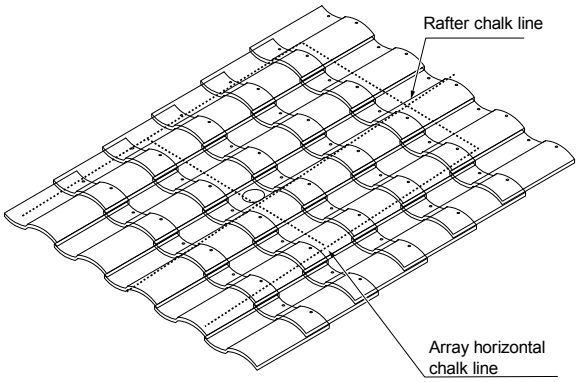


Sliders not to exceed more than 48" on center.

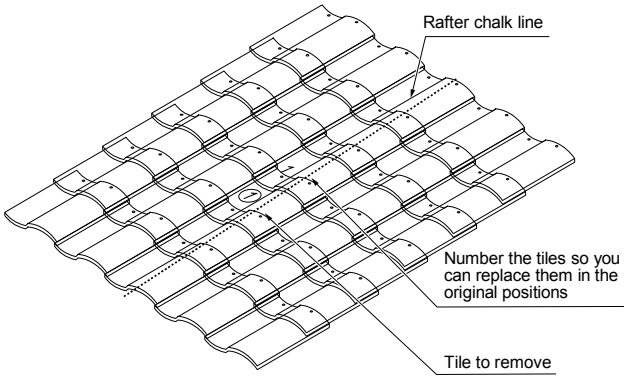


6.7 INSTALLING TILE SLIDER ASSEMBLY

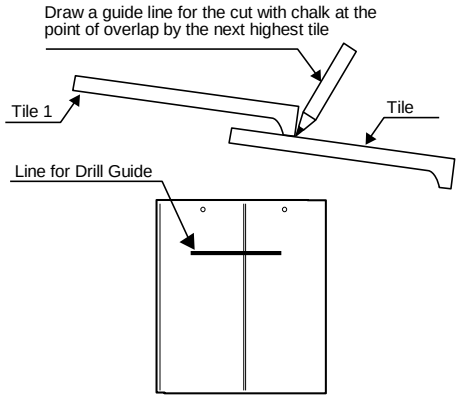
1. Identify the locations for the roof tile sliders so that each slider is located in the valley of the tile.



2. Number two tiles, one above the other. The lower tile will be removed to install the aluminum support plate.

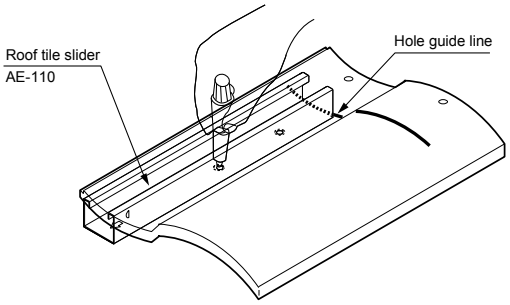


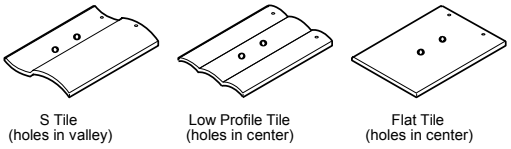
3. Mark the edge of the upper tile on the lower tile to insure proper alignment upon assembly.

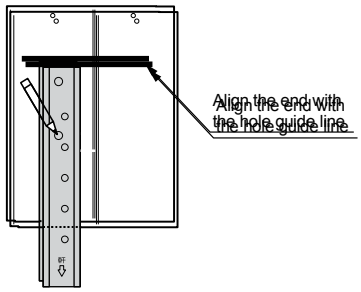


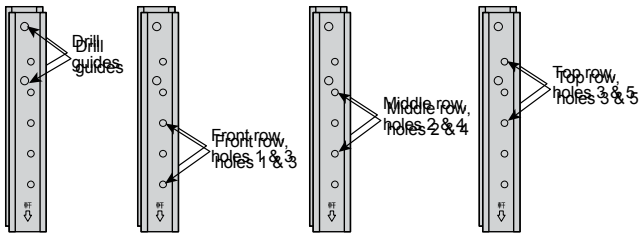
4. Remove the lower tile from the roof.

5. Place the roof tile slider on the lower tile and align with the horizontal line marked above. Mark two holes for roof tile stand off.

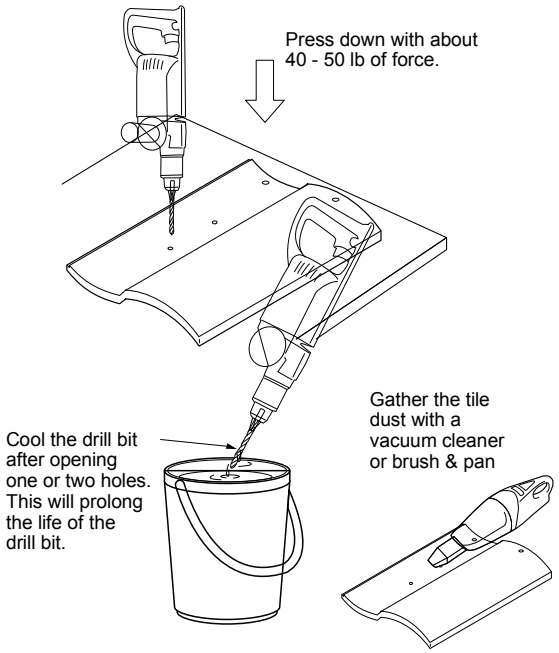








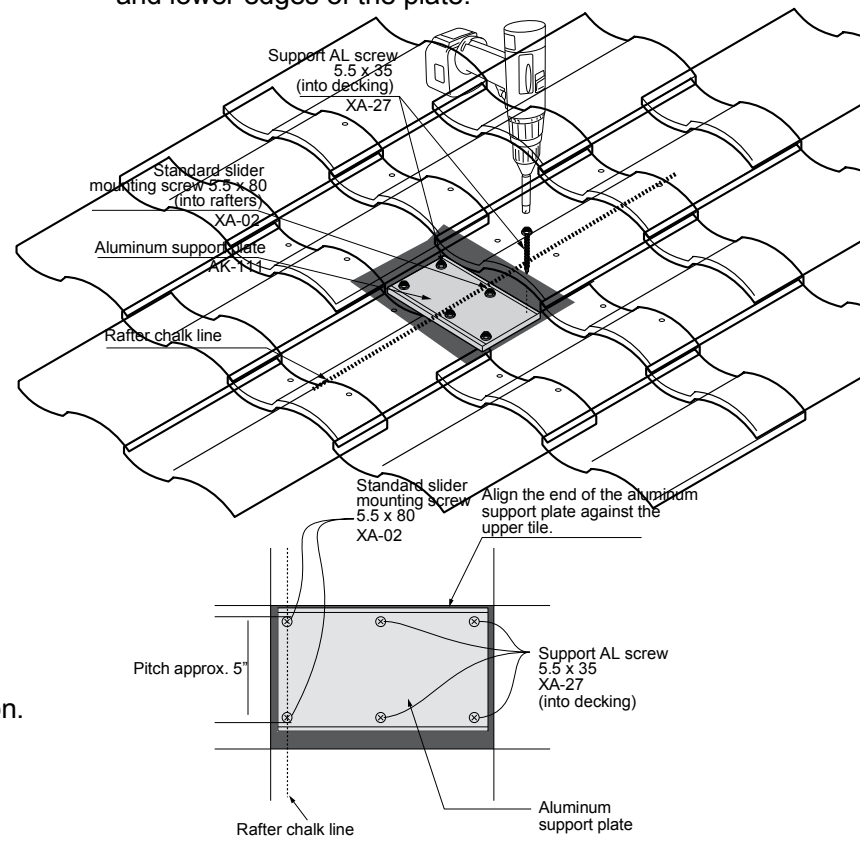
6. Drill 2 holes using the Sharp supplied drill bit (AE112). A high speed drill (approximately 1000 rpm) is required for this process. Exert a pressure of 40 to 50 lb. Make certain to dip the tip of the drill in water after drilling each hole. This will cool the drill bit. Clean any debris and dust after drilling.



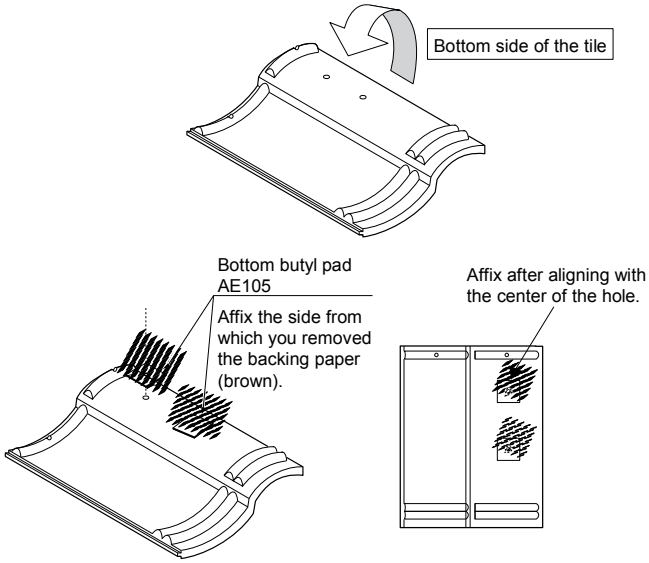
⚠ CAUTIO Drill holes on the ground for safety reason. Check back of the tile if drill would hit rib of the tile.

Do not use hammer drill because the tile may break.

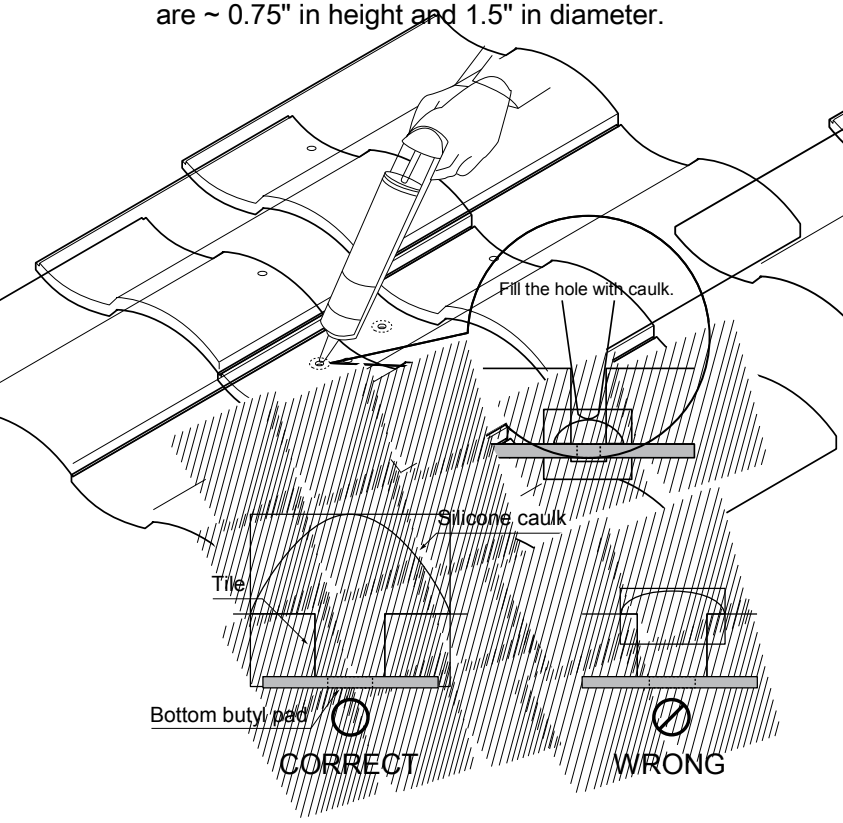
7. Locate the rafter and place the aluminum support plate on the deck. Install two 80 mm screws through the plate, spaced ~ 5" apart, into the rafter. Install four 35 mm screws through the plate and into the deck. The screws should be spaced equally along the upper and lower edges of the plate.



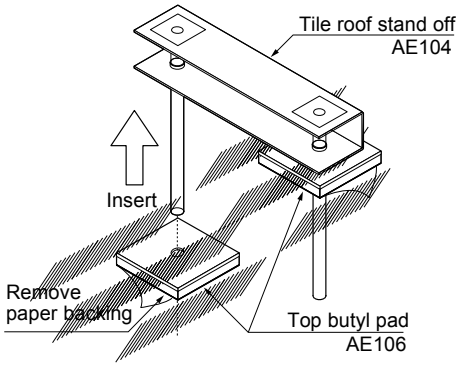
8. Place 2 butyl pads under the holes drilled in the tile. The butyl should be located on the underside of the tile. Reinstall the tile on to the roof, minding the locations marked previously.



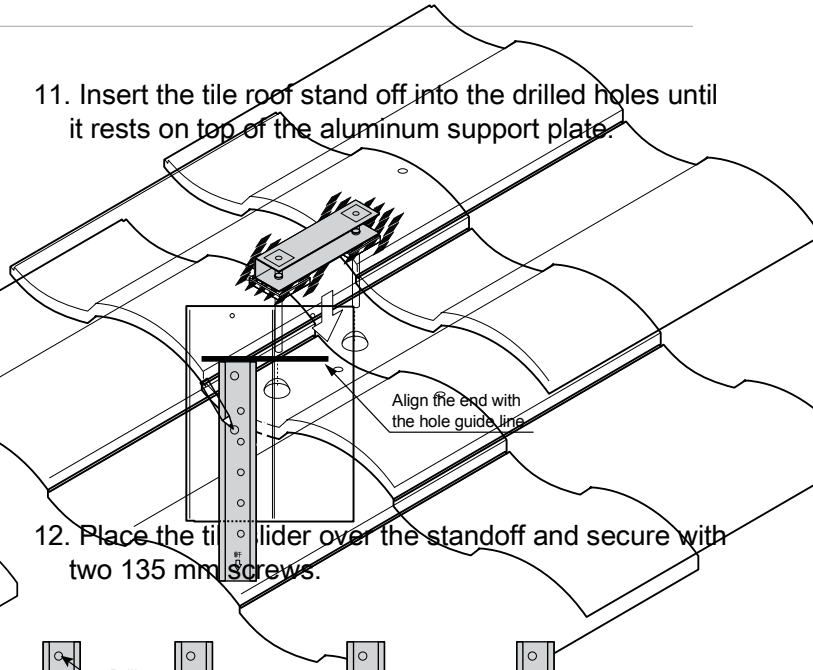
9. Inject Sharp supplied silicone caulk, AE107 into the holes to form a dome. The dimensions of the dome are ~ 0.75" in height and 1.5" in diameter.



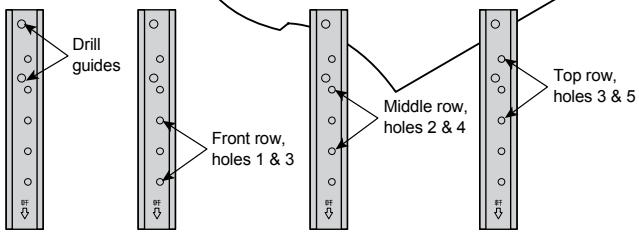
10. Insert 2 top butyl pads onto the tile standoff legs.

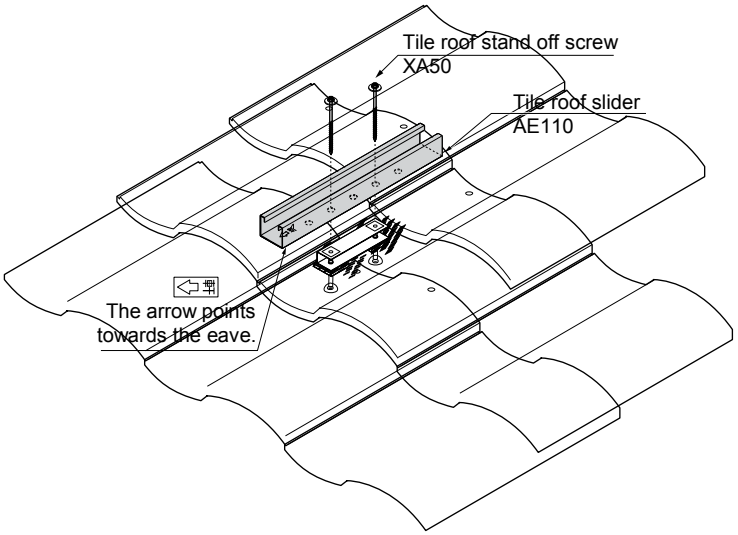


11. Insert the tile roof stand off into the drilled holes until it rests on top of the aluminum support plate.

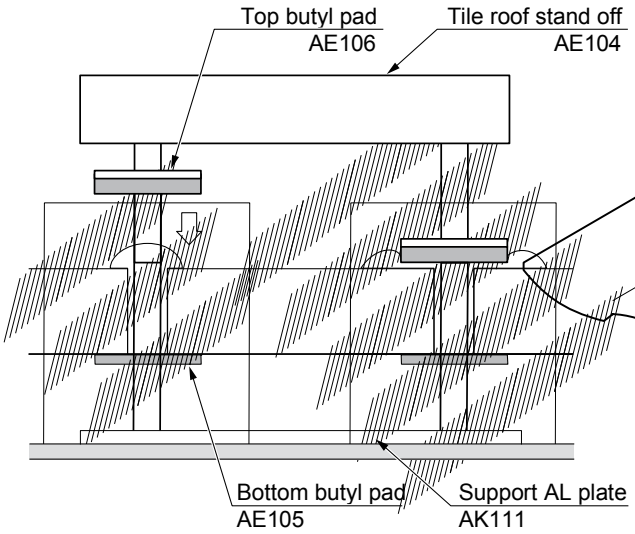


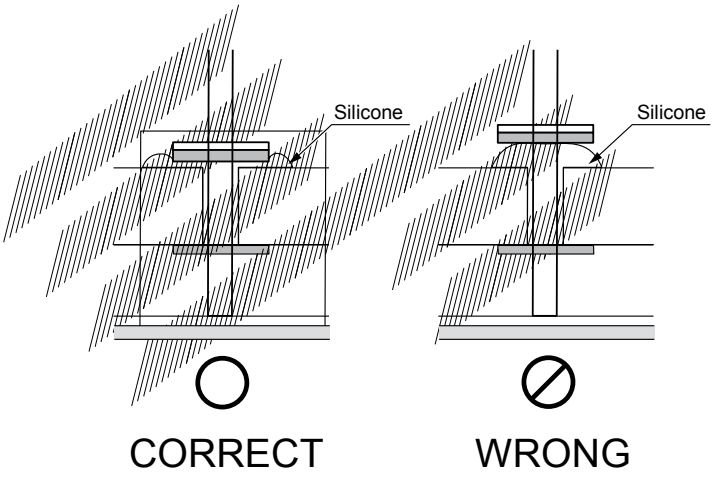
12. Place the tile slider over the standoff and secure with two 135 mm screws.



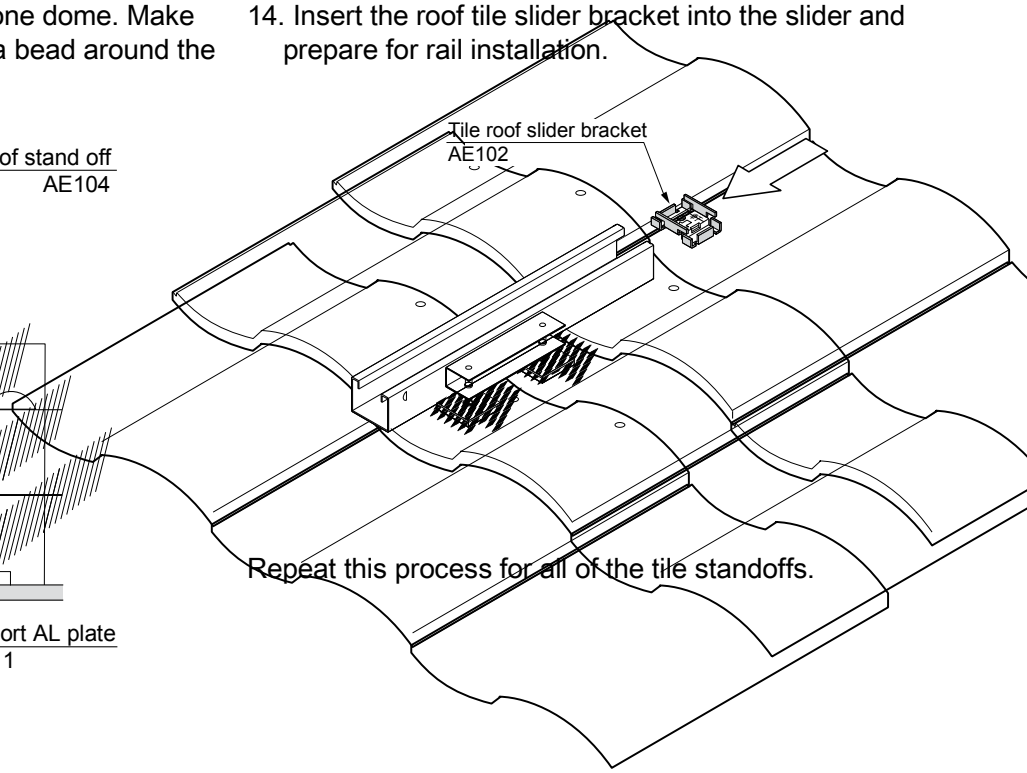


13. Push the top butyl pad into the silicone dome. Make certain that the silicone caulk forms a bead around the butyl pad.





14. Insert the roof tile slider bracket into the slider and prepare for rail installation.

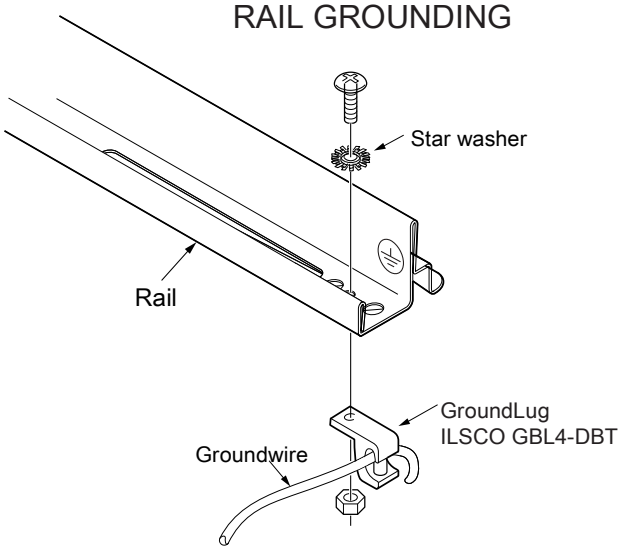


Repeat this process for all of the tile standoffs.

6.8 SYSTEM GROUNDING

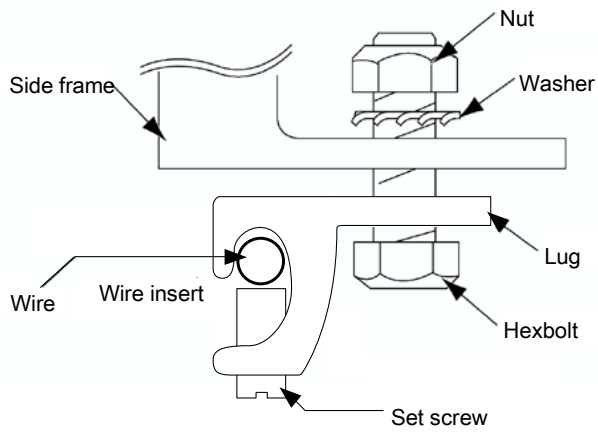
Upon completion of the array ground wire, bring to the rooftop junction box. Use at least a 10 AWG ground wire for this purpose. The ground will continue down to the DC disconnect and to the inverter. The inverter must be grounded to a ground rod. All of the Rails in an installation shall be provided with protective earth grounding wires when installed.

RAIL GROUNDING



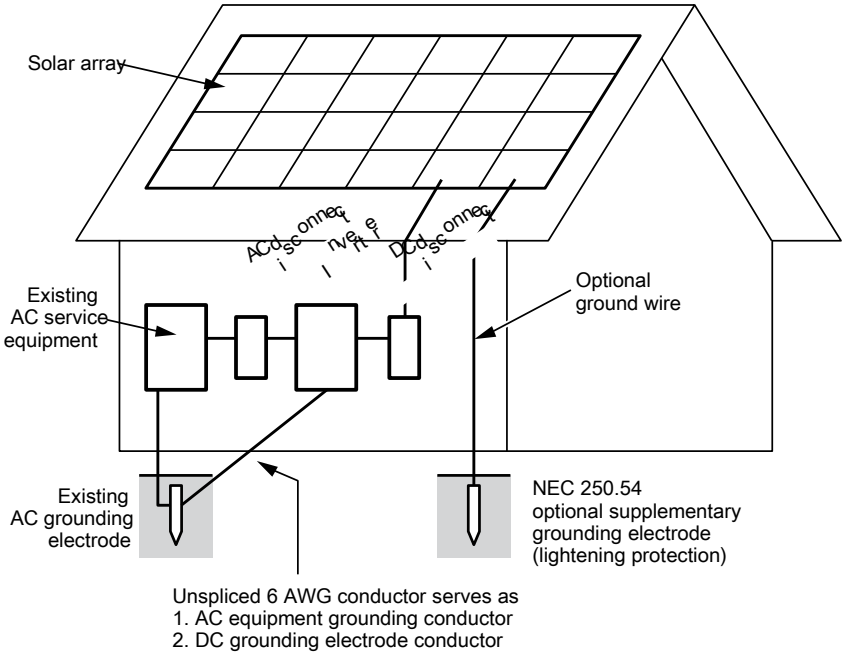
Use a # 10-32 x 1" stainlesssteelmachinescrew, lock washer and nut.

MODULE GROUNDING



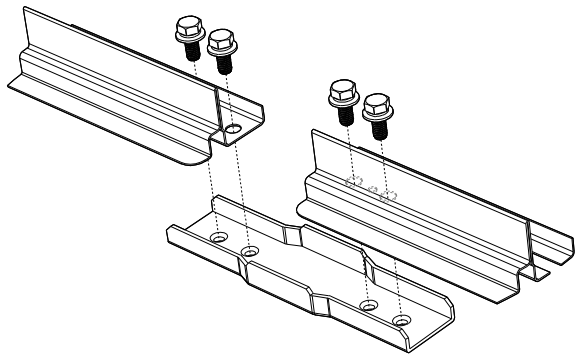
Accomplishing a code compliant grounding system is critical to the safety of the system. Continuous grounding of all modules and mounting system components is required.

1. Install outdoor rated ground lugs or ring terminals with ground wire (per above drawings). Use the marked ground hole on either end of the rail.
2. Connect a minimum # 10 AWG solid conductor, copper, ground wire to the ground lug or ring terminal.
3. Land the end of the ground wire in the array junction box.
4. Run the ground wire to the DC disconnect and inverter.
5. Run the ground wire from the inverter to a ground rod.

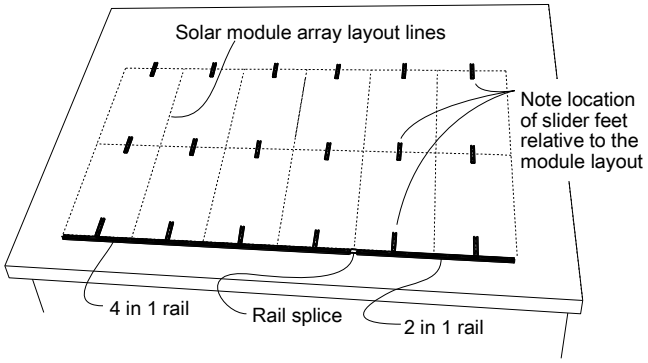


6.9 INSTALLING MODULE SUPPORT RAILS

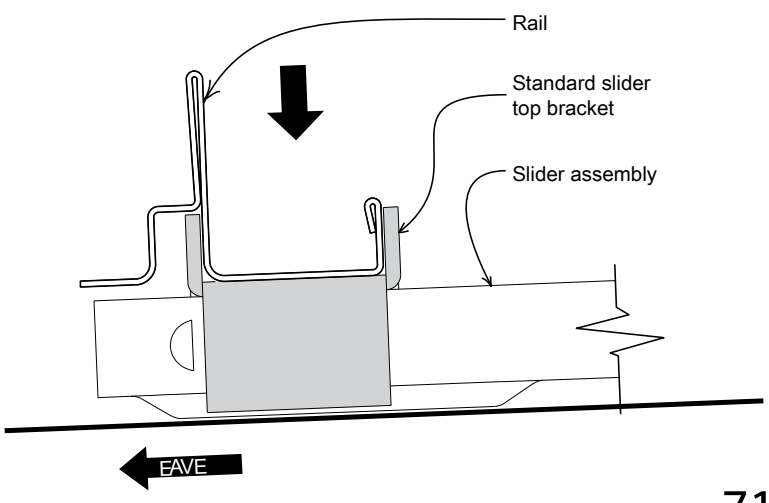
1. Create appropriate rail length by incorporating rail splice kit. Place splice under rails to be joined and fasten using 4 M8 bolts. Hand tighten 5 turns and use a 13 mm socket wrench to tighten to appropriate torque.



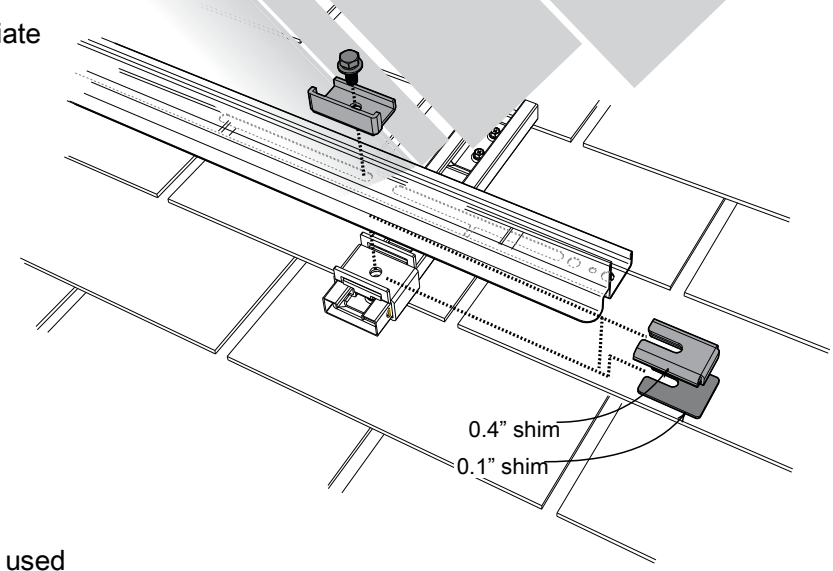
Note: a maximum of two 1 in 1 rail splices can be used to achieve desired rail length. Do not place next to each other.



2. Place rail on standard slider top bracket.



3. Insert M8 bolts through AD804 dock washer and fasten to standard slider bottom bracket.



4. Use shim kit to level the height of the rail on the roof. Place shim between rail and standard slider top bracket. Slide the shim into the bolt so that it is fully engaged.

Note: There are two types of leveling shims, 0.1" and 0.4". You will need to use bolts of different lengths, according to the total thickness of the shims. Refer to the following table.

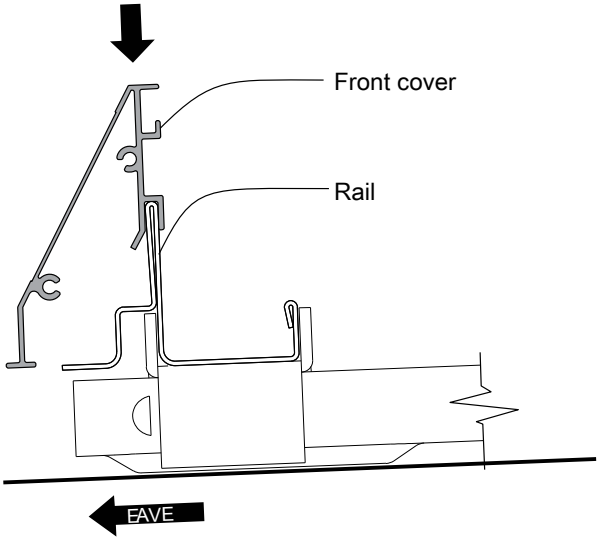
Total thickness of leveling shims (inches)	Bolt length
0.08 to 0.47	M8 x 30
0.47 to 0.87	M8 x 40
0.87 to 1.26	M8 x 50
1.26 to 1.65	M8 x 60
1.65 to 2.05	M8 x 70

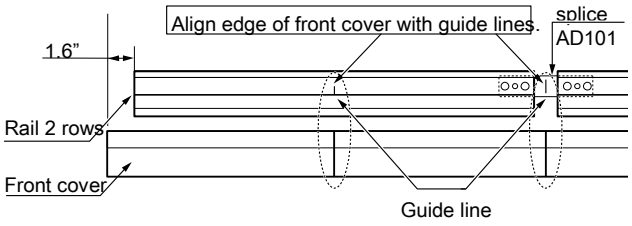
AK114 0.4" Shims	Bolt length
1	M8 x 30
2	M8 x 50
3	M8 x 60
4	M8 x 70

6.10 INSTALLING FRONT COVER

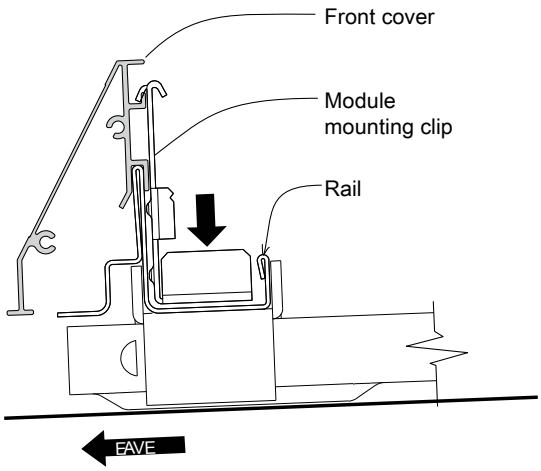
Prior to the installation of the bottom row of modules (located close to the eave of the roof) a front cover is installed to provide a finished appearance.

1. Place each front cover over the top of the support rail as shown below.

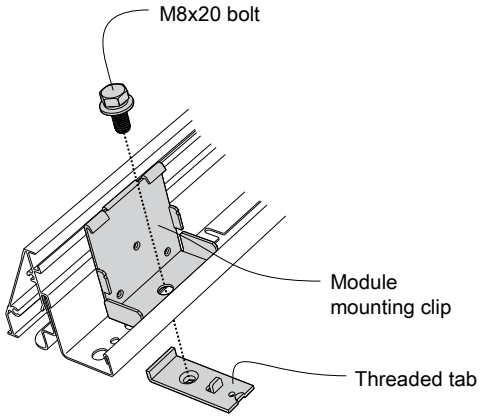




2. Place a module mounting clip, AD801 into the support rail. Make certain that the lip of the module clip captures the front cover as shown. Each module clip should be located approximately 8" (200 mm) in from the edge of the solar module.



3. Insert an M8 bolt through the clip and secure to AD105 threaded tab.

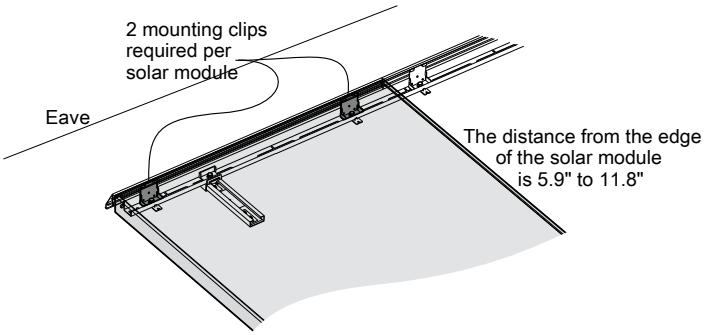


⚠ CAUTION Bolt Tightening Instructions

You must begin tightening bolts by hand. After 5 turns by hand, use a socket driver to finish tightening. Proper torque (SI units 12.5 Nm) (USA units 9.3 ft.lb).

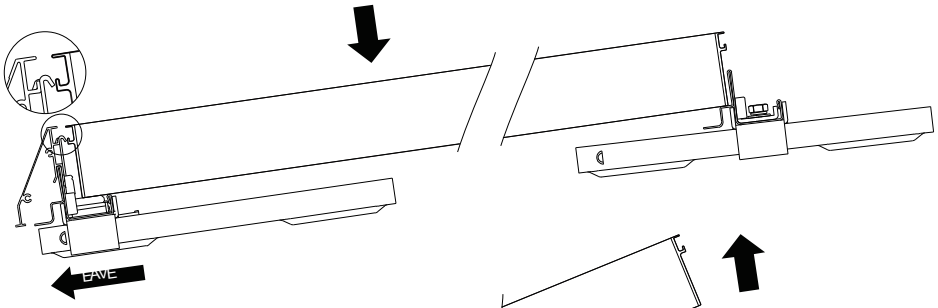
Protective earth grounding of the individual photovoltaic modules is achieved by the securement of the modules to the mounting frames. The assembly instructions should be closely followed, in order to ensure a reliable ground connection.

Note that 2 clips are required on each rail for each rectangular solar module. Securing the solar modules is important to the system durability.

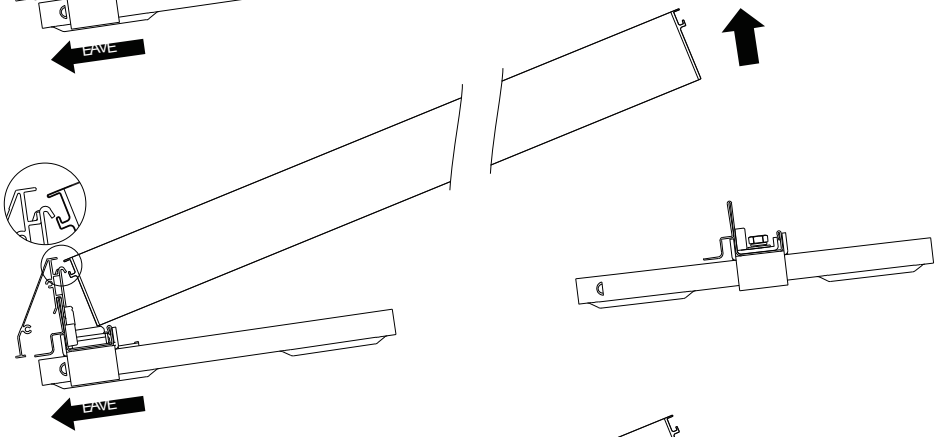


6.11 INSTALLING THE MODULES ON THE SRS MOUNTING SYSTEM

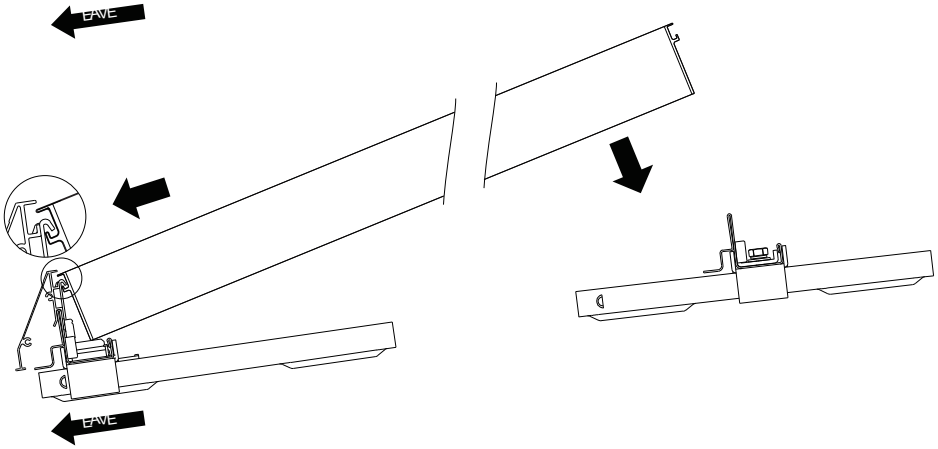
1. Stand at the ridge side of the roof and face the eave. Place the solar module on the rail so that it fits between the high points of the rail.



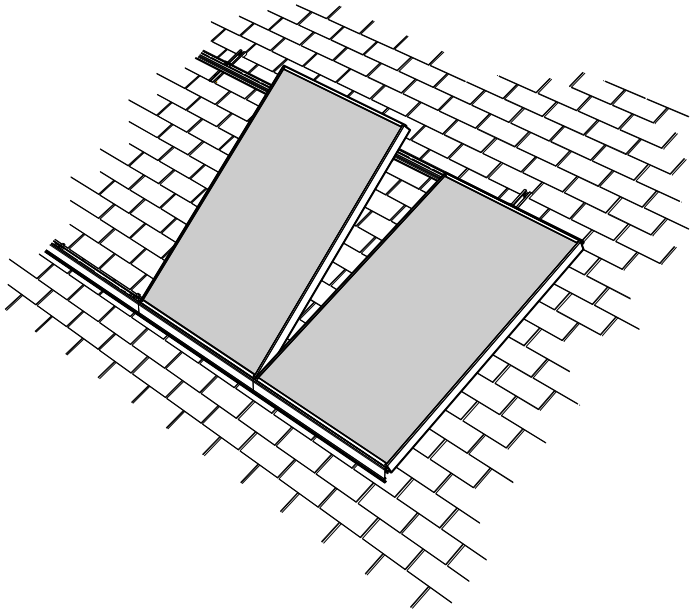
2. Lift the solar module at side facing the ridge of the roof. The solar module will slide forward slightly and will engage the locking clip (as shown).



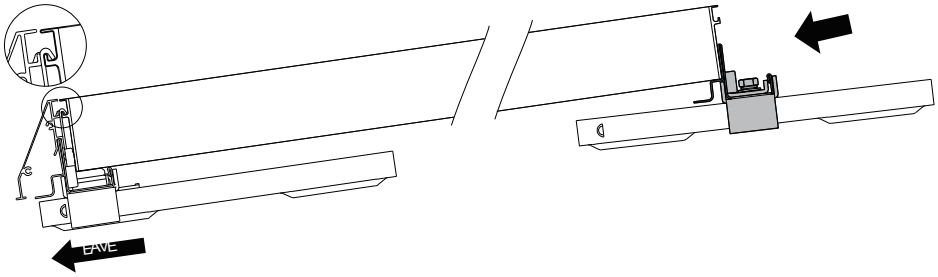
3. Push the solar module forward and rotate down to fully engage the locking clip (as shown).



4. Install all of the solar modules in the row using the same procedure.



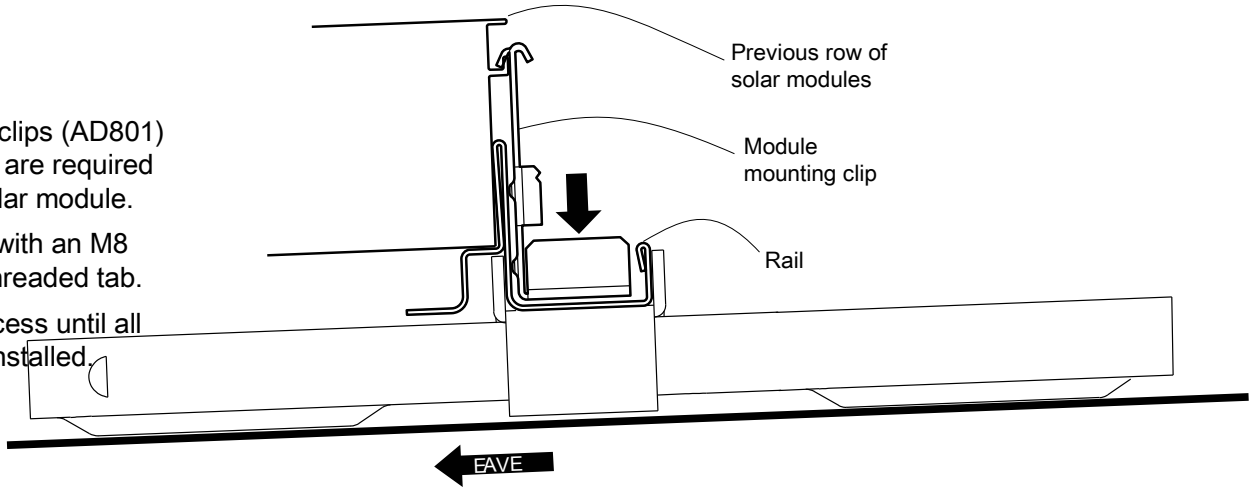
5. Install entire row of modules.
6. Push the rail towards the eave of the roof to tighten the fit of the row of modules.
7. This will eliminate all gaps between the modules and rails.
8. Tighten the rail bolts to fully secure the solar modules and rail.



9. Place the module clips (AD801) on the rail. 2 clips are required for each rectangular module.

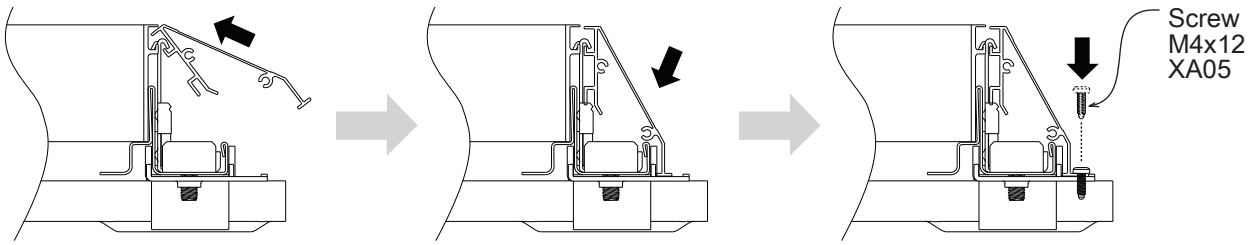
   Secure each clip with an M8 bolt and AD105 threaded tab.

   Continue this process until all rows have been installed.

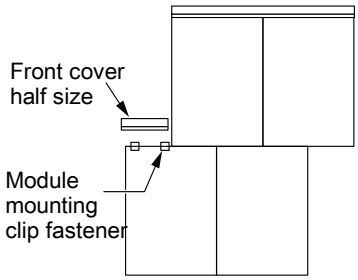


6.12 INSTALLING TOP COVER

1. Place rail cover at an angle to engage the rail clip.
2. Rotate the rail cover to fully engage the rail clip.

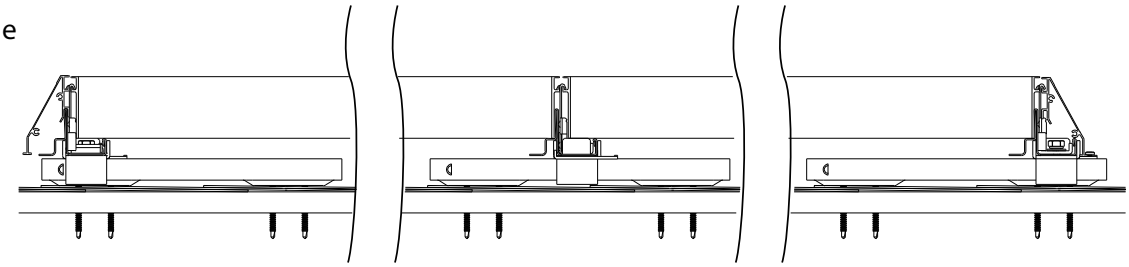


3. Insert the screw into the threaded tap and screw into place.

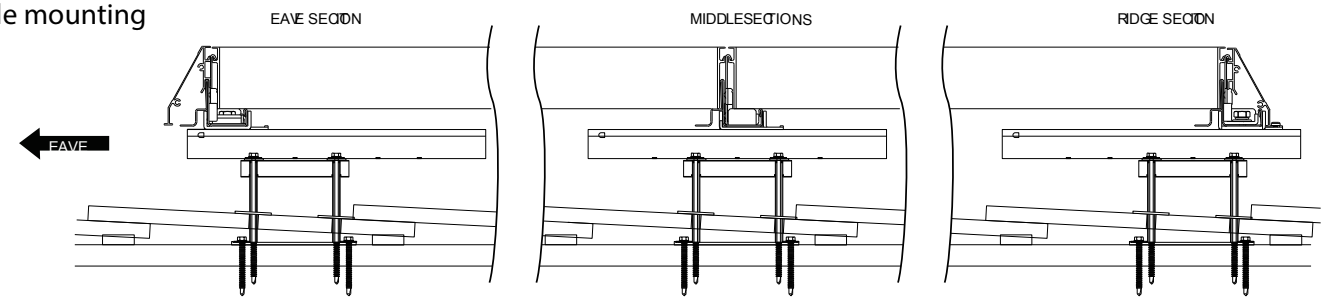


Note 2 clips to secure front cover

Asphalt shingle



Tile mounting



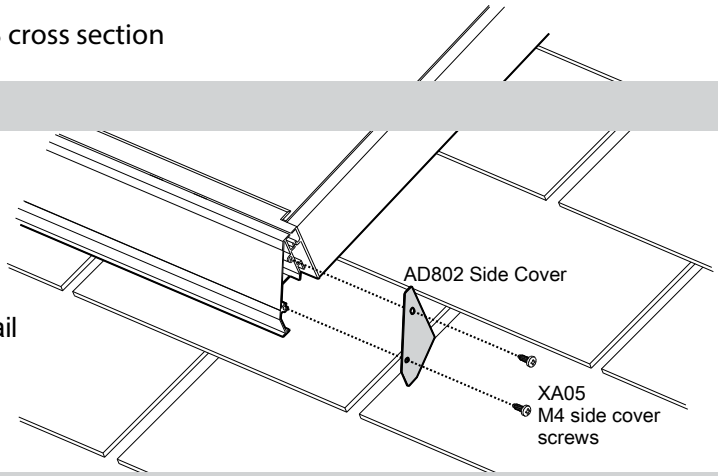
SRS cross section

6.13 INSTALLING SIDE COVER

Attach the side covers to the open ends of the rail covers.

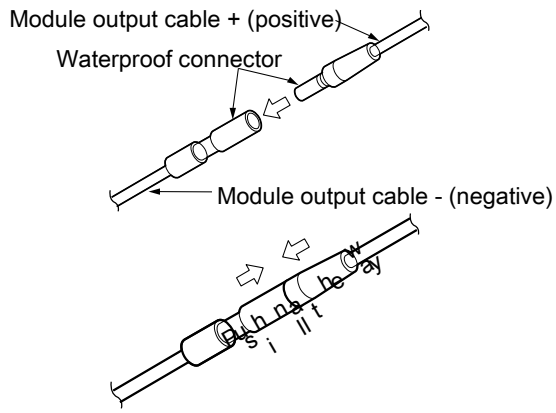
Use two side cover screws to secure each cover.

To save time, install side covers prior to installing rail covers.



6.14 CONNECTING THE SOLAR MODULES

1. Connect each array according to the solar array connection examples.
2. There is a cable + (positive) and a cable - (negative) on the rear side of each solar module. Connect the waterproof connectors on these cables, making sure to push the connectors all the way in.

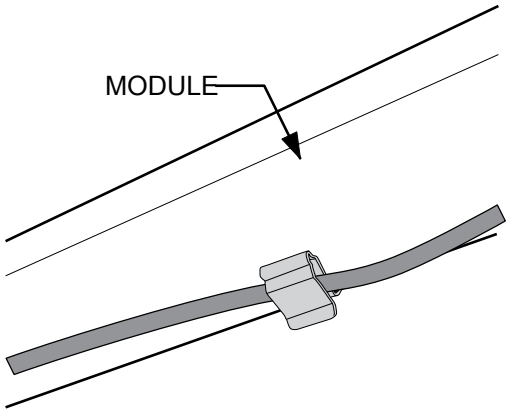


⚠ CAUTION Be sure to always push the connectors all the way in. Loose connections can result in heat, burns, and other damage.

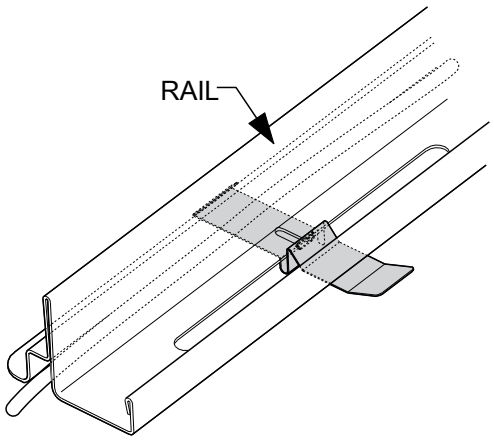
3. On the first solar module, connect the positive home run cable to the positive array output cable, and connect the negative cable to the positive cable of the second solar module.

   On the second solar module, connect the negative cable to the positive cable of the third solar module. Continue until you have series connected the appropriate number of modules for the desired voltage.

4. When you have made direct connections between the specified number of solar modules, use a digital multimeter to measure the voltage and current output of the array. Do this for each string, and record the measurement results.
   - This information is needed to check for solar module wiring mistakes, and it will also be needed by the electrician who makes the connections to the inverter.
5. Organize the cables between solar modules. Bundle the cables so that they do not touch the roof, and use cable clips to fasten them to the rear side of the module frame. Leaves and other debris can be caught around cables that are allowed to touch the roof, and over the years loose dirt can build up, potentially causing the roof to leak.



Use cable clips to secure wire to the module frame. Push clips onto the module frame where needed. Push wire into clip to secure.

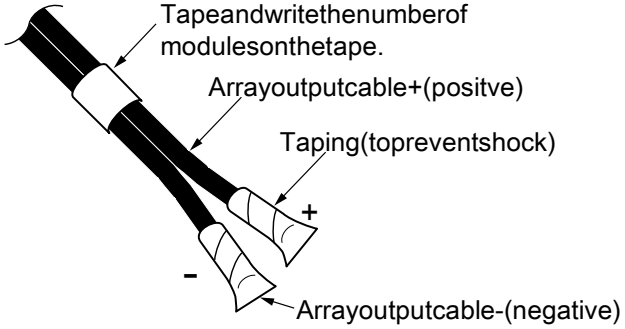


Use cable support bar to secure wire under the SRS rail. Locate wires under rail and snap bar into rail as shown above.

6. If the array cables stretch between rows, connect by running them underneath the mount.

> ⚠WARNIN Protect the terminals of the array output extension cables by covering them with insulating tape.
>
> High voltage is generated between output cables whenever sunlight strikes a solar power array. There is a danger of shock.

7. Tape the output cables for each array together, and write the number of solar modules in the array on the tape, so that it can be understood by the electrician who makes the connections to the inverter.

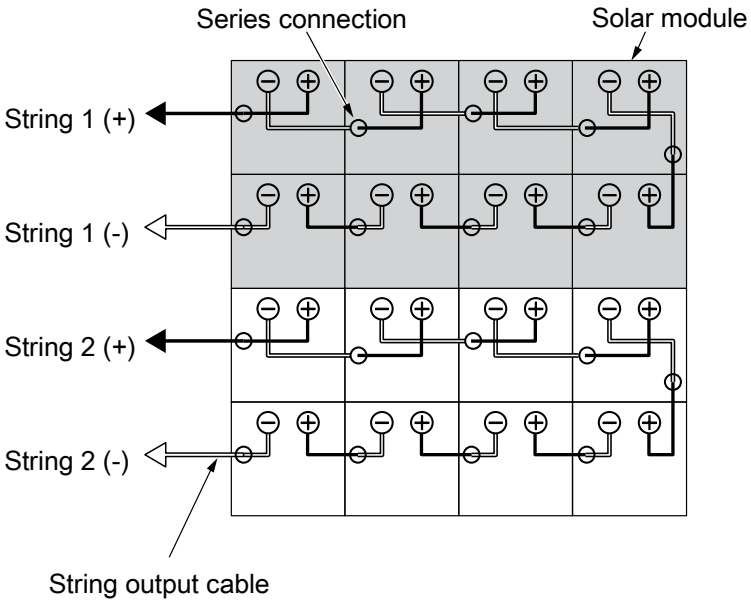


8. Tape the + (positive) and - (negative) cable ends separately.

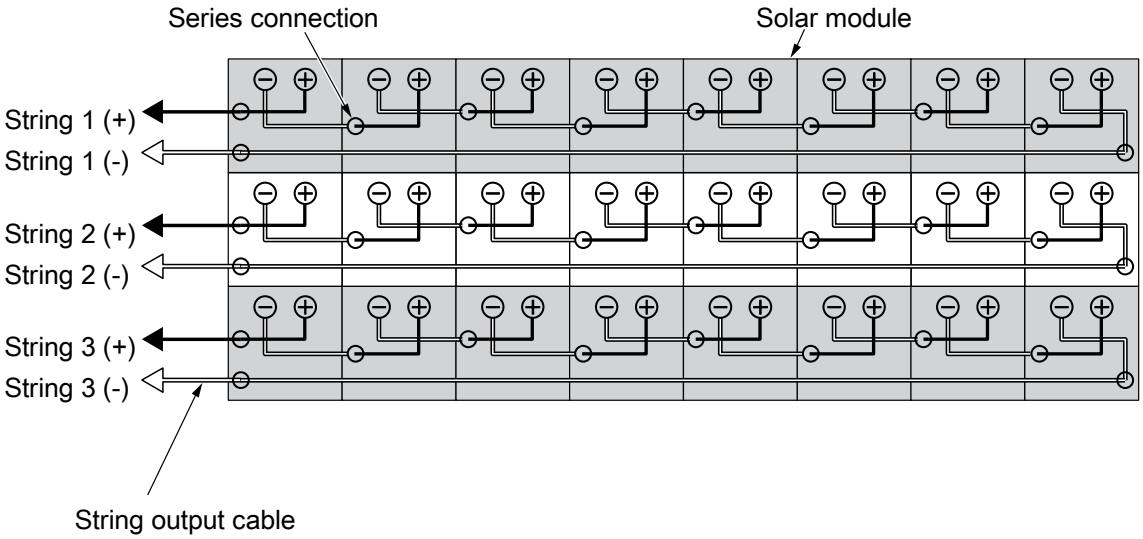
> ⚠ CAUTIO Follow the provisions of the NEC. Electric cable can deteriorate or be damaged if not protected.
>
> When cabling is installed outdoors or passed through walls, protect it with metal conduit, flexible metal conduit, or other protection. Failure to do so can result in shock or short circuits.

9. Always protect the array output cables with conduit wherever they touch the roof or are exposed to sunlight.

BELOW ARE ILLUSTRATIONS OF TYPICAL SERIES STRING WIRING CONNECTIONS



Solar module connections example, 4 rows, 4 columns



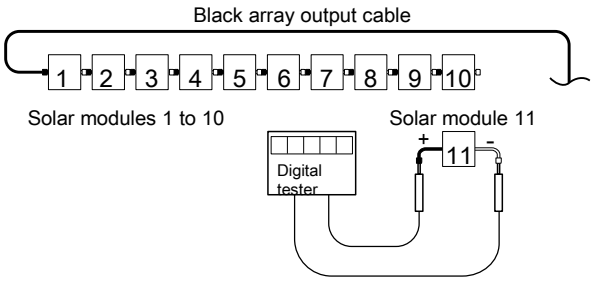
Solar module connections example, 3 rows, 8 columns

6.15 TESTING MODULE STRINGS FOR CORRECT VOLTAGE

Note: The examples in this section show values for ND modules. The voltage will differ for other modules.

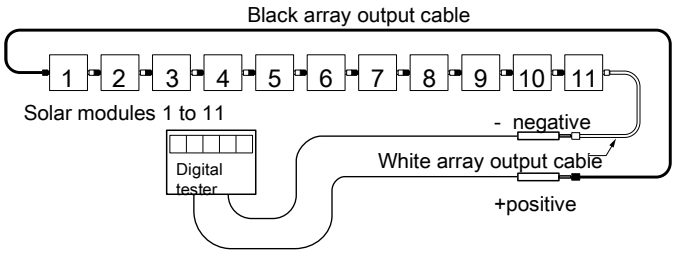
For an array of 11 modules, directly connect the first 10 solar modules and measure in the following order.

1. Measure the voltage of the 1st solar module.



Switch the tester to DC (50V range) and measure. The voltage will vary depending on the amount of sunlight, but the value should be from 30 to 35 VDC.

2. Next connect the 11th solar module to the 10th solar module. Switch the tester to DC 600V range and measure. Measure the voltage at the ends of the - (negative) array output cable connected to the 11th module, and the + (positive) array output cable connected to the 1st solar module.



The voltage will vary depending on the amount of sunlight, but it should measure, about 360V. Be careful of shock.

3. Check the measurements

- Multiply the value measured for a single solar module in step (1) by the number of solar modules.

  Example: 32.5V x 11 modules = 357.5V

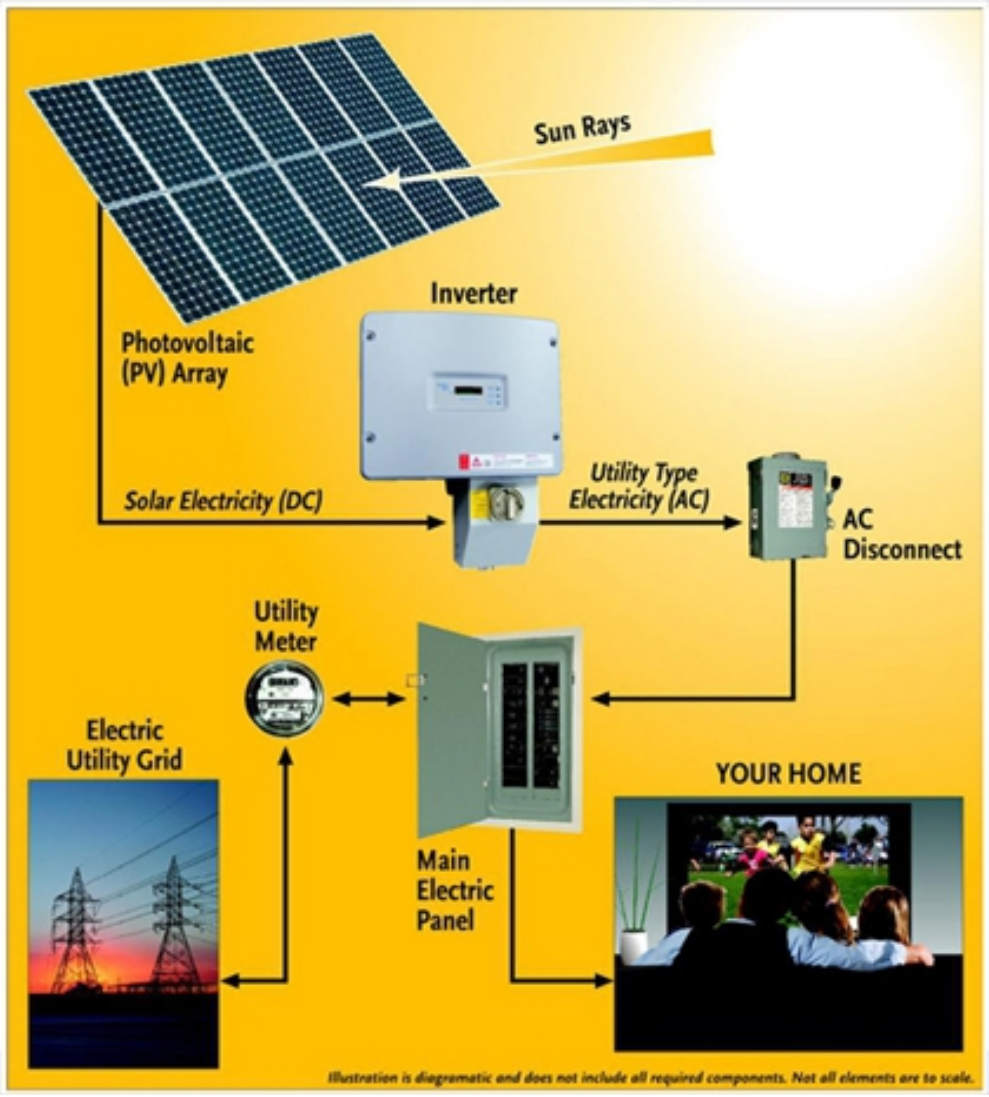
- Compare this value to the measured value (e.g. 360V) for the whole array. The string wiring is correct if the difference is 9V or less.

  Difference between (voltage of 1 solar module x N) and (voltage of whole array) less than 9V.

  N: number of solar modules in 1 string.

- If the difference is greater than 9V, repeat the measurement. If you obtain the same result, check for incorrect wiring.

NOTES

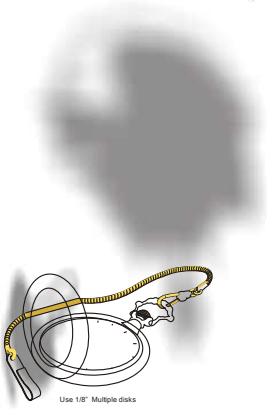

Sun Rays
Inverter
Photovoltaic
(PV) Array
Solar Electricity (DC)
Utility Type
Electricity (AC)
AC
Disconnect
Utility
Meter
Electric
Utility Grid
YOUR HOME
Main
Electric
Panel
Illustration is diagramatic and does not include all required components. Not all elements are to scale.

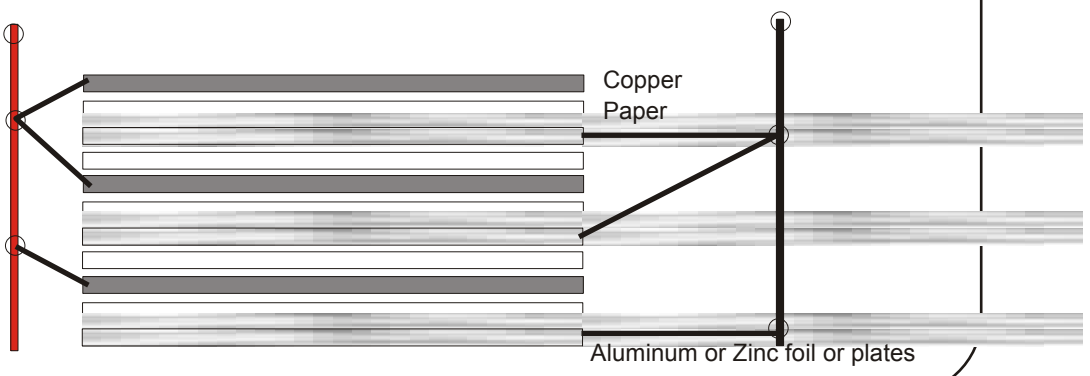
Homemade BATTERIES

Learn how to build a powerful homemade w[illegible]attery right in your own home. Research has proving that you can build a simp[illegible] cell battery, powerful enough to run a car as well as your home lighting. Alth[illegible]se plans are simple in design, you can provide yourself with hours of fun as we[illegible]oing complex research in this eld. To recharge your battery you simply replinis[illegible] water tank with fresh water and your battery is fully charged again. Many people [illegible]e to use pure water with just a touch of Chlorine or rain[illegible]ter. Rain water has some acid in it.

W[illegible]n these plans talk in part about us[illegible]e plans may suggest experimenting with Clorox bleach and liquid plumber, These chemicals are dangerous, please keep all of your experiments away from children and animals, always wear gloves and protective eye wear. Some of these experiments are not recommended for children under 18 years of age. We are not responsible for anything, you experiment at your own risk!

NOTICE: Below is a side view drawing of large copper and aluminum plate cells, they can be any shape that you want. All I can say is, Play around with dierent exotic metals and you will be surprised! Zinc and copper work great!





Homemade Batteries

There are many uses for homemade batteries cells. They are great for Emergency home lighting, as well as running small motors etc.. In many countries electricity can only be used for a few hours a day. which effects many people around the world who live in these areas, there economys just can not aord to run there power plants for long periods at a time. Many of these people have to use candles and oil lamps just to be able to eat or to read a book.

We have given away much of our technology to help many of these people, But there are still thousands of cities all over the world that can not aord to build such machines or they can not get the parts.

This is why we have introduced our Homemade Battery plans, It is a cheap alternative energy source for these people to use. Even if they built small cheap water batteries, these small batteries can still be used for low lighting which is better than nothing.

A good source for low emergancy lighting is the use of a low amp LED diode, by using a bright L.E.D light in series with a 1 meg resistor connected to any type of battery, you will get a light source that can last for months! if you left the circuit in gure 1 on for 24 hours a day the batteries would last up to 6 months, and if you use the light only at night it would last 12 to 14 months! Figure 1 is very easy and cheap to build.

Don't know what an LED Light is? It is a light Emitting DIODE, You can buy them from any Radio shack or electronics supply store. Or search the internet for electronic supplies. They are very cheap and easy to build.

You will want to buy a bright Yellow or orange LED, You can build many of them to go all around your home, The more you build the more light you will have in your home. Again use a LED light that is recommended for the voltage you are going to use.

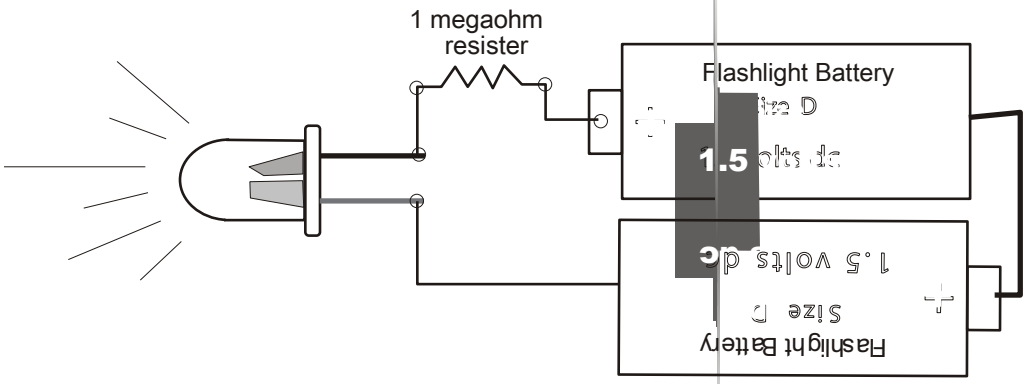


Fig. 1

Homemade Batteries

First we start o with the basics. Small and simple, but fun experiments to get you familiar with the subject. A much more sophisticated and powerful system can be made using car batteries or PVC type. Your Fuel is nothing but rain water mixed with a small solution of Clorox Bleach that you can buy at any store. Just like when you ll your car up with gasoline, you ll your batteries up with water. A great and powerful system for indoor and outdoor night lighting. These batteries will last a life time. you can buy old car batteries at any automotive Junk Yard or build your own PVC tube type.
do not try to charge these batteries. if you are going to use 12 volt Car batteries, THEN BE VERY CAREFUL THERE IS ACID INSIDE OF THEM. Drain acid out in a safe place away from animals and humans. YOU BUILD ALL OF THIS AT YOUR OWN RISK, WE ARE NOT RESPONSIBLE FOR ANYTHING IN THESE PLANS, BUILD AT YOUR OWN RISK.

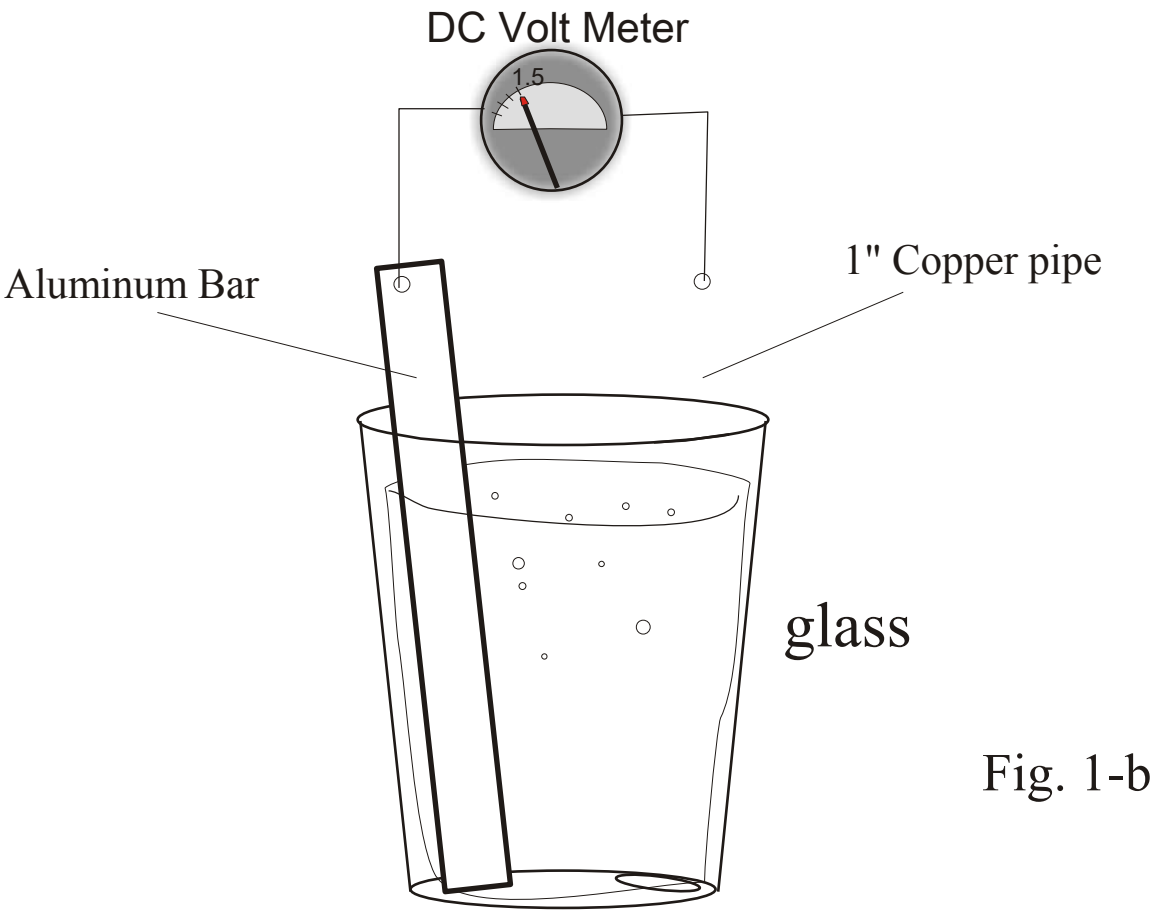


Fig. 1-b

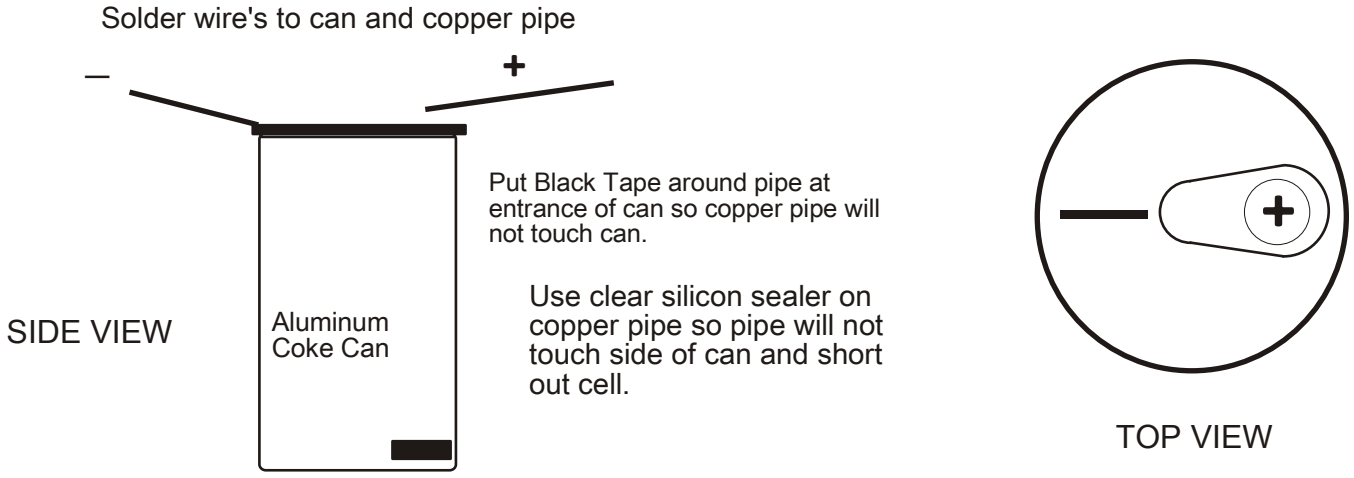
Glass is lled with tap water with 1/4 teaspoon of Bleach.

Homemade Batteries

In g 1-b, you should get about 1.5 volts DC with a small milliamp current. The more Bleach you use the more amperage you will get, but the faster the metals will corrode. The idea is to make your batteries where they only need to be refueled once every 3 months or so, and the metal will corrode very little. To do this you will need to use a teaspoon of bleach to every gallon of water. But this will not be enough amperage to do anything with so what you must do is add many cells together in series, (Fig 1b, counts as one cell) Just as you would Flashlight batteries. When you refuel, each cell must be turned over to let the old water solution out. You can refuel up to 6 months if you use regular tap water with a pinch of bleach, But again the less bleach the more cells you will need to add to get the voltage and amperage you want for your particular needs. The Aluminum and copper will last a very long time, The Aluminum will corrode faster than the copper. to keep your battery system working at it's best It is suggested that you take out and clean the metals with water and lightly sand the copper ones and then replace them back into the containers every 3 to 6 months. W e estimate both metals to last about 4 to 5 years and maybe longer?????

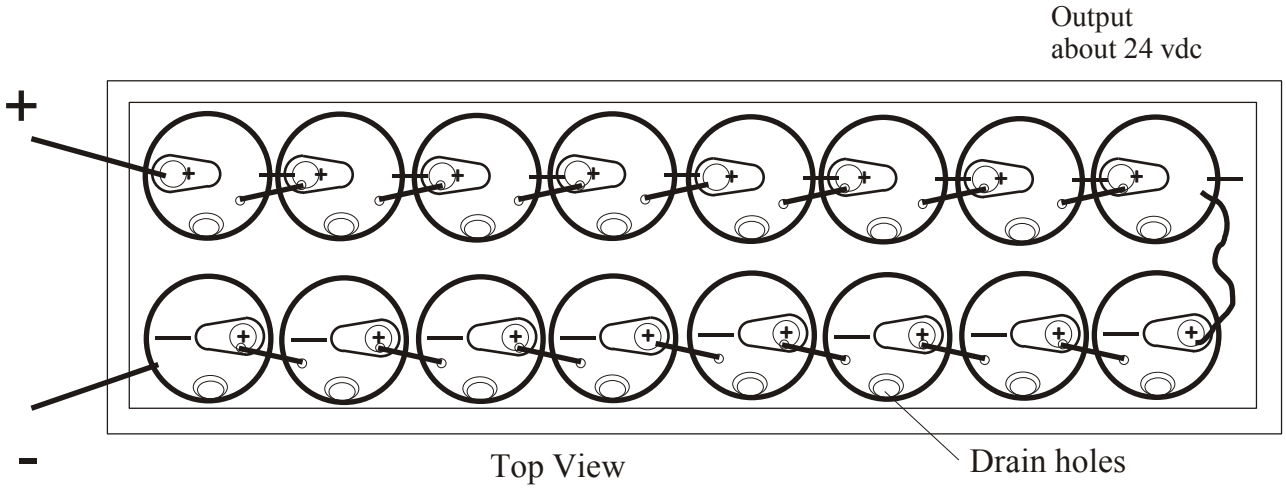
Aluminum can be a bit expensive, But you can cut your cost by using Old Aluminum cans. The aluminum can will be the Negative DC and the copper pipe will be the Positive. you will get a much more powerful cell using the can as so.

Notice: Coke cans are clear coated on the inside, you will have to use Hydrochloric Acid to remove the coating. Be careful!

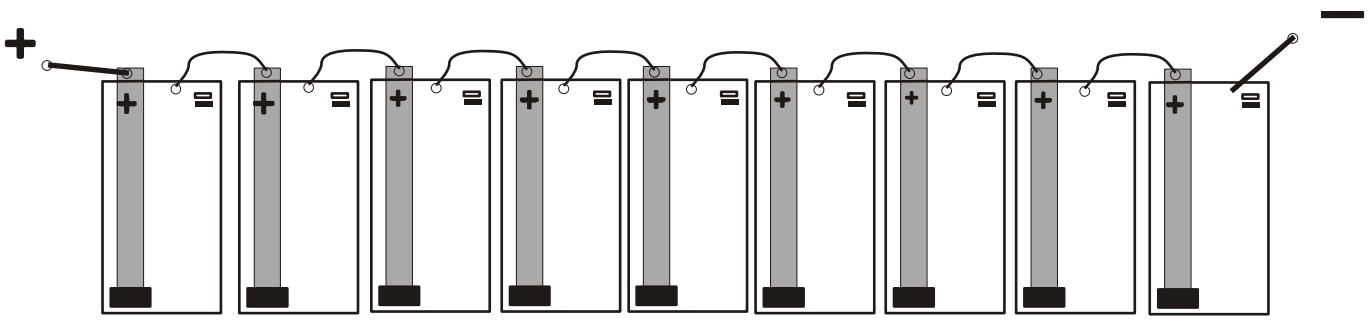


Aluminum Coke Can Cell

Aluminum Can Batteries / Cells



This is a top view of a rotateable wood box assembly , When it is time to change water (Fuel), you simply turn box over and all the water will drain out. (of course each can must be Glued with silicon on the bottom of each can to the bottom of each box.
Or the box can be stationary, W ith a small slit space on both sides of the box toward the bottom, so you can get to each can. and pull out a small 1/4" cork stopper from each can to let the water drain out.

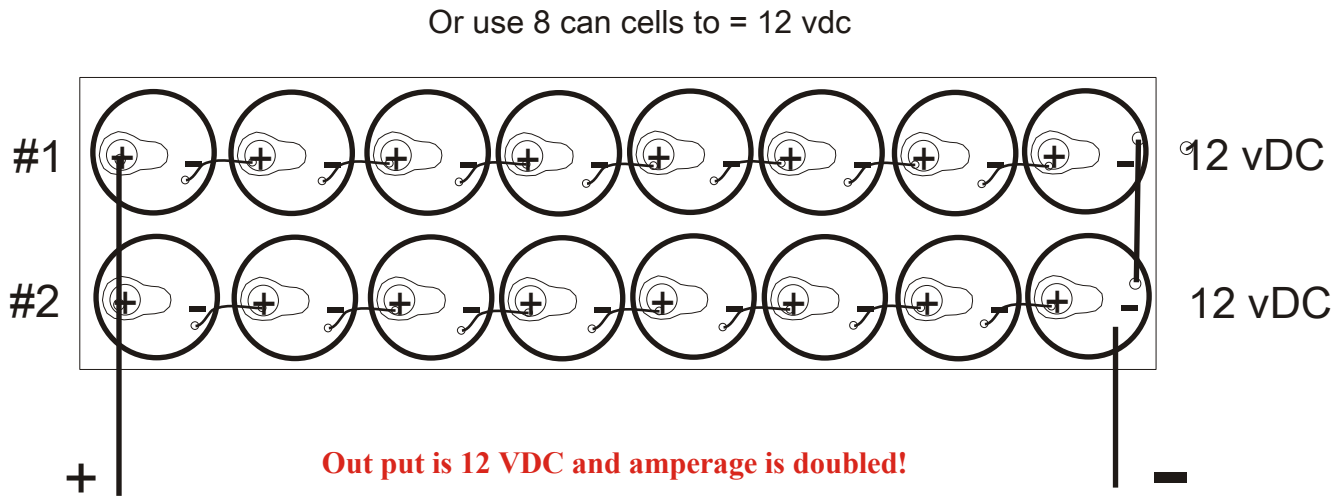


Side View Good for about 12 ½ volts dc

Homemade Batteries

The drawings on page 4 shows each can, or battery cell, hooked up in series, Just like a store bought dry cell battery, when you connect the batteries in series from positive to negative, the voltage is increased. When you connect your battery cells in parallel the voltage stays the same but the amperage (Power) is increased!
For parallel connections, connect each cell + to + and - to -.
To increase the amperage as well as the voltage, connect 6 cells or more in series which will count as one battery, which equals 6 vdc x 100 milliamp. Build 5 more of these batteries and then connect them in parallel this will give you more amperage. You will then have 6 volts dc x 600 milliamps!

Make sure that each cell does not touch the other (Aluminum to Aluminum) when you are connecting them in series or parallel or they will short out.



Basically what we are doing here is using water as a fuel to generate electricity with 2 dierent type of metals causing a chemical reaction in each cell. If you use these batteries out side in the summer in direct sun light you will get even more amperage.

Most everything you will need can be purchased at any hardware store, The nice thing about using an Aluminum can is, you can get them Free just by going on the side of the roads and collecting them. If you buy your Aluminum be prepared, it is not cheap. For extremely high amperage cells using only 16 cans, Use Pure Clorox bleach in each cell can, You will get a lot of power for a short time.(About 48 hrs.) The metals will corrode fast but In some emergency cases you may need it..
.

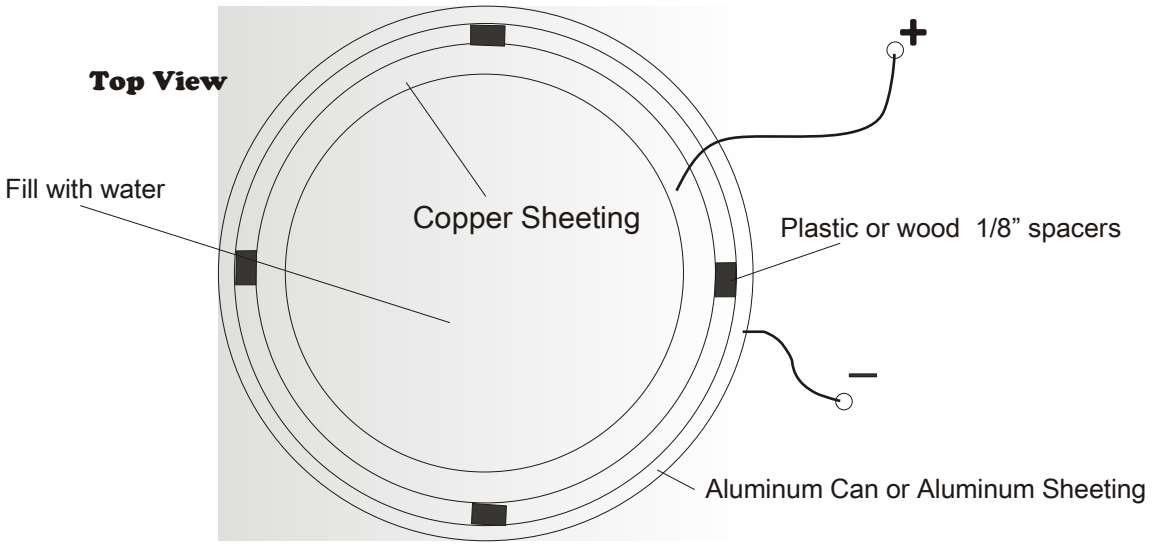
Homemade Batteries

A Long Lasting, Yet Powerful Battery! The closer the copper pipe is to the aluminum or zinc, the more amperage and voltage you will get. A good way to make this type of cell is to use thin copper foil or sheeting, which you can purchase at any Art Store, or check with your local hardware store, If they do not have it they can order it for you. If you are still having trouble nding a good Copper or Aluminum supplier check the web. Y ou can nd just about anything you want on the web if you now what to ask it to search for. I would simply type in, Copper Sheeting, or Copper foil. Y ou may also want to try copper supplies.

At any rate, you can still use the aluminum can technique, but this time you will need to cut o the tops of all the cans, then you can use acid to remove the inner can clear coating or sand it by hand using a wood Dow rod and a small piece of sand paper glued or taped to the end of the dow rod, you can then sand by hand or you can connect the wood dow rod to an electric drill.

You will now need to cut your copper foil to t inside of the can, and then apply spacers or plastic sheet spacers about 1/8" thick, or 1/8" space in between the copper and the aluminum. The closer the better! Wood spacer could be used also and glued into place.

Then simply connect each cell in series as on page 4 or 5 and ll each can up with tap water or pure water mixed with a touch of bleach or chlorine.



More Voltage, More Amperage

You can use Liquid Plumber which you can purchase in most stores. It is an acid that is used to eat through hair that is clogged in you Drain pipes. You can use Liquid Plumber instead of bleach as well as any type

ou can try making different cells using these acids full strength as well as deluting them with water. But your main goal is to use 1 part acid to 10 parts of water.

ALWAYS USE A PLASTIC FACE MASK HELMET AND RUBBER GLOVES WHEN HANDLING ACID. Again you will need to delute the acid in the water. Never Pour Water into the Acid, pour the Acid into the water. Read all warnings on the acid label that you purchase!

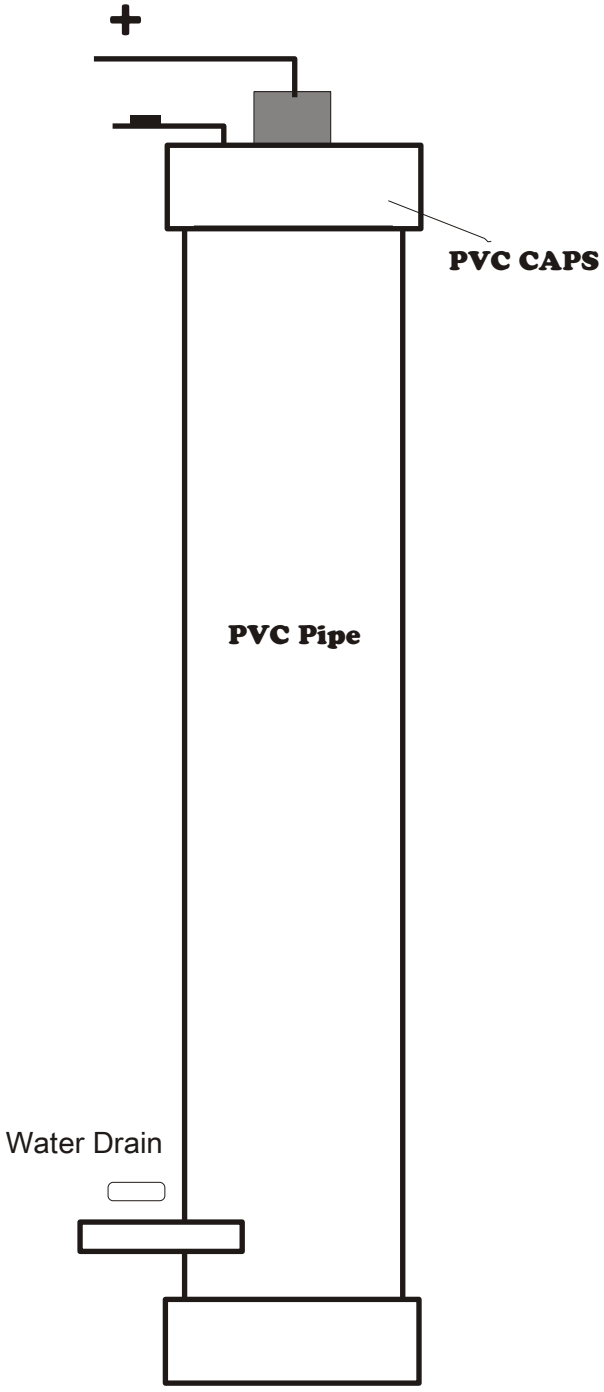
When you use Acid it will corrode the electrodes about the same as using Clorox. We recommend using Clorox Bleach.

Please Keep all of these Chemicals out of the reach of Children.

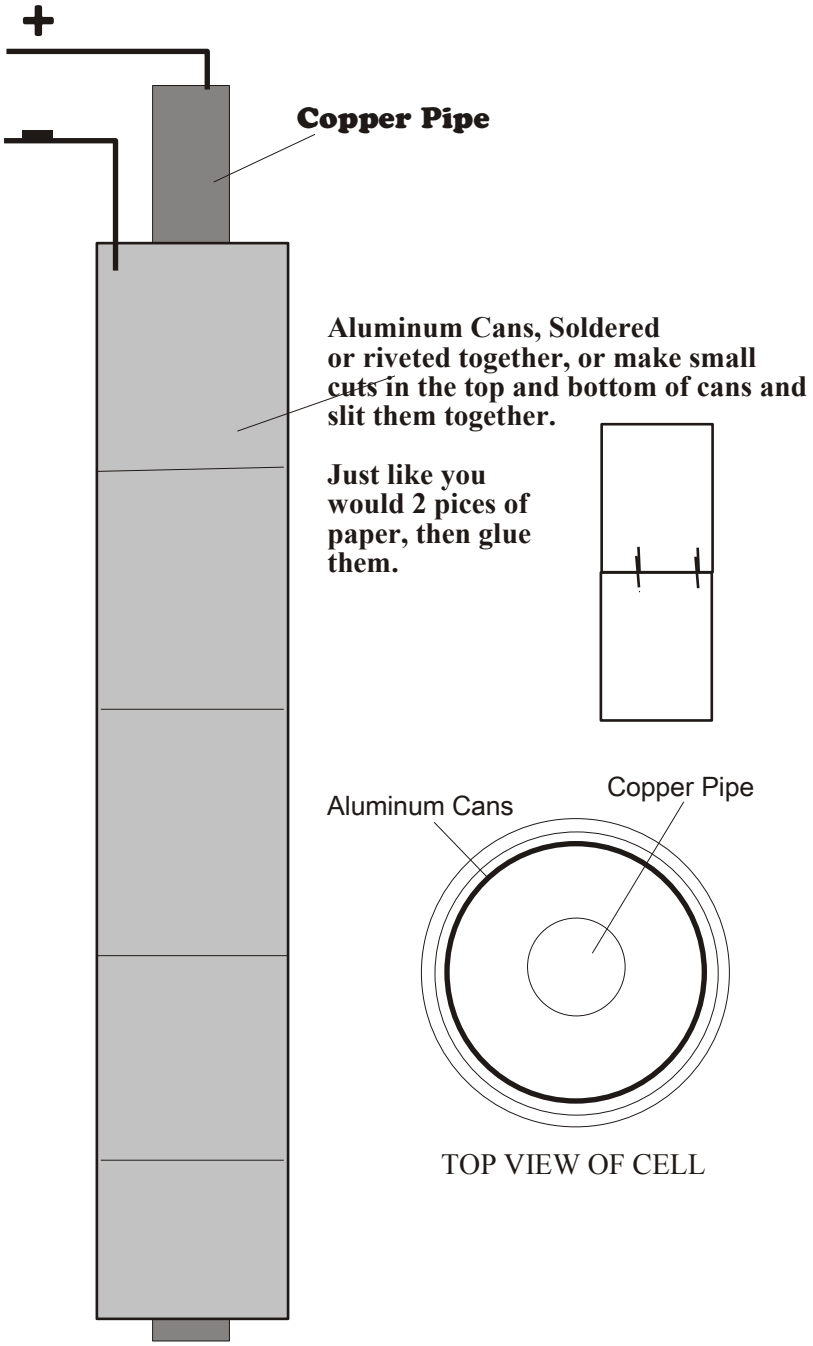
PVC Pipe Batteries

Making PVC Pipe Battery Cells is a little more expensive but well worth it. It is more convenient and produces a lot more power.
there are two ways you can do it using the Aluminum as your negative electrode, You can use aluminum cans soldered together and placed inside of the PVC pipe or you can use expensive Aluminum Rod or bar that you can buy from any hardware store.
We suggest using the Aluminum Cans. The Cells can be as tall as you like 3 foot to 8 foot. But we prefer 24 cells at 6 foot. They can be mounted across a garage wall and each one will have an on off valve located at the bottom of each PVC Cell. Each drain will be connected to a PVC 2" or so Drain Pipe which can be drained and directed to the out doors. The on and off valves you can buy at any hardware store they are PVC and are Cheap. Well good luck and God Bless, I hope we have giving you some good information here that you can use during Emergency's If you have any suggestions that you would like to see added to these plans please write us.

Homemade Batteries



Side view of Completed Cell



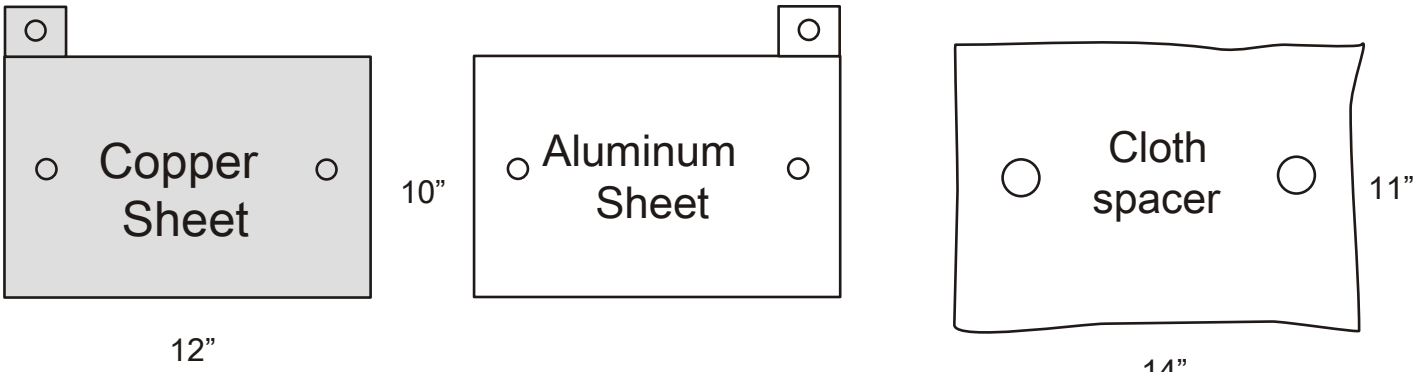
TOP VIEW OF CELL

Side view of inside of Cell

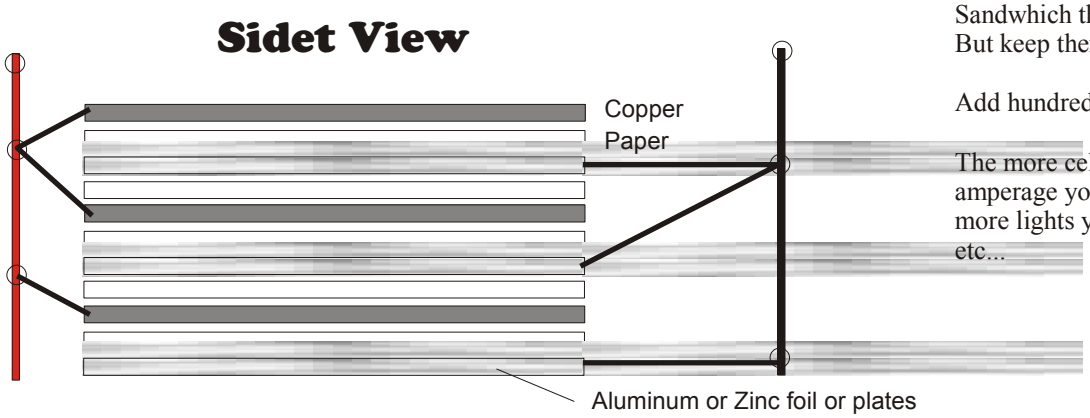
Cut the Bottoms and tops o of Aluminum Coke Cans.Y ou can Solder them together or cut small slits in each can so they can be joined together then you can glue them with silicon, if you glue on the outside of each can then make sure you allow enough space for the can assembly to t into the PVC pipe. Make sure all can are touching. You may have to sand the printing ink o of the tops of them , Just make sure they are all making a good electrical connection.

Homemade Batteries

Now that you have learned some basics on how to make a homemade battery, the following will show you how to make an even more powerful cell battery, using copper and aluminum sheeting foil or 1/8" thick or less sheeting. Simply cut as many copper, aluminum and cloth sheets as you can and then piece them together. It is best to drill or punch 2, 1/4" holes into the exact same areas on all of the materials, so you can use 2 wood Dow rods as guides. Cut a 14" x 12" piece of ½"plywood and then drill 2 holes for your Dow rods to go into and glue them into place using glue that can withstand water. Now place your copper plate down rst over the Dow rods and onto the base of the plywood, then 2nd, place your cloth spacer on top of the copper and through the Dow rods. 3rd, place your aluminum sheet over top of the cloth spacer as you did the copper piece. Simply repeat this over and over until you have about 100 pieces all stacked. Now wrap cloth string around the entire battery to secure it well, Now solder and or use bolts to connect all the copper leads and then do the same for the aluminum leads. And you are done, the battery is ready to be placed in a water container and immersed in water.



Front View



Sidet View

Sandwhich them together very tightly! But keep them as ate as you can.

Add hundreds of cells, think BIG!

The more cells you add the more amperage you will have, which means the more lights you can run in your home etc...

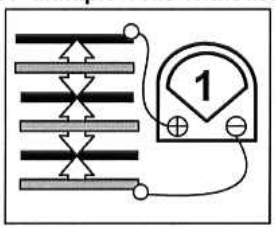
Free News

Sent in by one of our good customers out in California!
This guy went the extra mile and did an awesome job!

Two Methods of Cell Construction\Water Battery

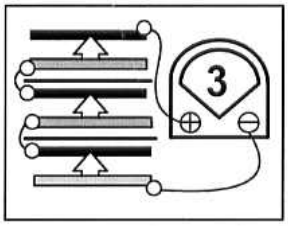
Individual cells must be separated by an electrical insolating barrier, such as plastic sheet. Any other insolating material may be used if it has both electrical and water insolating ability. Without this barrier, electrical chages will move in both directions between the differing plates, canceling any great potential flow. In the example illustration below, arrows represent direction of moving electrical charge. A simplified meter is measuring the sum charges actualy moving in the circuit.

Example #1 -Multiple Cells Without Barrier



Above, opposing charges causes cancelation resulting in output the same as one cell layer.

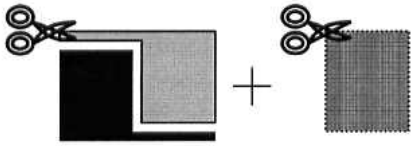
Example #2 -Multiple Cells With Barrier.



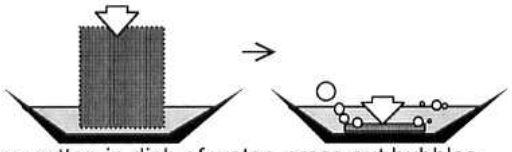
Above, charges move in same direction resulting in output the same as three cell layers.

Below, the two methods of cell construction differ only in their barrier design. The metals used, electrolyte, and plate seperaters are the same. Also note that the larger the plates, the more amperage/charge-flow is achieved between the plates; while the voltage/charge remains the same.

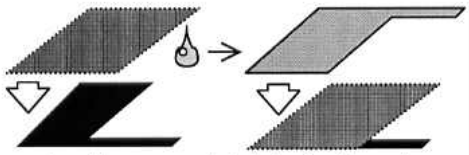
Method 1: Plastic Sheath



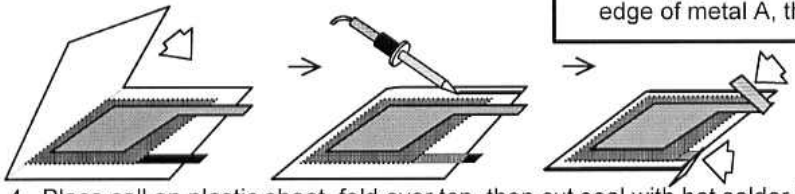
1.Cut foil design, both metals & cotton sheet larger.



2. Lay cotton in dish of water, press out bubbles.

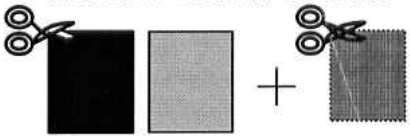


3. Place wet cotton on metal plate A, then place metal B on top, positioned as shown.

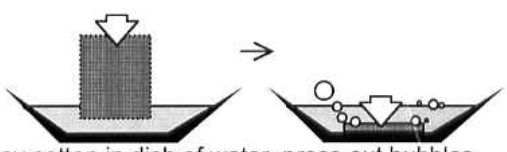


4. Place cell on plastic sheet, fold over top, then cut seal with hot solder-iron, then fold back tabs. ■

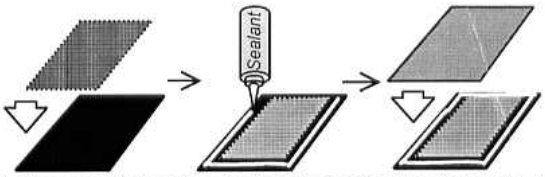
Method 2: Foil Sheath



1.Cut foil squares, both metals & cotton sheet smaller.



2. Lay cotton in dish of water, press out bubbles.



3. Place moist cotton (not dripping) on metal plate A, then apply sealant (Seal-All, or silicon) to outer edge of metal A, then press metal B on top. -done!

Free News

Sent in by one of our good customers out in California!
This guy went the extra mile and did an awesome job!

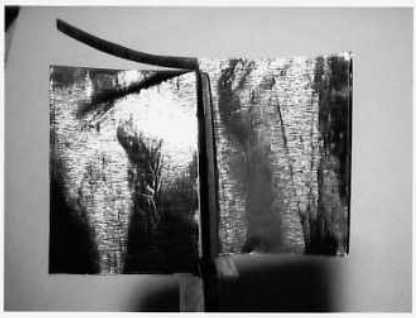
BONUS
Free News!

LAB NOTES, Water Battery 03-06-2001, page 2 of 2

(Details of Plastic Sheath type, -minuture 2"x1.378")

Cut foil design, metal A

Cutting foil, metal B

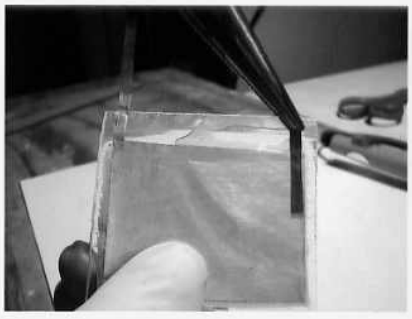


Filling cell with water

Sealing plastic with solder-iron

Shown after sealing/cutting

Bending back metal contacts



Measures .059 mA

Measures .421 vDC

Two cells measures .824 vDC

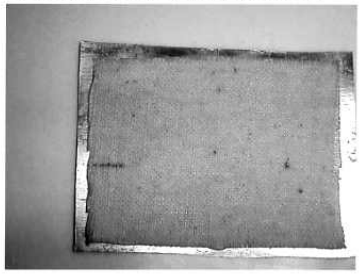
(Amperage approx. same as MetalSheath type cell shown previous page; but, voltage is less)

LAB NOTES, Water Battery 03-06-2001, page 1 of 2

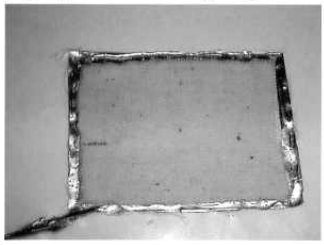
Smoothing Plate under paper

Cotton sheet soaking in bowl

Cotton placed on metal plate A



Applying sealant along edge



Pressing Metal plate B over A

Measures .507Volts DC

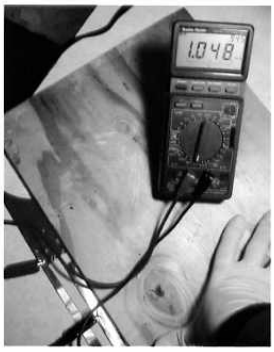
Measures .054 mA

10"x12" measure .196 mA

Pressing measure .521 vDC

Bonus free News

Pressing measure 1.048mA



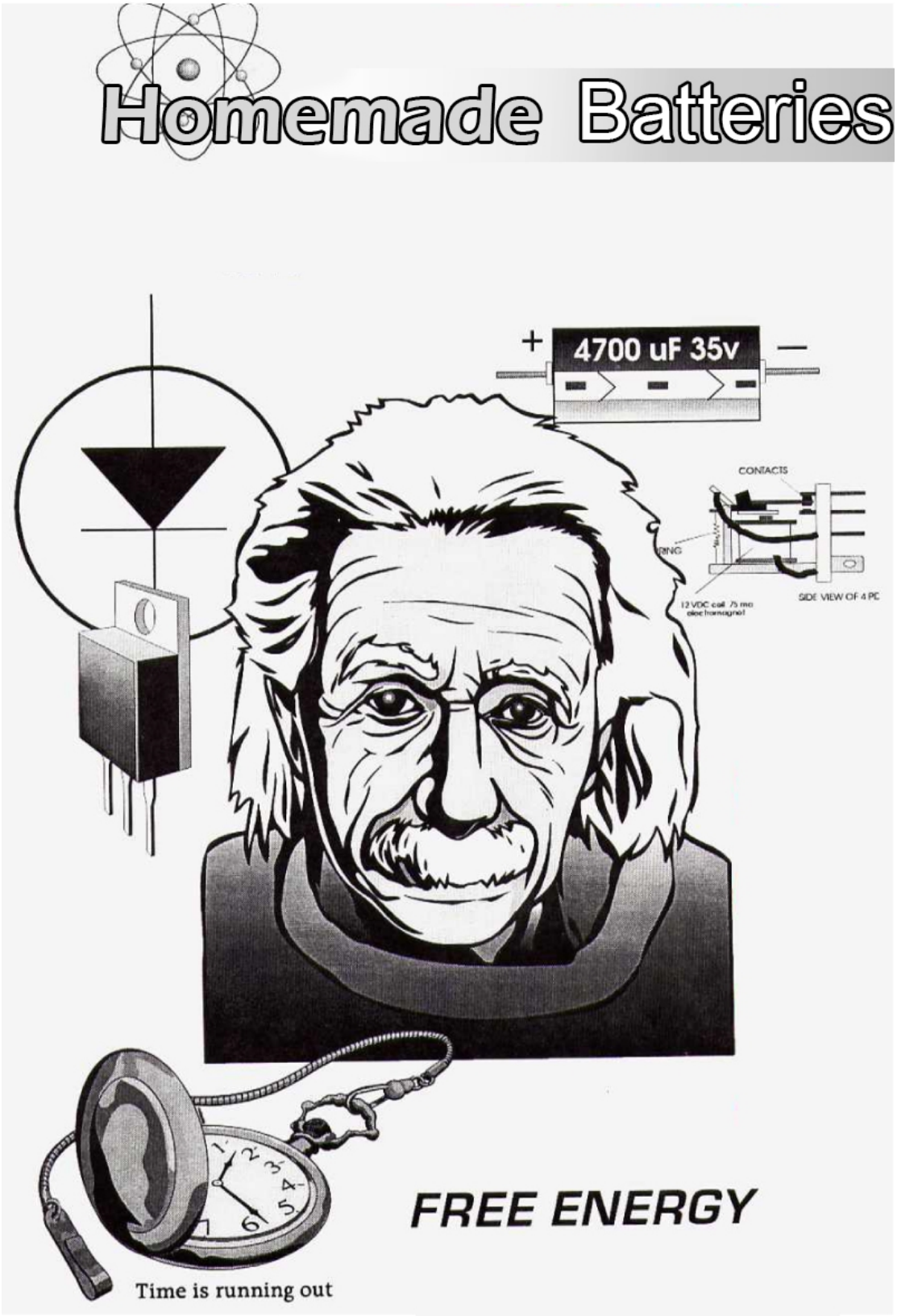
Released measure .777mA

Later increases to .821mA

Even Later .933mA

(Amperage was found to increase over time.)

Homemade Batteries



The Power Inverter

Unless you plan on using battery power for everything, you will need a Power Inverter.

Since the majority of modern conveniences all run on 120 volts AC, the Power Inverter will be the heart of your Solar Energy System.

It not only converts the low voltage DC to the 120 volts AC that runs most appliances, but also can charge the batteries if connected to the utility grid or a AC Generator as in the case of a totally independent stand-alone solar power system.

Square Wave power inverters :

This is the least expensive and least desirable type.

The square wave it produces is inefficient and is hard on many types of equipment.

These inverters are usually fairly inexpensive, 500 watts or less, and use an automotive cigarette lighter plug-in.

Don't even consider one of these types of power inverters for a home system.

Modified Sine Wave power inverters :

This is probably the most popular and economical type of power inverter.

It produces an AC waveform somewhere between a square wave and a pure sine wave.

Modified Sine Wave inverters, sometimes called Quasi-Sine Wave inverters are not real expensive and work well in all but the most demanding applications and even most computers work well with a Modified Sine Wave inverter.

However, there are exceptions. Some appliances that use motor speed controls or that use timers may not work quite right with a Modified Sine Wave inverter.

And since more and more consumer products are using speed controls & timers, I would only recommend this type of inverter for smaller installations such as a camping cabin.

True Sine Wave power inverters :

A True Sine Wave power inverter produces the closest to a pure sine wave of all power inverters and in many cases produces cleaner power than the utility company itself.

It will run practically any type of AC equipment and is also the most expensive.

Many True Sine Wave power inverters are computer controlled and will automatically turn on and off as AC loads ask for service. I believe they are well worth the extra cost.

I use a True Sine Wave power inverter myself and find that its automatic capabilities makes it seem more like Utility Company power.

The 2500 watt power inverter I use has a search feature and checks every couple of seconds for anything that wants AC, then it powers up automatically.

You just flick on a light switch (or whatever) and it works. When you turn off the light or the refrigerator kicks off for example, the power inverter shuts down to save battery power.

While the Modified Sine Wave inverter (sometimes called a Quasi Sine Wave inverter) is nearly half the price of a True Sine Wave inverter, I would still recommend using a True Sine Wave inverter if you want to supply automatic power to a normal home using a wide variety of electrical devices.

Also, most appliances run more efficiently and use less power with a True Sine Wave inverter as opposed to a Modified Sine Wave power inverter.

Grid Tie Power Inverters

If you are connected to normal Utility company power and just want to add some Free Sun Power electricity to reduce your electric bill and you do not need a totally independent system, it is possible that a Grid Tie power inverter will suit your needs.

With a Grid Tie power inverter, whatever electricity that your solar panels produce will reduce the amount supplied by the utility company, in effect lowering your bill.

And, if you are producing more power than you are using, you can actually sell the extra power back to the utility company!

For this type of setup a much smaller battery bank can be installed just to cover short term outages from a few minutes to an hour or two.

In fact, if you don't have frequent long term power outages and don't need back-up power, then you will not need any batteries at all. (But, really, what utility company never fails? :)

Input voltages. Should I use a 12, 24, or 48 volt inverter?

The main consideration when deciding on the input voltage (from your battery bank) of your Inverter is the distance between your solar panel array and your battery bank.

The higher the voltage, the lower the current and the smaller the (expensive) cables need to be.

Of course, when you decide on a system voltage, the Solar Panels, Inverter, and Battery Bank all need to use the same voltage.

More detailed information on voltage & current is explained in the tutorial on Power & Watts.

Inverter Stacking: Using multiple inverters.

Two inverters can be installed in a configuration known as stacking that can provide more power or higher voltage.

If two compatible inverters are stacked in series you can double the output voltage.

This would be the technique to use to provide 120/240 volts AC. On the other hand, if you configure them in parallel, you can double your power.

Two 4000 watt inverters in parallel would give you 8000 watts (8KW) of electricity.

Power Inverter considerations

The Power Inverter is connected directly to the batteries and the main AC breaker panel to supply power from the batteries to the loads (appliances).

Check out Wires & Cables for more info on the necessary wire size for installing one or use our new Wire Size Calculator. The Power Inverter converts the low voltage DC to 120 volts AC.

Power Inverters are available for use on 12, 24, or 48 volt battery bank configurations.

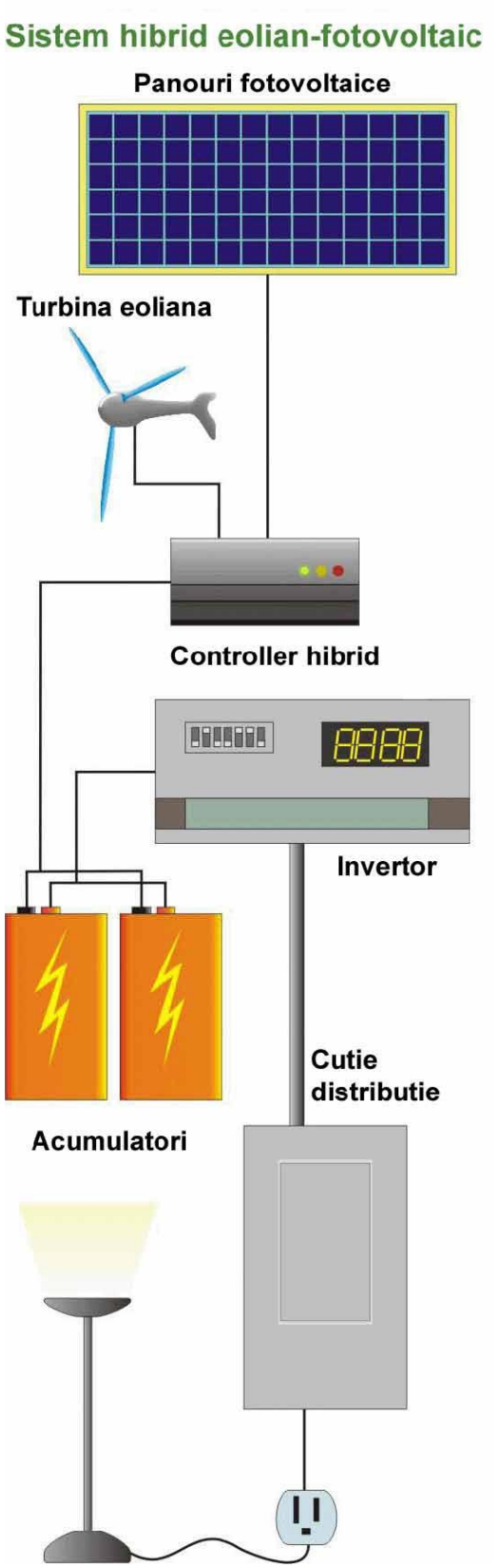
Most Power Inverters can also charge the batteries if connected to the AC line.

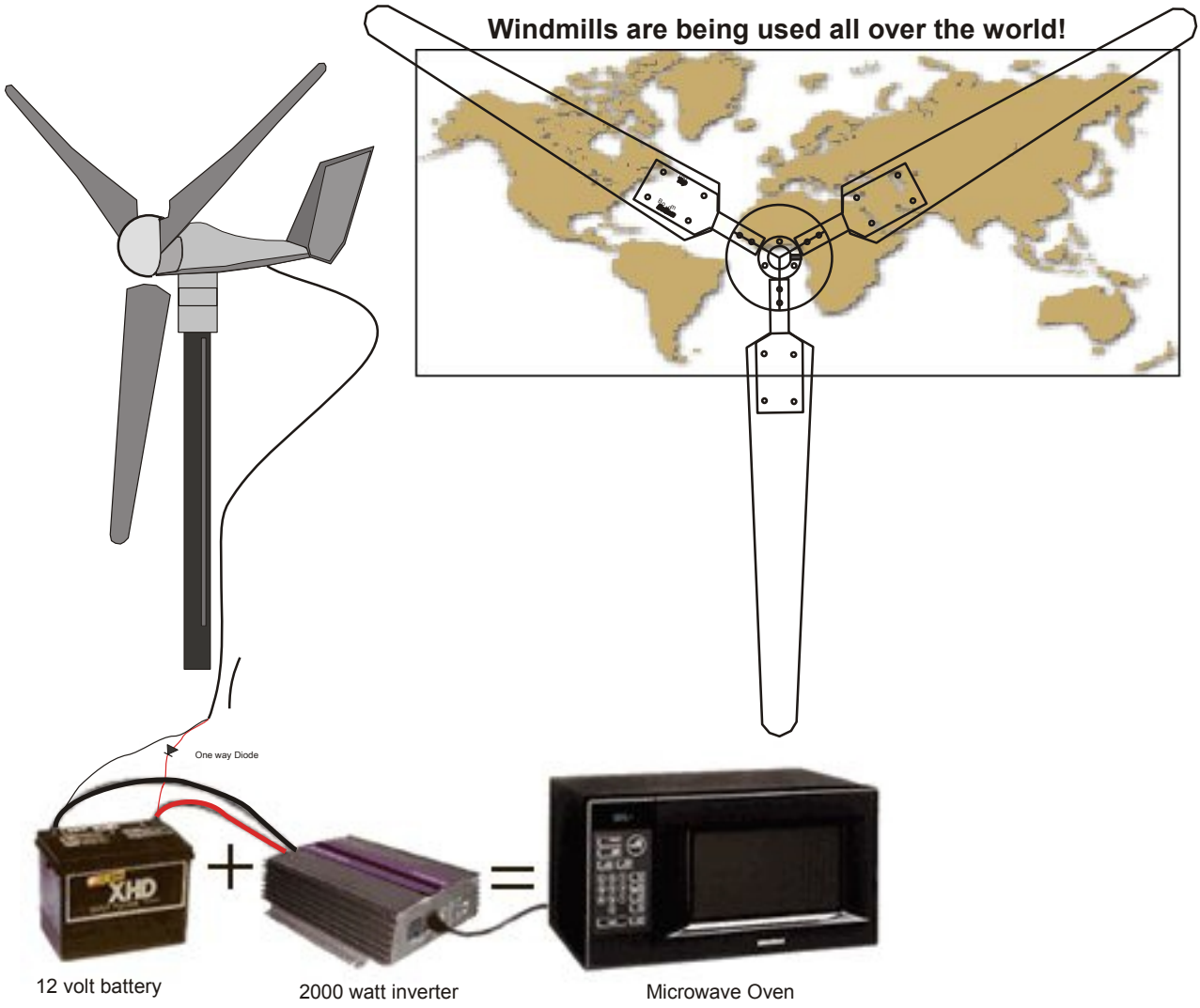
Alternatively, the AC line input could be your own AC Generator in the case of a stand-alone solar power system.

When using a AC Generator to charge the batteries, the Power Inverter transfers the AC Generator power to the loads via a relay.

This way the AC Generator not only charges the batteries but also supplies your AC power while it is running.

If your Generator is at least 5000 watts, you can charge your batteries and have extra AC power at the same time.





WIND MILLS for the 21st century!

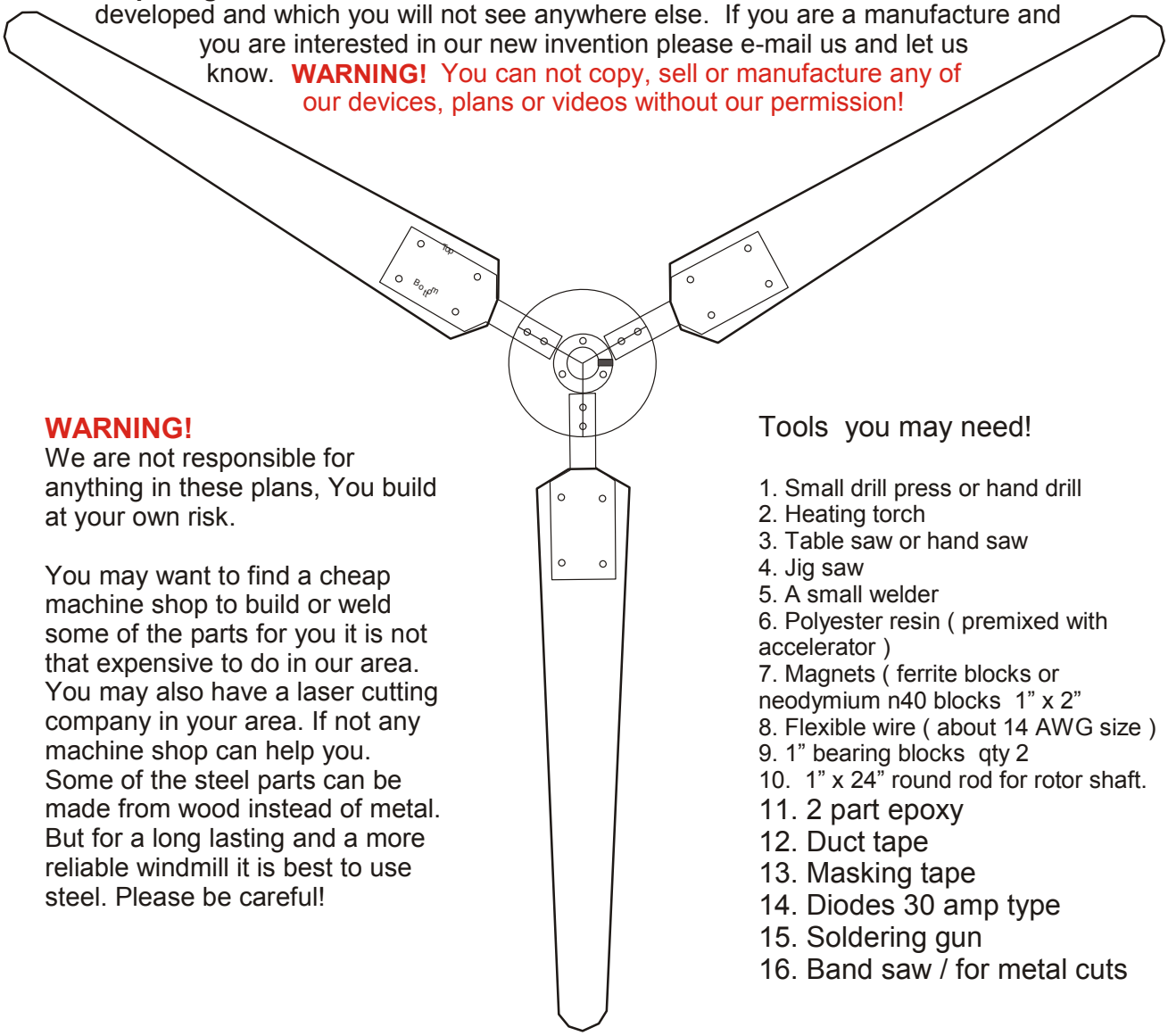
Many companies now have windmills so powerful they are selling the energy back to the electric companies! There are many windmill electric generating companies that are operating out west and supplying cities with free electric, It is amazing how much free energy you can get from just one windmill.

Use your windmill(s) to charge 12 volt dc deep cycle marine batteries, you can buy these batteries anywhere. then buy or build a 2,000 to 5,000 watt inverter, Inverters are sold on the internet from solar panel companies or RV supply stores in your area, I am also seeing smaller ones being sold at local automotive stores as well as K-mart Stores. The Inverter will hook up to any 12 vdc battery and step up the voltage to 115 vdc and then converts that 115 vdc to usable 115 vac x 60 hz, some are pure sine wave just as what is running into your home and some are modified sine wave inverters. You can run lights, tv's, vcr's, dvd players, etc..

Wind blade Construction

There are many options to building a powerful windmill and generator we will show you just a few. Some of the designs we have made have copyright and Patent Pending, such as our **New Sp500 Low Rpm Generator design** (not included in these plans... Cost is $70 order # Sp500)This is a new type of generator which has never been seen before, it was designed and developed by Martin Douglas. It is truly a**New Discovery** for the 21st century! **Very High Efficient!**

The Sp500 generator is a very powerful and high efficient low rpm generator that we have developed and which you will not see anywhere else. If you are a manufacture and you are interested in our new invention please e-mail us and let us know. **WARNING!** You can not copy, sell or manufacture any of our devices, plans or videos without our permission!



WARNING!
We are not responsible for anything in these plans, You build at your own risk.

You may want to find a cheap machine shop to build or weld some of the parts for you it is not that expensive to do in our area. You may also have a laser cutting company in your area. If not any machine shop can help you. Some of the steel parts can be made from wood instead of metal. But for a long lasting and a more reliable windmill it is best to use steel. Please be careful!

Tools you may need!

1. Small drill press or hand drill
2. Heating torch
3. Table saw or hand saw
4. Jig saw
5. A small welder
6. Polyester resin (premixed with accelerator)
7. Magnets (ferrite blocks or neodymium n40 blocks 1" x 2"
8. Flexible wire (about 14 AWG size)
9. 1" bearing blocks qty 2
10. 1" x 24" round rod for rotor shaft.
11. 2 part epoxy
12. Duct tape
13. Masking tape
14. Diodes 30 amp type
15. Soldering gun
16. Band saw / for metal cuts

Wind blade Construction

Wooden Windmill Blades: You can make the windmill blades out of wood, PVC plastic or aluminum. We feel we have made the windmill blade design much more easier to build than any other windmill design out there. The flat flywheel type generator in these plans is Nikola Tesla technology, It is a common low rpm generator design that is found in hundreds of windmills all over the world. but our **new Sp500 generator discovery** we feel is far better and is much more high efficient and can out perform the common Tesla type generator.

I will go as far as to say we have discovered a new Star Wars technology!

So why don't we include our New Sp500 discovery in these plans?
Because it is such a new and fantastic invention that we would be giving it away for free if we were to include it in these plans. It's a *New Discovery* that is going to *Change our World!*

We should be selling the plans for $600 but we are only asking $70 order # Sp500

Our New Sp500 Low Rpm Generator is not just a generator! It can be used in other applications as well!

Home Ceiling Fan Design:
Home ceiling fans *if you will look closely at them* are a great design to go by. They provide a great way to make a simple windmill blade system. You simply make a "steel wind blade plate assembly (part # 001") and have a laser cutting company or machine shop cut out the following design using 1/4" steel, you would be surprised how cheap it is to let them do it for you rather than you trying to cut it out by hand using a metal cutting blade and a jig saw.
You will need to cut 4 separate pieces,
3 Fin holders and 1 steel disk or flywheel.

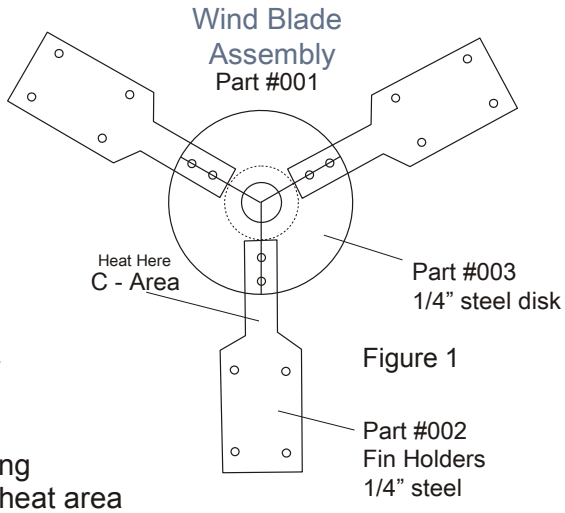
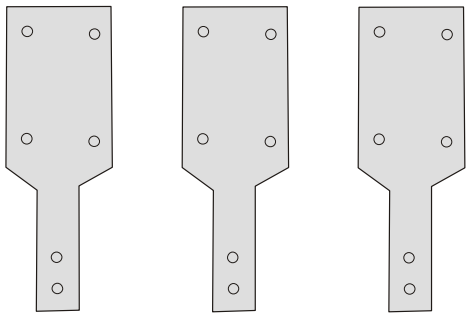


Figure 1

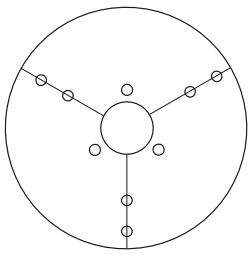
Laser cutting is best and will provide the best performance as far as a good balanced rotor.Ask the machine shop what they would charge to bend the Fin Holders (part #002) a good angle is about 30 degrees. If you think a machine shop is to high then shop around for the best price. I have found some shops to be much cheaper than others. Of course you can do the work yourself. Once you have the wind blade plate assembly cut out then you will need to bend the fin holders, place the fins in a vice grip or on a flat table, use Qty -2 pieces of angle iron and secure them both to the fin using 2 - small C - clamps. (You will also need a protractor) heat area C- with a heating torch or other and bend the fin to a 30 degree angle, repeat and do this to the other 2 remaining Fin Holders. Make sure you bend and do the exact same thing you did on the first fin holder.

You want all 3 fin blades to be the same. **See Fig 2:** Place section B (Bottom end of fin holder) in a table vice or other C-clamp vice method and heat C-section and bend section D to a 30 degree angle. Note: *Be sure to drill your bolt holes before you bend the fin blade holders.* Section B can be bolted to steel rotor disk or bolted and then welded.

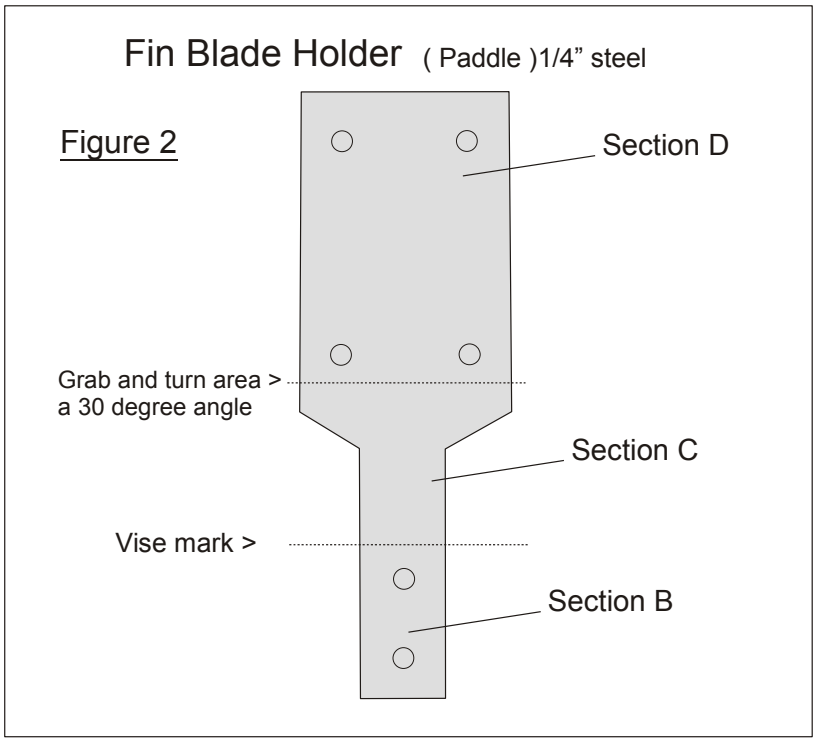
Once this is done you can attach your PVC Fin blades or wood fin blades to the 1/4" steel fin holders. We prefer to use 1/4" PVC blades which you can purchase 1/4" PVC at a local sign or screen printing company near you. Or you could order the PVC online. Wood is cheaper but will not last a long time. You will not have to do anything with the fin blades except cut them out with a hand jigsaw cutter and drill your holes. You do not have to bend and shape the wood fins as shown on many internet web sites, you can simply use flat wood. If you choose to build Fin blades as seen on the internet it would be best to cut and shape one model fin blade and then make a mold casting of it. You can use Fiberglass, or epoxy resin or automotive body filler for your mold casting. You simply cut and shape the one fin to the same design as seen on the internet, and then sand down the wood to a smooth finish, build a mold box, spray entire wood fin with cooking grease spray or other, Then place wood fin flat on a greased piece of plywood larger than the mold and fin. Center it inside of your plywood box mold and begin filling with resin epoxy or other. Wait overnight and remove fin from mold. Repeat the process 2 more times. If you need to make more than one windmill for yourself you now have the find blade molds. I have seen this process done on the internet they even provide color photo's.



Part # 002 Qty -3 1/4" steel Fin Blade Holders



Part # 003 1/4" steel flywheel Disk
Laser cut or use a metal cutting jig.

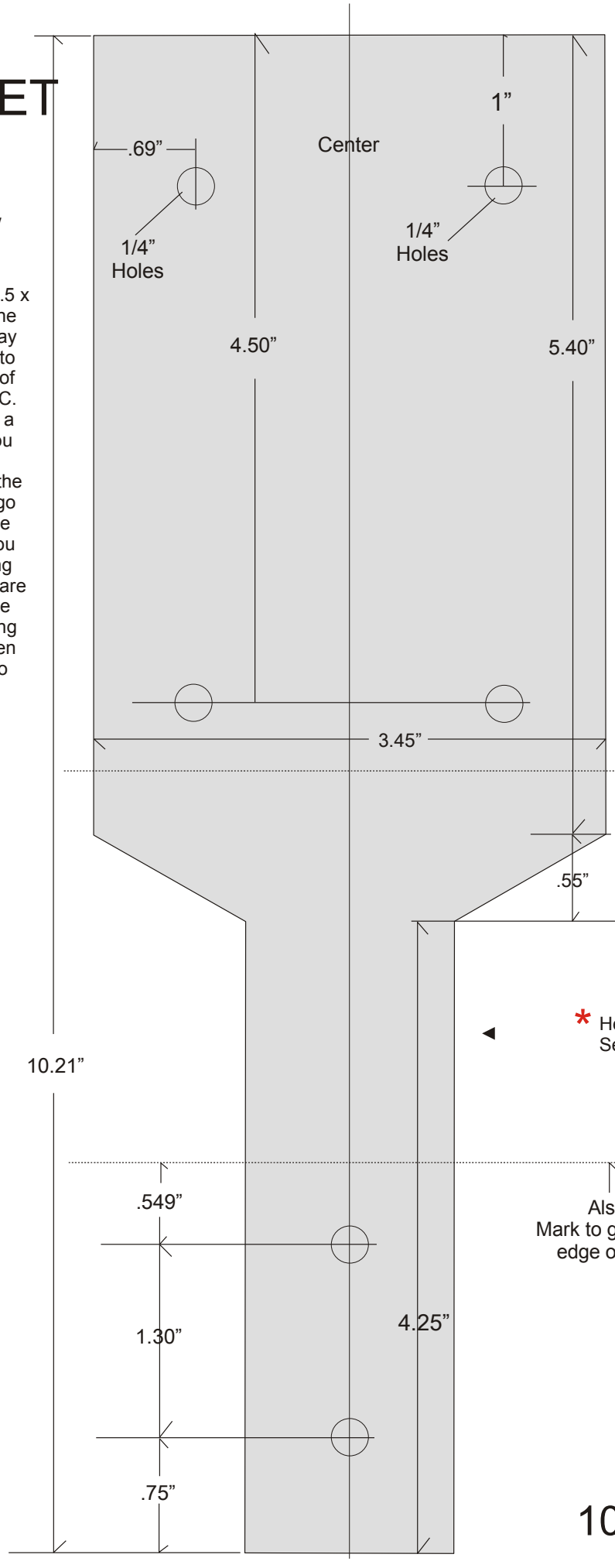


TEMPLET

Fin Blade Holder

If you cut out your self using a metal cutting blade and a hand held jig saw or table.

Copy 1 of these on 8.5 x 11" paper, spray the back side with spray adhesive and attach to a strong piece of cardboard or thin PVC. Cut it out and use as a Templet guide, or you can copy 3 pieces of paper and adhesive the back sides and go ahead and stick to the 1/4" steel sheeting you are going to be cutting out. Of course if you are going to let a machine shop or laser cutting shop cut it for you then you do not need to do the above.



Hex Bolts - Course Thread
QTY-18 1/4" x 1" Steel

Use a 4" wide x 1" thick hard wood blade. Prime the wood blades with white paint and then paint it with 2 coats of white oil base paint. The blades must be weather resistant!

If you need to round off the measurements that's O.K. It is not that critical.

WARNING! Do not copy!

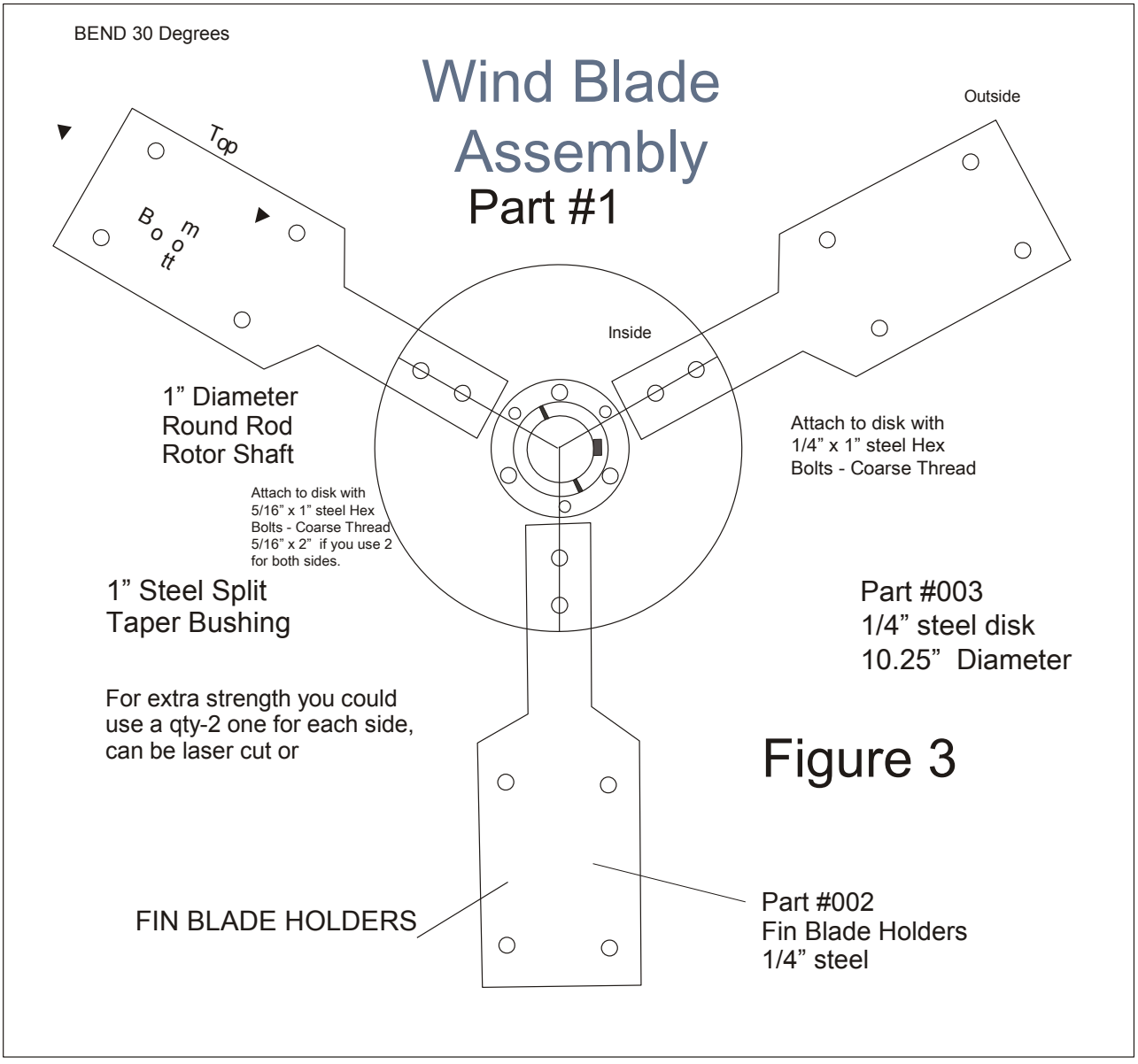
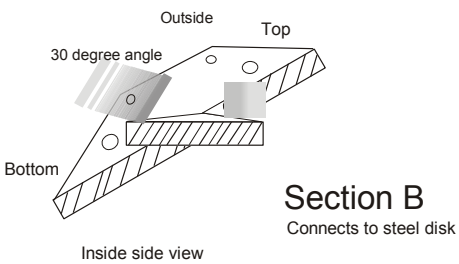


Figure 3

FIN BLADE HOLDERS

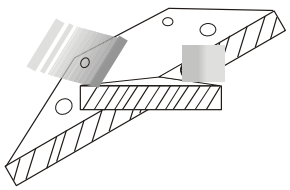


Section B
Connects to steel disk
Inside side view

Wind Pushes this way

FIN BLADE HOLDERS

1/4" Steel fin holder paddle without wood blade



This blade design works well but it is not the best for low winds! But it looks good, Maybe that's why most people and companies make them to look this way. If you want to raise the efficiency of the windmill, Ad more blades, the more the better.... Horsepower will increase and you can drive a bigger generator with it. Blades must all be the same size and weight so the best way to layout and cut the blades is to use a templet that you can trace with a very fine pencil. The Templet can be made out of fine cardboard or use 1/8" PVC sheeting it is the best and can be cut easy with a matt knife. The objective is to get every blade the same weight and shape as to achieve a perfect balance. It is also very important that you drill your holes in the exact same areas. When you attache the blades to the fin blade holders they must all be the same, you can't have one blade sticking out farther than another blade. It really is best to have a laser cutting company or machine shop cut and drill the holes in the steel fin holders. A laser cutter can cut out the fin holders and the bolt holes.

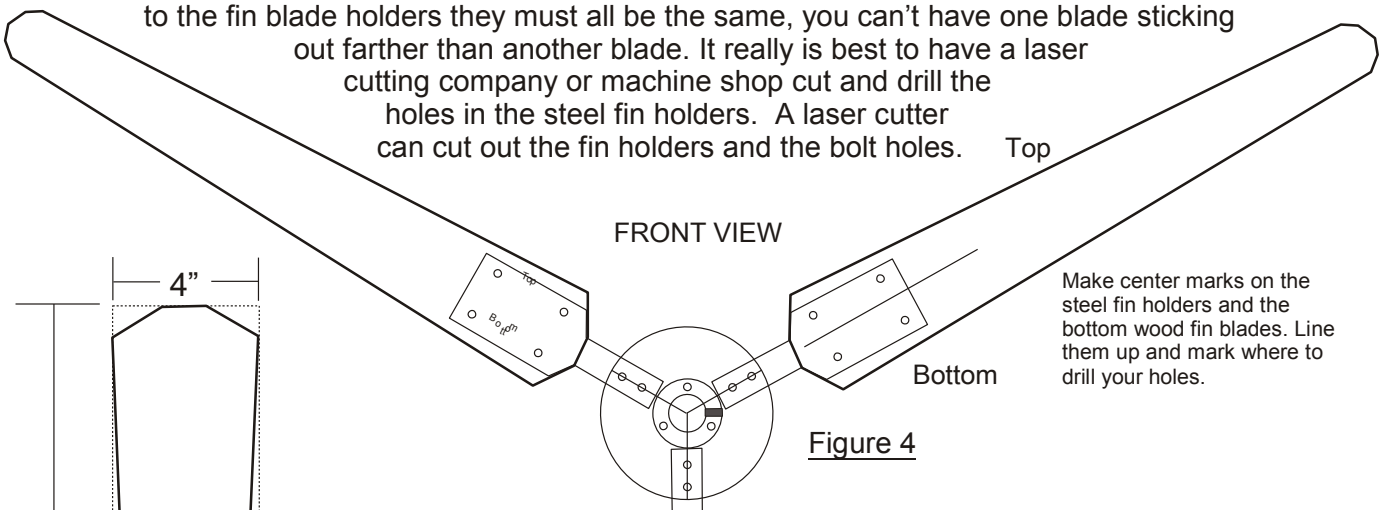


Figure 4

Make center marks on the steel fin holders and the bottom wood fin blades. Line them up and mark where to drill your holes.

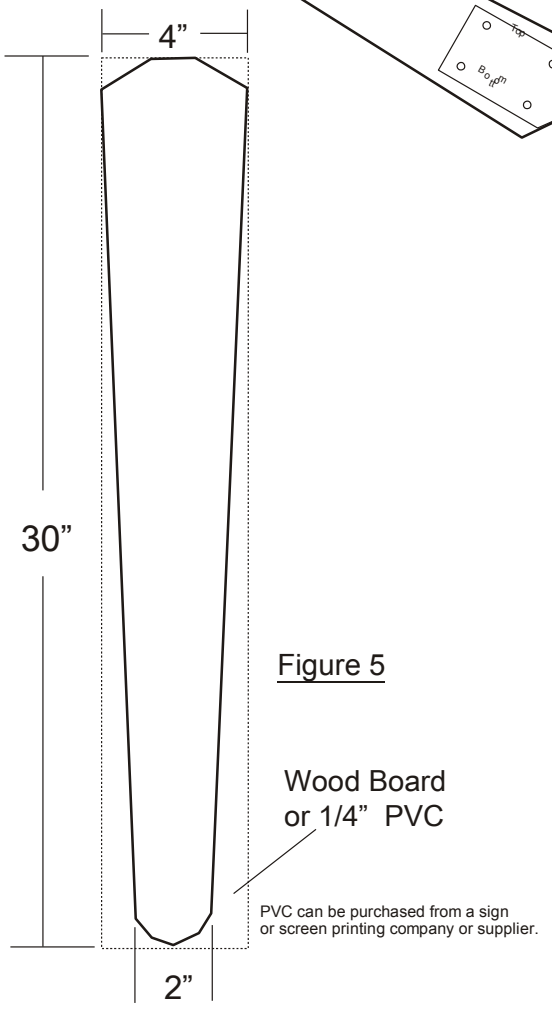
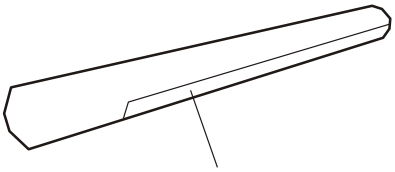


Figure 5

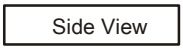
Wood Board or 1/4" PVC

PVC can be purchased from a sign or screen printing company or supplier.



Trim the bottom edges of each fin blade on the bottom side only. 28 degree angle or more. You do not have to do this but it helps with performance.

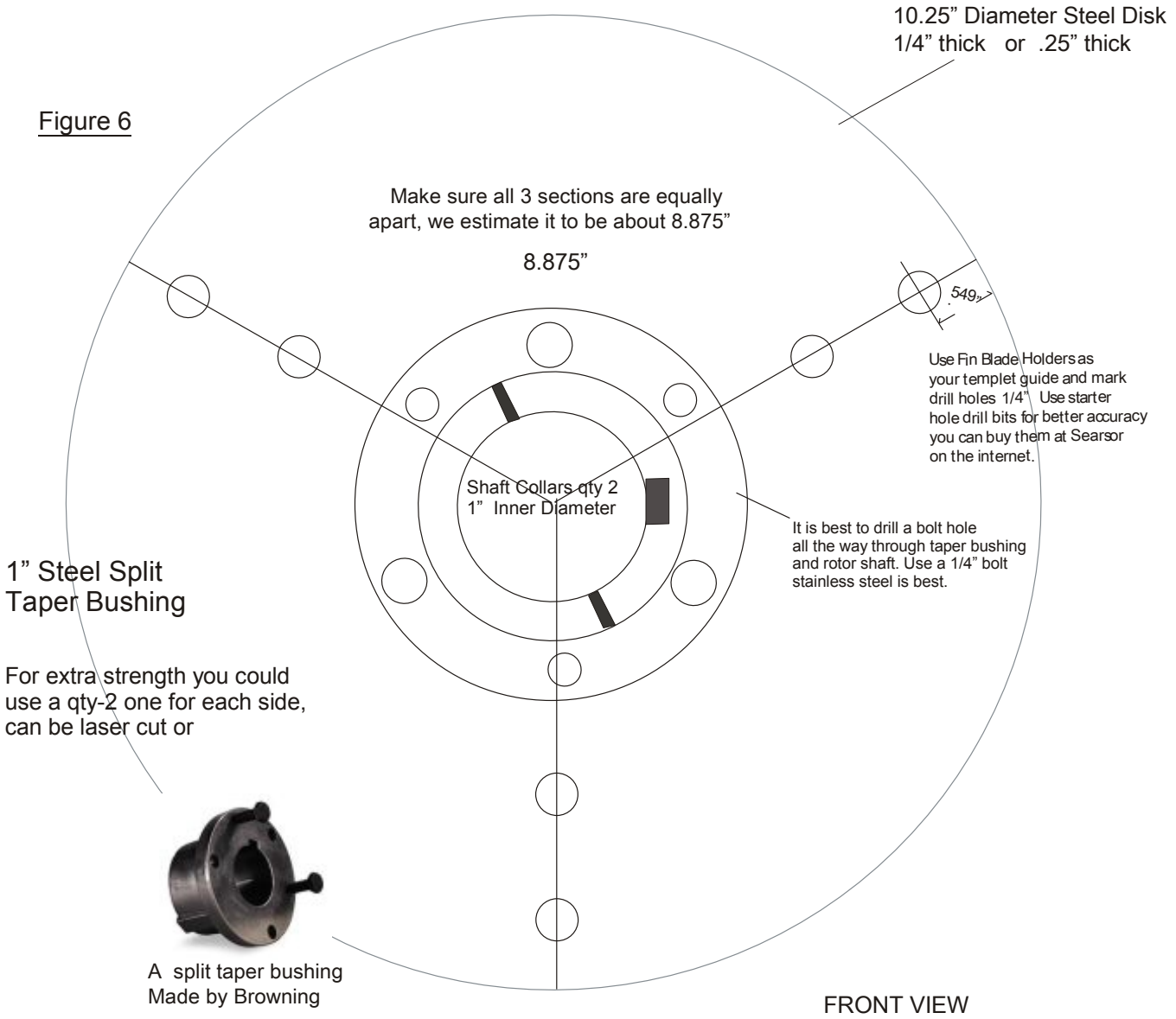
If helps to cut an angle edge but you can just keep it the same and still produce a good amount of torque. It's just that, the less drag (resistance the better)



Example: Fin Wind Blade after templet is placed on top of wood and marked with a very fine pencil mark. Cut out with a table saw or electric hand saw or jig saw.

STEEL FLYWHEEL DISK: Use 1/4" thick steel x 10.25" Diameter. (you can use wood but steel is better!) Have a machine shop or Laser cutting company cut the Steel Disk for you. Or you can cut it yourself using a band saw. The steel flywheel will be attached to the 1" steel shaft, use a 1" x 24" Steel shaft, you can see a list a steel round rod at www.smallparts.com you can get a very high grade steel made for motors for about $76 or buy a cheaper cold roll rod for about $15, or you can go to your local machine shop and they may sell you a chrome polished round rod for about $20.. Tell them what it's for.

Figure 6



PARTS

PARTS: see **www.Grainger.com** (they only sell to business but that's OK you start your own research business today, just give it a good business name and that's all Graingers needs.) You can also buy your supply's and parts from Small Parts Inc. at: **www.SmallParts.com** they carry some really awesome stuff! There phone # is 1-888-455-9712 Some of the parts you will need could be found right in your own local town area. Machine shops, Sign and screen printing companies, industrial junk yards, hardware stores, many hardware stores have catalogs and they can order you just about anything that you need.

QTY 3
Split Taper Bushings

One is for the steel ywheel disk and the other 2 is for the magnet disks.

1" bore size = $10.60 each

Granger.com
Part # 3A147 P1 1

QTY -2 Cast iron ang mount bearings 1" bore

These bearing are for the shaft to rotate on. The shaft, the rotor magnet assembly and the windmill blades assembly all move together. The windmill base and the generator coils do not move but are stationary! If you on a budget you can use a 3/4" shaft and a 3/4" QD's and ang bearing's.

1" Bore size = $24.41 3/4" Bore = $38.45

1" x 24" Steel ground tool rod SAE 0-1
Part # B-CGDR-16 $76.00 This is the best to use!
Machine shops may also carry polished chrome type round rod cheaper.

Or you can use Cold Steel Rolled Round Rod
1" x 24" = $15
Make everything 3/4" D and its cheaper yet.

Please Notice
we do not sell parts
only plans and videos

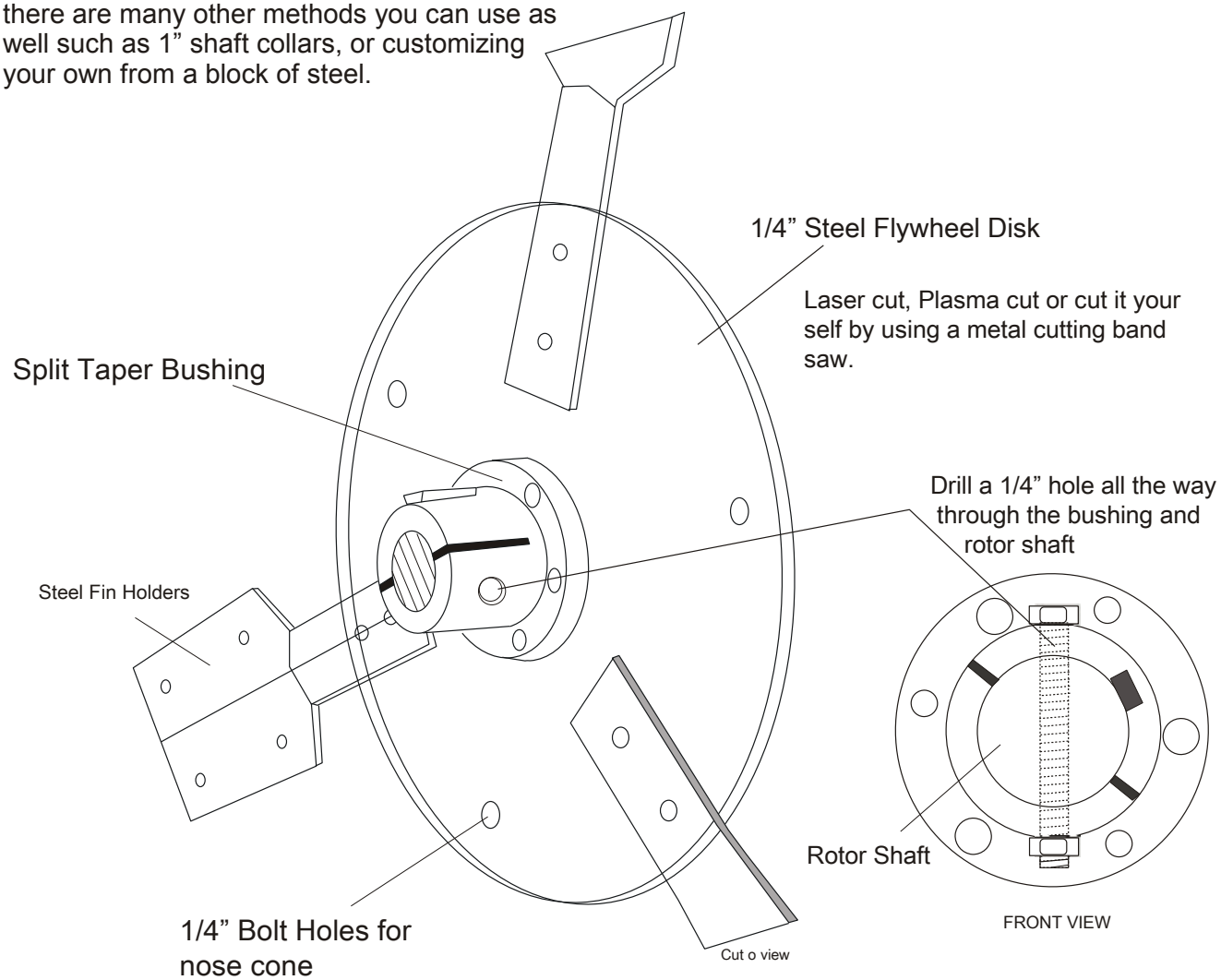
QTY- 32 Magnets

You will need 16 magnets per disk.
Use 1" x 2" x as thick of a magnet as you can afford. Use Neodymium they are the best but very high price, 2nd best is Ceramic.

Split Taper Bushings

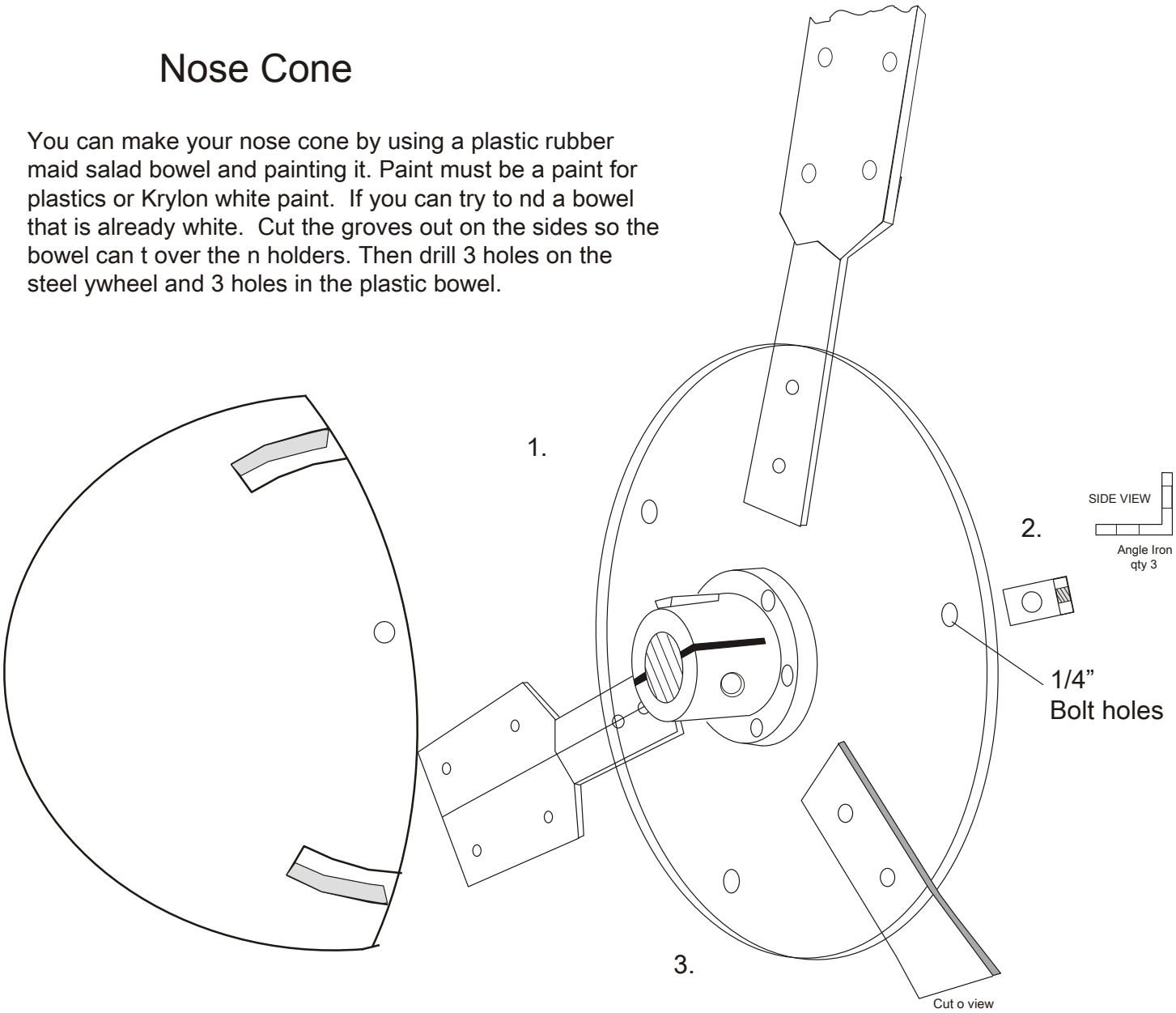
Split taper bushings I feel are the best to use to hold the steel flywheel disk and generator rotor disk in place on the rotor shaft. Drill a 1/4” hole all the way through the front of the bushing, this is where a bolt will go through the bushing and rotor shaft to hold the flywheel in place so the flywheel and the shaft can rotate together at the same time. Place the rotor shaft in a vice and place the steel flywheel disk onto the shaft. Then place the Split taper bushing onto the shaft and butt up against the flywheel and mark your drill holes. Don’t forget to mark the front bushing holes for the shaft. You will then need to drill 1/4” holes in the shaft as well. Remove bushing and flywheel disk and drill your holes. Of course there are many other methods you can use as well such as 1” shaft collars, or customizing your own from a block of steel.

Drill 1/4” bolt holes here and in the shaft also.



Nose Cone

You can make your nose cone by using a plastic rubber maid salad bowel and painting it. Paint must be a paint for plastics or Krylon white paint. If you can try to nd a bowel that is already white. Cut the groves out on the sides so the bowel can t over the n holders. Then drill 3 holes on the steel ywheel and 3 holes in the plastic bowel.



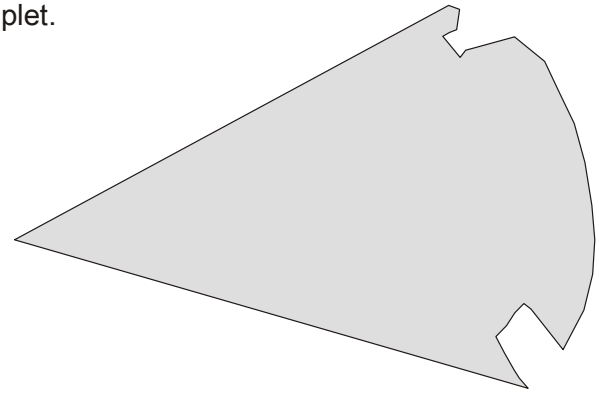
Drill all holes 1/4” in diameter. Cut small pieces of angel iron or aluminum angel, you will need 3 each. Drill 2 holes in each. These are used to attach the nose cone to the steel ywheel. Once cone is in place caulk all holes and cracks with clear silicon caulk to protect from weather. It is also a good idea to spray paint all metal pieces with 3 to 4 coats of enamal paint.

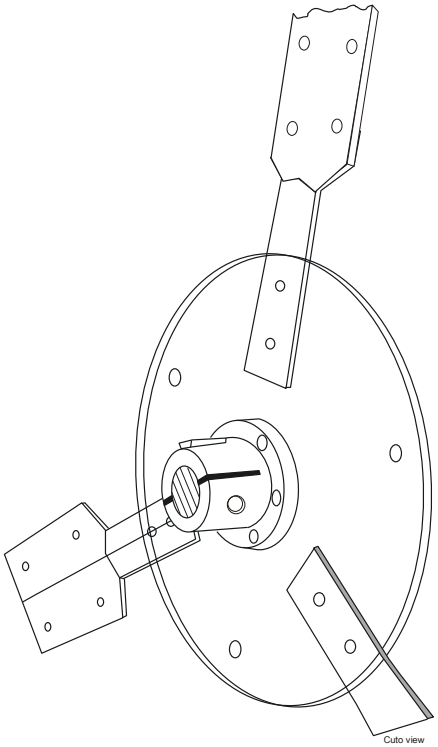
Another nose cone option would be to make a mold out of berglass or wood, make the wall of the cone no thinner than 1”. Use Fiberglass resin and steel mesh for strength. Other options: If you have a lathe you cane spin your own wooden cone, use soft wood. The inside does not have to be hollow all the way to the tip.

Nose Cone

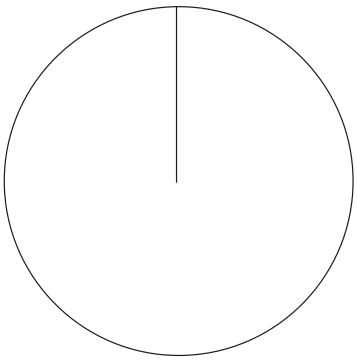
For a more high Ecient windmill it is far better to use a pointy tip cone rather than using a round tip. It does not look as good but performs better!

Cut out a paper or thin cardboard cone rst, then use the card board as a templet.



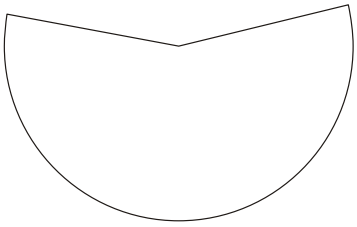


1.



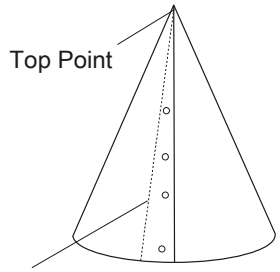
Thin Cardboard Templet

2.



Thin Cardboard Templet

3.

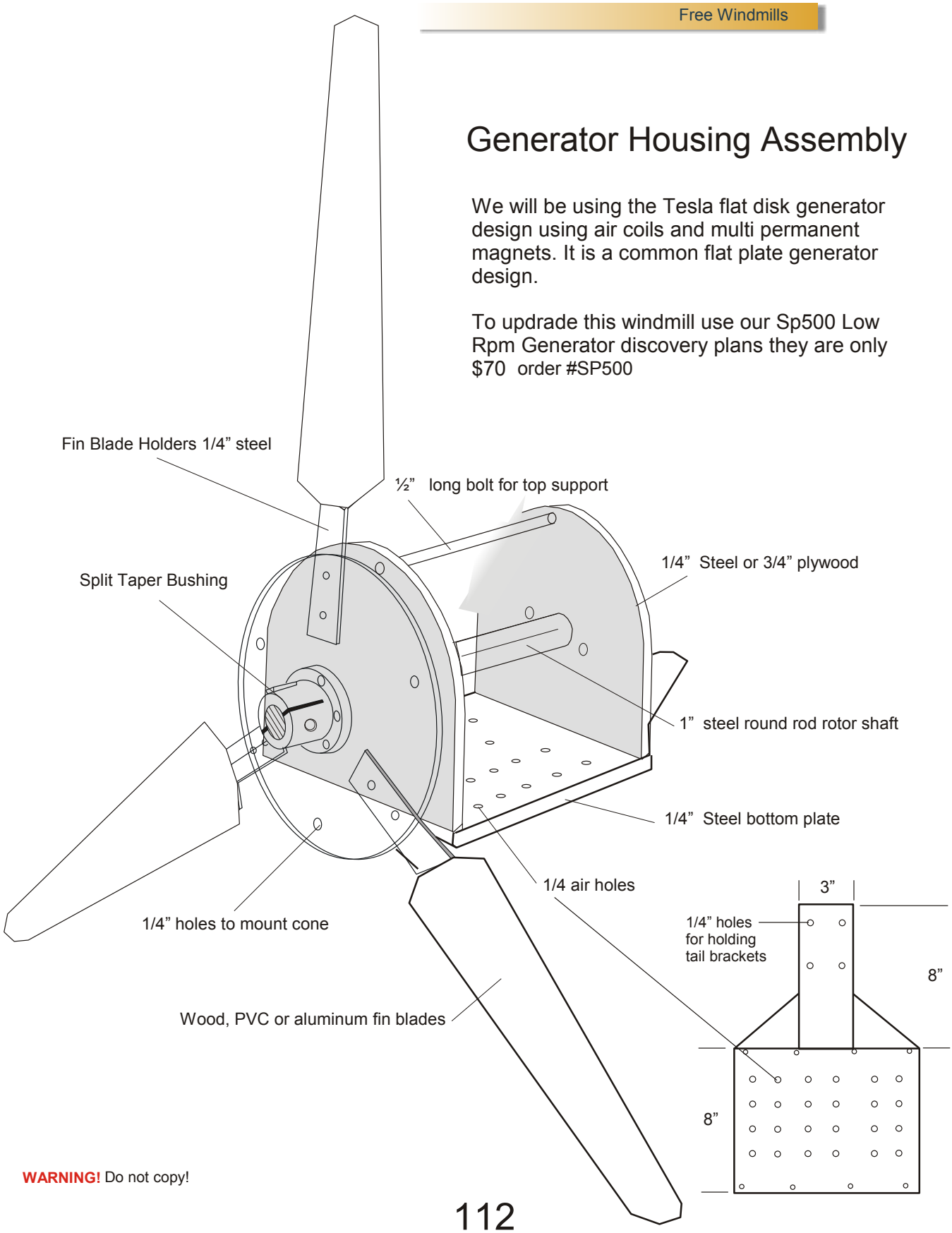


Now use the cardboard templet to draw lines on your sheet metal. Cut the sheet metal and shape it to a cone shape and drill holes in over lap area and place rivets in holes. Then sand down metal on outside and mix and use auto body puddy and fill in any cracks and seems. Let dry and then sand down to a smooth even look. You may want to grind off some off the top point a bit, if you do you can fill it with body puddy and then round it with a sander and by hand. Use course sand paper for first shaping then very fine sand paper for the finish. Once this is dine you can primer with 2 coates of primer paint and then 2 coates of semi gloss enamel spray paint.

Generator Housing Assembly

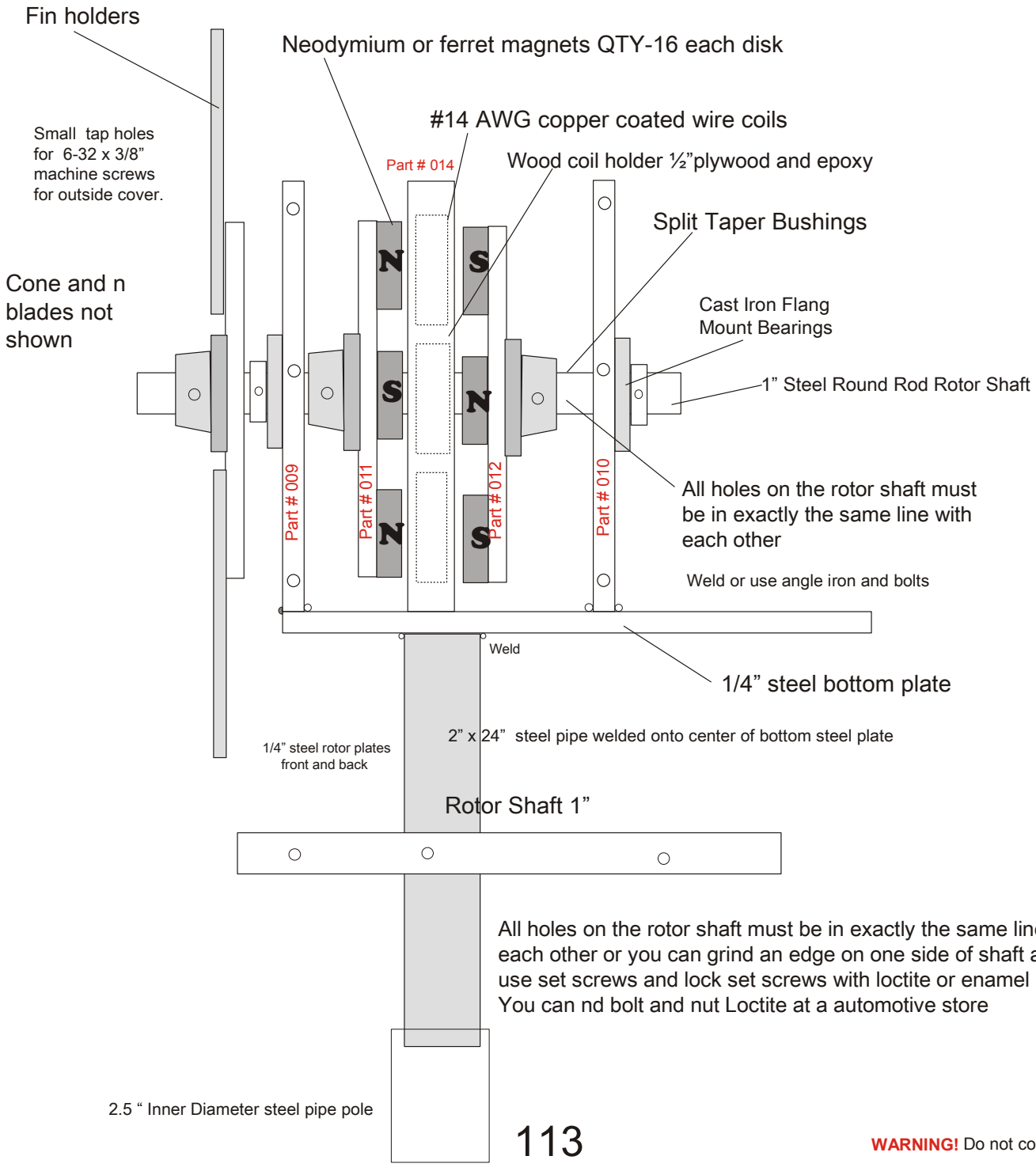
We will be using the Tesla flat disk generator design using air coils and multi permanent magnets. It is a common flat plate generator design.

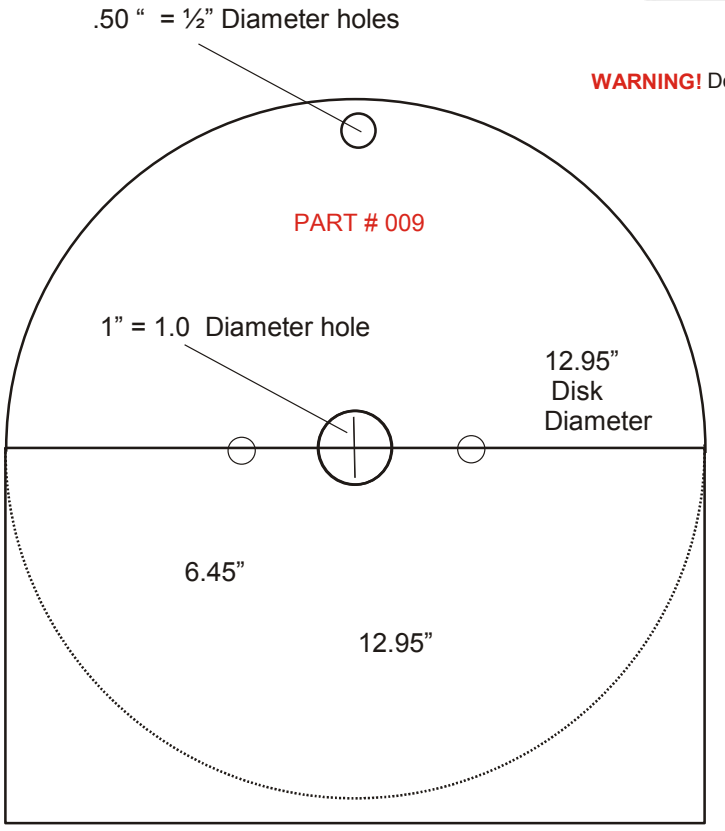
To updrade this windmill use our Sp500 Low Rpm Generator discovery plans they are only $70 order #SP500

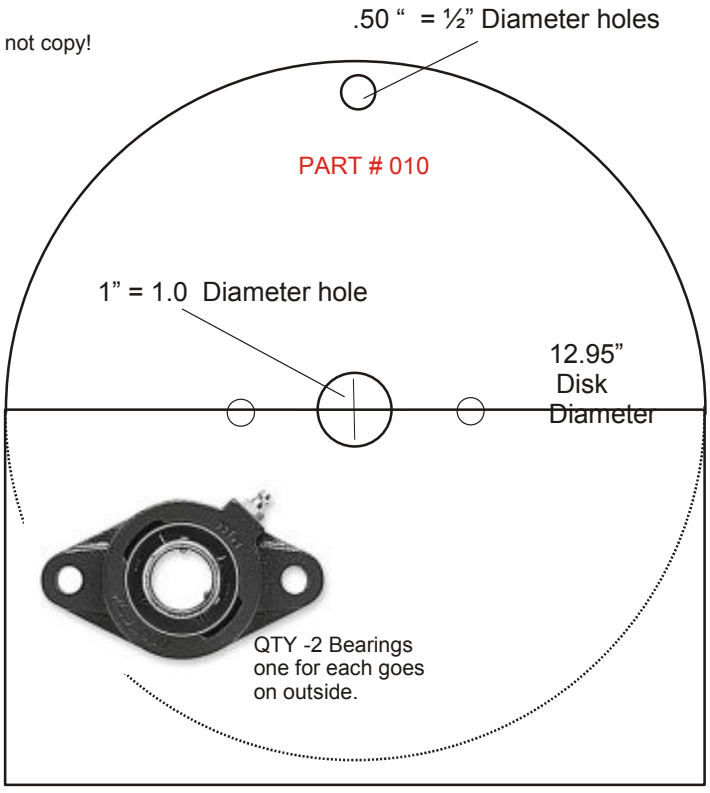


Side View

Generator Housing & Generator / Coils & Magnet assembly

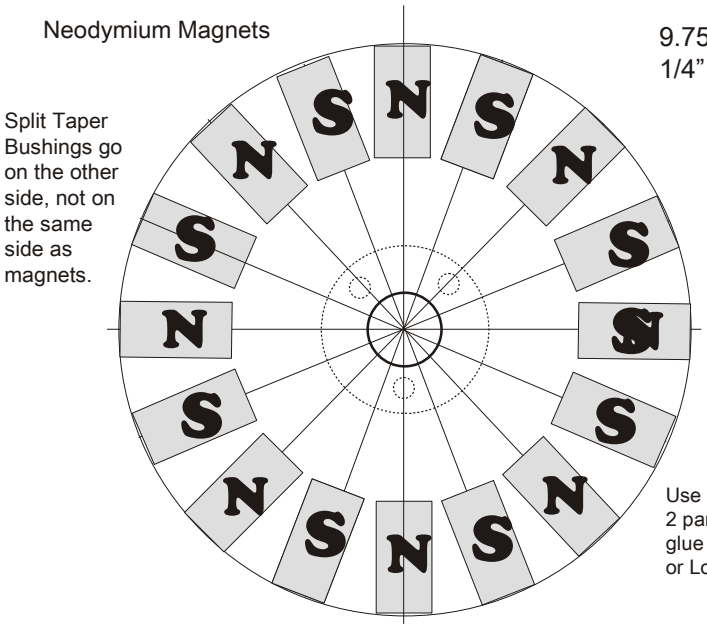


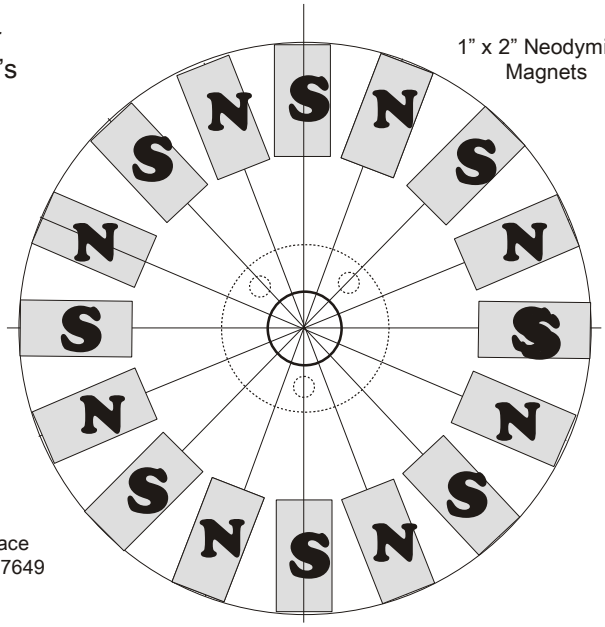




Part # 009 1/4" Steel or 3/4" plywood

Part # 010 1/4" Steel or 3/4" plywood





Neodymium magnets start to lose there strength at about 175 degrees F. So it is best to make sure you use a silver or white generator cover and make vent holes. Use screen mesh to keep out the birds and wasps. I am not sure but I have heard some windmill designs use Ferrite Iron Boron Magnets, they maybe able to take higher temps?? But they are weaker than neodymium makes. Neodymium are more expensive but can take a beating!

Drill holes in sides of each disk and tap out for machine bolts 6-32 x 3/8 to fit into and hold a aluminum or sheet metal holding plate.

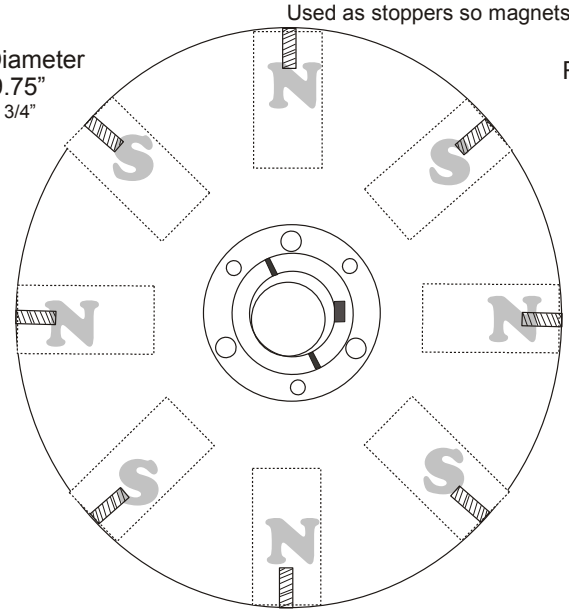
EXAMPLE ONLY: NOT ALL MAGNETS ARE SHOWN!

See Page 14

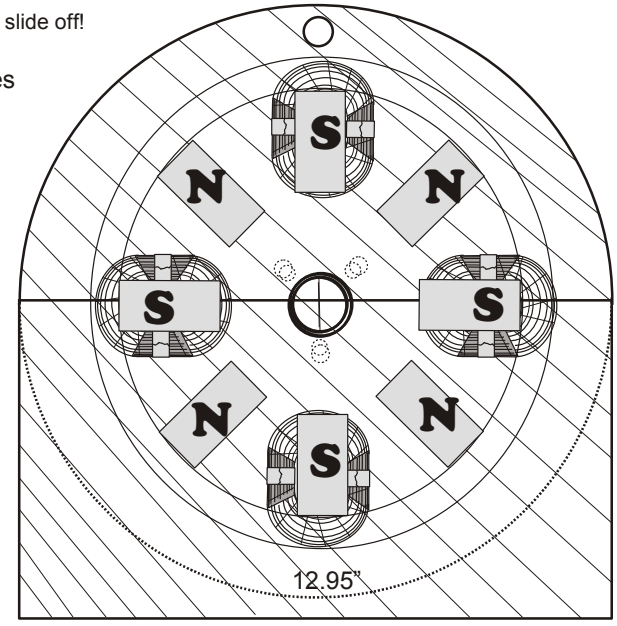
12.95 Diameter of wood

Used as stoppers so magnets to not slide off!

Disk Diameter = 9.75" =9 3/4"



Rotates



Coil mold hole Diameter 11.45"

#14 wire coils 100 turns

Stationary, does not rotate

Disk Diameter 9.75"

Front side, Magnets are located on back. Both magnet rotors rotate past the coils to generate AC electricity.

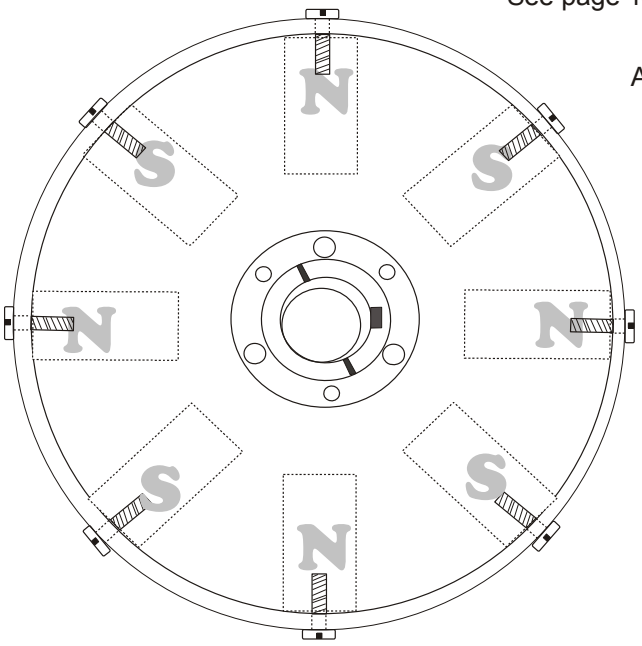
Part # 009 1/4" Steel or 3/4" plywood

Back Side, magnets facing coil

Machine bolts/ 6-32 x 3/8 or more

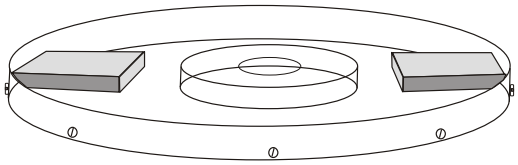
You will need a total of 32 1" x 2" Magnets, 16 per disk. See page 14

Wood Disk for center hole, grease the wood only it will be removed when epoxy dries. WARNING! The wood disk must be in perfect center, do not let it move when you ll with epoxy!



Aluminum outer Strip

1" center hole



Not all magnets shown, rough drawing.

Partial Side View

The magnets should have already been glued in place with epoxy, now fill in entire space area's between the magnets and up to the top of the magnets with 2 part Epoxy or Fiberglass resin. Let dry and remove wood disk in center. Center wood disk, and side aluminum strip should be the same height as the magnets. **WARNING!** This must be done or magnets will slide off of disk and destroy coils.

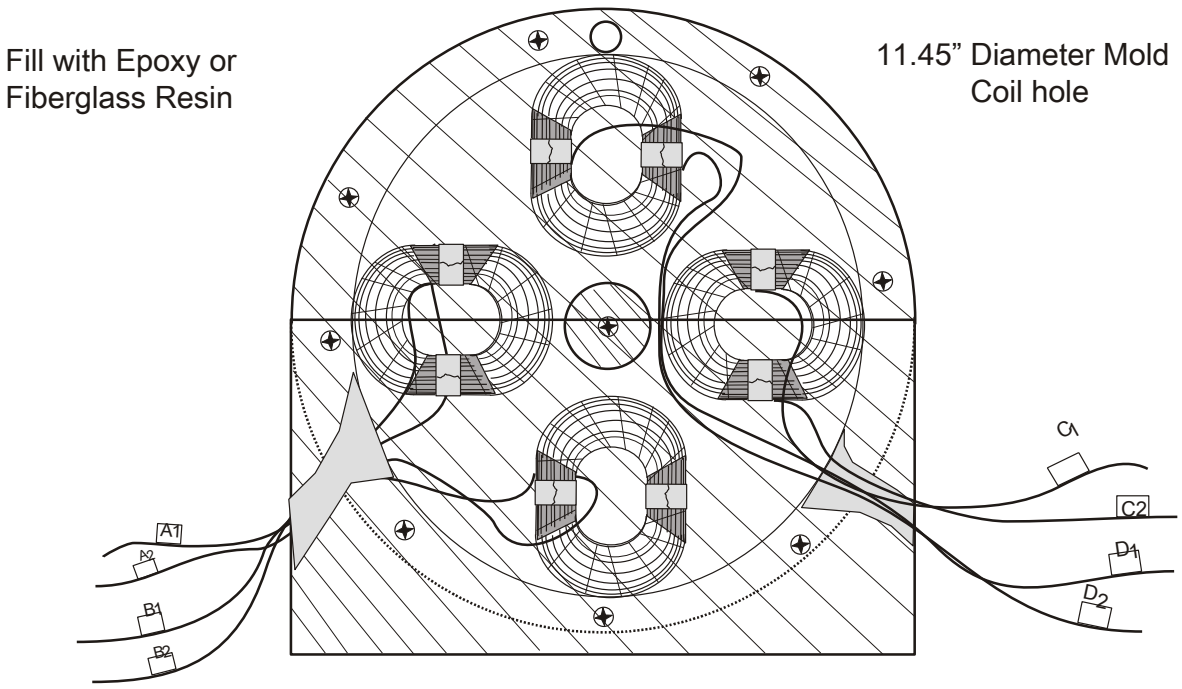
The Generator coils

Rough drawing of open coils Use #14 AWG or #16 copper coated magnet wire, at about 100 turns each. Use 3/4" thick plywood. You will need to make a special air bobbin so you can turn and wind your wire coils on- using a small table top drill press. If you have a drill press that will turn at about 70 - 100 rpms that would be great, if you do not you can always make one, by replacing the motor in an old table top drill press and replacing it with a 90 v dc conveyor belt motor with controller, you can buy these at www.Grainger.com for about $130.00

Make the center hole 1 ½" diameter so the rotor shaft can easily turn in it you can do this cutting our a 3/4 thick x 1 ½"wood disk centering on your 3/4" bottom mold plate and gluing it with wood glue or wood screws. Make sure it is center with the wood coil structure.

When making your coils mark each coil as you go. **Example:** coil #1= 1A & 1B, Coil #2 = 1A & 2B and so on.

Cut out a 1**1.45**" **D moldcoil hole** as seen **below**. Cut 3/8 groves in the sides so there is a place for the wires to come out of. Once you have the coils made you can then place the wood structure down on a piece of greased 3/4" plywood secure it with wood screws. Now place the coils in place asyou see here. You will need another piece of 3/4" x 15" x 15", but first mix your epoxy or fiberglass resin and pour it into the mold over top of the coils, fill the epoxy or resin all the way to the top of the 3/4" plywood coil structure, then place the 2nd piece of greased 3/4" x 15" x 15" wood over top of that and let dry overnight. Now remove 3/4" boards and paint the entire wood coil structure with a coat of epoxy or resin so, 1 -2 coats are best. Let dry and you are done.
Notice: No bare parts of the wood should be open to the weather that's why we coat them with epoxy or resin.



Part # 014 CenterGeneratorCoils

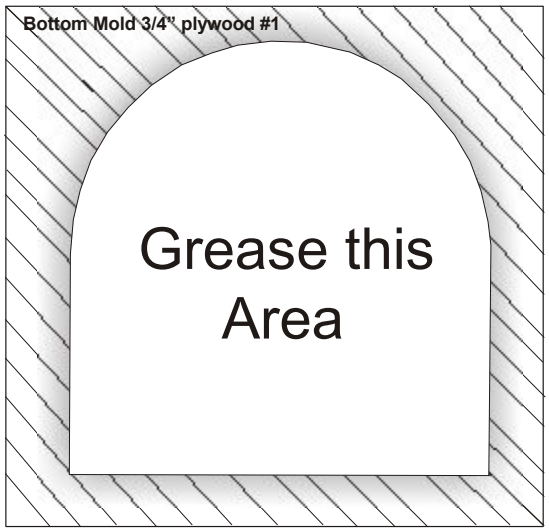
#14 or #16 copper coated wire spool

Using # 16 wire will get you a higher voltage output but a little less amperage than the #14

The Generator coils

Step #1

Bottom Mold 3/4" plywood #1

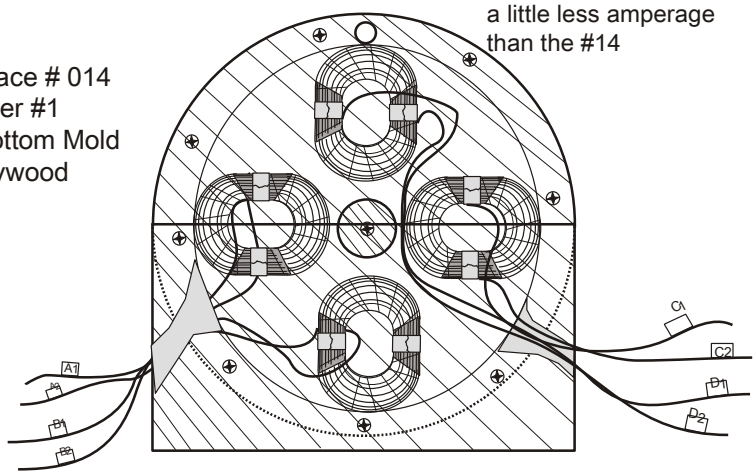


You will need QTY-2 of these boards

FRONT VIEW

Part #014

Place # 014 over #1 Bottom Mold plywood

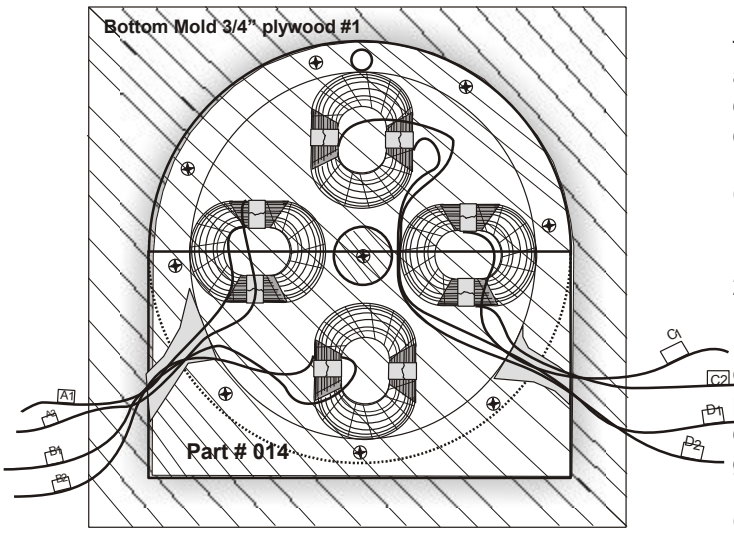


Part # 014 Center Generator Coils

SIDE VIEW

FRONT VIEW

Step #2



Lay the Bottom mold 3/4" plywood #1down flat on a table, then grease the area shown, then lay part #014 down flat on top of the 3/4 plywood mold. Then place the coils in as shown. attach part # 014 to the bottom 3/4" plywood using wood screws. Mix and pour in epoxy or other, fill to the top and then place the other top 3/4" plywood mold on top of that and let dry and cure overnight. Remove top and bottom 3/4" plywood when dry.

Step #3

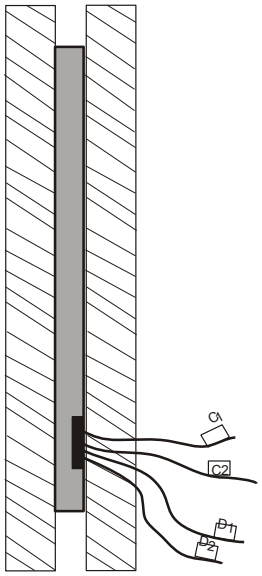
Mix and pour 2 part epoxy or fiberglass resin inside coils wire area. 2 part epoxy is best. Let dry overnight and double coat the outside also, including wood.

Other options as filler:
1. Auto body puddy.

2. Silicone Sealer 100%
Use clear Silicone 2 in a caulking gun. Apply in layers, let each layer dry about 5 to 6 hours, poke tooth pick holes into the layers on the 4 th or 6th hour so air can get in and cure dry the soft pockets. Let dry in a hot dry area outside. Once you have all layers filled in let dry for 2 to 3 days. Use tooth pick test to make sure there are no soft spots.

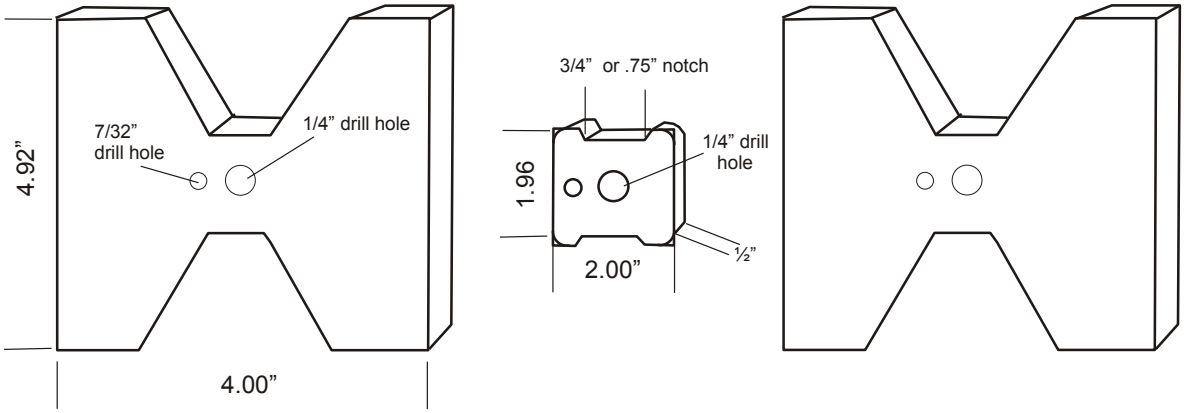
Step #4

Coils 3/4" boards



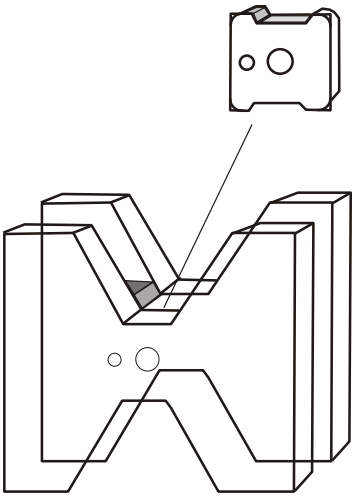
The Generator coil bobbin jig

This is a copper coil wire bobbin jig, you will be making your #14 or #16 coils with this. Cut the jig out using smooth ½"plywood, then sand down all parts using very fine sand paper. Drill your holes as shown and assemble the 3 parts as shown. place your holding bolts in the holes and place nuts on the bolts. One bolt is a long bolt, it should be about 1/4" x 6" long, the other is a short 7/32" nut & bolt. Wind about 100 turns if wire around the bobbin. Once you are done you will need to use black tap or masking tap and tape the center wires at V areas. Then remove nuts and bolts and then remove coil. You want to make the coil wire fit tight together, so you can tape them the rest of the way or best to use small #27 copper coated wire wrap tightly all around coil. Once you have finished you can continue to make the rest of the coils. Make sure you wind all the coils in the same direction and mark the bottom of the coils on the tape as bottom. The bottom is were you first started your wind. Which your beginning wire will be hanging out of. This is the bottom. Place all coils bottom side down in mold.

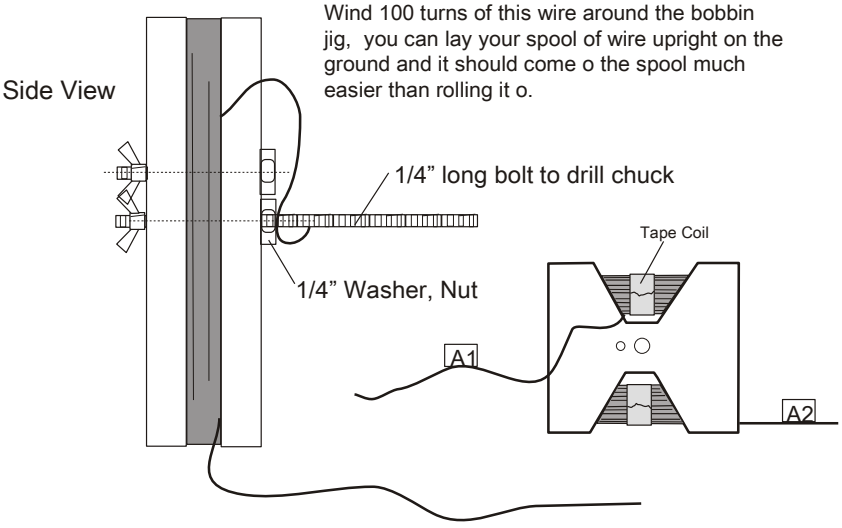


Example: 4.00" = 4"

You will need a 6 to 10 lb spool of #14 or #16 copper coated magnet wire. You can but magnet wire on the internet search for "Magnet Wire" or see: **MWS** Industries 1-800- 423-5097 www.mwswire.com



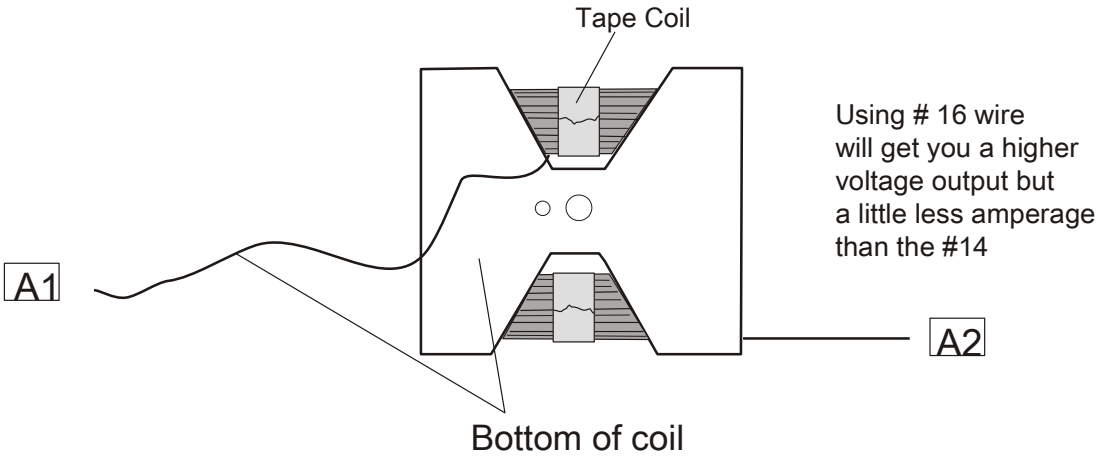
Wind 100 turns of this wire around the bobbin jig, you can lay your spool of wire upright on the ground and it should come o the spool much easier than rolling it o.

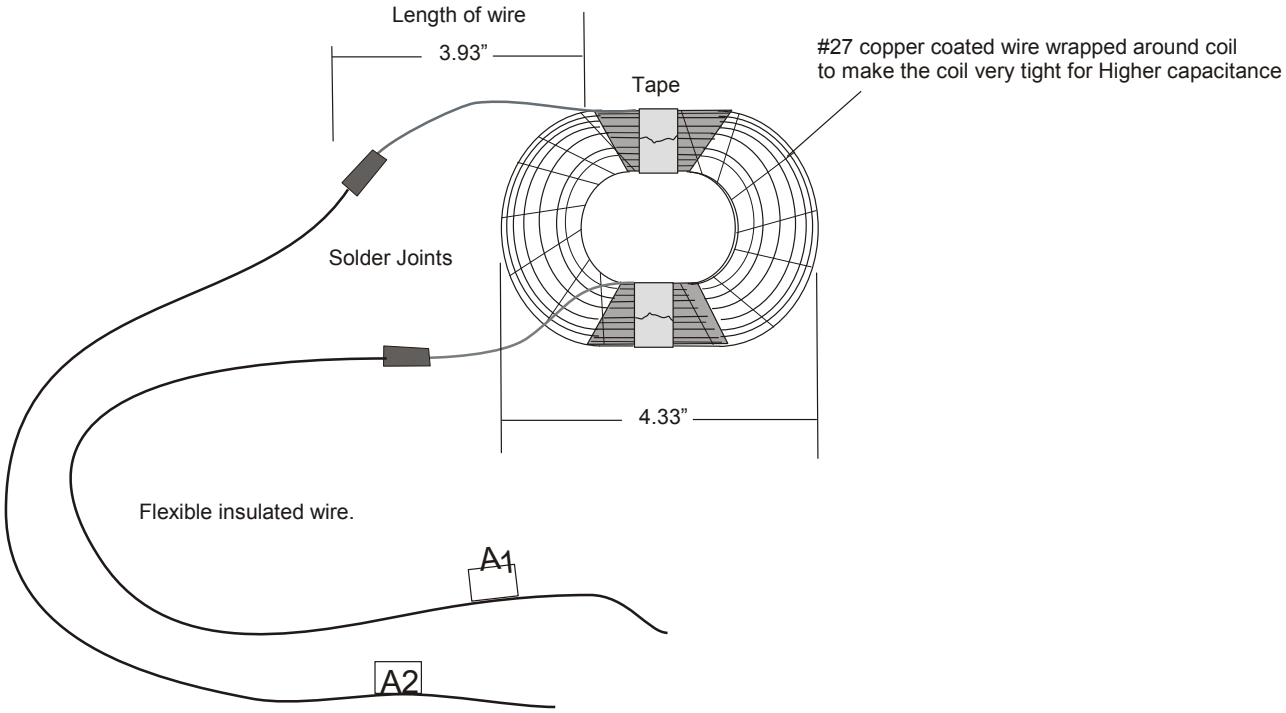


Stack the 3 pieces like this bolt into place. Use a 1/4" long bolt for the center. This will fit into the drill press chuck. You can then wind the coil by turn the chuck or belt pulley by hand or use a D.C. 90 v motor than will turn at 20 - 100 rpms using a controller. See Graingers.com

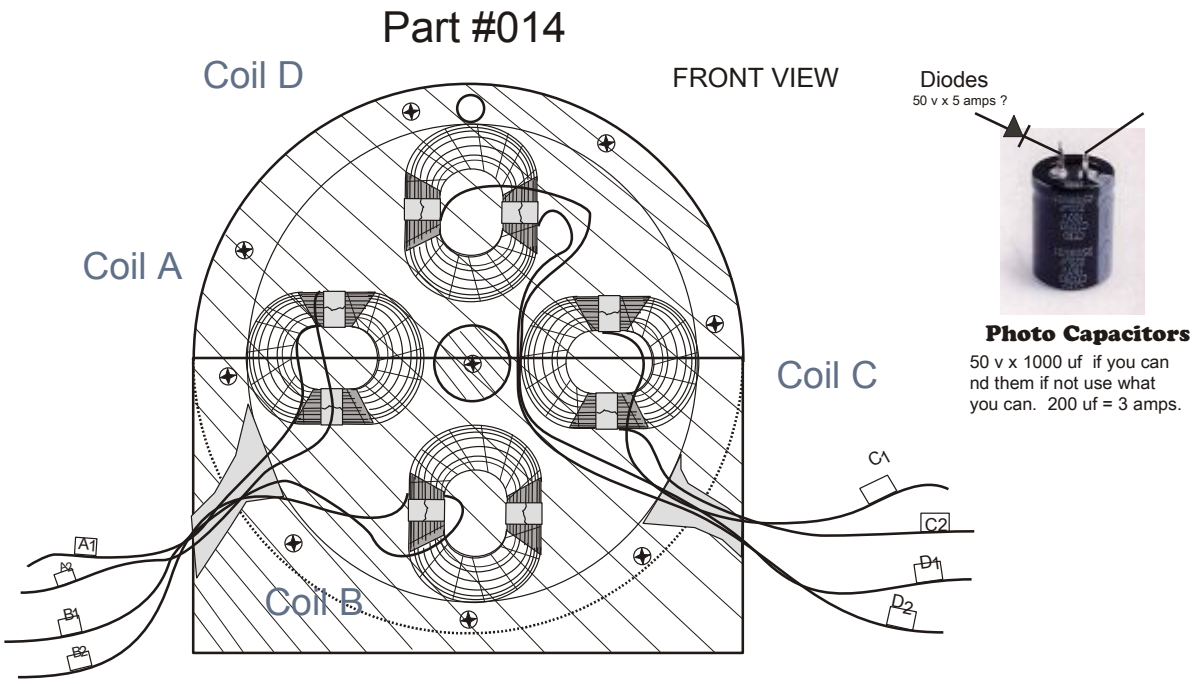
The Generator coil / bobbin jig

Mark and tag each coil as so: A1A2, etc... B1 B2. Solder long flexible wire to the leads. A1 & A2. Also: See our Sp500 Generator plans for only $70 order **#SP500** our new Low RPM generator is 10 times better in power output and easy to understand and make. We are looking for a manufacturer to manufacture & sell our **new discovery!** This new **Star Wars** Technology!



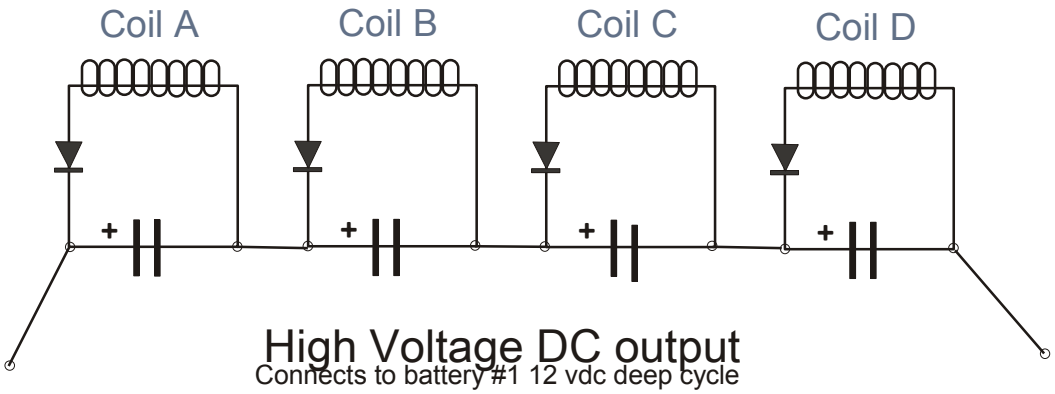


If you want to ad more coils you will need to make the coils longer and more narrow. So they will all fit together inside of the wood mold part #014. There are many ways in which you can hook these up. Direct, 3 phase, or in series.
Put together the entire generator assembly and magnet disks first and hook up the coils and test them. Use the method you think is best for you, which can depend on if your in a high wind area or low wind area. If you live in a low wind area you will need our Sp500 Generator plans. It is far better and is superior in design and is SUPER high efficient! Our Sp500 works very well in low and high winds! We designed the Sp500 over 1 year ago and have kept it classified until now! Order# Sp500 plans - cost $70



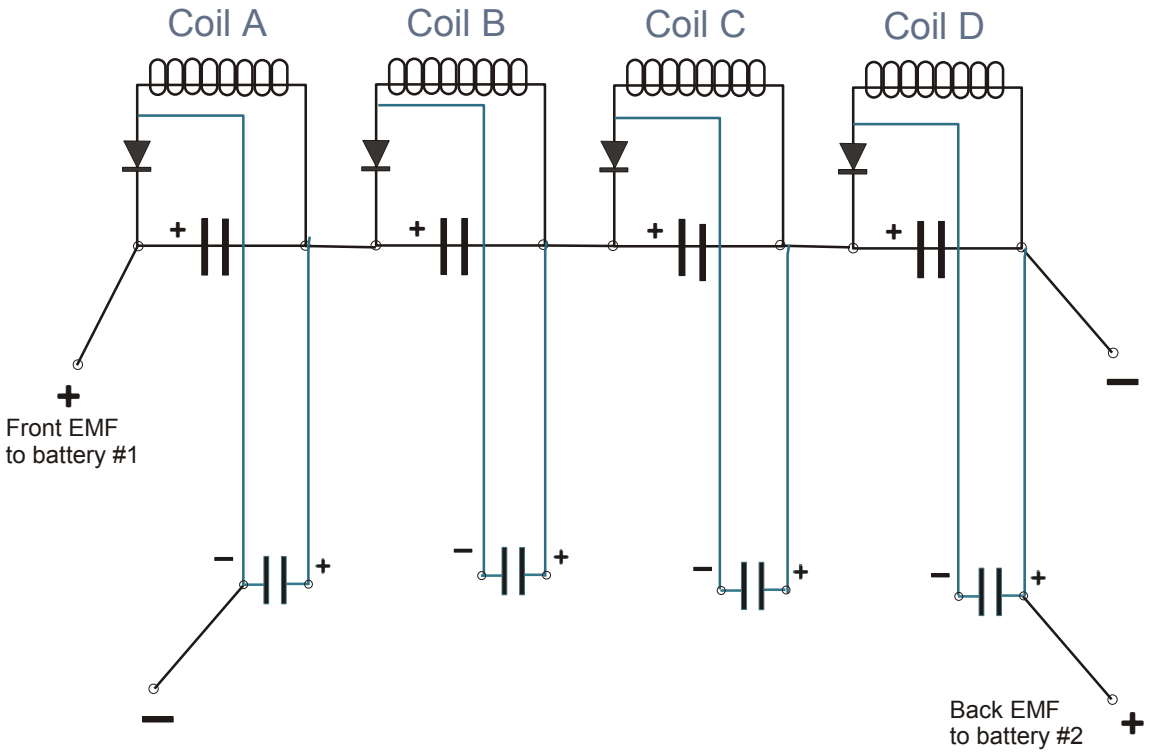
Part # 014 Center Generator Coils

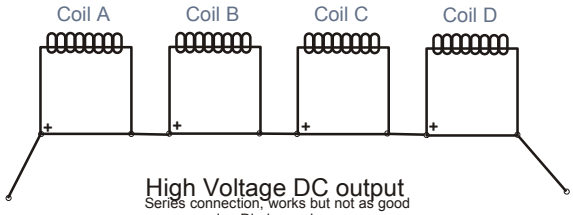
Option One Connecting the coils: In this option we use our Vortex Effect, (Patent Pending) we can not explain why it works because of Trade and Patent Secrets! But in this example we are driving the generator coils separate using diodes as a one way valve and 500 to 1000 uf photo capacitors! Photo capacitors are very high efficient! Each coil charges it's own capacitor, the capacitors are then connected in series to multiply the voltage even higher. In this example we are only collecting the front EMF.

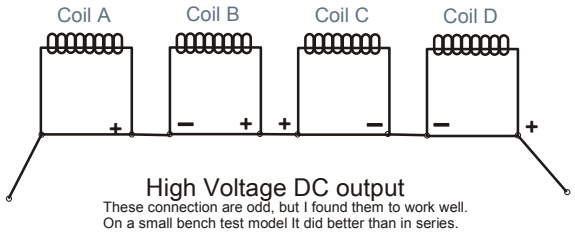


Front Emf and Back Emf Collection

You can purchase Capacitors & Diodes at any Radio Shack store or from off the internet, search for Electronic parts and supplies or search for capacitors and diodes

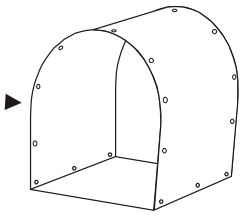






Test everything thing before you install the entire assembly onto a 20 to 30 foot pool. Do wind tests, Generator tests etc... Make sure everything is working right. Make sure all steel and wood parts are painted and or double coated with epoxy to withstand the weather. You may also want to keep in mind to keep out birds and insects, use clear caulking for all small cracks and aluminum screen mesh for larger areas and bottom air holes of

Side View
of
Aluminum or
plastic cover



Plastic or Aluminum Bowels as covers or make your own nose cones from sheet metal and auto body puddy.

Bolt down then weld to steel bottom

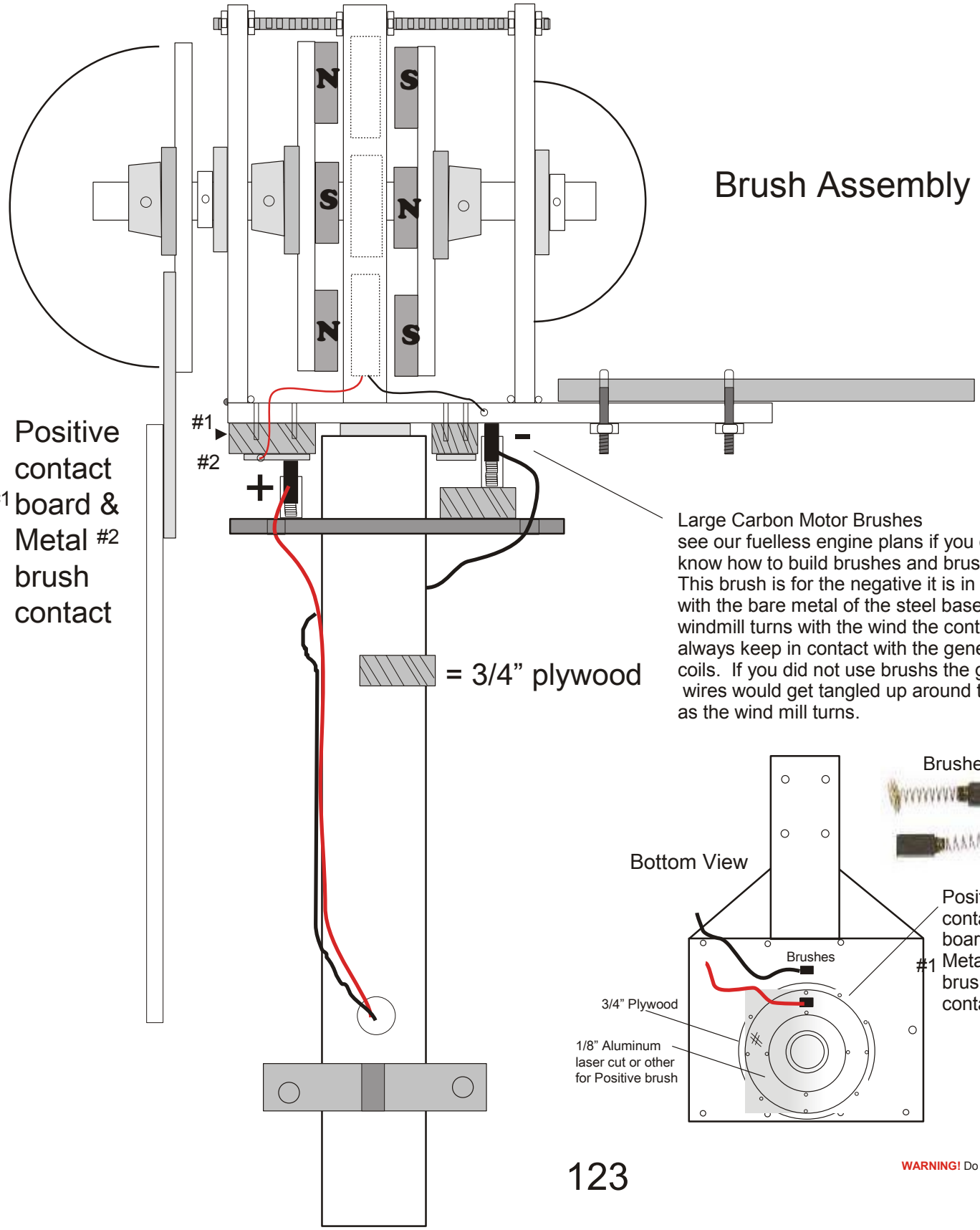
Use a 2" x 36" long Aluminum pipe or steel pipe
The tail can be made out of aluminum. You can bolt it on or weld it on.

Brush Assembly
See page 23

36" to 40" long so high winds will not lift out and off of pole. This steel pipe is welded to the 1/4" steel generator base and slips down into a steel pipe that is bigger in diameter. Do not use to thin of steel piping.

Dril a hole for your generator wire to go through.

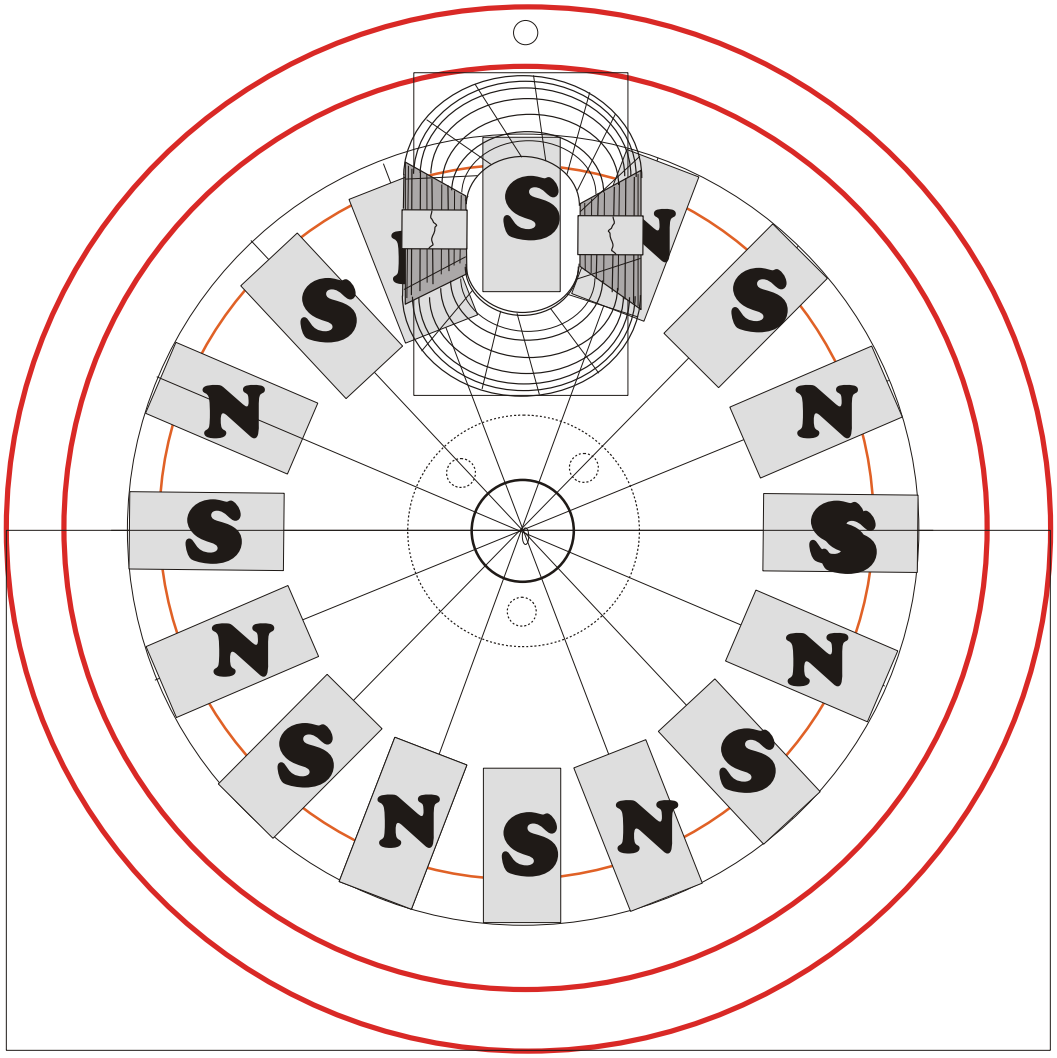
Use steel guide pole wire holders, it is a good idea to weld them onto pole.
See TV attenna supplies for Home TV Poles. Radio Shack or other.



Brush Assembly

Large Carbon Motor Brushes
see our fuelless engine plans if you do not know how to build brushes and brush boxes. This brush is for the negative it is in contact with the bare metal of the steel base. As the windmill turns with the wind the contacts will always keep in contact with the generator coils. If you did not use brushes the generator wires would get tangled up around the pole as the wind mill turns.

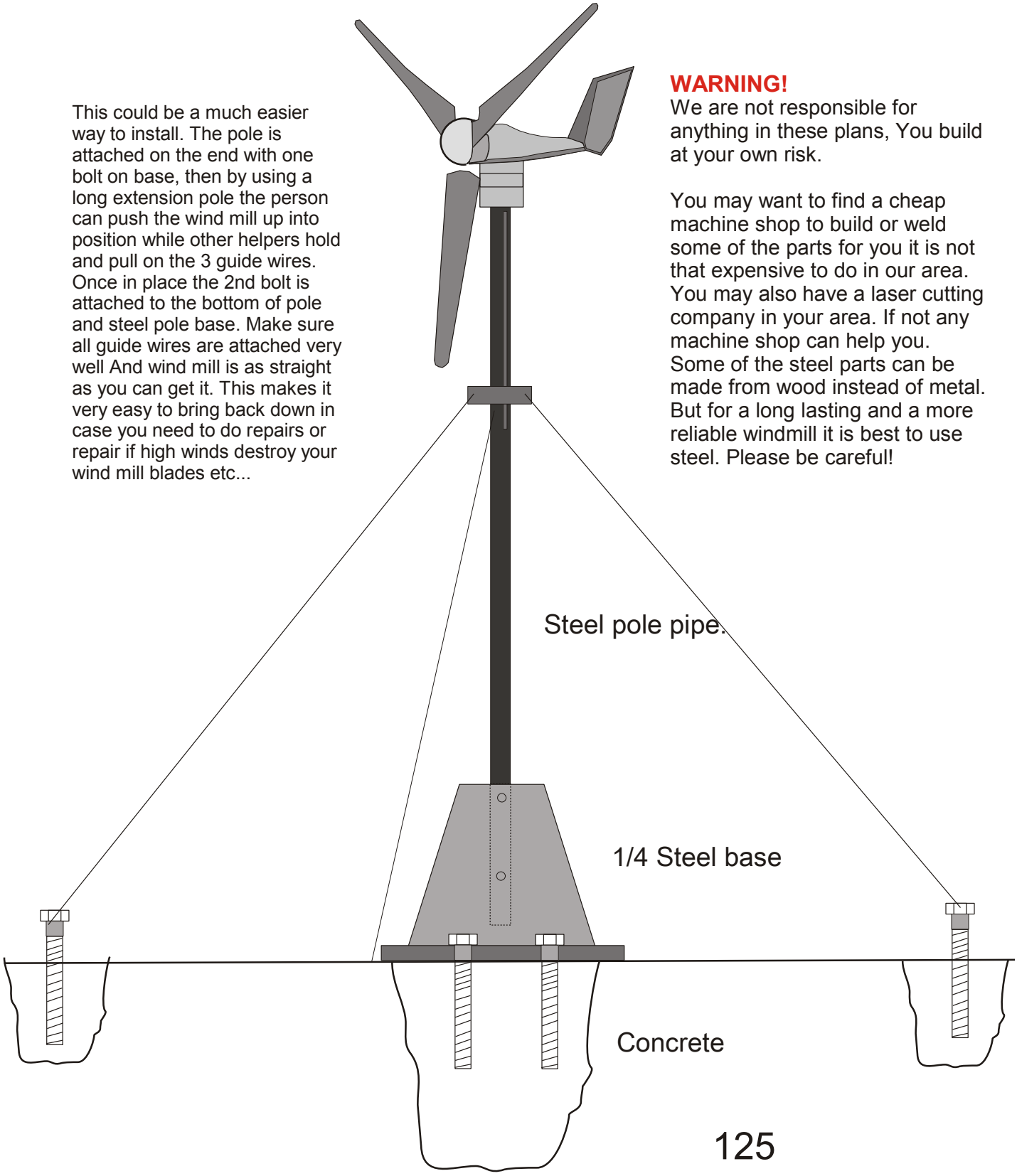
This is a rough over lay to help give you an idea of how the magnets line up with the coils etc..



This could be a much easier way to install. The pole is attached on the end with one bolt on base, then by using a long extension pole the person can push the wind mill up into position while other helpers hold and pull on the 3 guide wires. Once in place the 2nd bolt is attached to the bottom of pole and steel pole base. Make sure all guide wires are attached very well And wind mill is as straight as you can get it. This makes it very easy to bring back down in case you need to do repairs or repair if high winds destroy your wind mill blades etc...

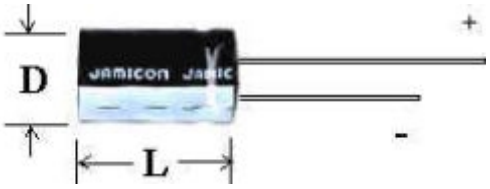
WARNING!
We are not responsible for anything in these plans, You build at your own risk.

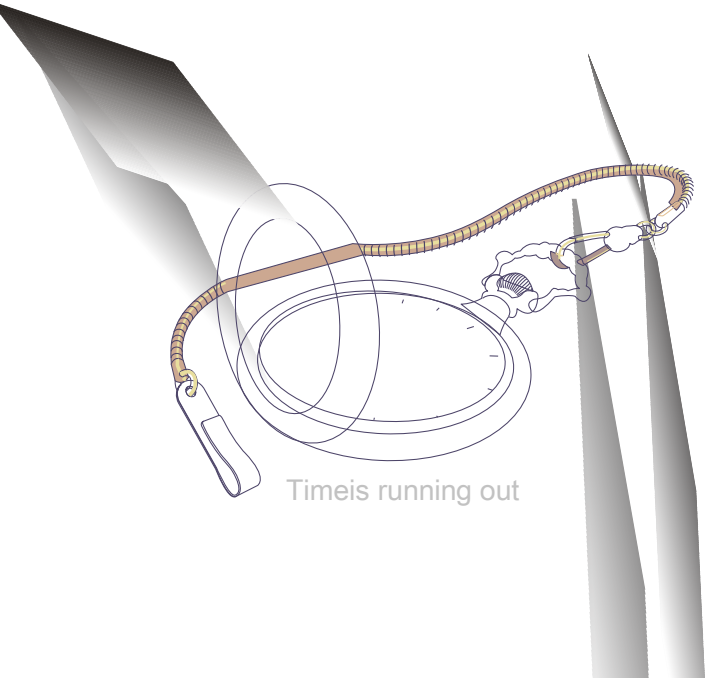
You may want to find a cheap machine shop to build or weld some of the parts for you it is not that expensive to do in our area. You may also have a laser cutting company in your area. If not any machine shop can help you. Some of the steel parts can be made from wood instead of metal. But for a long lasting and a more reliable windmill it is best to use steel. Please be careful!



FREE ENERGY SCIENCE

InformationBig Brother & the Oil Companies do not want you to know!





Timeis running out

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