

**BACKPACK**

*Electricity*







Plans,  
Tables  
& Lists

# PARTS LIST FOR BASIC UNIT

Used For	Part Description	Qty	Source	Cost <sup>11</sup>
Power generation	3"x 6" Solar cells	36	eBay seller - topsolar_china	\$44.83
Stringing solar cells	Tabbing wire		Came with solar cells	~
Connecting strings	Buss wire		Came with solar cells	~
Soldering cells	Solder flux pen	1	Came with solar cells	~
Soldering cells	Solder		My workshop	Nominal
Backing board	5mm, 4'x 4' Underlayment p/n 757295000115	1	Home Depot	\$8.97
Sealing backing board	Latex paint	~	My workshop	Nominal
Sealing solar panel & solar cell adhesive	Silicone caulking	1 tube	Home Depot	\$5.92
Spacer & sealing of solar panel to glazing	Double-sided adhesive foam	2 roll	eBay seller - blackduckdeals	\$6.99

<sup>11</sup> Cost is total cost for the quantity used, but does not include tax or shipping.

Glazing	"Optix" Plexiglass 32"x 44" p/n 11235	1	Lowe's	\$25.98
Panel power leads	14 gauge red/black Zip cord cat # WRB-14	4'	www.AllElectronics.com	\$2.40
Power plug	2-conductor weather- resistant connector, 14 gauge - cat # CON-319	1	www.AllElectronics.com	\$2.40
Solar panel Frame	Aluminum C- channel 3/4" x 3/4" x 1/8" thick 6063-T52	12'	www.OnlineMetals.com	\$17.22
Frame corner brackets	3" Flat corner brace p/n 030699152964	4	Home Depot	\$3.27
Mounting corner brackets	#8 Machine screws	16	My workshop	Nominal
Solar charge controller	30 Amp PWM Controller p/n CMTP02	1	eBay seller - topstore222	\$14.02
Battery	Mighty Max 12v 7.2 AH sealed lead-acid battery p/n ML7-12	1	eBay seller - ecomelectronics	\$16.99



Voltage Inverter	750 Watt Voltage Inverter item # 66817 <sup>12</sup>	1	Harbor Freight Tools	\$44.99
Backing board	1/2" plywood scrap	1	My workshop	Nominal
Attaching parts to backing board	#8-32 x 1-5/8" Eye bolts p/n 887480166712	8	Home Depot	\$4.72
Attaching solar charge controller	#6-32 x 1/2" pan head sheet metal screws	4	My workshop	Nominal
<b>Used For</b>	<b>Part Description</b>	<b>Qty</b>	<b>Source</b>	<b>Cost<sup>13</sup></b>
Backpack harness	14 gauge red & black hookup wire	3'	My workshop	Nominal
Backpack harness	Various crimp connectors		My workshop	Nominal
Solar panel harness	14 ga Outdoor cable 14/2	18'	www.AllElectronics.com	\$8.10
Solar panel harness	2-conductor weather-resistant connector, 14 gauge - cat # CON-319	1	www.AllElectronics.com	Cost included in panel
Solar panel harness	1/4" heat shrink tubing	8"	My workshop	Nominal

<sup>12</sup> A smaller voltage inverter can be used. I used this one because I had it. Harbor Freight has a 400 watt one, which is sufficient for the basic unit for \$25.99

<sup>13</sup> Cost is total cost for the quantity used, but does not include tax or shipping.

Backpack	Day pack	1	My workshop	Varies
Panel harness	1" wide webbing	6 yd	Hobby Lobby	\$8.70
Panel harness	Buckles	5	Hobby Lobby	\$7.95
<b>Total (with 1 panel):</b>				<b>\$223.65</b>

Please note that the suppliers listed are those that I used. Just about everything on this list can be purchased from a variety of sources. eBay is a great source for unusual parts, such as the solar cells. Shop around and see where you can get the best deal.

<sup>14</sup>Most hardware items are not listed, simply because I used what I had available in my workshop. Where specific items were purchased, I've included them in the list.

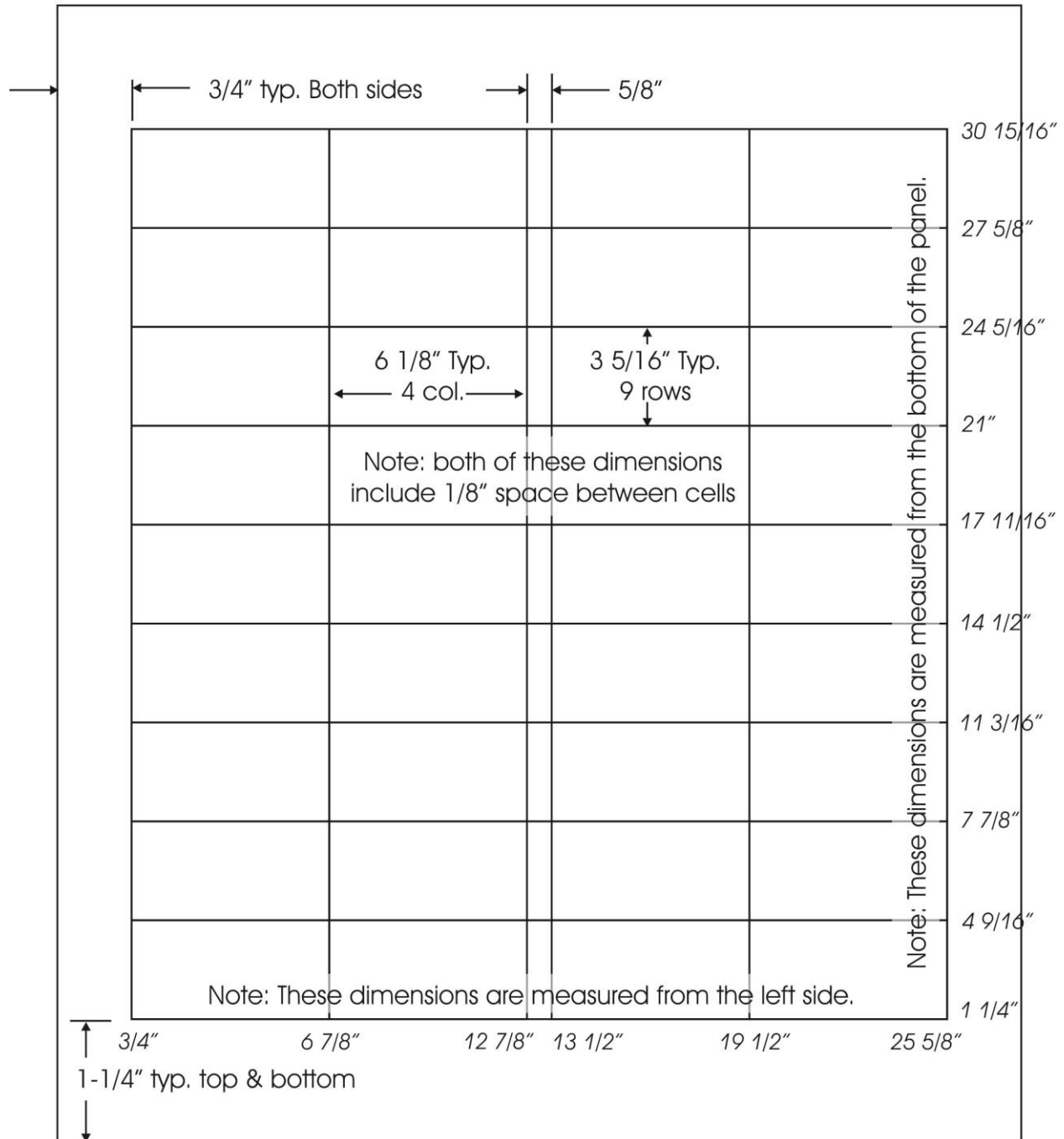
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<sup>14</sup> The quantities listed for the solar panel are for one panel. Additional panels would mean multiplying these quantities by the number of panels you are going to build.

# CELL LAYOUT FOR 36 - 3"X 6" CELLS

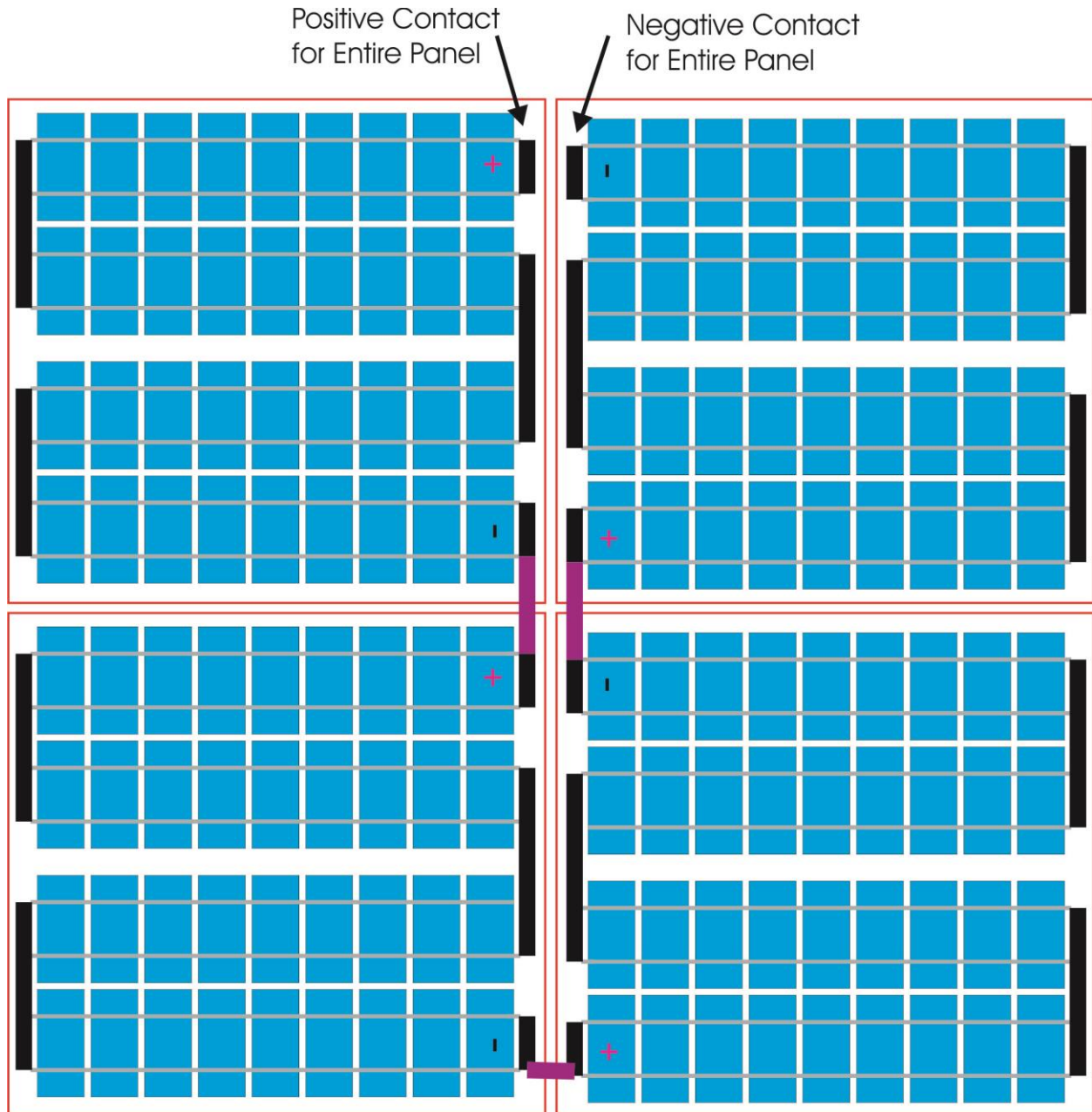
## Panel Layout for 3"x 6" Cells

Overall size - 26-3/8" x 31-11/16"



# LARGE SOLAR PANELS

Multiple strings can be put together to form large panels. In the diagram below. Four strings of solar cells, or four of our basic 2 cell panels, are combined together to make one large panel. Each string is outlined in red to identify them and the additional buss wires needed to connect the panels together is shown by the thick purple lines.





## PARTS LIST FOR MID-LEVEL UNIT

Used For	Part Description	Qty	Source	Cost <sup>15</sup>
Wood pack frame	1" square hardwood dowels	2	Home Depot	\$7.16
Wood pack frame	1/2" x 4" x 2' poplar	2	Home Depot	\$5.16
Wood pack frame	1"x 3" x 6' poplar	1	Home Depot	\$8.12
Wood pack frame	1/4" dowel pin - Item #81601	1	Lowe's	\$1.98
<b>Sub-total:</b>				<b>\$22.42</b>
Metal pack frame	22 ga. 1" square steel tubing	10'	Steel Mart	\$7.50
Metal pack frame	1/8" x 1-1/2" steel strap	2'	Steel Mart	\$5.00
Metal pack frame	Welding wire	~	My workshop	\$0.00
<b>Sub-total:</b>				<b>\$12.50</b>
Pack belt & straps	Alice pack belt	1	Local Army surplus store	\$10.00
Pack belt & straps	2" webbing	4'	Hancock Fabric	\$13.96
Pack belt & straps	1" webbing	5'	Hancock Fabric	\$12.95
Pack belt & straps	Buckles	2	Hancock Fabric	\$3.98
Pack belt & straps	1" elastic	1'	Hancock Fabric	\$1.99

<sup>15</sup> Cost is total cost for the quantity used, but does not include tax or shipping.

Pack belt & straps	Washcloth	5	Dollar Store	\$8.75
Pack belt & straps	Foam rubber	1' sq.	My workshop	\$0.00
Pack belt & straps	Duct tape (black)	~	My workshop	\$0.00
Pack belt & straps	Thread	~	My workshop	\$0.00
<b>Sub-total:</b>				<b>\$51.63<sup>16</sup></b>
Battery	12v Deep cycle lead-acid battery	1	Auto Supply	Varies
Battery	NiMH Battery pack (used)	1	Local carpenter	Free
Recondition Battery	Baking Soda - large	1	Local supermarket	\$2.12
Recondition Battery	Epsom Salt	1	Local supermarket	\$2.86
<b>Sub-total:</b>				<b>\$4.98</b>

<sup>16</sup> A large part of the reason that this price is so high is that we bought just about everything for it, mostly at the local fabric store. If you were to use straps off of an old day pack you had sitting around, a sturdy belt you had in the closet and some scrap fabric (to cover the foam pads), perhaps from an old work shirt, you could eliminate most of this cost. You could also save by buying buckles and webbing on eBay.

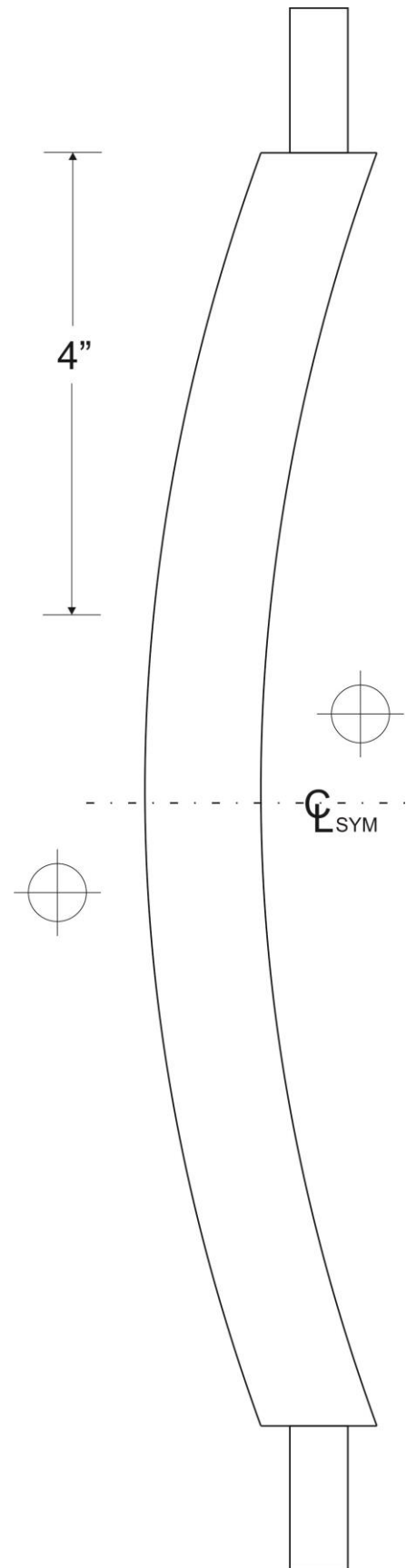
# WOOD BACKPACK FRAME - PATTERN FOR CROSSBARS

Print the next page and check the 4" dimension shown, to verify that the pattern printed the correct size. Cut out the two pieces of the pattern below, leaving the bulls-eye symbols attached. You can use those to align the two pieces of the pattern, placing one on a window and overlapping it with the other. The light coming through the window should allow you to see the bulls-eyes on the bottom piece of paper. Tape together with the bulls-eyes aligned.

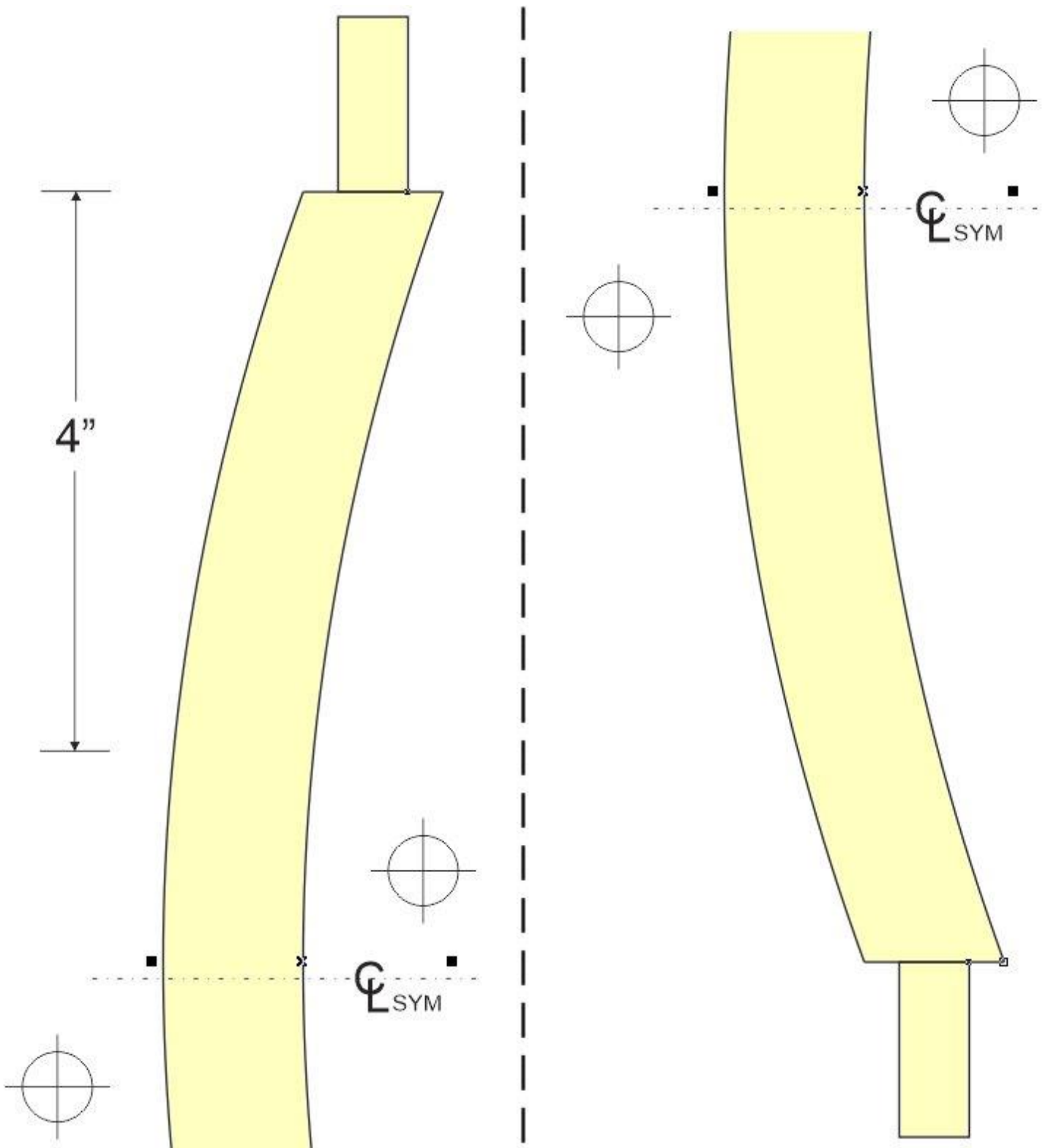
The diagram to the right shows how your pattern should look, once fully assembled. Trace this onto your wood for cutting and then cut the profile of the cross brace to use as the pattern for the pieces.

You will need two of these pieces, cut the same, as mentioned in the text. Cut them out of 3/4" thick hardwood; I mentioned poplar in the text as the wood which I chose.

The "CL" symbol on the diagram refers to that line as the centerline of the pattern. The letters "SYM" after it refer to the fact that the pattern is symmetrical across that centerline.

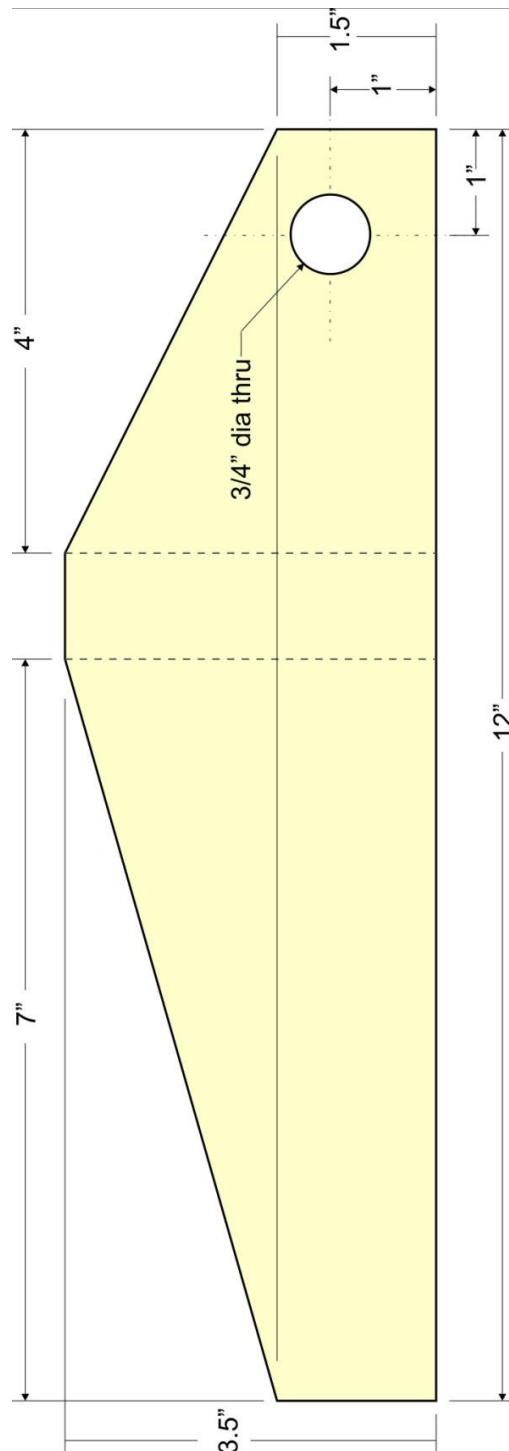






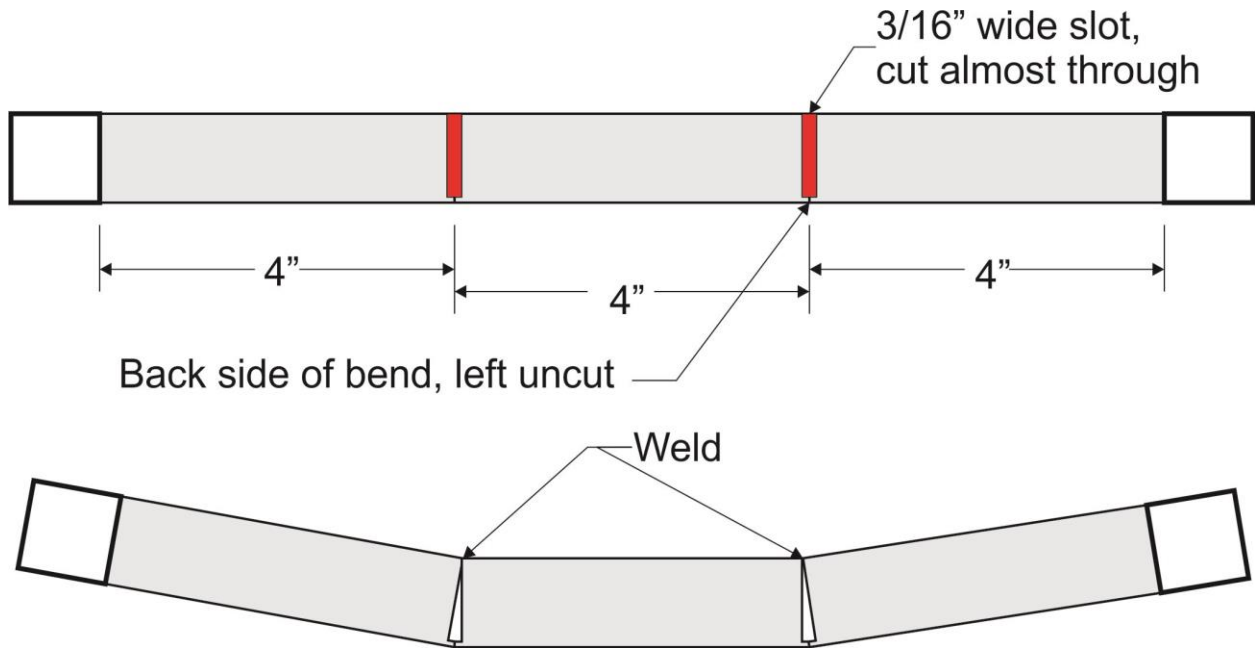
# WOOD BACKPACK FRAME - SHELF BRACKET

This bracket is cut out of a 1/2" thick poplar board, 4" nominal width (3-1/2" actual width). Two are required. Draw in the two lines that are dashed on the drawing, to use as reference when attaching the brackets to the frame.

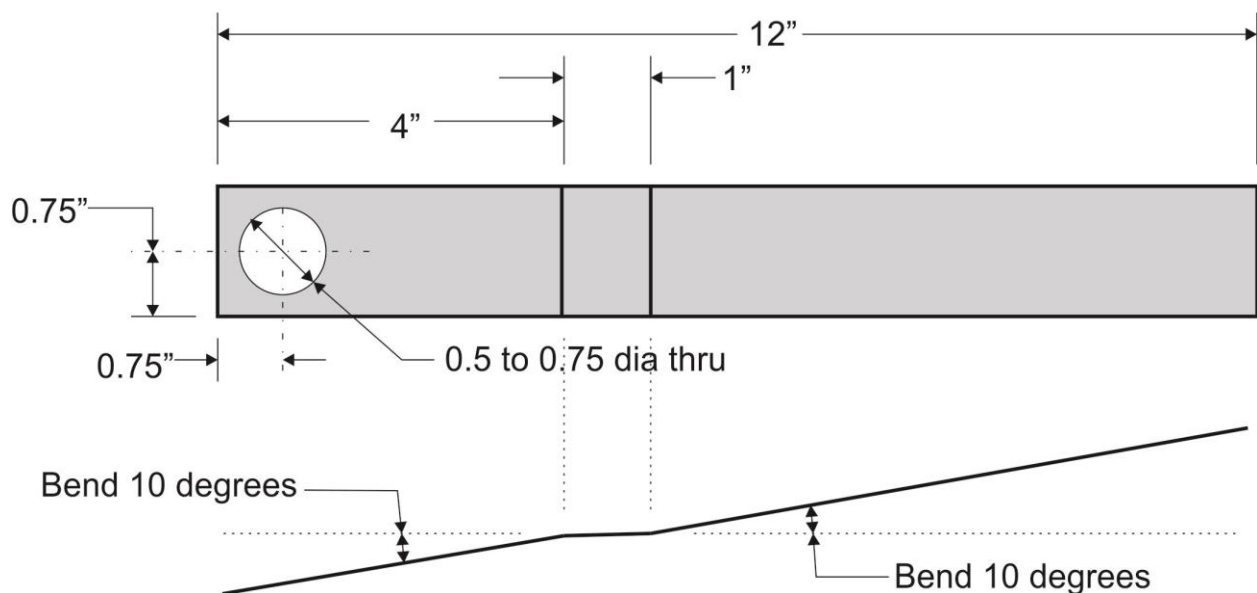


# METAL BACKPACK FRAME

The crossbars are cut almost all the way through, for bending. The bend isn't completed until after the crossbars are welded to the vertical members.

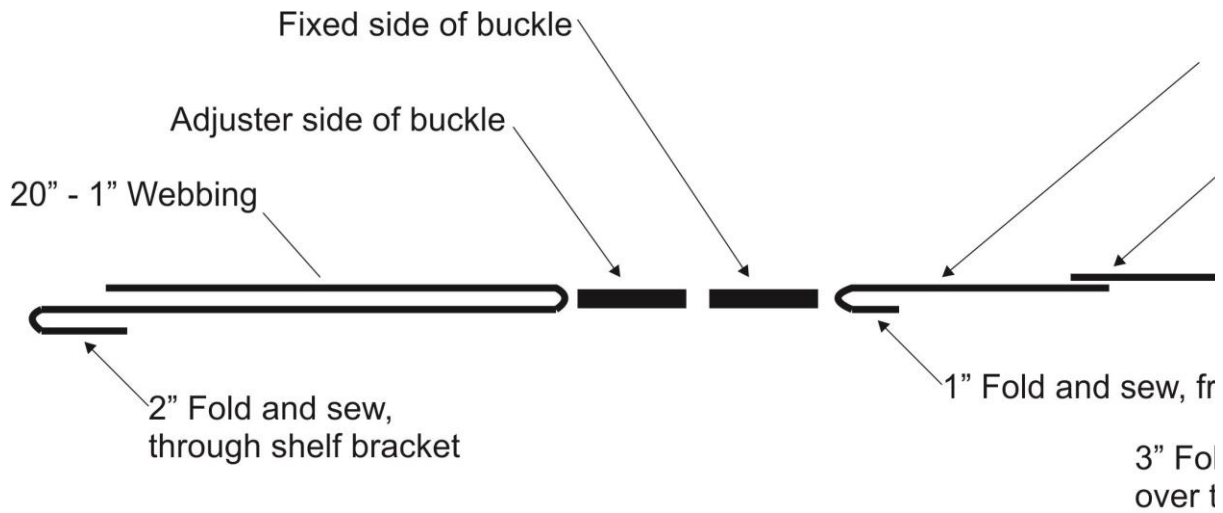


The shelf brackets on the metal backpack frame need to be bent, to make up for the vertical members being at an angle.





# SHOULDER STRAPS & BELT



## PARTS LIST FOR ADVANCED UNIT

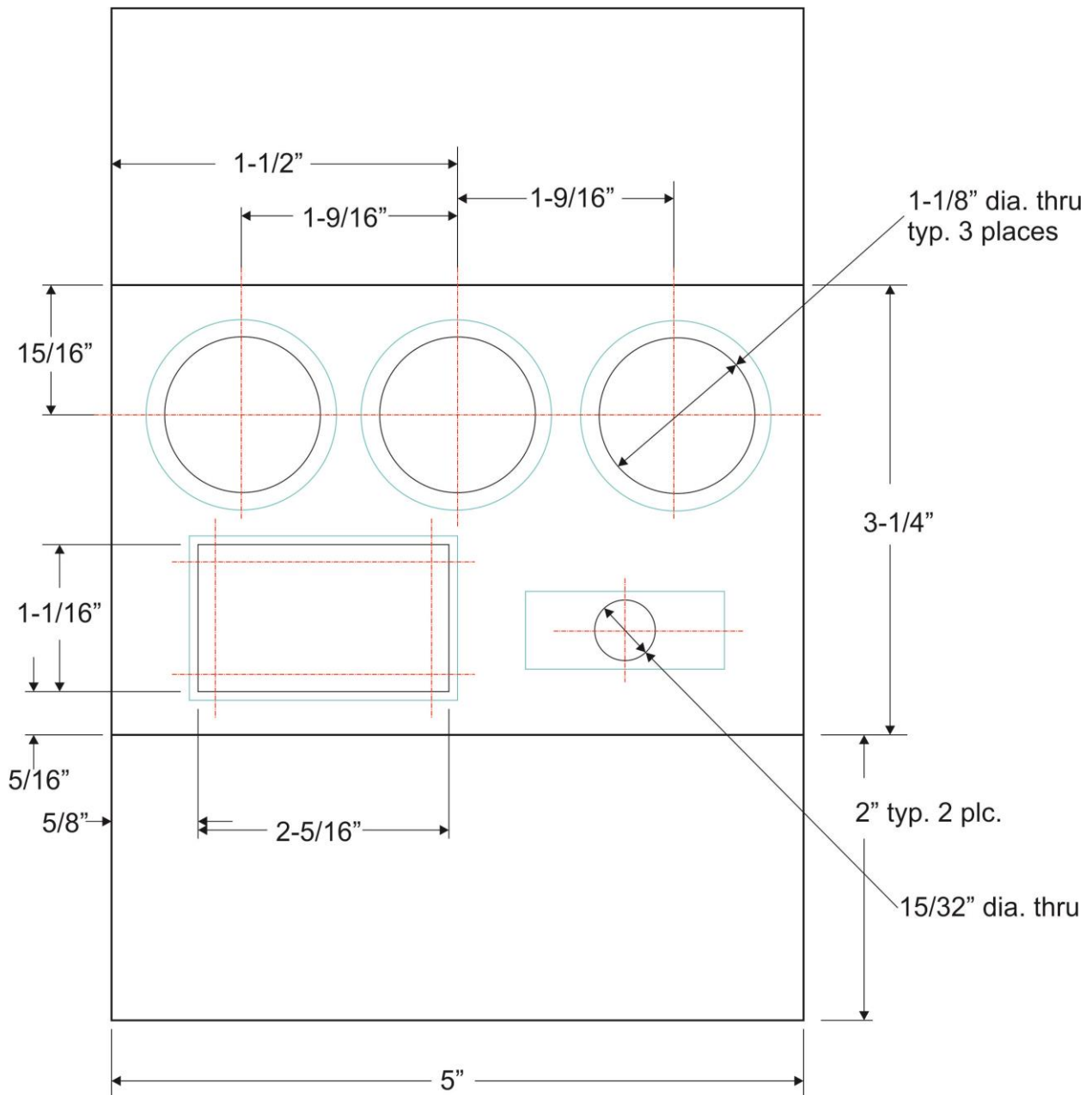
Used For	Part Description	Qty	Source	Cost <sup>17</sup>
Connection Panel	5" x 8-1/4" Plexiglas	1	Scrap from your solar panels	\$0.00
Connection Panel	Automotive 12V cigarette lighter/accessory connector	2	eBay seller - sunnyshop06	\$5.98
Connection Panel	Dual USB 5V automotive adapter/charger	1	eBay seller - jimshop268	\$13.60
Connection Panel	Digital Volt Meter - p/n 6BX4793	1	Newark Electronics (newark.com)	\$23.23
Connection Panel	Wire & crimp connectors	~	My workshop	\$0.00
Connection Panel	Pop rivets	4	My workshop	\$0.00
<b>Sub-total:</b>				<b>\$42.81</b>

<sup>17</sup> Cost is total cost for the quantity used, but does not include tax or shipping.

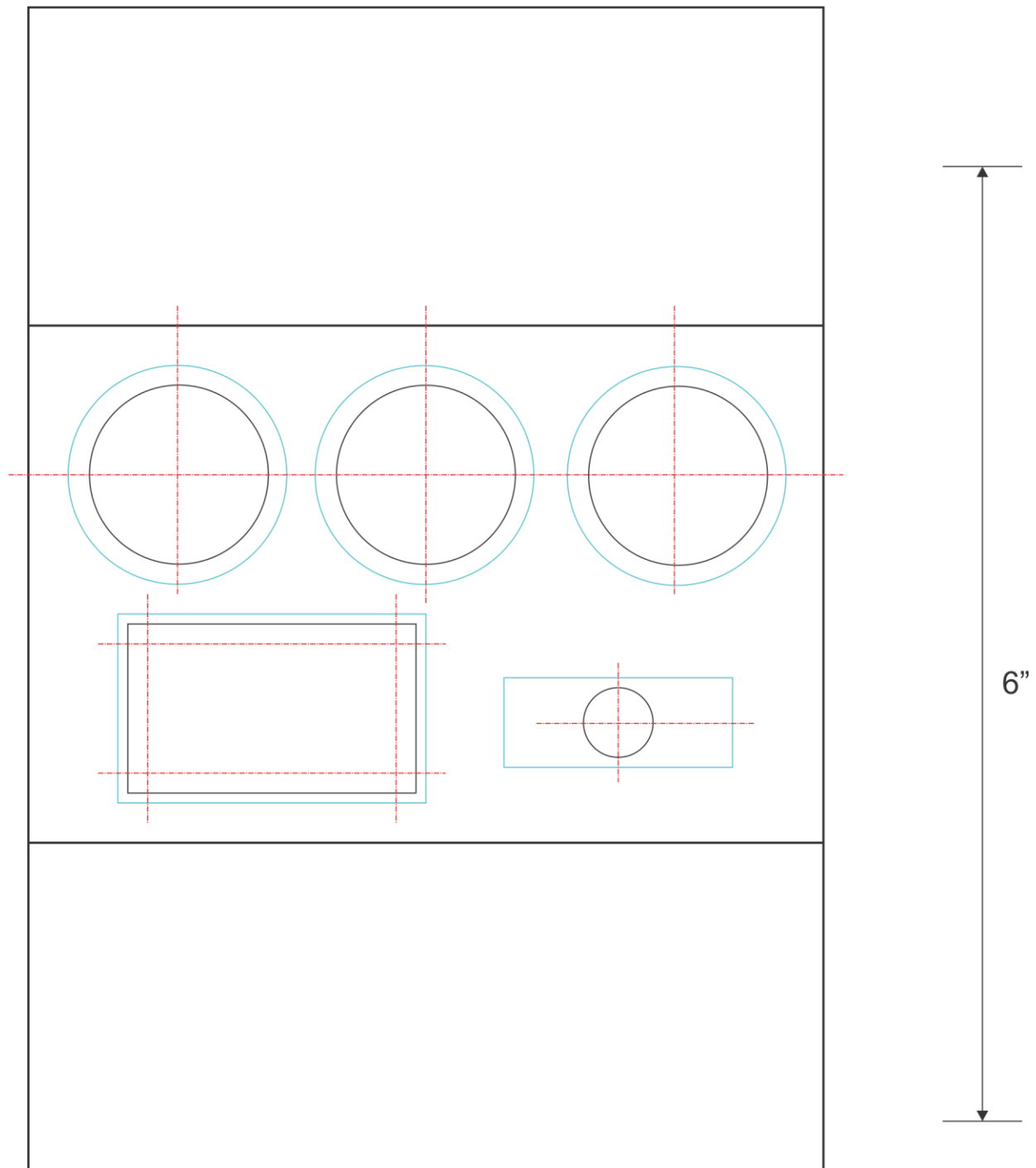
EMP Shielding	5052 H32 Aluminum Sheet, 24" x 36" x 0.02" thick	1	www.OnlineMetals.com	\$10.33
EMP Shielding	Piano Hinge - item #030699151745	1	Home Depot	\$7.47
EMP Shielding	3/16" Pop rivets - item #045731124038	Pk	Home Depot	\$5.98
<b>Sub-total:</b>				<b>\$23.78</b>

# CONNECTION & CONTROL PANEL

This panel is made from scrap Plexiglas. Please note that you may need to adjust the dimensions to match the actual parts you use and how much space you have on your control panel. These dimensions are all based upon the parts I used in this book, but other parts might require different dimensions.





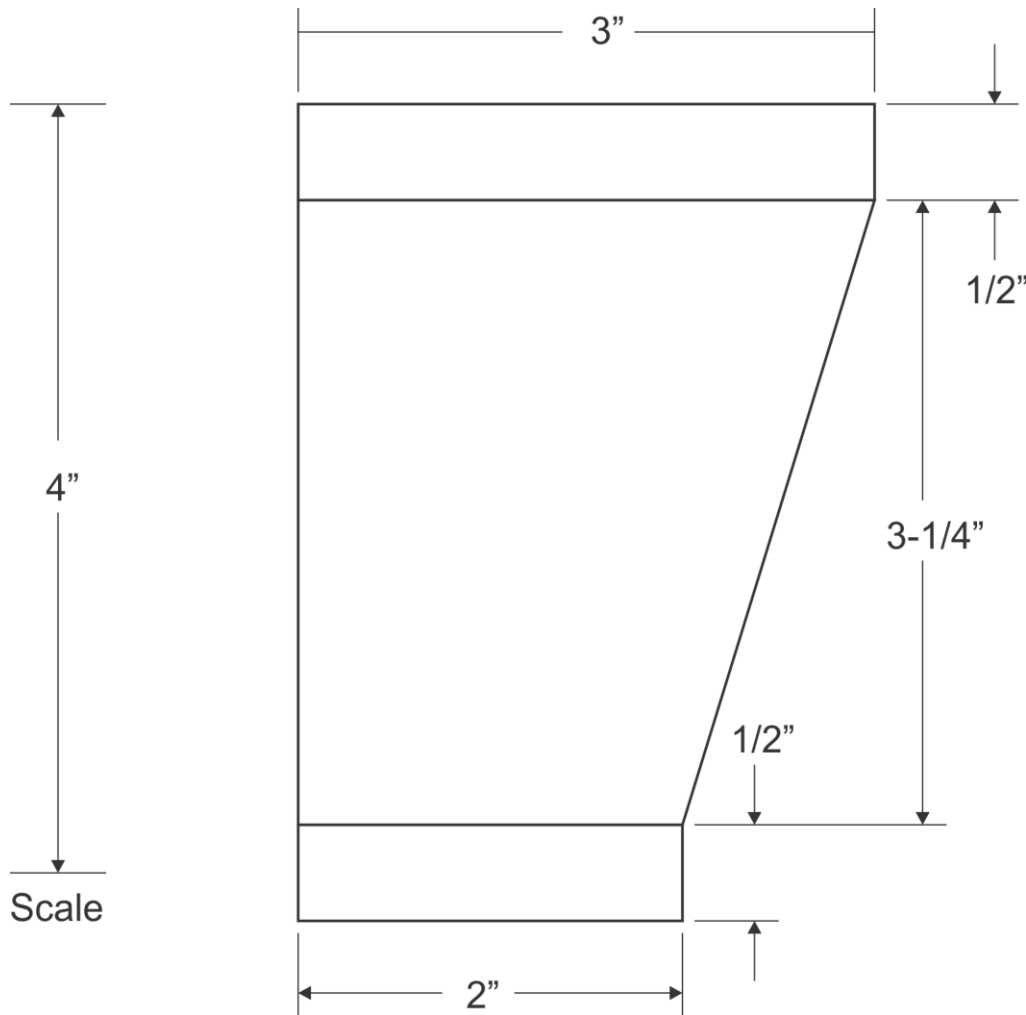


Notes:

- Blue lines are outlines of the parts, for reference only
- Red lines are there to mark where the center point is for drilling. I recommend using a center punch to mark these locations and then drill
- If you have enough material, you're better off making the flanges of the C larger. That way, they will help protect from accidental shock

# CONNECTION & CONTROL PANEL SIDES

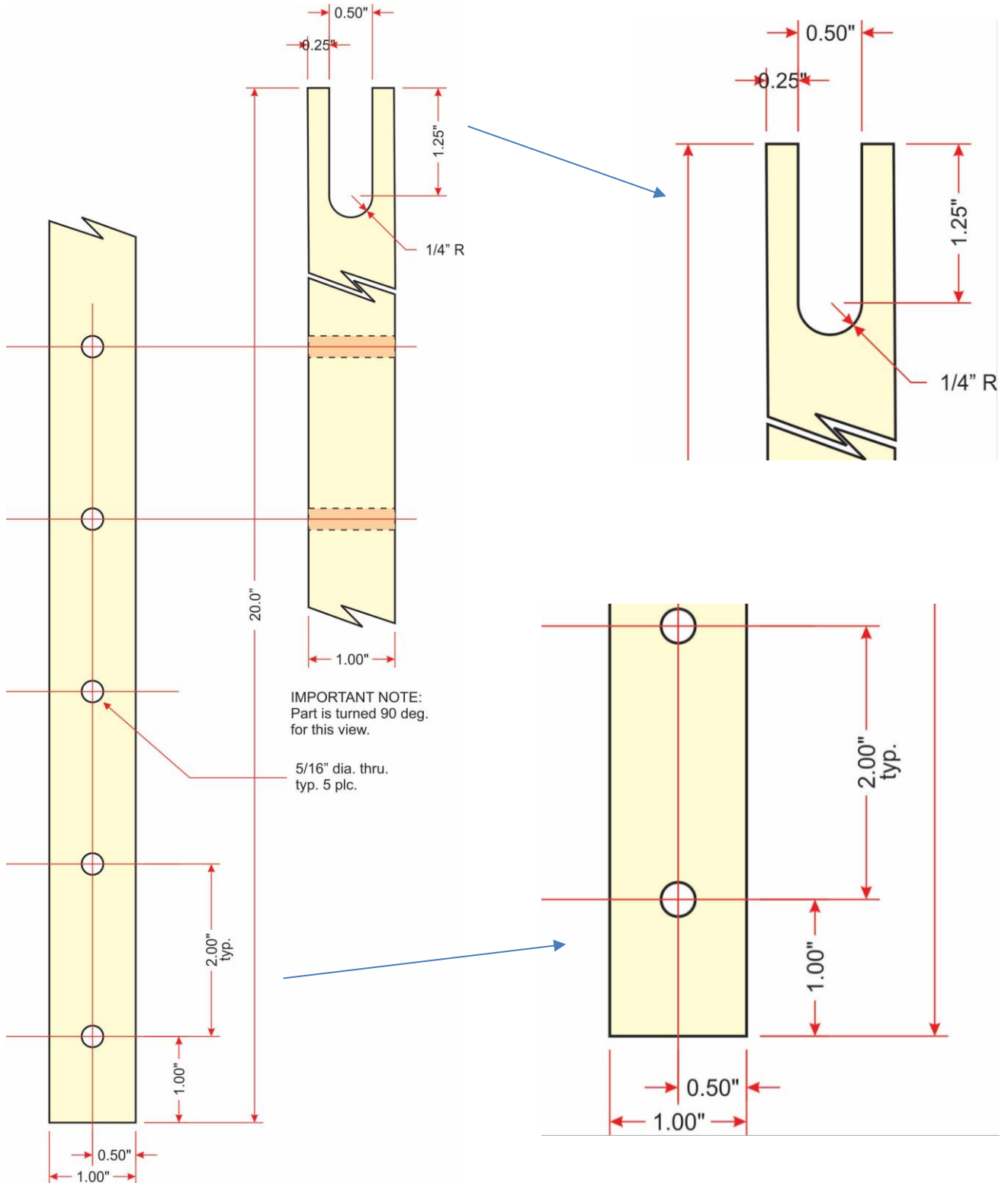
This is not a requirement, but I've added it to my backpack power unit to add strength to the connection & control panel and prevent any accidental shocks from fingers getting into the connections.



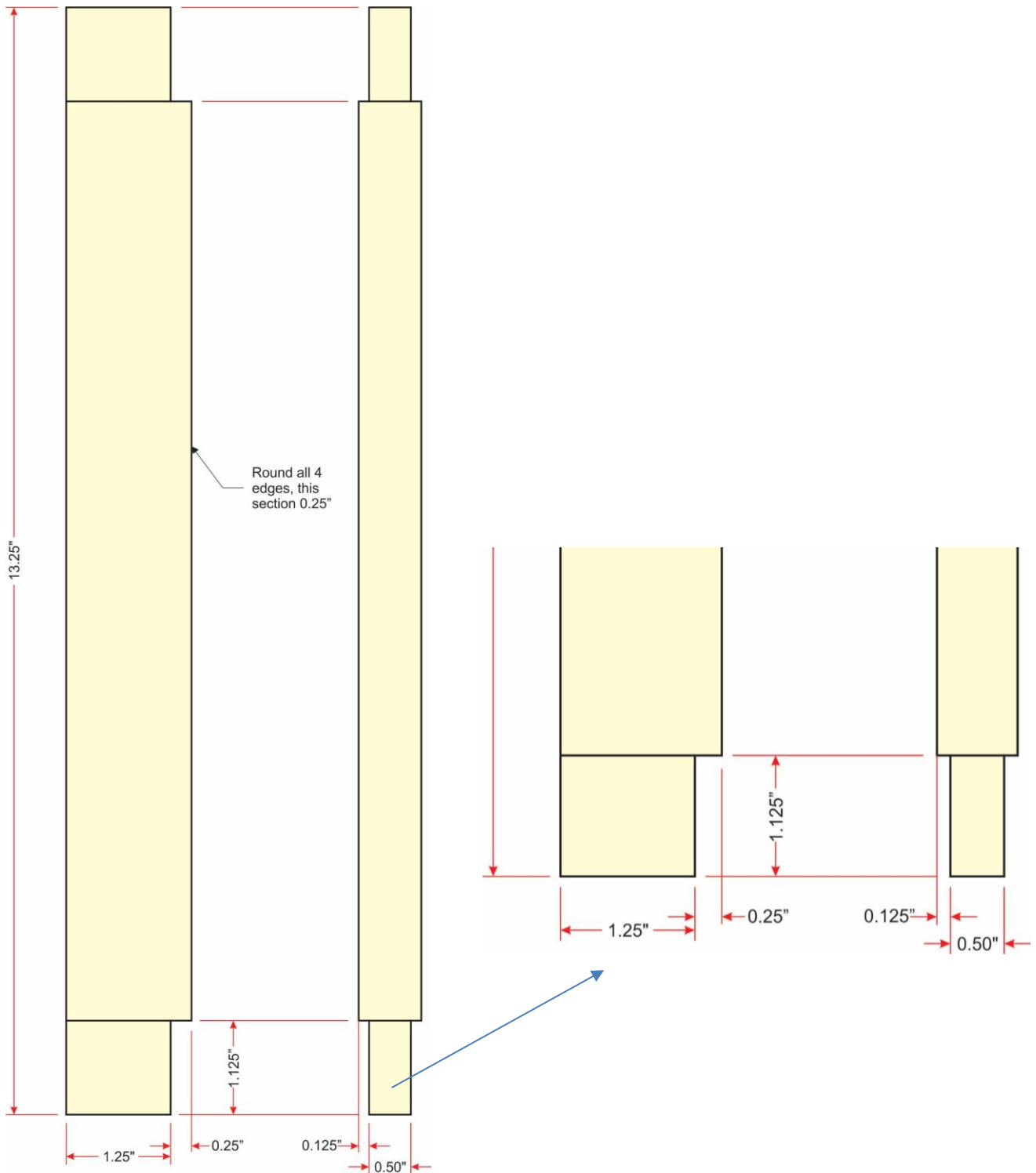
Please note that you need one of these with the tabs at the top and bottom bent up (towards you) and the other with the tabs bend down (away from you), so that they can go on the two ends of the connection and control panel.

You may need to adjust the dimensions, depending on the dimensions of your connector and control panel.

# HANDLE UPRIGHTS FOR USE WITH WHEELS - WOOD BACKPACK FRAME



# HANDLE CROSSBAR FOR USE WITH WHEELS - WOOD BACKPACK FRAME



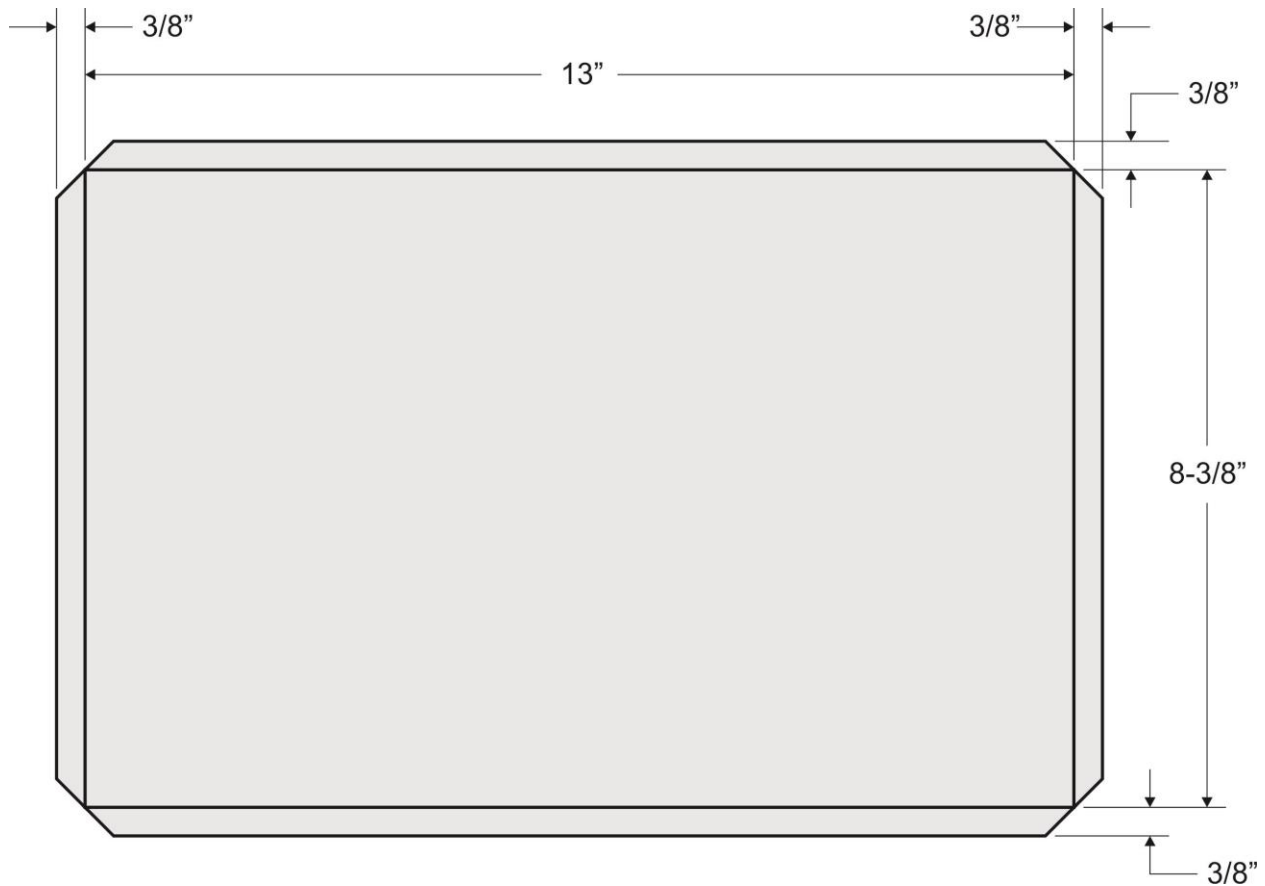
## Notes for Handle for use with Wheels - Wood Backpack Frame

- Two uprights are required, but only one crossbar.
- Uprights are made of 1" square hardwood dowel.
- Crossbar is made of 1"x 2" select pine. You can use a lower grade of pine, but will need to cut a section without knotholes. If you leave the knotholes in, it will be harder on the hands of whoever is pulling the unit.
- The string of five holes in the upright are for mounting it to the wood backpack frame. This allows three different height adjustments. The holes are intentionally oversize at 5/16" for the 1/4" thumb screws being used to attach the two together.
- Relieve the edges of the mounting holes slightly with a countersink to avoid chipping of the wood.
- When you install the threaded inserts into the wood frame, make sure you put them flush or below flush with the surface of the wood. Level the edge of the hole with a chisel, as it will rise slightly from the rest of the surface.
- **IMPORTANT NOTE:** When looking at the drawing for the uprights, the section on the right is at 90 degrees to the section on the left. This will make the mortise visible from two opposite sides, where the mounting holes are not visible. You shouldn't be able to see the mounting holes and the mortises on the same sides of the pieces.
- Centering of the 1/2" holes in the uprights for the mortises is fairly critical, as it will affect the positioning of the mortise.
- Cut with care, when cutting the mortises and tenons. Your cuts need to be straight, so that they will align properly and you'll have good gluing surfaces. But if you are off a bit, make sure they fit anyway. The dowel pin will hold the parts together, even if you have gaps. Fill the gaps with wood putty and nobody will be the wiser.



# EMP SHIELDING - BACK

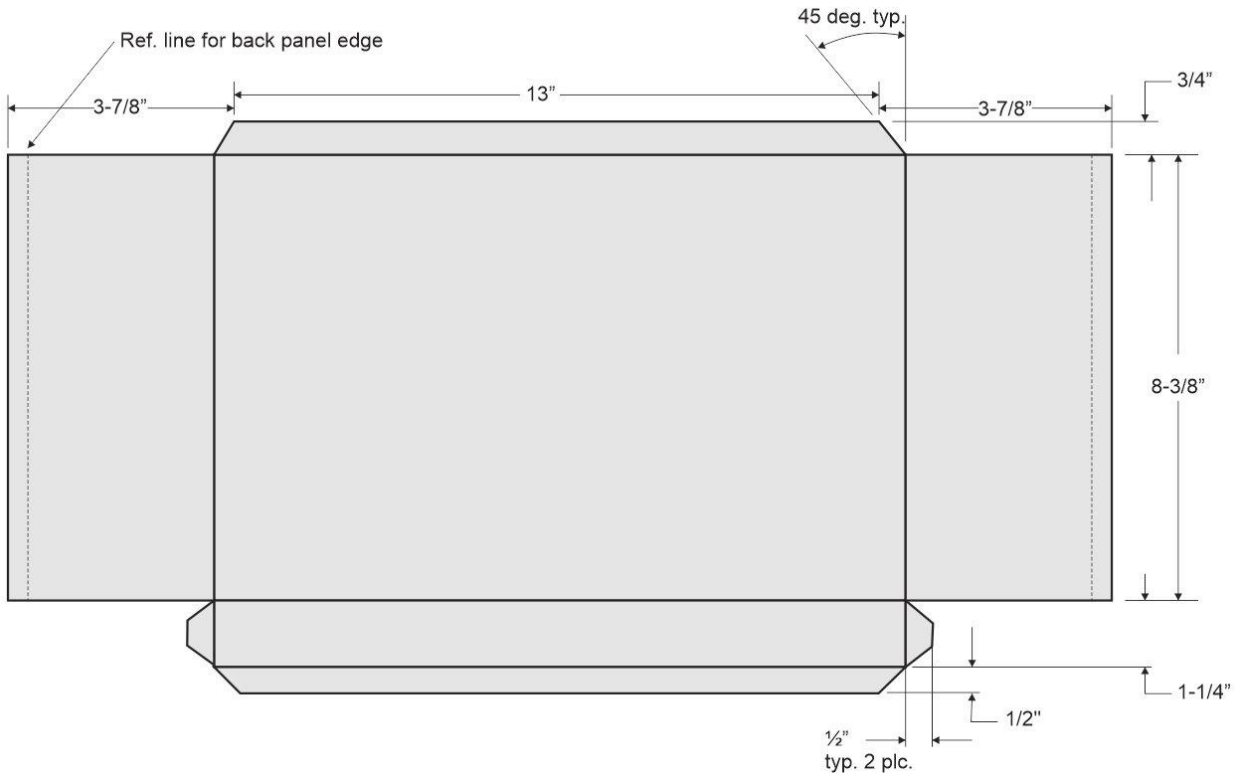
This part is made out of 24 gauge aluminum sheeting. The only lines to be cut are the exterior. The rest of the lines are bend lines.



Please note that the dimensions are taken from the backing board on my backpack power unit. If your backing board is larger, you'll need to adjust the dimensions accordingly. Likewise, if it is thicker, you'll need to increase the size of the flanges from 3/8" to match your backing board's thickness.

# EMP SHIELDING - FRONT

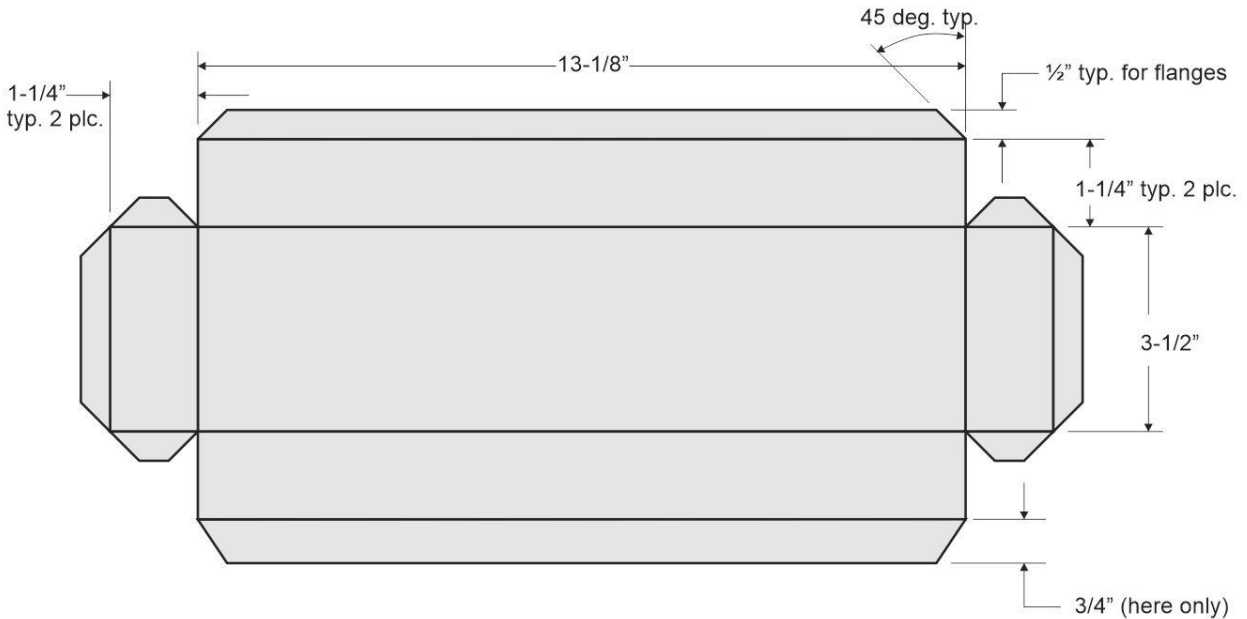
This part is made out of 24 gauge aluminum sheeting. The only lines to be cut are the exterior. The rest of the lines are bend lines.



Please note that the 13" and 8-3/8" dimensions are based on the size of my backing board. If your backing board is larger, you'll need to adjust these dimensions accordingly. The 3-7/8" dimension (2 places) is based upon the height of the connection panel and the thickness of the backing board. If your connection panel is more than 3-1/4" high or your backing board is more than 3/8" thick, you'll need to adjust these dimensions.

# EMP SHIELDING - LID

This part is made out of 24 gauge aluminum sheeting. The only lines to be cut are the exterior. The rest of the lines are bend lines.

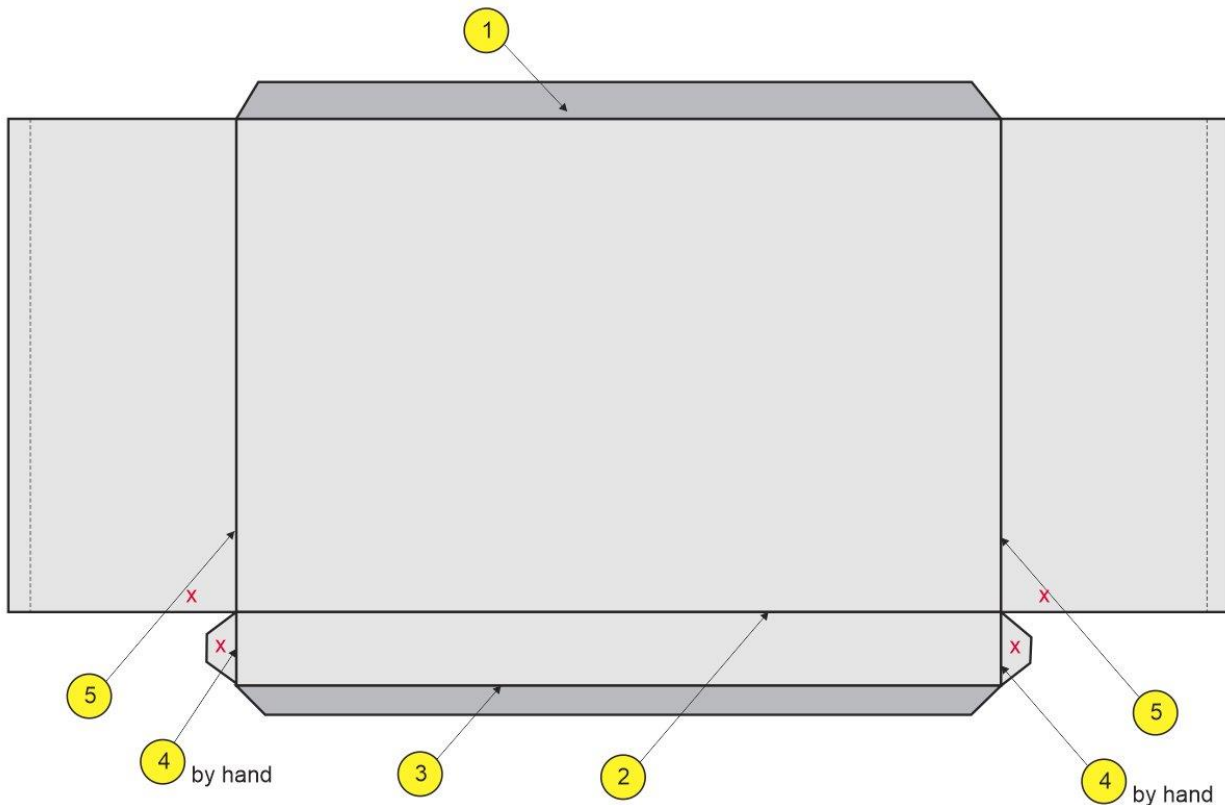


Please note that the  $13\text{-}1/8"$  dimension is based upon the width of the backing board. If your backing board is wider, you'll need to adjust this dimension. It is purposely wider than the front part of the EMP shielding, so that it will overlap it slightly on both sides.

# EMP SHIELDING - BENDING ORDER

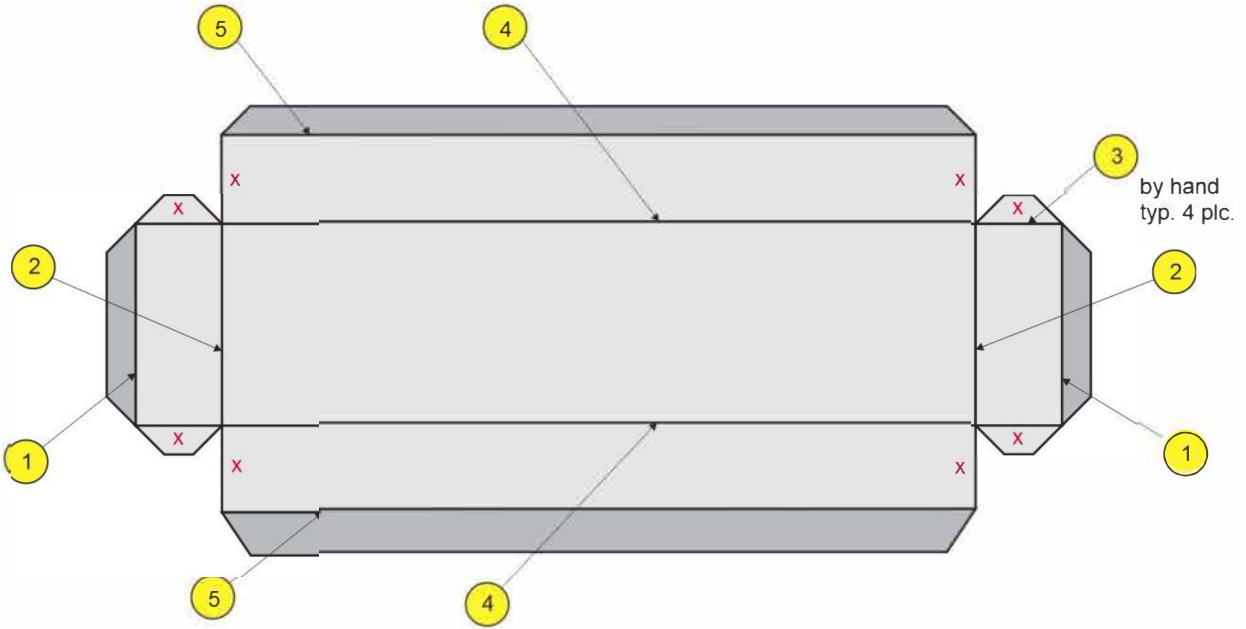
The diagrams below show the order in which the bends should be made in the front and lid of the EMP shielding, so that one bend doesn't get in the way of the next. The darker shaded areas are to be bent 180 degrees, forming stiffeners for the parts. All the rest of the lines are to be bent 90 degrees.

Front



Note: The red **X**s on these drawings are to indicate the hole locations for the rivets to attach the pieces together, once bending is complete.

# Lid





# TABLE OF WEIGHTS

I've shown you various configurations of the Backpack Electricity system in this book. One question that might be floating around in the back of your mind is "How much does this all weigh?" That's a good question. Let's take a look at the weight of the various components and options.

Configuration	Weight
Basic unit - without backpack <sup>11</sup>	6 lbs. 3 oz.
Unit on wood backpack frame - with original battery	13 lbs. 11 oz.
Unit on metal frame - with original battery	15 lbs. 12 oz.
Unit on wood backpack frame - with car battery	44 lbs. 2 oz.
Unit on wood backpack frame - with Li-Ion batteries	11 lbs. 4 oz.
Unit on wood frame - with original battery, EMP shield and rain cover	19 lbs. 15 oz.
Full-sized solar panel	10 lbs. 2 oz.
Folding solar panel	14 lbs. 3 oz.

Here are the weights of individual components, if you need to adjust the above weights in any way.

Item	Weight
Wood backpack frame	3 lbs. 7 oz.
Metal backpack frame	5 lbs. 8 oz.
Backing board with connection panel	2 lbs. 2 oz.
Solar charge controller	5 oz.
Voltage inverter	1 lb. 12 oz.
Belt & straps	1 lb. 2 oz.
EMP shield	13 oz.
Rain cover - with support	9 oz.
Small battery	4 lbs. 9 oz.
Car battery	35 lbs.
Li-Ion battery packs (3)	2 lb. 2.4 oz.

<sup>11</sup> Backpacks themselves vary extensively in weight. Therefore, I've left that weight out.