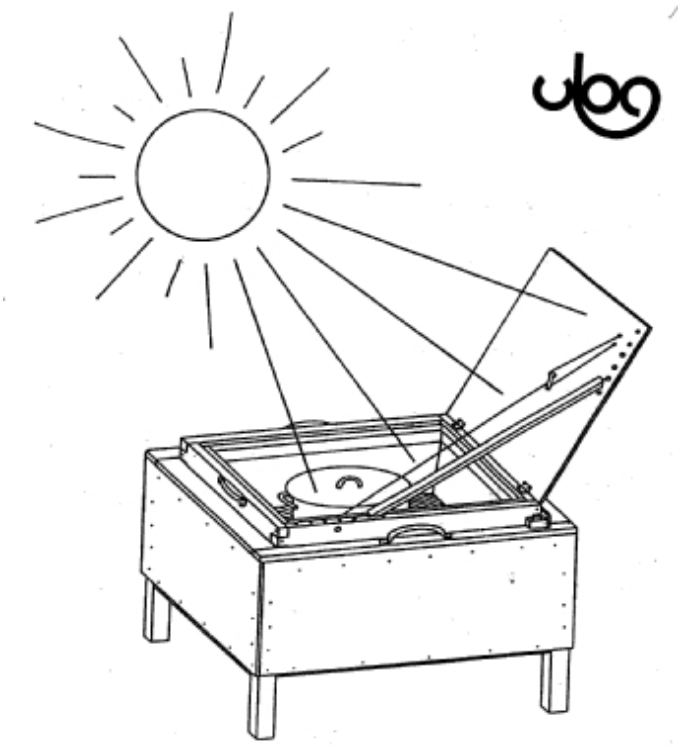


SOLAR-OVEN ULOG

FOR COOKING AND BAKING IN TROPICAL AREAS

Self-Construction Directions

Editor: Group ULOG, Basel
Third Edition 1993
These directions are also available in the following languages:
Arabic, french, german, portuguese and spanish.

SOLAR ENERGY FOR ALL!

This is the motto of the group ULOG, a loose alliance of active people in Switzerland and Germany who stands for the idea to make the energy of the sun available for the world population equally in all countries. Wood, the most common energy-source for cooking and baking, especially in the southern countries, is getting more and more scarce in many places. This leads to soil erosion and desertification of vast areas, which is again linked to global social problems like hunger and migration. Solar-cookers can help to preserve valuable trees and also help create awareness for global problems in the northern countries.

The solar-oven is a useful and well proved alternative to burning wood. It is an extremely simple cooker which relies exclusively on the direct radiation of the sun. Most dishes can be cooked in it, and this without additional work, quite the contrary! Cooking with the solar-oven does not need supervision because stirring the pan is not necessary. The solar-

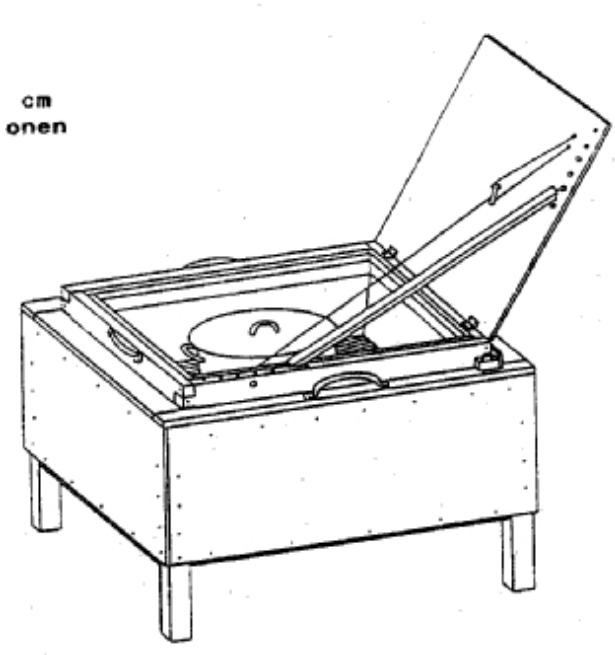
oven functions according to the greenhouse effect, i.e. the light rays from the sun (not heat-rays) penetrate the window and are absorbed by the dark surfaces in the inside and so changed into heat. As the inside of the oven is airtight and as glass is largely impermeable to heat radiation, the temperature inside rises until the losses by heat-radiation are equal to the energy that falls in. To reduce the losses of heat the window is double glassed and the inside of the oven is insulated all-round. Thereby temperatures above 100°C are obtained, enough for cooking and even for baking.

As only little heat can be stored, we need direct sun radiation during most of the cooking time. The following construction manual should enable even an amateur to build a solid and long-lasting solar cooker. The necessary material is easy to get and not expensive.

The basic measurements may be adapted according to given facts (e.g. different size of the glass, longer legs). You can get construction manuals for other models from group ULOG in Basel/Switzerland. Construction kits and ready-made solar-ovens of all models can be delivered.

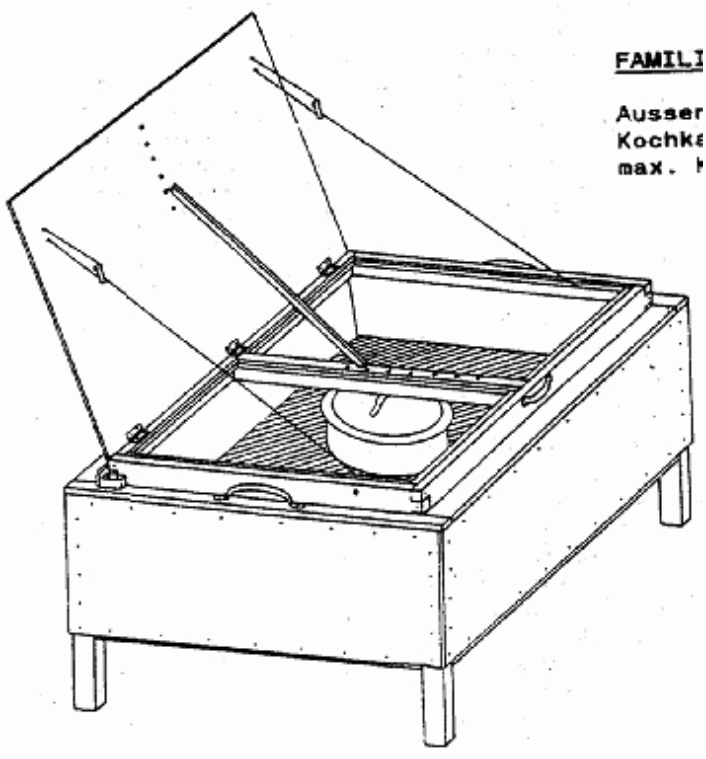
In addition to the solar-oven a construction manual on how to build solar-dryers for the conservation of food and for a simple solar water-heaters is available, too. Solar Community Kitchens as developed by W.Scheffler serve for big communities like schools, hospitals and monasteries . They suit for cooking and baking for several hundred people. We are glad to give more information on request. Members of our group also travel abroad to help initialise solar-cooker projects. Local artisans are instructed and trained in construction and use of the cookers. Dissemination-strategies are developed together.

Financial support might come from Globosol (a Swiss organisation for the promotion of solar cooking) or other associations.



STANDARD-SIZE "S"

- outside dimensions 67 x 67 x 50 cm
- capacity for up to 6 persons
- maximum high of cooking pots 19 cm



FAMILY-SIZE "F"

- outside dimensions 120 x 67 x 50 cm
- capacity for up to 12 persons
- maximum high of cooking pots 19 cm

List of parts for STANDARD- "S" AND FAMILY-SIZE "F" Solar Cooker

item	number S F	description	dimensions (cm)	material
1	2 4 4	sheet of glass	50 x 50 x 0,3	window glass
2	4 2	frame for glass	54,9 x 6 x 2,2	wood
3	- 2	frame for glass	107,6 x 6 x 2,2	wood
4	- 1	cross bar	50,5 x 6 x 2,2	wood
5	8 16	retaining fillet	49,5 x 1,4 x 1	wood
6	4 8	spacer fillet	49,5 x 2,4 x 1	wood
7	1 -	reflector lid	55 x 55 x 0,5	plywood bakelised
8	- 1	reflector lid	108 x 55 x 0,5	plywood bakelised
9	1 -	reflector foil	55 x 55 x 0,01	alufoil, tinfoil
10	- 1	reflector foil	108 x 55 x 0,01	alufoil, tinfoil
11	2 3	hinge	3 x 3	steel, galvanized
12	1 1	prop for reflector	50 x 1,5 x 1,5	wood

13	1 2	cord	∅ 0,3 x 100	nylon
14	1 2	cord tightener	3,5 x 1,5 x 0,5	plywood bakelised
15	2 2	window holding ledge	25 x 2,5 x 1	hardwood
16	2 2	buffer block	5 x 2 x 2	hardwood
17	2 2	revetment	67,5 x 6,3 x 1,5	wood
18	2 -	revetment	55 x 6,3 x 1,5	wood
19	- 2	revetment	107,8 x 6,3 x 1,5	wood
20	3 3	handle	16,5	steel chromium plated
21	1 -	stove bottom (trough)	78 x 78 x 0,03	offset plate, alu sh.
22	- 1	stove bottom (trough)	131 x 78 x 0,03	offset plate, alu sh.
23	2 2	frame f. stove bottom	50,5 x 8 x 2,2	wood
24	2 -	frame f. stove bottom	66,5 x 8 x 2,2	wood
25	- 2	frame f. stove bottom	119,5 x 8 x 2,2	wood
26	4 4	frame joint	7,5 x 15 x 0,8	plywood
27	4 2	side wall	67 x 27 x 0,5	plywood
28	- 2	side wall	120 x 27 x 0,5	plywood
29	4 4	leg	40 x 4 x 4	wood
30	4 2	reinforcing strip	58,5 x 2,5 x 1,5	wood
31	- 2	reinforcing strip	111,5 x 2,5 x 1,5	wood
32	1 -	floor	67,5 x 67,5 x 0,5	plywood
33	- 1	floor	120,5 x 67,5 x 0,5	plywood
34	30 40	wood screw countersunk	∅ 0,3 x 2	steel
35	24 48	wood screw countersunk	∅ 0,3 x 2,5	steel
36	4 4	wood screw countersunk	∅ 0,35 x 2	steel
37	12 12	wood screw countersunk	∅ 0,35 x 3,5	steel
38	- 4	wood screw countersunk	∅ 0,35 x 5	steel
39	4 6	button head rivet	∅ 0,3 x 0,8	aluminium
40	131 152	nail flat-headed	∅ 0,14 x 2	steel
41	18 24	nail sunk-headed	∅ 0,14 x 3	steel
42	14 14	nail sunk-headed	∅ 0,2 x 5	steel
43		glue for wood		
44		paint		black, mat, dull

45		insulation material	8 cm thick	mineral wool mats
46		weather protection		e.g. linseed-oil

Variations for some parts of the list.

- 1 : Different thickness of glass: 2 mm or more than 3 mm, if necessary adaption of the width of item 5. Use tempered glass plates for greater crash-proofness. This so-called snety-glass is at least 3.5 mm thick and costs double the price of ordinary window-glass. It has to be ordered in the right measurements and cannot be cut later. Also it is not everywhere available. The additional expenditure is only worth-while greater number of pieces.
- 2 / 3 / 4 : If the quality of the wood is bad, we need thicker wood, up to about 2,5 cm . According to that, the length has to be adapted so that the measurements of the inside of the frame remain unchanged.. Adapt the width of items 17, 18 and 19 too.
- 5 / 6 : It the quality of the wood is poor a greater thickness (up to 1,3 cm) is necessary with according adaption of the lengths.
- 7 / 8 : Ordinary plywood (not bakelised) 8 to 10 mm thick. If one uses plywood of 4 to 5 mm thickness only, then the lid must be strengthened all round on the upper side by a frame (ledges or reinforcing strips with a profile as e.g. items 30 and 31.
- 9 / 10 : Offset plate or polished aluminium sheet.
- 11 : Straps of strong textiles, fabric, leather or skin, about 10 x 5 cm (for "S" 4 pieces, for "F" 7 pieces). Fix them on the upper side of the lid and on the glass frame each with a ledge of plywood 4,5 x 54 cm or 4,5 x 107 cm respectively and with nails as item 40.
- 20 : Handle cut out of curved branches or out of hardwood.
- 21 / 22 : Aluminium sheet 0,2 - 0,3 mm thick or galvanised sheet metal (e.g. flattened corrugated iron) of max. 0,2 mm thickness.
- 23 / 24 / 25 : If the quality of wood is poor you need thicker wood up to about 3 cm. Accordingly the distance between the upper edge of the sidewall 27, 28 and the upper edge of the leg 29 has to be adapted.
- 27 / 28 : Plywood 4 mm thick.
- 32 / 33 :
- 29 : With wood of poor quality we need a stronger profile which may also be rectangular. To lift the solar cooker higher from the ground, the legs may be longer.
- 39 : Wood screw countersunk ∅ 0,3 x 2 cm. To fix and anchor it, a piece of wood (ledge) must be fixed on the upper side of item 7, 8.
- 44 : Blackboard-paint or a dye mixed according the following recipe: Mix soot or black ferrous-manganese powder with "half-oil". "Half-oil" consists of one part of turpentine and one part of cooked linseed-oil. Let stand the mixture over night. Then paint a sample with a brush and bake it in the solar cooker at a temperature of at least 130° C. If the result is not covering enough, you must add more powder. If the coat shines too much, reduce the part of linseed-oil.
- 45 : Insulation material: Organic stuffs such as hay, straw, choir, peanut shells, wood wool, kapok, raw cotton, balls of newspaper, scraps, but no styrofoam because it does not resist the heat.
- 46 : waterproof varnish, enamel paint or lacquer.

Construction directions

1. General informations:

- The guidance refers to tthe parts mentioned in the parts list. Variations to single parts are listed sparately on page 6 .
- Making the parts and fitting them together you have to work exactly. Lack of precision may reduce the efficiency of the solar oven. Corrections need a lot of working time.
- All joints of wooden parts are done with glue, except specially mentioned cases.
- S and F are the symbols for the Standart- and the Family-size model. For the construction only the instuctions with the respective symbol are valid.
- Drawings are only displayed for S, but they are valid also for F with siutable adaptions.

2. Window:

- (S/F): Make on the four glass-frame battens 2 and 3 a tenon at one end and two tenons at the other end with waw and chisel according to drawing page 12. Put the four parts together to a rectangular and distortion free square. Secura all 12 tenons with a nail (42) each.
- (F): Fix the cross bar 4 in the middle of the rectangle with two screws (38) on both ends.
- (S): Fix four retaining fillets (5) on the inner side of the glass frame exactly parallel to the outer edge and without steps in the corners. Use three screws (35)for each fillet but no glue, so that they can be removed easily in order to replace a broken pane lateron. The fillets should be bored beforehand (∅ 3mm) Put now one glass pane (1) in. This is fastened roundabout with four spacer fillets (6). You need three nails (40) for each fillet. Before putting in the second glass pane both must be cleaned thoroughly. To avoid the covering with moisture when the solar oven is used, we treat the inner surface of the glass pane either with a clarifying cloth or with transparent soap. The glass pane that must be protected is coated several times criss cross with the soap. Then you rub the soap lines with a dry cloth until the glass is clear again. The four remaining fillets (5) are used to fasten the second glass pane analogous to the first one.
- (F): The same procedure as for model S for the two window-parts side by side.

3. Reflector:

- (S/F): Mount the reflector foil (9,10) on the reflector lid (7,8). If you do have a self-adhesive foil use contact-glue or cobbler's glue. Fasten the hinges (11) on the reflector lod on the reflecting side with the rivets (39). Now you can fix the lid with screws (34) on the glass frame.
- Hammer into both ends of the reflector prop (12) a nail (42) each until one cm is left protruding. (With harder wood drill a hole with a diameter of 1.5mm into the centre of the end of the prop, otherwise it might split.) Big heads of nails must be cut off and the ends filed around. Bend both spikes about 45° to the same side. Now rasp on both ends of the prop the edge as shown on page 13.
- (S): Drill on the right side of the shut lid holes (∅ 5mm) through the lid about 1 cm into the glass frame and on the same side only in the lid two holes (∅ 3mm) for the cord as drawn on page 13.
- The cord (13) is pulled through a lateral borehole (∅ 3mm) in the frame. Sink the hole first conically from outside and make a knot into the cord at the outer end. Pull the knot into the countersink and secure it there with a nail (40). The cord-tightener (14) is fitted with two holes (∅ 3mm) and rounded off on both ends. The other end of the cord is now pulled through the one hole of the tightener and then through the two holes of the lid. Push the end of the cord from below through the second hole of gehe tightener and knot it as shown.
- (F): The holes for the prop are made in the middle of the reflector lid, respectively in the cross bar (4). There are two tightening cords, one on each side of the window.

4. Frame for stove bottom:

- (S/F): Build with the four parts 23 and 24 respectively 23 and 25 a rectangular fraim. Join them together with four fraim joints 26 using eight nails (40) apiece. For S results a rectangle of 66,5 x 119,5 cm.

5. Stove body:

- (S/F): Fasten on each sidewall 27, 28 every time at the same side one leg 29, each with three nails 40 as well as one reinforcing strip 30, 31 with five nails 40 each for 30 respectively with nine nails for 31 according to the drawing on page 11.
- (S/F): Fit up the four sidewalls one after the other with six nails 40 each for 27 respectively with eleven nails 40 for 28 to the frame for stove bottom and join them together at the legs, so that a stiff and gigid body results.

6. Stove bottom (trough):

- (S/F): Transfer the drawing page 14 for the stove bottom 21, 22 on an offsetplane that is big enough and cut along the drawn out lines (e.g. with a carpet knife and a ruler, slit it two to three times and beak it by bending). If you can't get offsetplates or aluminium sheets which are big enough you may join together two or three smaller sheets by folding according to drawing on page. Take care that these joints are placed on the bottom of the trough and if

possible in the middle. If the sheet is only a few cm too small, the width of the brim may be reduced from four cm to two cm. - Now the trough is formed in the following way: Bend up first the four sides along the dotted lines one after the other by pressing a sharp edged piece of hardwood or metal on the edge of the bottom. Hereupon you put the respective two pints A, B, C and D (see drawing page 14) together in the four corners and then only press the resulting triangular lappet in the middle together. These lappets must then be bent so that they lie close and flat on a side (as shown in the drawing page 8). Finally bend the upper edge outward, in the best way over the edge of a table.

- Put the trough into the frame for stove bottom and nail it down with four respectively seven nails 40 per side. Paint the bottom of the trough with the black, mat and heatproof colouring 44.
- In case that the stove bottom sags too much because you use very thin sheet metal, we recommend to strengthen it from below by one or two supporting strips (profile e.g. as item 30). You fasten them rectangular at the front- and back-wall with nails as e.g. item 41 in a way that the strips con not twist.

7. Insulation:

- (S/F): Fill the cavity between the sidewalls and the trough as well as the space between the trough bottom and the lower edge of the sidwalls with the insulation material 45. With loose material you take care to push in so much that no cavities are left and that it cannot set (sag) with the time. But you must not cram too much because there must be enough air between the fibbers for the best insulation.
- (S/F) Before fixing the floor (32,33), you have to cut out the recess for the legs on all four corners. The floor is fastened without glue with five respectively nine screws (34) per side, so that it an be removed iasily lateron if nessesary for exchanging the insulation.

8. Window lining:

- (S/ F:) To fix the revetment (17, 18, 19) you put first the window in the right position on the frame for stove bottom. Place then the four parts narrowly adjacent to the frame for the glass, so that the parts for the frame of the stove bottom overlap in the corners, and nail them down with nails (41).

9. Final works:

- (S/ F): Fasten with four screws 36 a handle 20 in the middle in front of the glass frame close to the upper ridge, so that the fingers find comfortably space for opening the window. To carry the box fix the two other handles at both sides outside on the revetment with four screws 37 each.
- (S/ F): A locking device should prevent the window from shifting when it is opened. This consists on one hand of two window holding ledges 15 which are fixed on the back part of the glass frame with three screws 34 each, so that they protrude two cm on both sides, and on the other hand it consists of two buffer blocks 16 which are screwed onto the lateral revetment with two screws 37 each adjacent as well to the frame for the glass as to the window holding ledge 15.
- (S/ F): The whole finished solar cooker should be treated with a weather protection 46, except the bakelised plywood which is allready waterproof.

Drawings

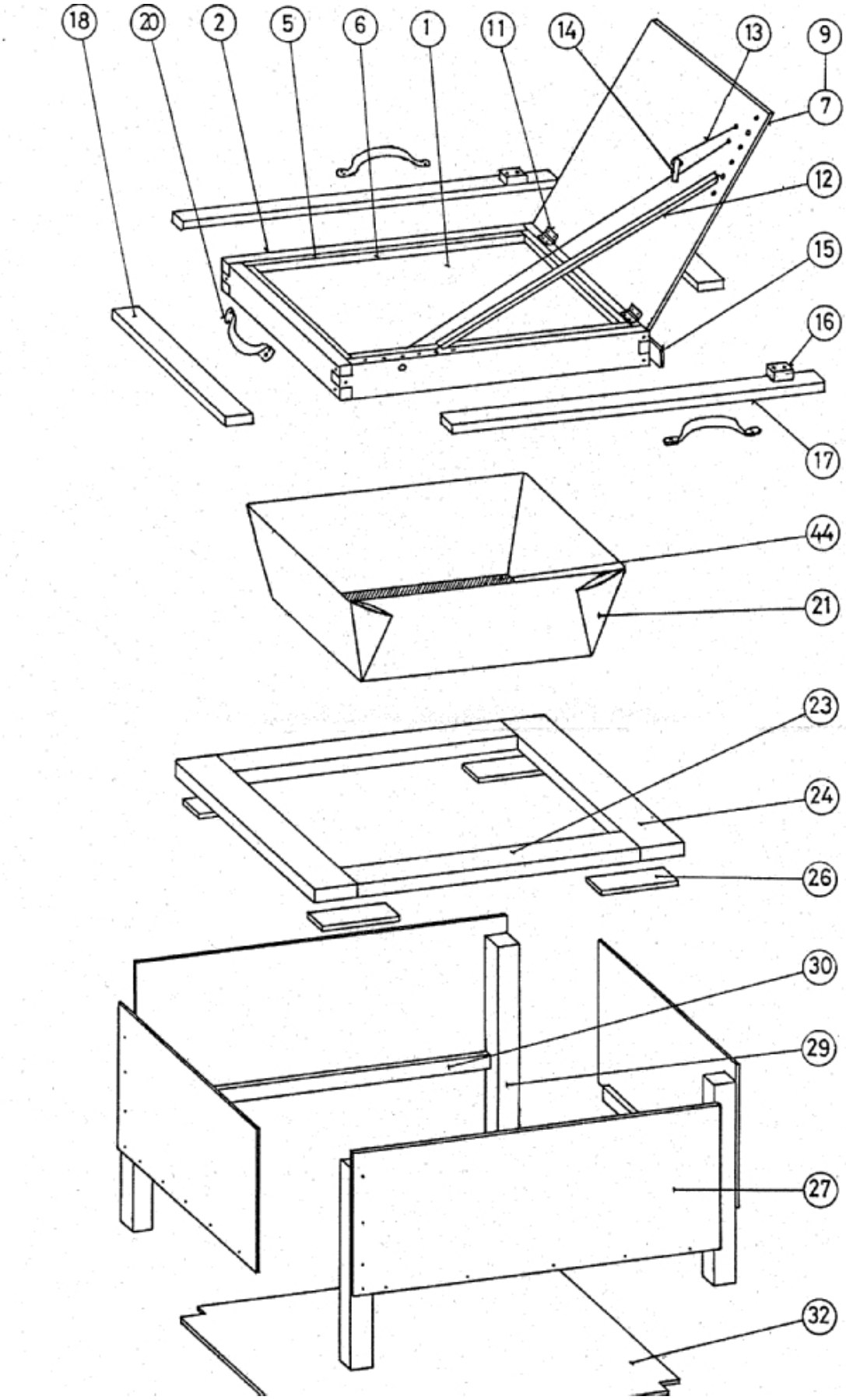
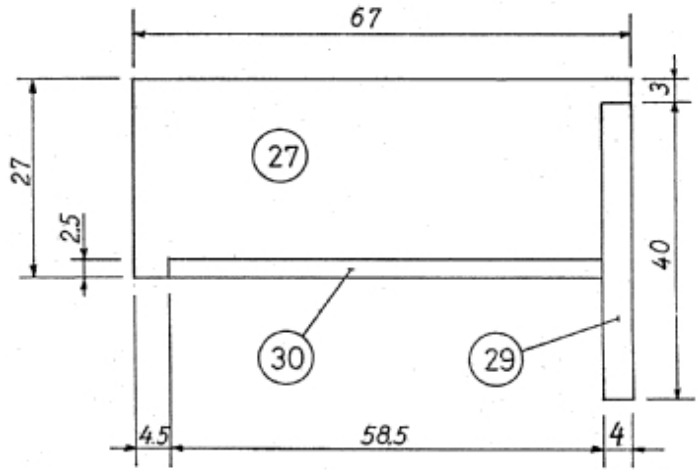


Fig. 4 Explosion schema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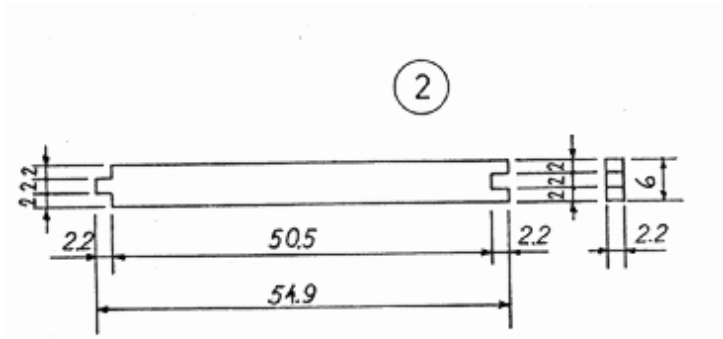
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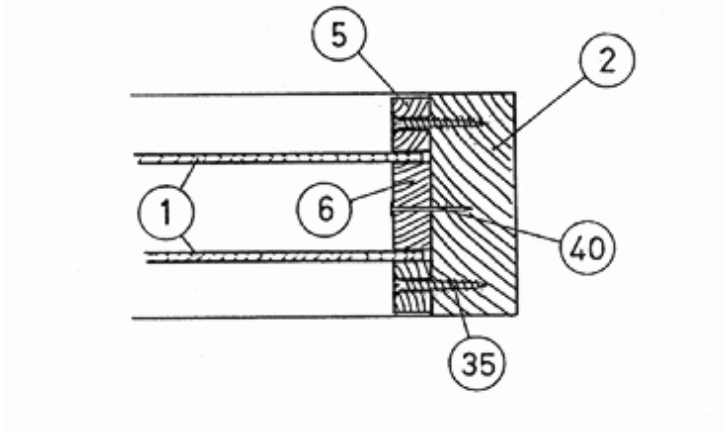
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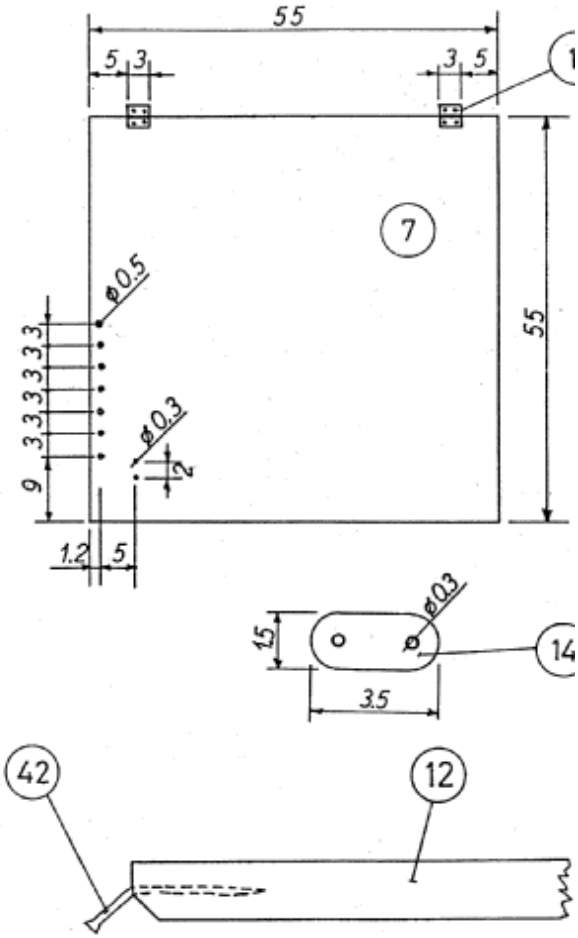
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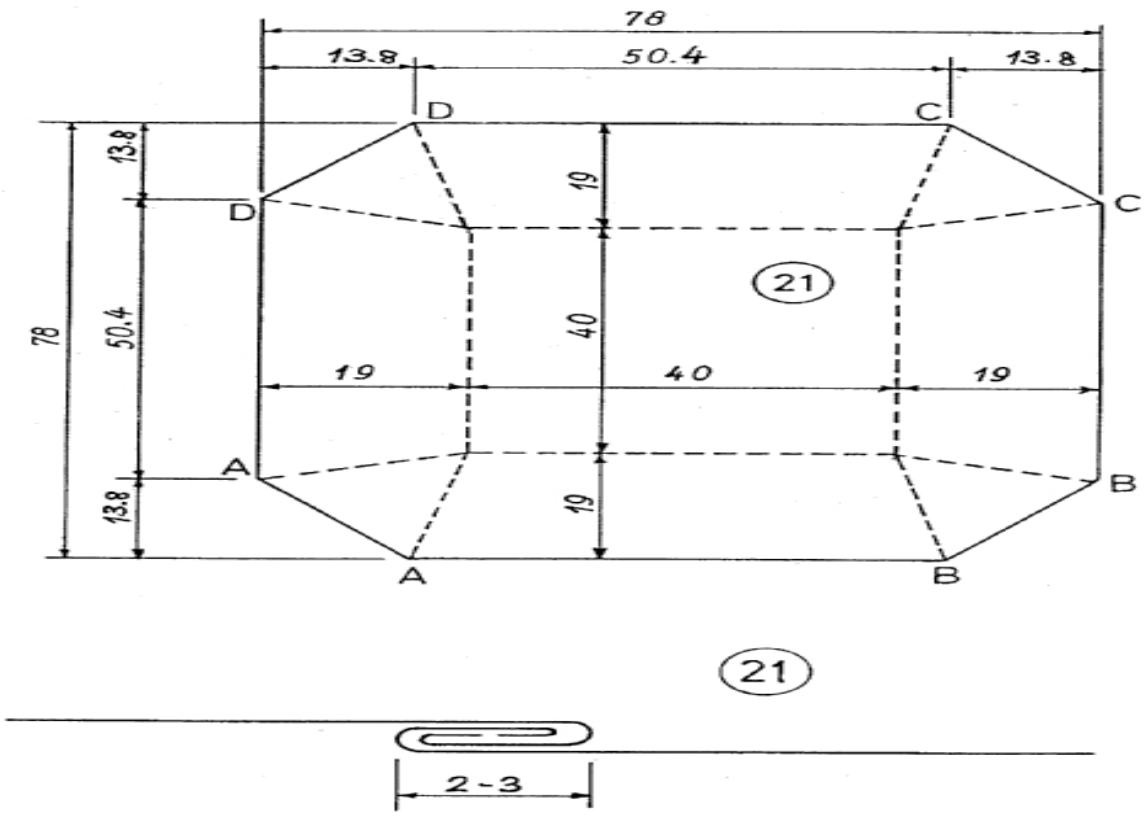

Some important tips for the use of the solar-cooker/oven (SO)

- When you use the SO for the first time, don't cook food in it, as long as the black paint in the black paint in the inside discharges badly smelling fumes.
- The SO only works with direct sun light. Clouds, mist od dust reduce the radiation and lengthen the cooking-time accordingly. On the other hand the temperature of the atmosphere has only little influence.
- Install the SO at a sheltered place where no shadows may hit the SO during cooking time.
- To catch the greatest radiation energy that is possible you align the SO correctly to the sun. At a low position of the sun the reflector serves to increase the light that is taken in. The best position of the SO can be controlled as follows: The shadow of the reflector prop falls straight on to the part of the glass frame that lies beneth. The reflection of the sun from the reflector is in the middle of the trough. You see it better, if you move the reflector slightly up and down. Then you fix the reflector in the best position with the prop and tighten the cord. It is not necessary to adapt it often. You may even renounce to adapt it if you position the SO at the beginning of the cooking time a little ahead of the sun. You can cook with the SO even if you are absent.
- If ever possible don't open the SO during the cooking process to lose as little heat as possible. And if you have to open the SO nevertheless, then only briefly. It is best to add all seasonings at the beginning except salt which should be added after cooking. It is not
- necessary to stir because nothing will burn or boil over.
- The cooking-respectively baking-time comes to two to four hours dependent on the dish, the quantity and the radiation of the sun. As the food hardly boils down in the SO, it may be left inside for once longer then need be. Normally temperatures from 120° to 150° C are attained in the SO. Therefore it is not possible to fry or to bake crisp. You do best with food soaked in water such as cereals, beans and vegetables. The usual amount of water has to be reduced by about one third because nothing can evaporate. But the SO is also good for stewing of meat and baking of bread or cakes. Other possibilities of use are among others roasting of nuts, boiling of water and sterilising of medical instruments.
- To keep cooked food warm for a longer time, e.g. until after sun-set, simply shut the reflector lid. With an additional storage-substance of stone or metal the time for keeping the food warm may be prolonged.
- For good thermal efficiency the pots, crockery and baking-molds should be dark outside, best is dull black. To attain short cooking-times use thin-walled aluminium pots and distribute the stuff to be cooked on several smaller pots. For a better heat-exchange don't put them directly on the floor but on a grate or simply on two wooden bars

of about two cm high. This will allow the hot air to circulate under the pot and to heat it from below.

- Except the cleaning of dirty windows hardly any upkeep of the SO is needed. Even if it is fitted with a weather-protection, it should be protected from wetness. Taking care is worth and pays out, the SO will do its useful service over years.
- "Practice makes perfect" is also valid for cooking with the SO. Only by trying out the various dishes will be a success. And the more you succeed, the more the cooking and baking in the SO is fun.