How to build a Solar Oven out of scraped materials.

Fig. 1. The solar oven. Front left: The outer box. Front right: The inner box. Behind: The window.

By: Steen Carlsen M.Sc. E.E.
Regenburgsgade 11
8000 Aarhus C.
Denmark
E-mail carlsen@power-electronics.dk
Mobile +45 23-63 69 68

Contents.

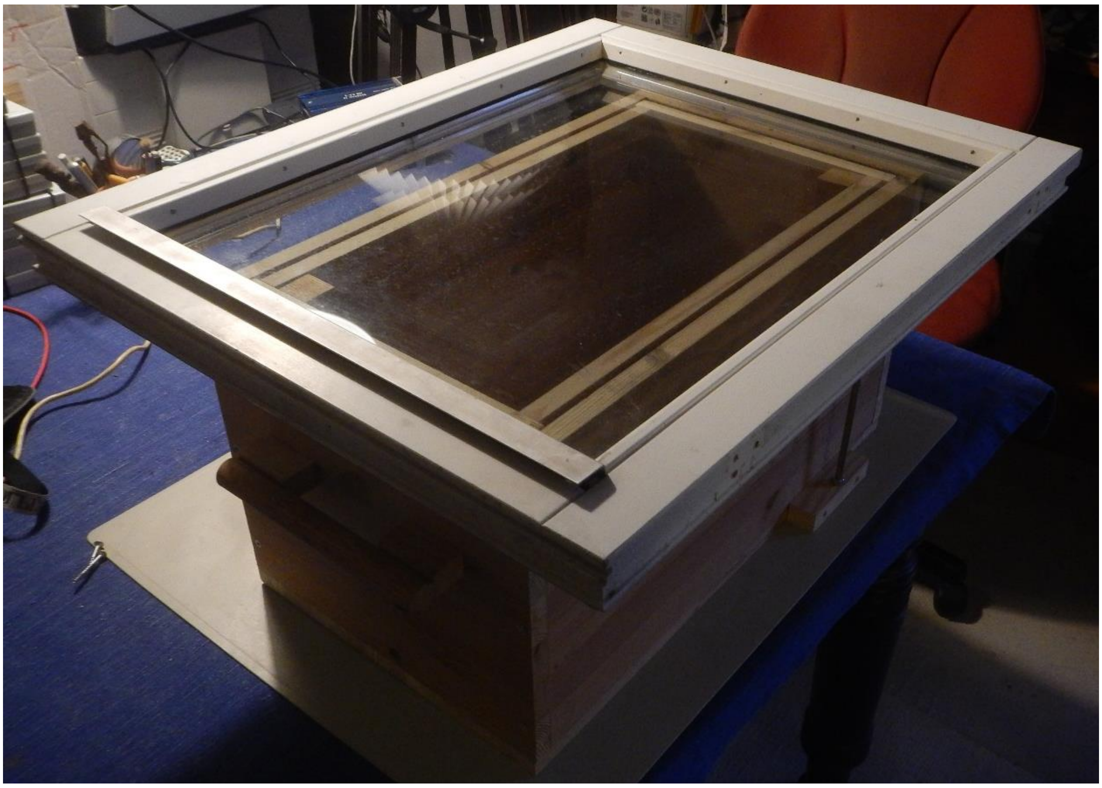

Fig. 2. The solar oven with the window on top.

How to build a Solar Oven out of scraped materials.

1. Introduction. In 2022 I built the first prototype of a solar oven. Now, in 2024, I have built a mark II solar oven. This is a brief guide-line on how to build a solar oven - based on my experiences with building a homemade solar ovens, at the lowest possible cost, with simple tools and using scraped materials.
It is aimed to reduce the need for fire wood and other fuels in refugee camps.

2. Solar ovens can be used:
1. To produce pasteurized drinking water.
2. To cook: A. Either by using the sun to heat the food (which eliminates the need for fuel)
– or B. By using fuel to heat the food (and some water), and then place the food (and the hot water) in the solar oven (using it as a hay box), where the oven will keep warm for long and to finish the cooking without the need for any further fuel.
3. To pasteurize milk.

3. Various designs of solar ovens. Solar ovens exist in many shapes and versions. Some are based on high technology concepts (e.g. parabolas). I have focused on two simple versions A and B (see Fig. 3) – both based on low technology and suitable for refugee camps. Both versions are made from a second hand window and two wooden boxes. The boxes are upward open and the window is placed as a lit on top of the boxes.

Generally, it is easier
A. To find a second hand window, which is bigger than the top of the solar oven – than
B. To find a window of a specific length and width.

The version A where the window extends beyond the outer box is shown at the top of Fig. 3.
The version B where the boxes are made to fit tightly around the windows frame is shown at the bottom of Fig 3.
Version B is lighter but requires higher accuracy in the manufacturing of the boxes, compared to version A.

The drawings are not drawn to scale.

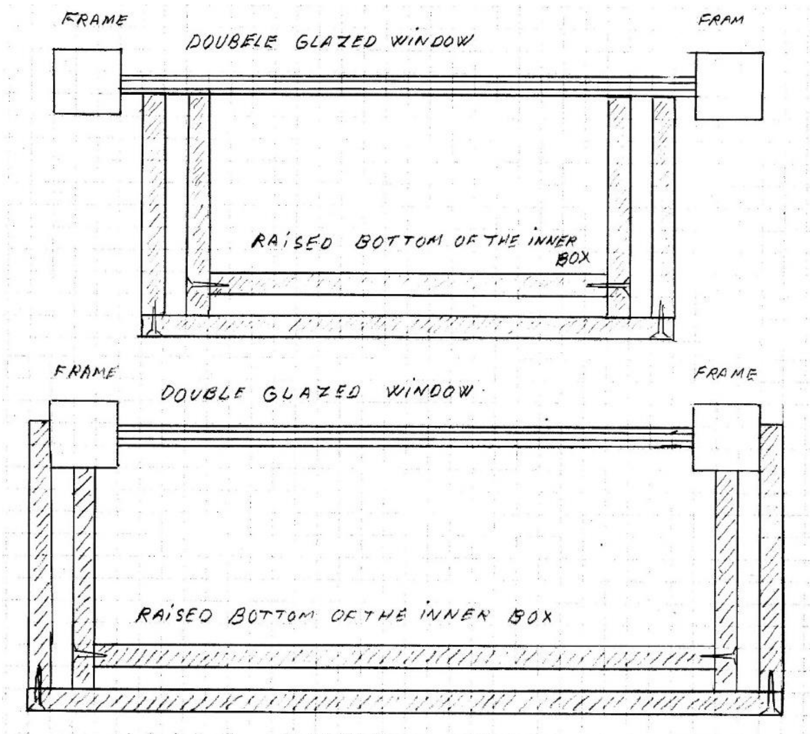

Fig. 3 shows the two versions of solar ovens. The top one – version A; The window extends beyond the boxes. The bottom one – version B – comprises the window frame within the boxes.

Steen Carlsen MSc. E.E. Regenburgsgade 11, 8000 Aarhus C. Denmark. Mail: carlsen@power-electronics.dk, Mobile: +45-23 63 69 68

Fig. 4 shows the A version of the solar oven, where the window overhangs the sides of the outer box.

Both the A and the B versions consists of - at least - two components:

1. A window (or a pane), though which the sun shines into –

2. A box, in which the food or the liquid to be heated, is placed.

If you wish for your oven to reach a high temperature, and to keep warm for a long time, you will need two boxes – an inner box and an outer box.

This guide-line describes how to build an oven with: 1. A Window. 2. An inner box – and 3. An outer box.

Apart from a few exceptions an adequate space between the inner and the outer box is roughly 5 - 10 mm.

We all make mistakes. When you are short of money and materials, you need to improvise and use the materials available. Hence, start your project by making drawings and plan the work. That can save you from wasting time and materials.

When I made my first solar oven, I made the mistake to use chip-board for the boxes. Both chip-board and ply-wood contains formaldehyde, which is toxic. On top of that, chip-board is susceptible to humidity, which is generated by cooking. More-over, chip-board has a shorter lifetime and it is both weaker and heavier than solid wood. Hence, avoid to use both chip-board and ply-wood for the oven.

4. The window. The window will most likely be the most difficult component to find. I have seen a solar oven, which was made out of a window with only one layer of glass, but if you can get hold of a double-glazed window – and preferably a sealed unit - I will strongly recommend, that you go a long way to get it.

Generally, it is easier
A. To find a second hand window that is bigger than the top of the oven – than
B. To find a window of a specific length and width.

For most people it is difficult to cut glass. Thus, try to find a second hand double glazed window of a size bigger than- or equal to- the size of the oven. When you have found a suitable window, adjust the size of the boxes to the window you found. A sealed unit is better than a simple double-glazed window, which is very much better than a single layer window.

Steen Carlsen MSc. E.E. Regenburgsgade 11, 8000 Aarhus C. Denmark. Mail: carlsen@power-electronics.dk, Mobile: +45-23 63 69 68

Fig. 5 shows the corner of a double glazed sealed window.

For the first solar oven, which I built, I cut the glass myself. But it was very difficult. Thus, I recommend you to try to find a manufactured window with a sealed unit.

Not only can it be difficult to find the type of window, which you wish. It will probably be very difficult to find a window with a frame of just the height and just the width, you wish for. An attractive solution will often be a solar oven, which allows the window frame to be bigger that the outer box. Thus, if you cannot find the size you want, look for a window with a frame that is bigger than the footprint of the outer box. (See the top of Fig. 3.)

If the size of the wood you have found allows it, try to build the outer box in a size so that the length (and perhaps also the width) of the outer box has a clearance of ca. 2 mm inside the window frame. (See the left side of Fig. 5). In that way the outer box helps to keep the window frame in place relative to the oven.

Try to make the top edges of both the outer and the inner box to the same height, so that the glass of the window will rest on the top edges of both the outer- and the inner box. That will give you a fairly air proof separation between the inner- and the outer boxes, and it will contribute to a low heat loss from the solar oven.

Mind the weight of the solar oven. The lighter the oven is, the faster will it heat up. Thus, do not make it any heavier than required. A solar oven has to be adjusted to the sun regularly, which is another reason why it should not be too heavy. Look for solid wooden boards or plates with a thickness of aprox.10-15 mm.

Steen Carlsen MSc. E.E. Regenburgsgade 11, 8000 Aarhus C. Denmark. Mail: carlsen@power-electronics.dk, Mobile: +45-23 63 69 68

5. Three ways, by which the oven might lose heat.
There are three ways, in which the oven might lose heat.
1. Conduction, where heat passes from one part of the oven to another, because the two parts touches each other.
2. Convection, where moving air along a part of the oven transports the heat and renders that heat to the surroundings of the oven.
3. Radiation, where the heat is transported in the form of "light" radiated from the oven.
This is why the colour of the different parts of the solar oven is important.

5.1. The heat lost by conduction occurs, where one part of the inner box – either directly - or indirectly through a third part - touches a second part of the outer box. The conduction losses are minimized by minimizing the areas of the parts of the two boxes, which are in physical contact with each other.

5.1.1. One of the physical contacts between the inner and the outer box is the area of the heads of the four screws in the bottom of the inner box. In this case the diameter of the head of the screws is 5 mm. Hence, the area of the foot print of the four screws is $4 \times (5 \text{ mm} / 2)^2 \times \pi = 79 \text{ mm}^2$.

5.1.2. Another conduction loss is the connection from the upper rim of the vertical sides of the inner box - through the window glass – to the upper rim of the vertical sides of the outer box.

5.1.3. A third – potential – conduction loss is the risk of the end plates of the inner box to touch the inner sides of the outer box. If this becomes a problem, you might cut a little of the width of the end plates of the inner box.

5.2. The heat lost by convection is reduced by the space between the inner side of the outer box and the outer side of the inner box. The measurements made at the first solar oven indicated that a distance of 5 – 10 mm between the inner- and the outer box provides a good insulation. For this oven I have chosen a space of 7 mm.

To further restrict the flow of the air in the space between the inner and the outer box, the horizontal width of the two end-plates of the inner box have been extended so that there are only gabs of ca. 1 mm left between the vertical ends of the end plates – and the inner sides of the outer box – see fig. 6. These gabs of 1 mm increase the resistance of air movements by approx. 18 times compared to an air gaps of 7 mm. In addition, they contribute to centre the inner box within the outer box.

Fig. 6. Showing the space between the inner- and he outer boxes. Also shown is how the extended width of the two end-pates of the inner box forms the five - almost separate - sections between the inner– and the outer boxes.

5.2.1. The raised bottom of the inner box. The movement of the air within the space between the two boxes is also inhibited by raising the bottom of the inner box (10 mm), so that - apart from the height of the screws - an almost airtight hollow room is formed between the top side of the bottom of outer box and the lower side of the (raised) bottom of the inner box. This minimizes the movement of the air between the boxes - and thereby contributes to raise the temperature in the oven. (The extended end-plates are not shown at figure 7.)

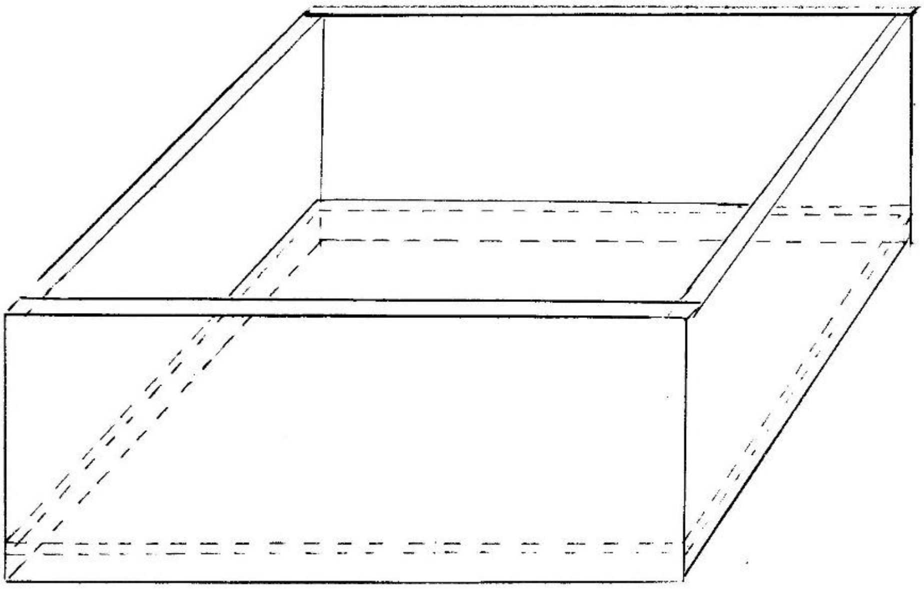

Fig. 7. The raised / elevated bottom in the inner box, shown by the dotted lines.
(The extended end-plates are not shown at the drawing.)

5.2.2. The adjustment screws.
Fig. 8 shows the four small screws in the bottom of the inner box. They serve two purposes:

1. To allow adjustment of the height of the inner box –
2. To minimize the physical areas of the inner- and outer box, which are in physical contact.

When you build a solar oven, try to saw / cut in straight lines and be as accurate as possible. Try to make the upper rims of the all eight vertical sides (of the inner and outer boxes) to exact the same height, so that the glass at the bottom of the window will touch / rest on both the inner- and the outer rims of the boxes. Use the screws at the bottom of the inner box to compensate / trim the inaccuracies the best you can.

Fig. 8. The inner box viewed from the (raised / elevated) bottom, showing the four screws.

5.3. The power radiated (and lost) from the outside of the oven to the (colder) surroundings can be reduced by painting the outside surfaces of the oven (except for the window glass) - white or shinning.

In order to maximize the power absorbed by the pot inside the oven, the pot should be black.
To maximize the heat absorbed by of the bottom of the inner box – paint it black. If you can find a black metal plate (steel, aluminium or copper) to place on top of the bottom of the inner box, it will improve the heat transferred to the pot.

5.3.1. Using aluminium foil in the oven. If the window of the oven is not perpendicular to the direction towards the sun, a part of the sunrays will shine on the sides of the inner box (rather than on the food, the liquid and the bottom of the inner box). In order to get as much heat from the sun as possible, I suggest to cover the vertical sides of the inner box with an aluminium foil, which can act as a mirror and reflect the light, which would otherwise had been absorbed in the vertical sides of the inner box.

In the first solar oven I built, the sides (only the vertical sides - not the bottom) of the inner box were covered with aluminium foil. I used 10 µm = 0.01 mm aluminium foil, which can be bought in roles. Aluminium foil is cheap and commonly available in supermarkets in Europe. (I have, however, never looked for them – and hence never noticed them - in supermarkets in Uganda).

But I find the 10 µm (= 0.01 mm) foil too fragile. Yet, many products are - when they are sold - packed in more ridged aluminium trays made from 80 – 160 µm foil. I suggest to collect such 0.1 – 0.2 mm aluminium packaging, cut it into rectangles and fasten it to the vertical inner sides of the inner box. If you use small counter sunk screws to fasten the aluminium foil on solid wood, you might be able to tighten the screws so much, that the top of the screw heads will be pulled so far down that the top of their heads will be in level with the surrounding aluminium foil. Choose the shiniest side of the foil to face inward to the box. The aluminium foil will also ease the cleaning of the oven.

A thermos flask – or a vacuum flask - is designed to keep warm for a long time, by minimizing the heat it loses to the surroundings. This is done by having two bottles – one within one another. Both the interfacing surfaces of the bottles are reflective and function as two mirrors, which reflect the heat – thereby reducing the heat transferee.

To obtain the similar property / mirror for the solar oven, I recommend to cover:
1. The outer side of the inner box (including the underside of the bottom) - and
2. The inner side of the outer box (including the inside of the bottom) – with 0.05 to 0.2 mm aluminium foil – with the shiniest sides facing each other.

In this report all photos show the naked wood of the oven, *before* the aluminium foil is mounted. This is in order to show how the oven is assembled.

5.4. When using the solar oven as a hay box you want to keep / withhold the heat in the oven, for as long as possible. The best way to keep the high temperature in the oven for a long time is to cover the window with a sheet of blank aluminium foil (with the shiniest side facing away from the oven) - and to cover the aluminium foil with a coat, a quilt or a blanket.

Beware, that when the lit / window to the solar oven is opened; the heat of the oven quickly disappear and its temperature will drop to the temperature of the surroundings.

Steen Carlsen MSc. E.E. Regenburgsgade 11, 8000 Aarhus C. Denmark. Mail: carlsen@power-electronics.dk, Mobile: +45-23 63 69 68

6. Maintaining the distance between the inner side of the outer box and he outer side of the inner box.
The more the inner box will touch the outer box – the more heat will be lost to the surroundings – and the lower the temperature of the oven will be.

The extensions of the end plates of the inner box aim to avoid too much contact between the long sides of the two boxes.

To prevent the outside of the end-plates of the inner box from touching the inside of end plates of the outer box I have mounted two (brown) wooden strips (right-angled triangular mouldings) along the joints between the end-plates and the bottom of the inner box. See Fig. 9.

The strips are to keep the inner box centred in the middle of the outer box. The strips also help to keep the joints between the end-plates and the bottom of the inner box air-tight.

Fig. 9. One of the strips, which guide the inner box into position.

7. The adjustment of the oven to face the sun.
In order not to lose too much of the solar power, the direction of solar oven has to be adjusted to face the sun at least every second hour - best every hour!

I recommend the deviation from the direction of the sun to be less than 15° from perpendicular (which corresponds to ~4% loss of power).

If the path of the sun describes an arc of 180° over a day of 12 hours, and each adjustment of the position of the solar oven brings it (back) to an exact alignment, then 180°/15° = 12 daily adjustments, which are needed, to maintain the lost power to be less than 4%.

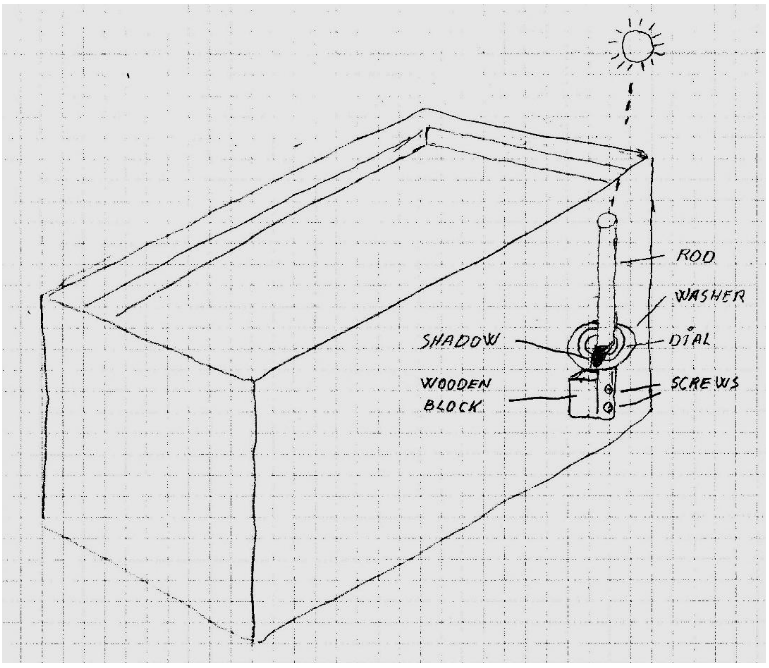

Fig. 10. A gadget to assist the inclination and the direction of the solar oven.

But - if (at each adjustment) - the oven's position will be shifted from 15° *behind* the trajectory of the sun - to 15° *ahead* of the sun, the same power loss can be obtained for only 6 daily adjustments.
This, however, requires a better understanding by the person, who is responsible for the alignments.

To ease the adjustments of the inclination and the direction to the sun, I suggest to mount a rod at the side of the oven as shown on fig. 10 and fig. 11.

The idea is to mount an approximately 20 cm long pipe, stick, nail or rod, which works as a sundial, where the shadow of the rod indicates the direction towards the sun. The rod is mounted in a distance of 2 – 3 cm from- and parallel to- the side of the outer box.

The top end of the rod should be flat and cut perpendicular to the axis of the rod. Neither the top or the bottom of the rod must extent above the top or below the bottom of the oven. Most important, the axis of the rod must be perpendicular to the top of the window.

When the oven is positioned / adjusted for maximum power, the length of the shadow from the rod will become zero. In other words, the shadow of the rod will merge with the rod itself and disappear. If a washer is placed at the bottom of the rod, the length of the shadow of the rod (at the washer) will, by the length of the shadow, show the degree of un-alignment - and in which direction the oven must be shifted to become aligned.

The rod, which I found, is 240 mm high. By a misalignment of 15^o *behind* the sun - to 15^o *ahead* of the sun – the horizontal length of the shadow of the rod will go from minus 62 mm - through zero - to plus 62 mm. (240 mm x cos 15^o = 62 mm.)

Fig.11. The rod to assist the inclination and the direction of the solar oven.

8. The handles. To ease the handling of the solar oven – and not least, the alignment of the oven relative to the sun – a handle in each end of the outer box is practical. The temperature of the oven can exceed 80 ^{o}C, thus, to prevent burns through the eight screws, which fasten the handles to the outer box – the screws are mounted from inside the outer box (see Fig 9). One of the two identical handles can be seen at Fig. 11. Each handle is made from a round timber 190 mm long and 20 mm thick and two wooden blocks seized 50 x 27 x 20 mm.

Make sure that the screws are long enough to go through the end-plate of the outer box, the wooden block - and to go *almost* all way through the round timber. Where the round timber touches the wooden blocks, use a file or a saw to flatten an approx. 8-10 mm brought line in the round timber, so that you increase the contact areas between the wooden blocks and the (now no longer) “round” timber. This flattening of the round timber strengthens the handles. Try to find counter sunk screws and make sure their heads are sunken into the wood at the inside of the end-panels of the outer box.

To ease lifting the oven with the window frame on top, the handles are placed approximate 100 mm below the upper rims of the boxes. To ease lifting the inner box out of the outer box, two wooden blocks (30 x 30 x 30 mm) are mounted in diagonally upper corners – approx. 1 mm below the rim of the inner box.

Steen Carlsen MSc. E.E. Regenburgsgade 11, 8000 Aarhus C. Denmark. Mail: carlsen@power-electronics.dk, Mobile: +45-23 63 69 68

9. The scrap materials, which I found and used for this solar oven.

I was very fortunate, when I looked for scraped materials for this MARK II solar oven. At the garbage dump I found a double glazed sealed window with an outer size of 517 x 621 mm and a frame thickness of 56 mm. The size of the glass within the frame is 405 x 510 mm.

The height of the glass in the window (510 mm) was decisive for the length of the solar oven (508 mm). The width of the glass in the window was 405 mm. I was afraid, that if I would make the solar oven that broad, (that it would match the width of the window (405 mm)), the oven would be too heavy - both to handle – but also that the weight would slow down the heating of the oven.

I thought that my chances to find a better and more suitable window were very small. Hence, I chose the width of the outer box of the oven to be 300 mm and accepted the window to overhang the two long sides of the oven by 405 mm – 300 mm = 105 mm. Based on the sizes of the window and the wooden plates, I decided that an adequate size for the length, the width and the height of the outer box would be 508 mm x 300 mm x 270 mm.

During the work process, I had to make some minor changes to the size. I have tried my best to bring all measures, calculations and drawing up to date.

My good fortune prevailed and not long after I had found the window, I found a number of plates from a second hand cupboard - made out of laminated solid wooden boards. (Laminated here means, that the plates are made out of planed wooden boards – which are glued together.)

The sizes of the plates, which I found, were:
4 pcs of 935 x 515 x 15.8 mm and named: A, B, C & D
1 pcs of 935 x 530 x 14.1 mm and named: E
2 pcs of 935 x 550 x 15.8 mm and named: F G
1 pcs of 1200 x 370 x 16.2 mm and named: H

Given the sizes of the window and the wooden plates, As mentioned an adequate size for the length, the width and the height of the outer box would be 508 mm x 300 mm x 270 mm. This would allow for the frame around the window to just match / fit (down over) both ends of the outer box - thereby keeping the window positioned - relative to the box. It also allowed for a kerf of 2 mm, which is the width of most common saw blades. As can be seen at top of Fig. 3 (version A) - it implies, that the height of the inner and the outer boxes must be identical.

Fig. 12 (next page) shows a top-view cross-section of the frame and of the two boxes – one inner (i) within the other outer (o). You can see, that the sides of the two end-plates of the inner box (i) have been extended (in both ends of the inner box). The extension narrows the gabs between the boxes from 7 mm down to 1 mm, hence, it obstructs the movement of the air in the space between the outer and the inner box. These obstructions reduce the heat lost from the oven and thereby increase the temperature of the oven.

Furthermore, the extended end-plates – together with the right-angled triangular mouldings (shown at Fig. 9) - help to centre the position of the inner box within the outer box.

Also – to obstruct the movement of the air and to reduce the heat lost from the oven and thereby increase the temperature of the oven - the bottom of the inner box has been raised approx. 10 mm above the bottom of the outer box. Again, the purpose is to minimize the movement of the air between the boxes - and thereby maximize the temperature in the oven.

Steen Carlsen MSc. E.E. Regenburgsgade 11, 8000 Aarhus C. Denmark. Mail: carlsen@power-electronics.dk, Mobile: +45-23 63 69 68

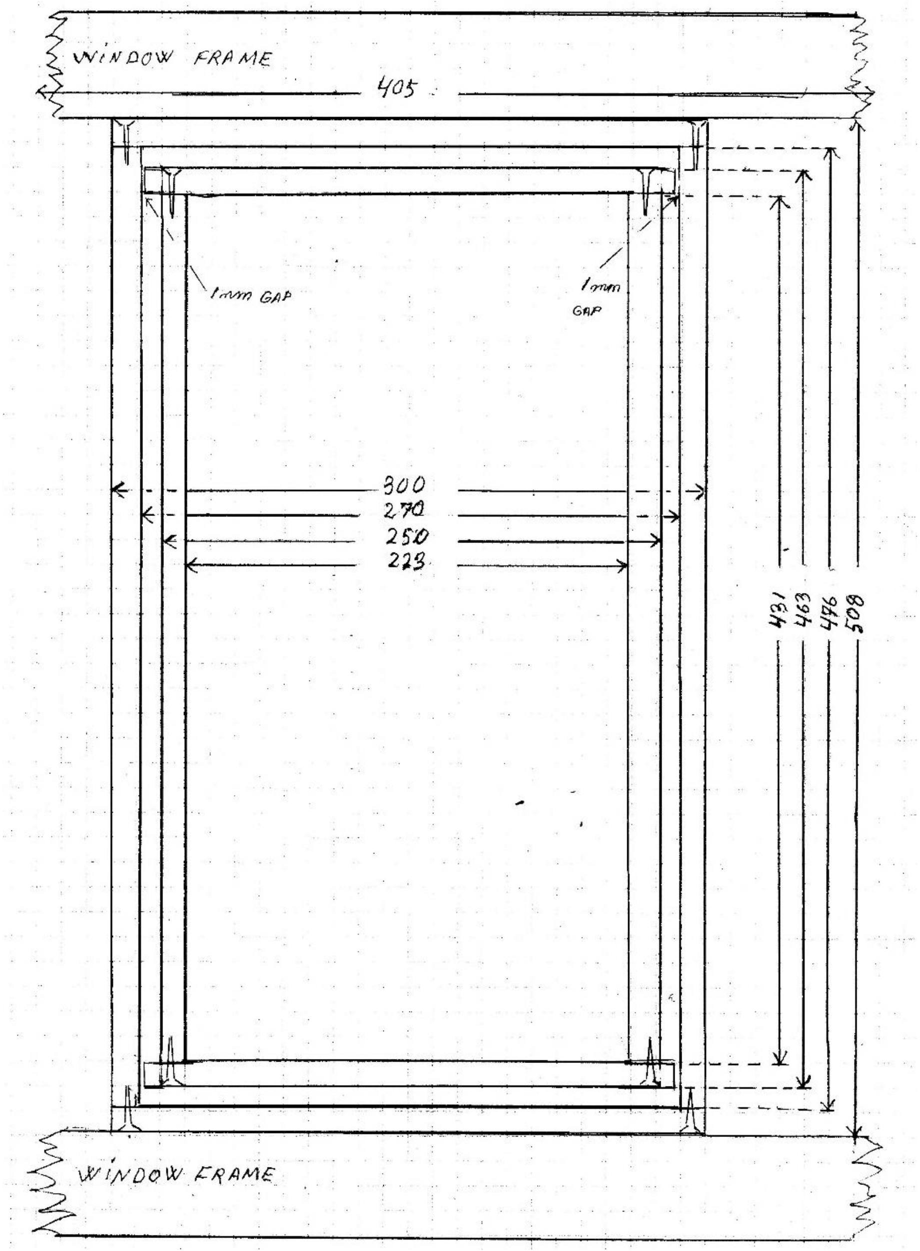

Fig. 12. A horizontal cross section of the window frame on top of the two boxes. At the top and the bottom of the figure fractions of the window frame are shown.

10. Merging boards into plates.

Only once, in the 73 years I have lived, have I found – or even seen – laminated solid wooden plates of the quality, which I have used for this solar oven. It will take a miracle, for anyone to find wooden plates of a similar quality. Hence, I believe it will be more realistic to expect, that you will have to look for whatever wooden boards you can find, cut or plane the boards to be straight enough to be assemble them into wooden plates without too many cracks (see Fig 11).

Steen Carlsen MSc. E.E. Regenburgsgade 11, 8000 Aarhus C. Denmark. Mail: carlsen@power-electronics.dk, Mobile: +45-23 63 69 68

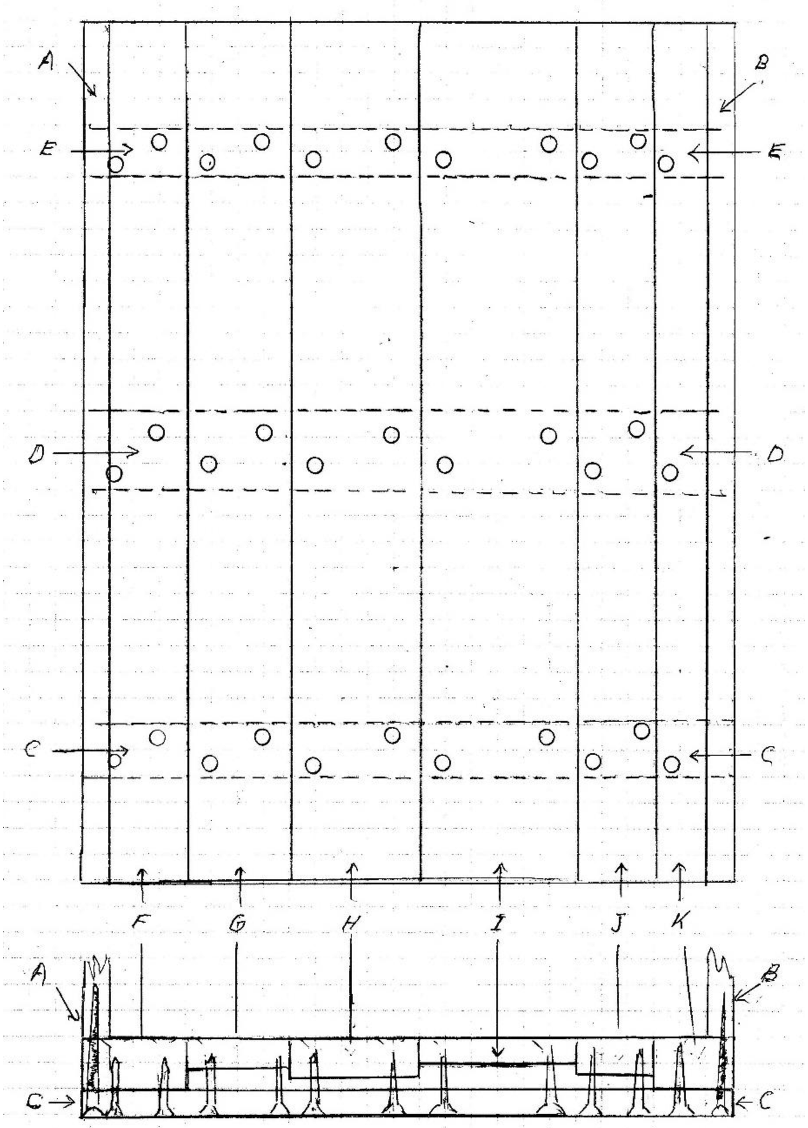

Fig. 11 shows an example of a plate – made of a number of boards of different widths and thickness – are assembled to become the smooth bottom plate in the inner box of a solar oven.

Fig. 11 shows an example of how different sized boards can be cut and shaped and thereby be enabled to be merged together to form plates, which can be used as parts of a solar oven. The bottom of the drawing shows how the two thickest boards (F and K) are placed outmost at each side of - what is going to be the plate. The thinner and the broadest boards should be placed in the middle of the plate.

To get a high temperature in the solar oven, it is important that the two boxes are as airtight as possible. So to avoid cracks in the joints between the boards, use a plane, a saw or a file to shape the boards (F, G, H, I, J and K) so they become straight and with the same width from one end to the other (to avoid cracks). If you have access to the white carpenter glue, it is very good mean both to strengthen the box and to seal it. Likewise, the paint can contribute to the sealing.

When you have collected enough boards (shaped and placed them next to each other – very close together) you must find a number (2 – 10) of sticks (here named C, D & E) and fasten them perpendicular to the boards to keep the boards (F to K) together. Place the boards on a flat table while you fasten the sticks. Use self-tapping screws or self–cutting screws. By using screws, which have their thread going all way through - from the pointing end to the head - the thread of the screws will keep / maintain the distances between the sticks and the boards – which will produce a flat surface at the side of the plate, which was facing the table, as the screw was screwed in.

Steen Carlsen MSc. E.E. Regenburgsgade 11, 8000 Aarhus C. Denmark. Mail: carlsen@power-electronics.dk, Mobile: +45-23 63 69 68

It is important for the cooking function that the inner vertical surfaces of the inner box are fairly smooth - 1. So that they can be covered with aluminium foil, which can act as a mirror. 2. So that they can be kept clean.

The smooth sides of the inner box, must face inward, and the uneven sides of the inner box, must face outward. All sides of the inner box – except the bottom – should be covered with aluminium foil. For the outer box the smooth sides should face inward. All inward sides of the outer box should be covered with aluminium foil.

The outward sides of the outer box, should be painted white. Try to close any cracks with paint – black inside the inner box - white on all other surfaces – except for the glass surfaces!

Steen Carlsen MSc. E.E. Regenburgsgade 11, 8000 Aarhus C. Denmark. Mail: carlsen@power-electronics.dk, Mobile: +45-23 63 69 68

11. Organizing and calculating how to cut the wooden plates for the outer box (o) and the inner box (i).

Outer box (o). The bottom (o) plate.
Both the long sides and the end-plates shall all rest- / stand on the bottom-plate (o). Thus, the length of the bottom (o) plate will be the same as the longest of the distances between the inner sides of the window frame (510 mm) – with a clearance of 2 mm. Use plate A = 935 X 515 X 15.8 mm. for the bottom-plate.
The length of the bottom (o) plate should be cut to 508 mm.
The width of the bottom (o) plate should be cut to 300 mm.
Surplus - left of plate A: (935 mm – 300 mm – 2 mm) x 515 mm = 633 mm x 515 mm.

End-plate (o): The width of the end-plates is identical to the width of the bottom-plate (o),
i.e. the width should be 300 mm.
The height of the end-plate is chosen to half the width of the plate A = 935 X 515 X 15.8 mm.
The height of end-plate: half width of plate A, i.e. ½ x 515 mm (minus the kerf and clearance) = 254 mm.
Use plate A = 935 X 515 X 15.8 mm to cut 2 pcs of end-plates to 300 X 254 mm
Surplus - left of plate A: (935 mm – 300 mm – 300 mm – 4 mm) x 515 mm = 331 mm x 515 mm.

Long sides (o): use plate B = 935 X 550 X 15.8 mm.
The length of the two long sides is:
The length of the outer box – 2 x plate thickness = 508 mm – 2 x 15,8 mm = 476.4 mm -> 476 mm.
The height of the long sides: half width of plate A, i.e. ½ x 515 mm (minus the kerf and clearance) = 254 mm.
Surplus - left from plate B: (935 mm – 476 mm – 2 mm) x 515 mm = 457 mm x 515 mm.

Inner box (i): **Bottom (i).**
Cut the bottom (i) from plate C, D or H.
Length of bottom plate = the outer size of the outer box – 2 x the space between the boxes - 4 x plate thickness
= 508 mm – 2 x 7 mm - 4 x 15,8 mm = 430.8 -> 431 mm.
Width: the outer size of the outer box – 2 x the space between the boxes – 4 x plate thickness
= 300 mm – 2 x 7 mm – 4 x 15,8 mm = 222.8 -> 223 mm.
Surplus e.g. - left of plate H: (1 pcs of 1200 X 370 X 16.2 mm.)
(1200 mm – 431 mm – 2 mm) x (370 - 223 mm – 2 mm.) = 767 mm x 145 mm.

End-plates (i).
Cut the end-boards (i) from board A = 935 X 515 X 15.8 mm.
The width of the inner box is
= the width of the outer box – 2 x the space between the boxes – 2 x plate thickness
= 300 mm – 2 x 1 mm – 2 x 15.8 mm = 266.4 mm. -> 266 mm.
The height of the end-plates (i) is: half the width of plate A minus the kerf and clearance for adj. screws
= i.e. ½ x (515 mm – 2 mm) – 6 mm) = 250 mm.
Surplus - left of plate A: (935 mm – 300 mm – 300 mm – 266 mm – 4 mm) x 515 mm = 65 mm x 515 mm.

The long side boards (i).
Cut the long side (i) from plate B = 935 X 515 X 14.1 mm.
Length of the long sides of the inner box (i):
= the length of the long sides of the outer box – 2 x the space between the boxes - 2 x plate thickness
= 508 mm – 2 x 7 mm - 4 x 15.8 mm 430.8 -> 431 mm.
The height of the long side plates (i) is: half the width of plate A minus (the kerf and clearance for adj. screws)
= i.e. ½ x (515 mm – 2 mm) – 6 mm) = 250 mm.
Surplus - left of plate board B: (935 mm – 476 mm – 431 mm – 4 mm) x 515 mm = 17 mm x 515 mm.

Total volume of wood:
Plate A & B: ((300 x 508) + 2 (300 + 476) 254 + 2(270 + 431) 250) x 15.8 mm^3 = 14,174,306 mm^3
Plate H: 431 x 223 x 16,2 mm^3 = 1,557,031 mm^3
Weight = Volume 15,731,337 mm^3 x Density approx. 0.5 kg / 100000 mm^3 = 7.9 kg. My scale reads 8.0 kg
See fig. 13 for the layout of the cutting of the plates.

Steen Carlsen MSc. E.E. Regenburgsgade 11, 8000 Aarhus C. Denmark. Mail: carlsen@power-electronics.dk, Mobile: +45-23 63 69 68

12. The layout for the cutting of the plates for the inner- (i) and outer (o) boxes.

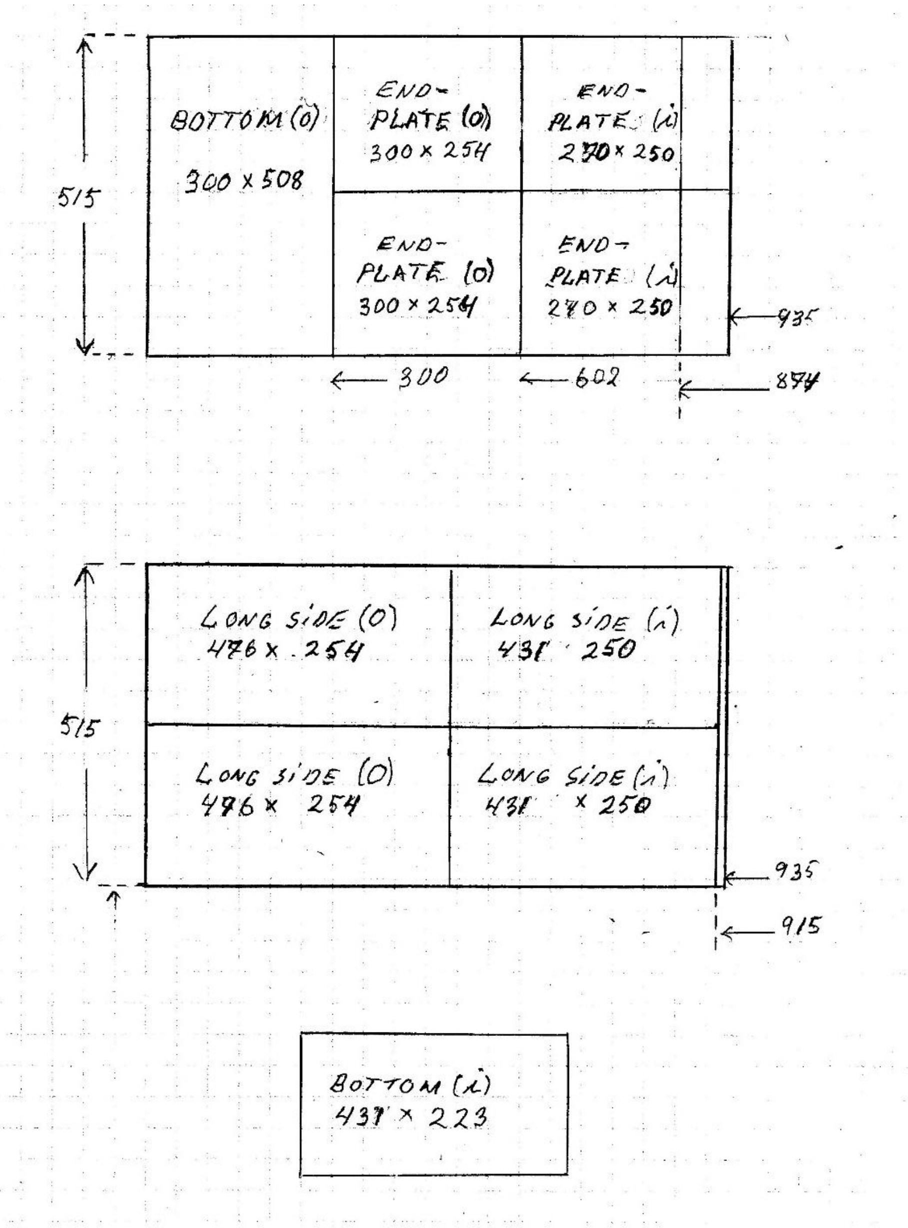

Fig. 13. Layout for the cutting of plates for the inner- (i) and outer (o) boxes.
Top = Board A; Middle = Board B and Bottom = Board H.

13. Miscellaneous notes.

This book "How to build a solar oven out of scraped materials" is written 2024 by undersigned Steen Carlsen, who hereby claims the copy right to the book. The book can be distributed and copied free of charge, as long as it is in pdf-format. The present book is aimed to alleviate the shortage of fuel in refugee camps, and it comprises a guide-line in form of simple practical instructions on how to make a solar oven.

If you need information about more technical issues about solar ovens, you can contact the address below, and request the more scientific 2022 report "Considerations, design calculations, construction, test and evaluation of a cavity walled solar oven" also free of charge in pdf format.

Aarhus Denmark 09.09.2024.
Steen Carlsen

Steen Carlsen MSc. E.E. Regenburgsgade 11, 8000 Aarhus C. Denmark. Mail: carlsen@power-electronics.dk, Mobile: +45-23 63 69 68