Construction manual for the $2m^2$ Scheffler-Reflector

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with help of
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Table of contents:

Aluminum Sections

Type	Dimensions [r	Length [mm]
Square Tube	50x50x2	4400
	34x34x3	2600
	15x15x2	2500
Channel	20x30x20x2	1500
	30x40x30x3	100
Pipe	16x2	1900
	20x1,5	23
Flat bars	50x12	150
	50x5	400
	50x4	500
	40x5	800
	25x12	130
	25x6	1410
	25x4	13500
	20x4	1362
Square bar	10x10	900
Round bars	10	1100
	12	700
Angle (L-profile)	25x25x3	150

Nuts and Bolts, Stainless Steel

Type	Length [mm]	Quantity
M12	60	2
	Nuts	5
M8	120	4
	110	1
	80	5
	70	2
	30	3
	Nuts	21
M6	70	16
	50	7
	30	15
	20	2
	15	16
	Nuts	56
M4	40	2
	30	14
	15	23
	10	8
	Nuts	38
M3	6	3

Plus washers and spring washers for every bolt size.

Aluminium Pop-Rivets

Diameter [mm]	Lenght [mm]	Quantity
4	8	34
4	12	76

Aluminum Sheet

Thickness [mm]	Dimesnions [mm]	Area [sqm]
1	240x155	0,04
2	666x500	0,36
3	300x240	0,1
3	260x260	0,1

Mild Steel Sections

Flat bar	25x3	240

Stainless Steel Sheet

Sheet	0,6 -0,7 mm	0,056 sqm
	0,6-0,7mm	200mm dia

Other Materials

Sproket with 8 teeth (½ inch x 1/8 (fits to normal bicycle chain))
Bicycle-chain (1/2 inch * 1/8, 122 links)
Motor, 1.5 V with gear 262:1
Gear 100:1
2 pairs of banana plugs
4 photovoltaic (PV) modules. Each 0.5 V, 300 mA (laminated onto aluminium sheet to dissipate the heat produced by concentrated radiation)
Lens: glass cylinder (dia ~ 45 mm, length ~ 140 mm), e.g.: old twist off olive glass filled with water
4 springs, dimensions see manual

1,5 m electric cable (two-core, 2 x 0.75 mm² cross section)
2 m² mirror (e.g. aluminium sheet)
14 strips of a polycarbonatpanel (commonly used for green houses). Strips: 6mm thick with walls in a distance of 6mm, each 2m long
94 plastic blind rivets, length 6 mm, diameter 3 mm, for 5 mm
144 plastic blind rivets, length 4 mm, diameter 3 mm, for 2 mm
3 washers M12
Stainless steel pipe 15 dia x1, length 56mm
Wire, stainless steel, diameter ~0.5 mm, length ~3 m
Epoxy glue
Double-sided adhesive tape
Soldering equipment
(welding equipment for iron (not urgently needed, only to make bending tools)

For some of these materials you can find adresses on the next page.
If it is not possible to order them there or find these parts some where else, you can contact Wolfgang Scheffler and Heike Hoedt:

Solare Brücke e.V. G.v.Werdenbergstr.6 D-89344 Aislingen
inf@solare-bruecke.org www.Solare-Bruecke.org

Addresses to order some materials:

Gear motor 1:100:

Conrad Electronic GmbH
Klaus-Conrad-Strasse 2
D-92530 Wernberg-Köblitz
www.conrad.de
Order number: 227560-17
Rb-35 Getriebemotor 1:100 (13.95 Euro)
(Only the gear is needed. At the time of writing this manual it was only possible to buy the gear with a motor)

PV-cell:

Solarstromtechnik Heitfeld
Telgenkamp 26
D-48249 Dülmen
0.5V; 300mA (1 cell ~ 6 Euro; 4 cells necessary)

Motor (262:1):
For 1.5 V

Faulhaber GmbH & Co.
Antriebssysteme
Daimlerstrasse 23
D-71101 Schönaich
www.faulhaber.de
motor: 1516 E 1.5 S
gear: 16A (reduction 262:1)

Aluminium sheets:
(for the mirror surface)

EG-SOLAR e.V.
Neuöttingerstrasse 64c
D-84503 Altöttingen
www.eg-solar.de
eg-solar@t-online.de
Sheets: 1250 x107.5mm; 17-18 pieces

Sproket with 8 teeth:

WMH-Herion
Kreuzloh 1
D-85276 Pfaffenhofen
Order number: 201-211-008

Plastic blind rivets:

Traudl Riess
Werklehrmittel
St.Georgen-Strasse 6
D-95463 Bindlach

To build a Scheffler-Reflector you need all the materials mentioned on the previous page. These addresses might help you to find some special parts needed.
This booklet will guide you through building the reflector step by step.

List for cutting the materials:

Aluminium:

Square tubes: 

Dimensions [mm]	Length [mm]	Pieces	Name
50x50x2 / 40º / 40º * see page 8	883	1	S1
50x50x2 / 40º \ 12.5º * see page 8	long side: 861	1	S2
50x50x2 / 50º / 12.5º * see page 8	long side: 562	1	S3
50x50x2 / 25º \ 40º * see page 9	long side: 568	1	S4
50x50x2 0º 40º * see page 9	long side: 104	1	S5
50x50x2 (position depends on the latitude)	1000	1	S6**
50x50x2 0º 25º *	short side: 79	1	T1
34x34x3 (length depends on latitude)	230	1	S7**
34x34x3	36	2	RS1
34x34x3	107	2	RS2
34x34x3	1370	1	RS3
34x34x3	640	1	RS4
15x15x2	463	1	RS5
15x15x2	1850	1	R11

* check the orientation of the angles in the drawings on page 8 (S1, S2, S3), 9 (S4, S5), 44 (T1)
** The length or position of these parts depends on the geographical latitude. If the cooker is not for Central Europe view page 53 before cutting.

Square bars: 

Dimensions [mm]	Length [mm]	Pieces	Name
10x10	597	1	C4
10x10	90	2	C5
10x10	70	1	C6

Angle (L-Profiles): 

Dimensions [mm]	Length [mm]	Pieces	Name
25x25x3	25	4	C9
25x25x3	25	2	RS8

Channels (U-Profiles): 

Dimensions [mm]	Length [mm]	Pieces	Name
30x40x30x3	93	1	RS6
20x30x20x2	1500	1	RS7

Bars:

Dimensions [mm]	Length [mm]	Pieces	Name
50x12	150	1	S14
50x5	80	1	S8
50x5 (depends on latitude)	260	1	C3**
50x4	50	2	S9**
50x4 0º 25º * see page 44	long side 100	2	T3
50x4	50	2	SA5
40x5	91	1	S10
40x5	70	4	RS9
40x5	192	2	R12
40x5	15	1	R13
25x12	30	1	S11**
25x12	25	1	S12
25x12	30	2	SA6
25x4 / 50º / 50º * see page 11	77	2	S13
25x6	40	1	S15
25x6	1364	1	R1
25x4	355	1	RS11
25x4	125	2	RS12
25x4	34	2	RS13
25x4	599	1	C1
25x4 (depends on latitude)	120	1	C2**
25x4	1362	2	R2
25x4	1001	1	R3
25x4	1270	1	R4
25x4	1408	1	R5
25x4	1428	1	R6
25x4	1378	1	R7
25x4	1242	1	R8
25x4	964	1	R9
25x4	470	1	RS10
20x4	1362	1	R10

* check the orientation of the angles in the drawings on page 11 (S13), 44 (T3)
** The length or position of these parts depends on the geographical latitude. If the cooker is not for Central Europe view page 53 before cutting.

Pipes: 

Dimensions [mm]	Length [mm]	Pieces	Name
16dia x2 (depends on latitude)	800	1	S16**
16dia x2 0º 30º *	long side 44	1	C8
16dia x2	540	1	SA1
16dia x2	470	1	SA2
20dia x1.5	23	1	T2

* check the orientation of the angles in the drawings on page 22 (C8)
** The length or position of these parts depends on the geographical latitude. If the cooker is not for Central Europe view page 53 before cutting.

Round bars: 

Dimensions [mm]	Length [mm]	Pieces	Name
12dia	700	1	C7
10dia	555	1	SA3
10dia	485	1	SA4

Sheets:

Dimensions [mm]	Length [mm]	Pieces	Name
aluminium sheet 3mm	view page 11	2	S17
aluminium sheet 3mm	view page 11	2	S18
aluminium sheet 2mm	500x666	1	C10
aluminium sheet 2mm	80x130	1	T4
aluminium sheet 2mm	120x120	1	T5
aluminium sheet 1mm	245x155	1	T6

Steel:

Bars:

Dimensions [mm]	Length [mm]	Pieces	Name
25x3	240	1	C12

Sheets:

Dimensions [mm]	Length [mm]	Pieces	Name
0.6mm	200dia	1	C11
stainless steel sheet 0.6mm	50x20	13	R14
stainless steel sheet 0.6mm	50x20	3	R15
stainless steel sheet 0.6mm	30x20	10	R16
stainless steel sheet 0.6mm	30x20	4	R17

Pipes: 

Dimensions [mm]		Length [mm]	Pieces	Name
15dia x1	(stainless steel)	56	1	C13

Construction part by part:

Stand

Name	Dimensions [mm]	Length [mm]	Pieces
S1	50x50x2 / 40º / 40º * see page 8	883	1
S2	50x50x2 / 40º \ 12.5º * see page 8	long side 861	1
S3	50x50x2 / 50º / 12.5º * see page 8	long side 562	1
S4	50x50x2 / 25º \ 40º * see page 9	long side 568	1
S5	50x50x2 0º 40º * see page 9	long side 104	1
S6**	50x50x2	1000	1
S7**	34x34x3	230	1
S8	50x5	80	1
S9**	50x4	50	2
S10	40x5	91	1
S11**	25x12	30	1
S12	25x12	25	1
S13	25x4 / 50º / 50º see page 11	77	2
S14	50x12	150	1
S15	25x6	40	1
S16**	16dia x2	800	1
S17	view page 11		2
S18	view page 11		2
C4	10x10	597	1
C5	10x10	90	2
C6	10x10	70	1

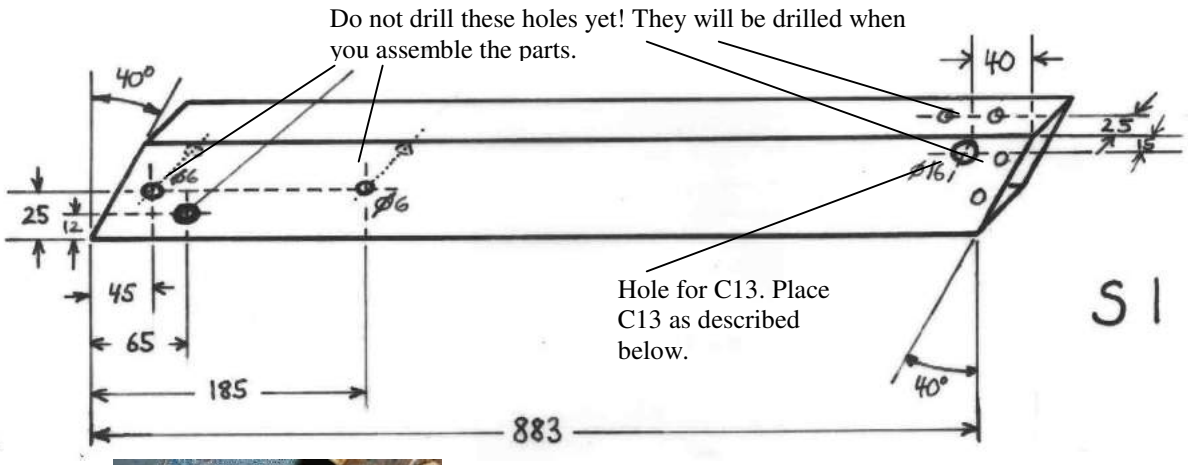
* check the orientation of the angels in the drawings on page 8 (S1, S2, S3), 9 (S4, S5), 11 (S13)

** The length or position of these parts is depending on the geographical latitude. If the cooker is not for Central Europe view page 53 before attaching these parts.

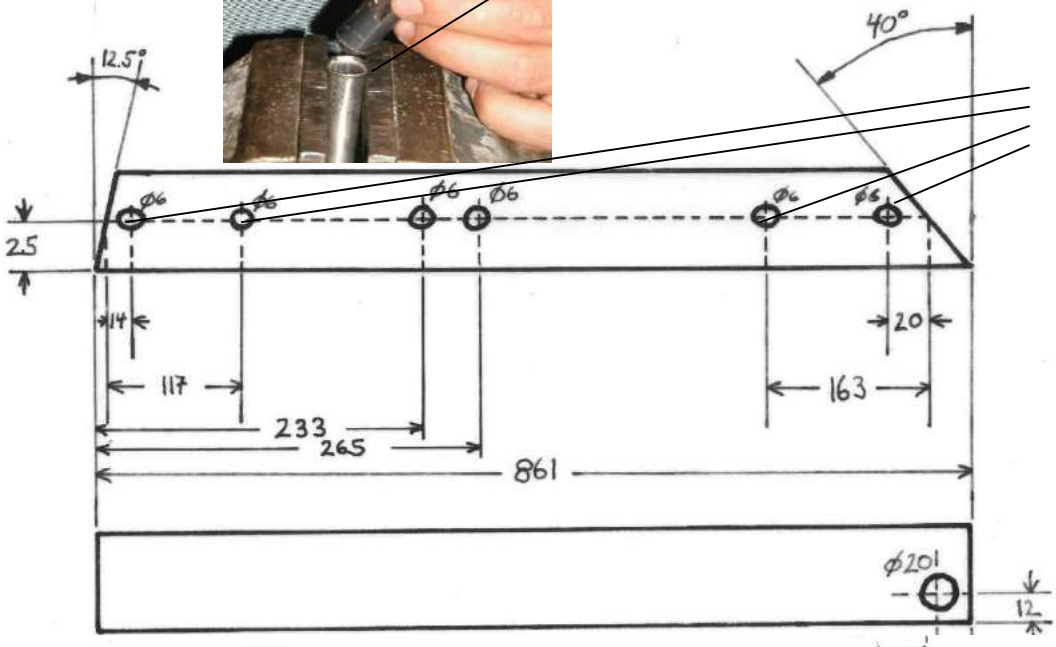
Name	Diameter / Dimensions [mm]	Length [mm]	Pieces
Bolt M12	12	70	1
Bolt M8	8	120	1
Bolt M8	8	110	4
Bolt M8	8	80	1
Bolt M6	6	70	9
Bolt M6	6	20	3
Bolt M4	4	40	6
Bolt M4	4	16	2
Pop rivets	4	12	6
Nut M12			1
Nut M8			7
Nut M6			12
Nut M4			8

Plus washers and spring washers.

Position of holes in the parts of the stand:

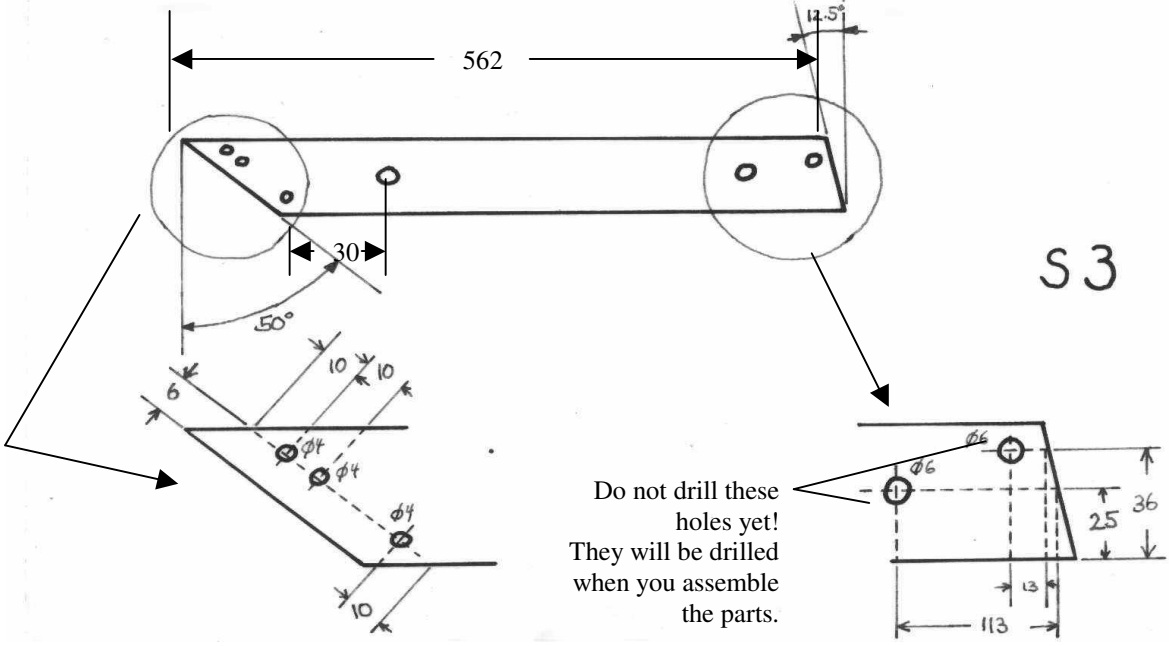


Bend the rim on one side of C13 the way shown in the picture. Then insert it in the 16mm hole on S1. Now bend the rim on the other side so the steel tube sits firmly in the hole.



Do not drill these holes yet! They will be drilled when you assemble the parts together.

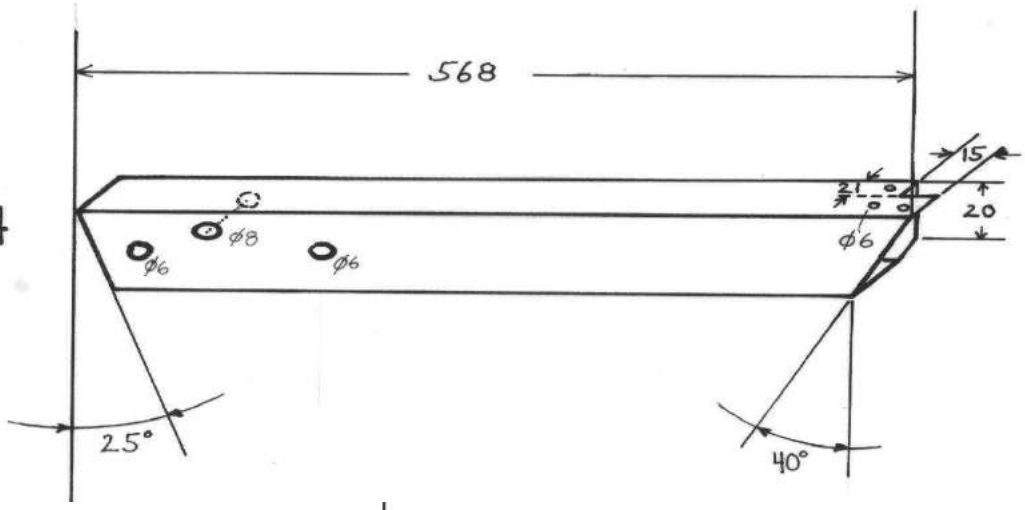
S2



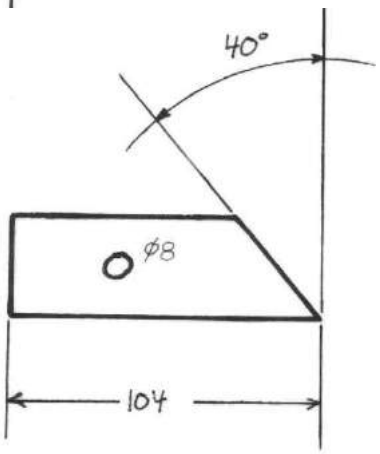
Do not drill these holes yet! They will be drilled when you assemble the parts.

S3

S 4

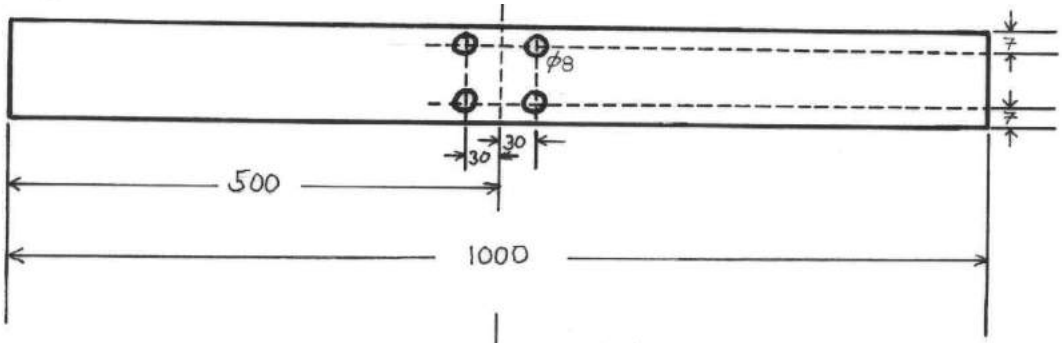


S5

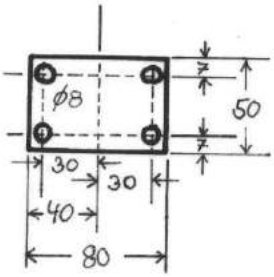


Do not drill the holes in S4 and S5 yet!
They will be drilled when you assemble the parts.

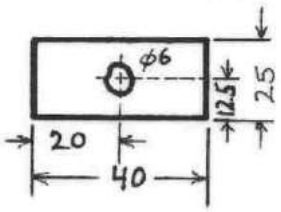
S 6



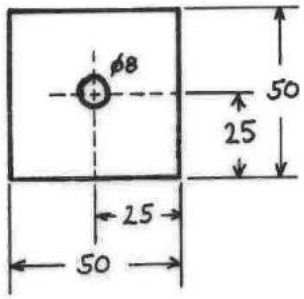
S 8



S 15

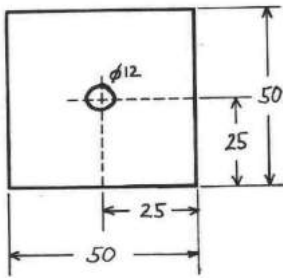


S9 (1x with 8mm hole)

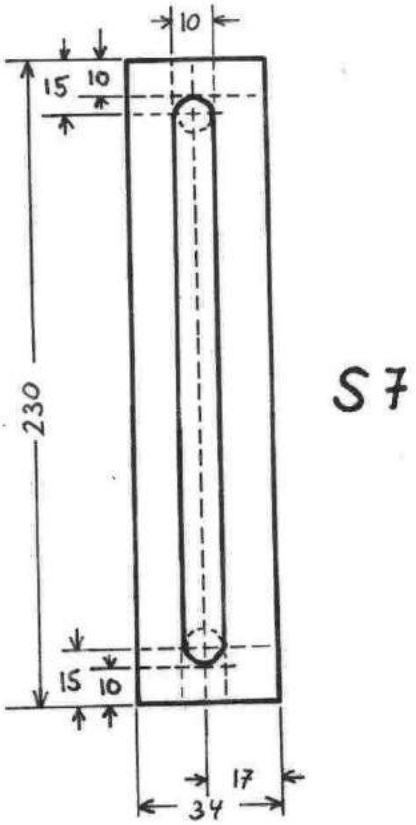


Above: handle for M8 bolt to adjust S7

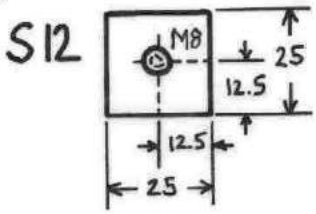
S9 (1x with 12mm hole)

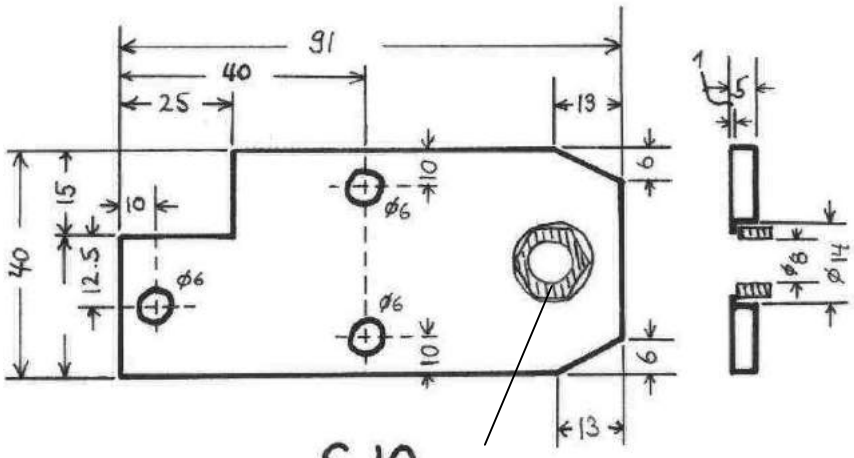


Above: handle for M12 bolt to adjust S16



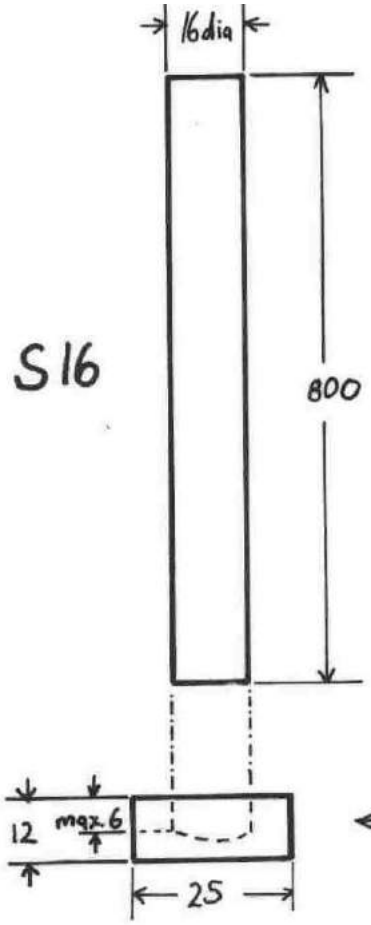
S7





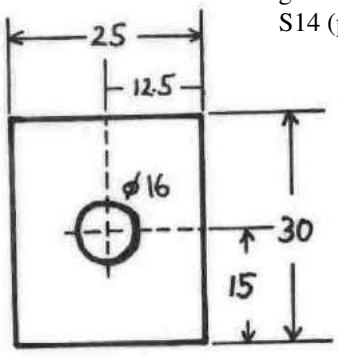
S10

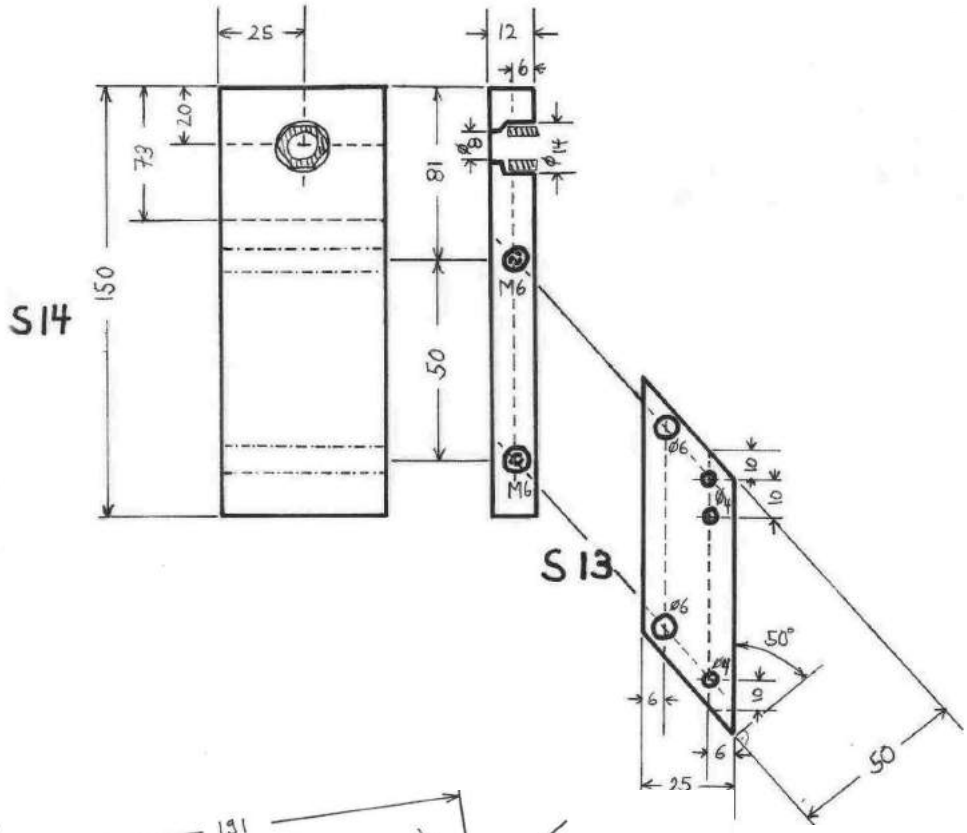
M8 nut. Remove thread with 8mm drill. Then press the nut in the hole and secure it with epoxy-glue. Do the same with the nut in S14 (page 11).

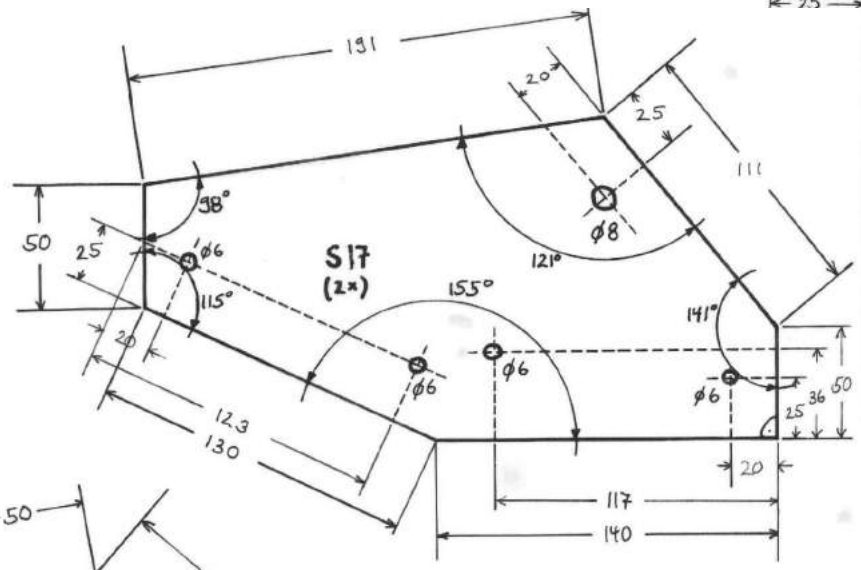


S16

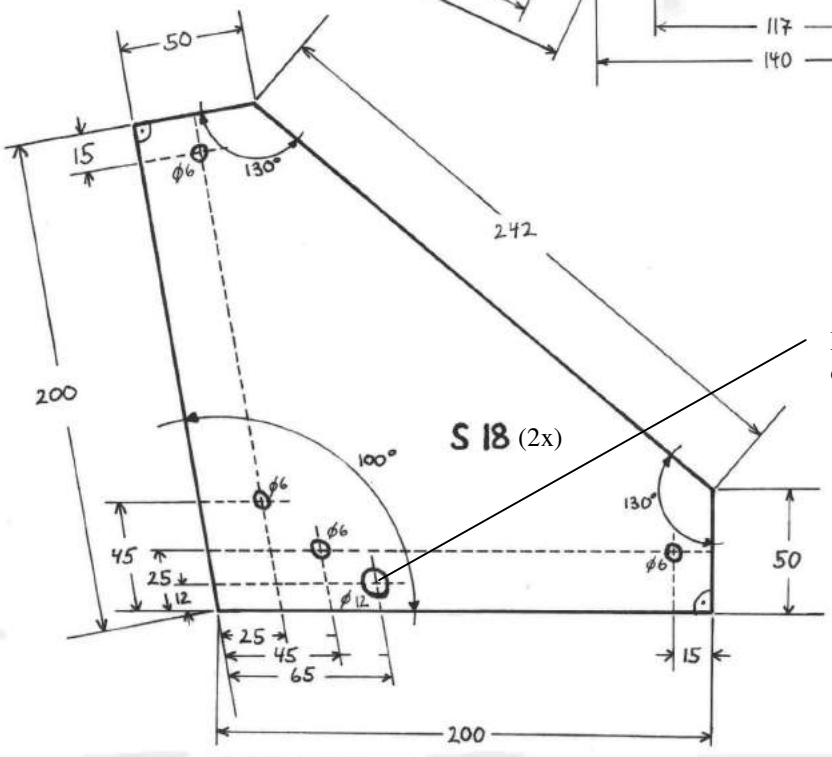
S11







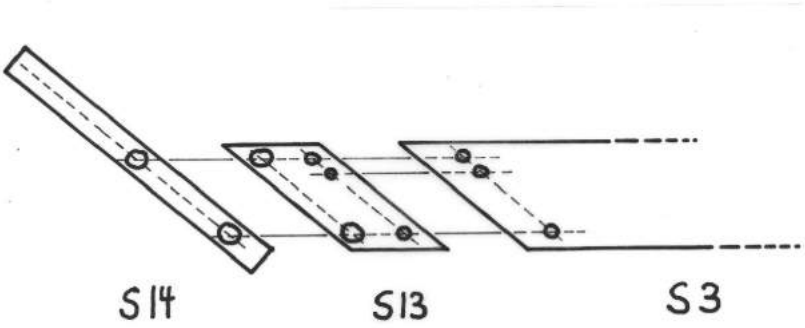
Make two S17



Make two S18, drill the 10mm hole only in one S18.

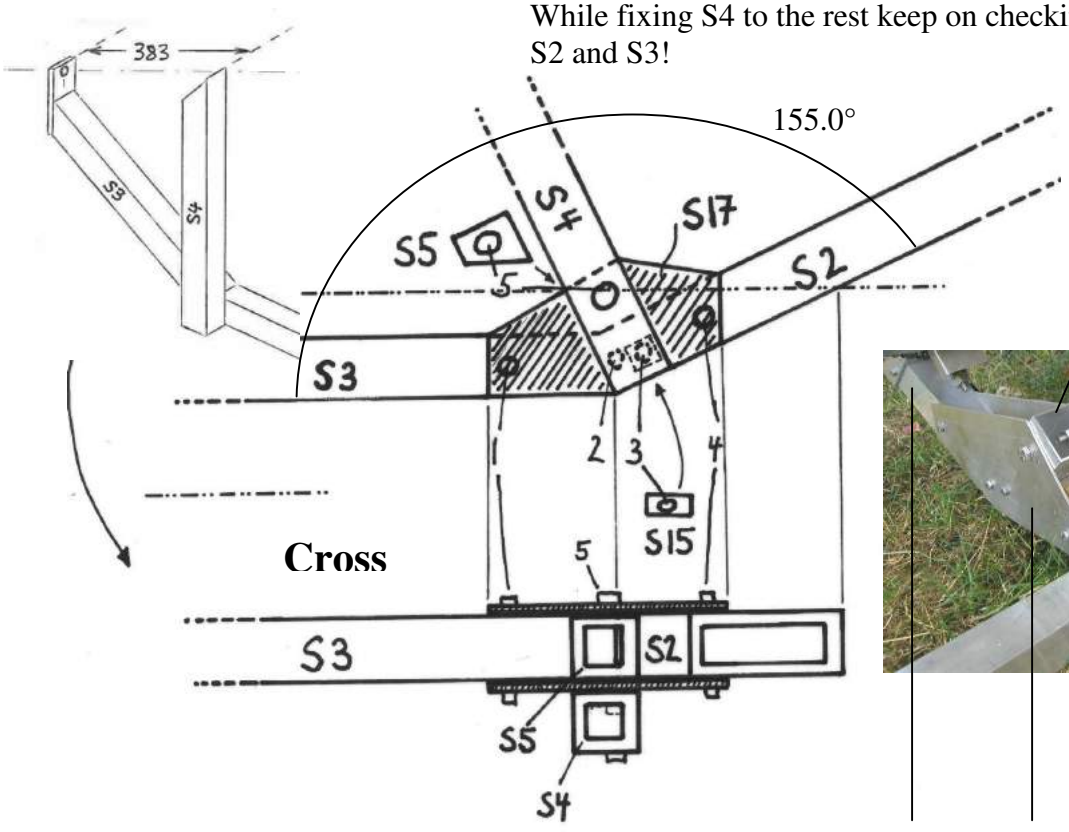
How to assemble the parts step by step:

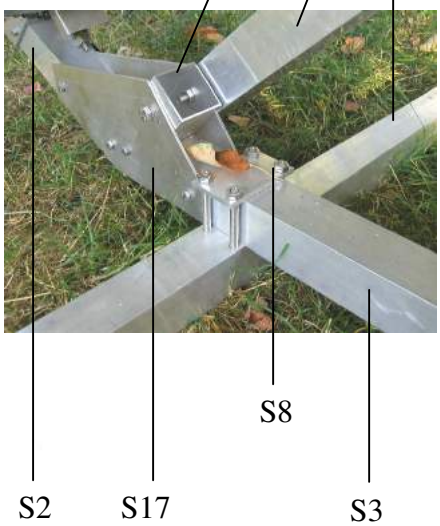
A) Combine S14 and S3 with S13 (comes on the outside of S3 and S14) by putting the holes together as shown in the drawing below. Use pop rivets to fix S13 to S3 and bolts M6 x 70 to join S13 with S14. Use bolt S13 to join S3 with S14, matching the holes.



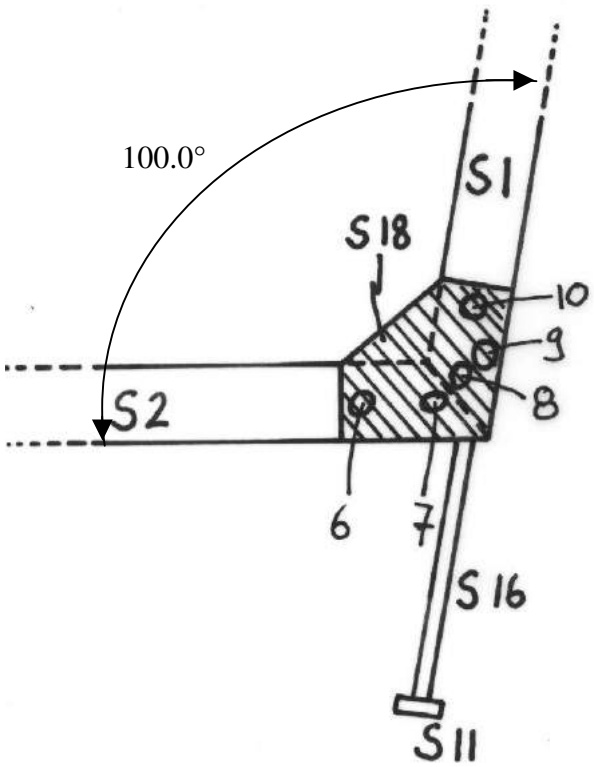
B) First draw an angle of 155° on a flat surface. Place S2 and S3 on the drawing of the angle, then put one S17 on top and drill the holes 1 to 4 (see drawing below) through the top wall of the square tube. Place S2 and S3 upside down on the same drawing, put the second S17 on top and drill the holes 1 to 4, then put bolts M6 x 70 through the holes 1 and 4. Next step is fixing S4 and S5 by drilling hole 2 through them, so that the end of S4 is flush with S2. As indicated in the small drawing below the distance from S14 to S4 has to be 383. Adjust S4 according to this distance and then drill hole 3. Do not forget to put S15 inside the square tube S4 for stabilisation. In the end drill hole 5 through S5 and S4, S5 has to be put parallel to S4.

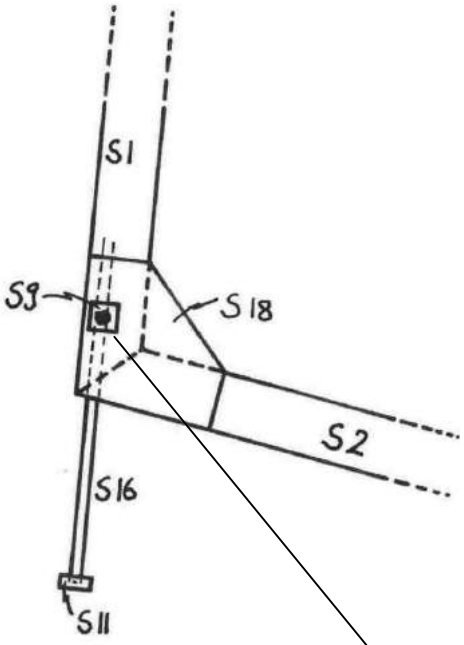
While fixing S4 to the rest keep on checking the 155° between S2 and S3!



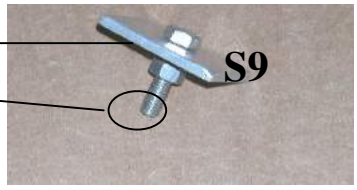


C) Draw an angle of 100° for S1 and S2 on a flat surface, put S18 on S1 and S2 and then you can drill the holes 6 to 10 in S1 and S2 through S18, follow same procedure as for S17, S2, S3. Do not forget to drill hole 9 (10mm) only through one side of S1! Cut a thread in hole 9 (M12) after you have tightened the bolts 6, 7, 8, 10 (all M6 x 70).

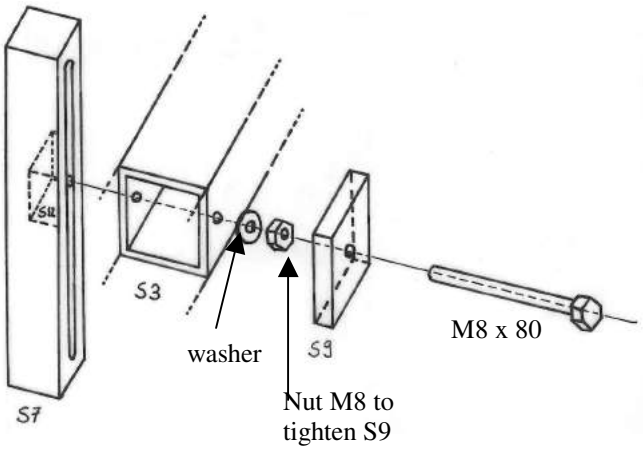




D) Building the telescope foot: First glue S16 into the hole on S11. This foot is passed through the hole on the bottom side of S2. In hole 9 (drawing above) screw in a bolt M12 with S9 as handle (see photo below). Also it is important to file the end of the bolt so it will not cut into S16 when tightened.



On this end file the edge

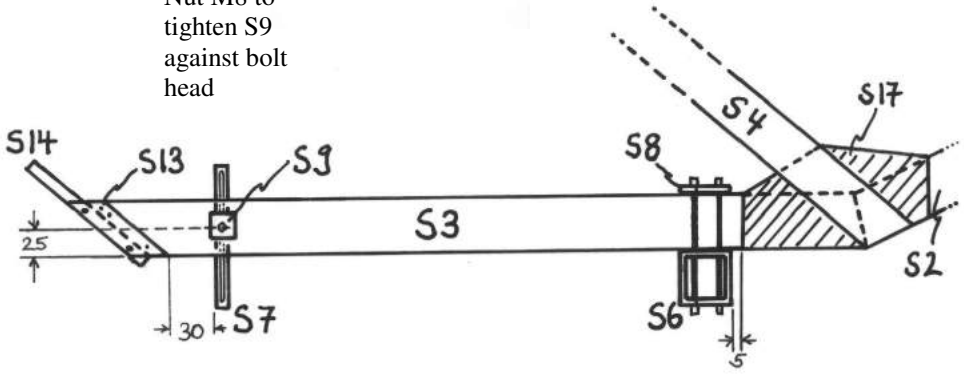


washer

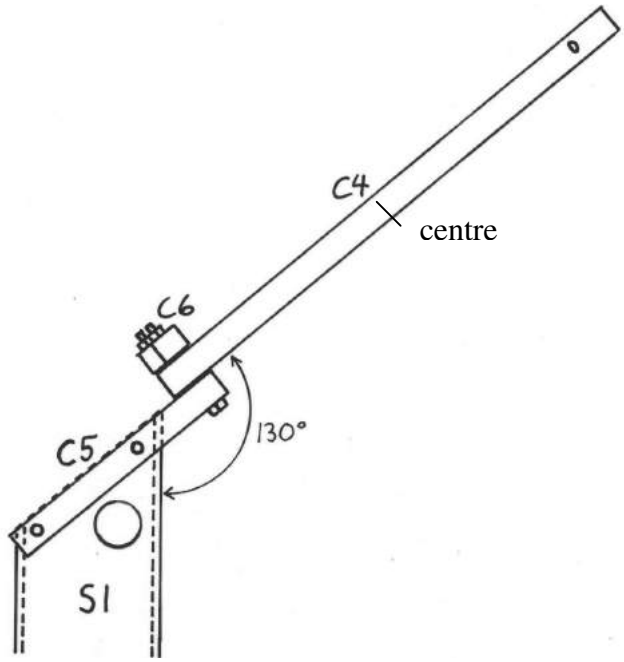
Nut M8 to tighten S9 against bolt head

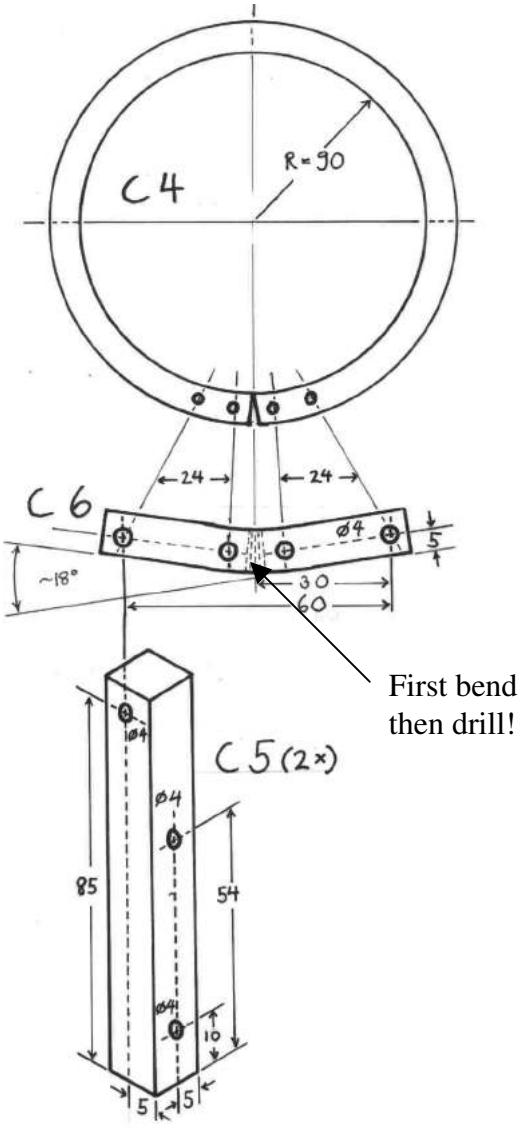
E) Attach the second foot (S7) to S3. (see drawing on the left)

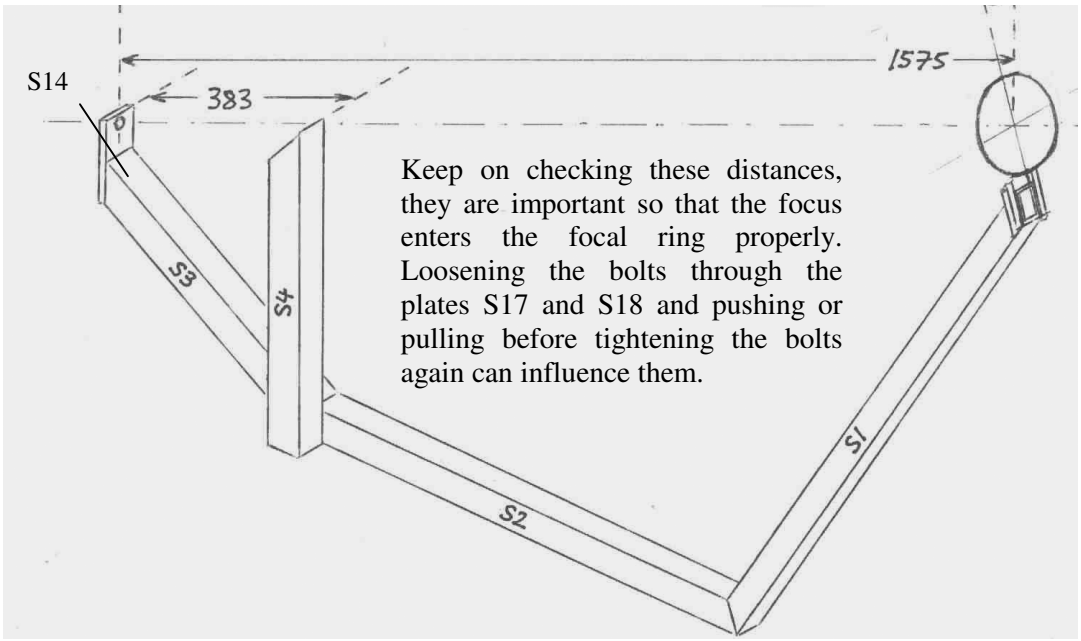
And attach the side support (S6) to S3. If you are building the reflector for Europe, it is useful to put S6 close to S17. In the photo on the previous page you can see how S6 is fixed on S3.



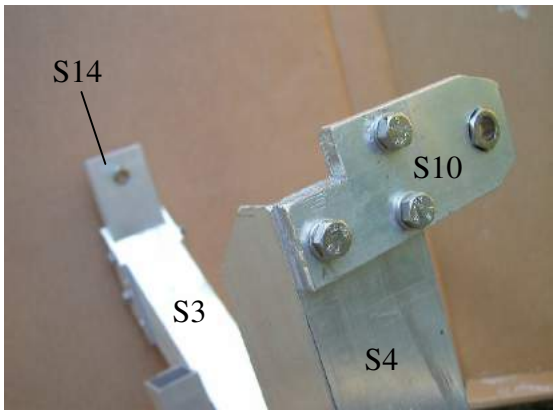
F)The two ends of the focal ring are joined with the help of C6. The two outer holes of S6 connect also to two C5. Join C5 to the sides of S1. It is important that the angle between the focal ring and S1 is 130° and the centre of the focal ring is in 1575mm distance from the inner edge of S14 (see drawings below).

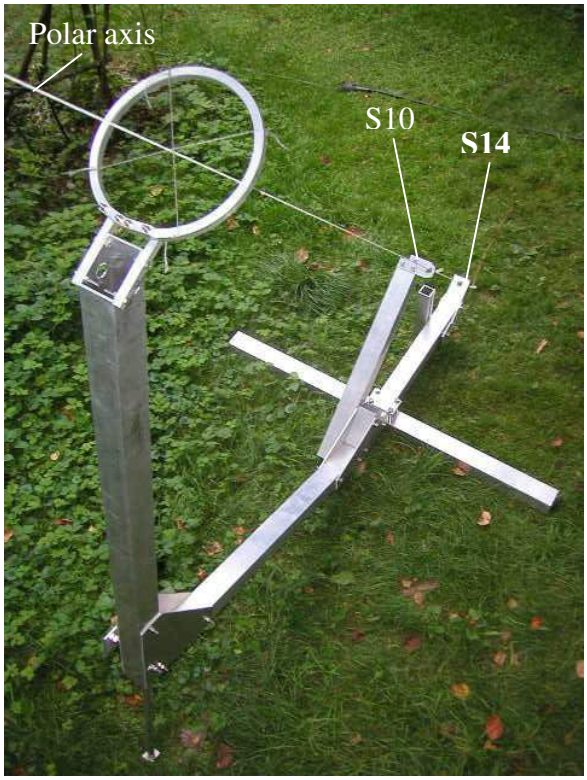






G) How to align S10:
The polar axis has to go exactly through the centre of the drilled nuts in S14, S10 and the centre of the focal ring. Clamp S10 to S4, align S10 on S4 and then drill the holes.
The accuracy can be tested with a thread passing through the centre of each part, like in the picture on the right.

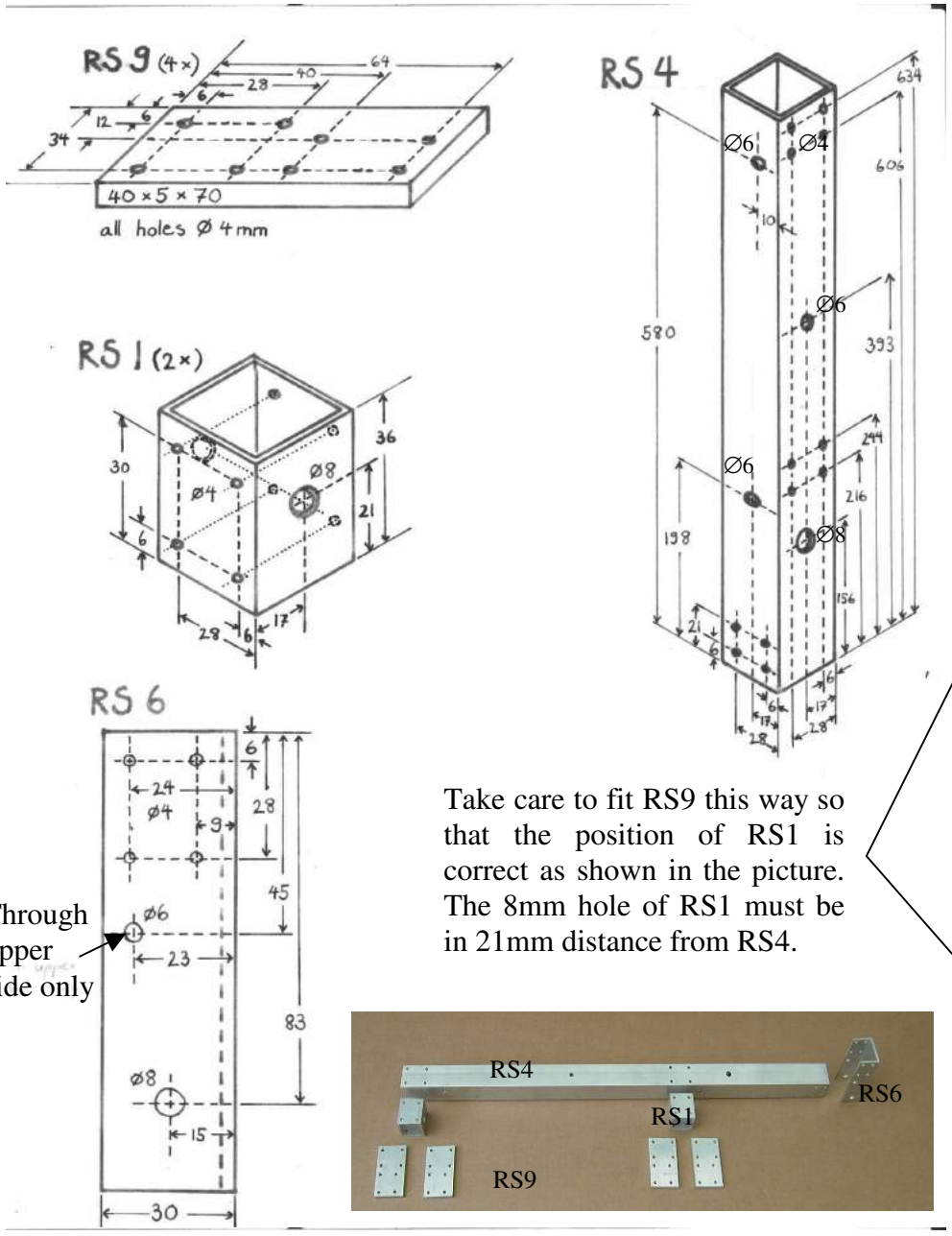


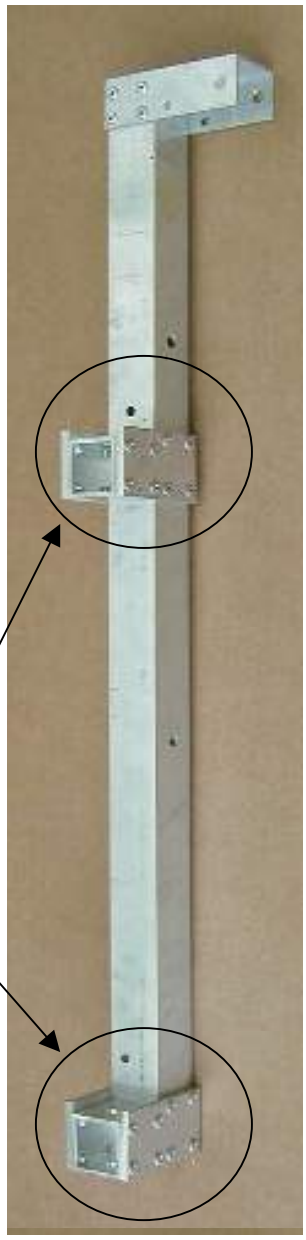


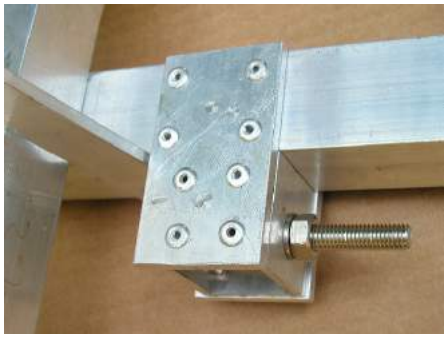
Rotating Support

Name	Dimensions [mm]	Length [mm]	Pieces
RS1	34x34x3	36	2
RS2	34x34x3	107	2
RS3	34x34x3	1370	1
RS4	34x34x3	640	1
RS5	15x15x2	463	1
RS6	30x40x30x3	93	1
RS7	20x30x20x2	1500	1
RS8	25x25x3	25	2
RS9	40x5	70	4
RS10	25x4	470	1
RS11	25x4	355	1
RS12	25x4	125	2
RS13	25x4	34	2

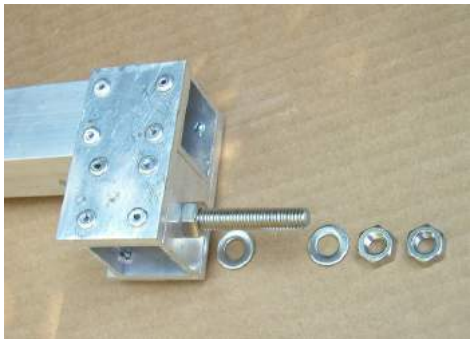
Axle



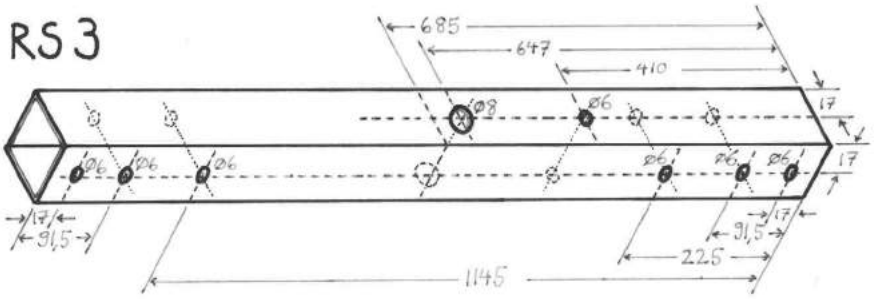


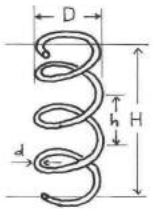


Use two bolts (M8x80) as pivots for the Axle. Pass them through the drilled nuts on S10 and S14. Do not forget to put two check nuts at the lower bolt. Otherwise wind could lift your reflector from the stand!

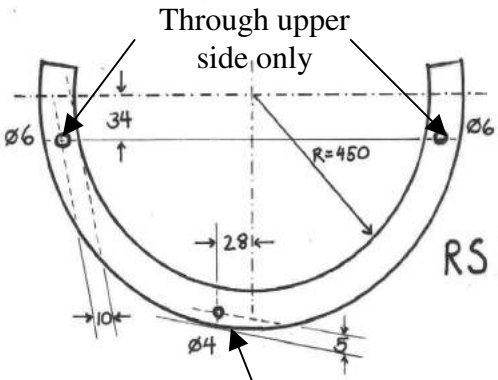


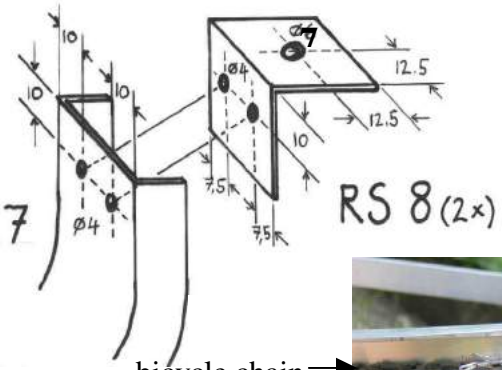
Tracking Channel





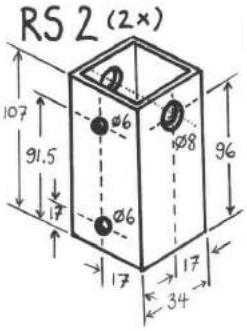
You need two springs to keep the bicycle chain under tension from both sides.
D = 10
d = 1.5
H = 20
h = 6

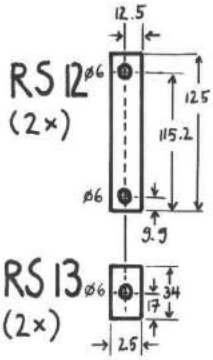




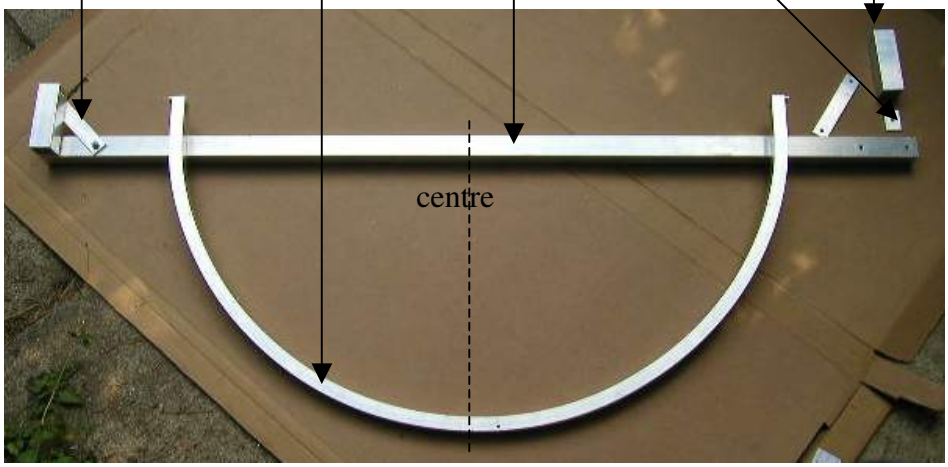
With a short wire you can tighten the bicycle chain to the bolt with the spring

RS8

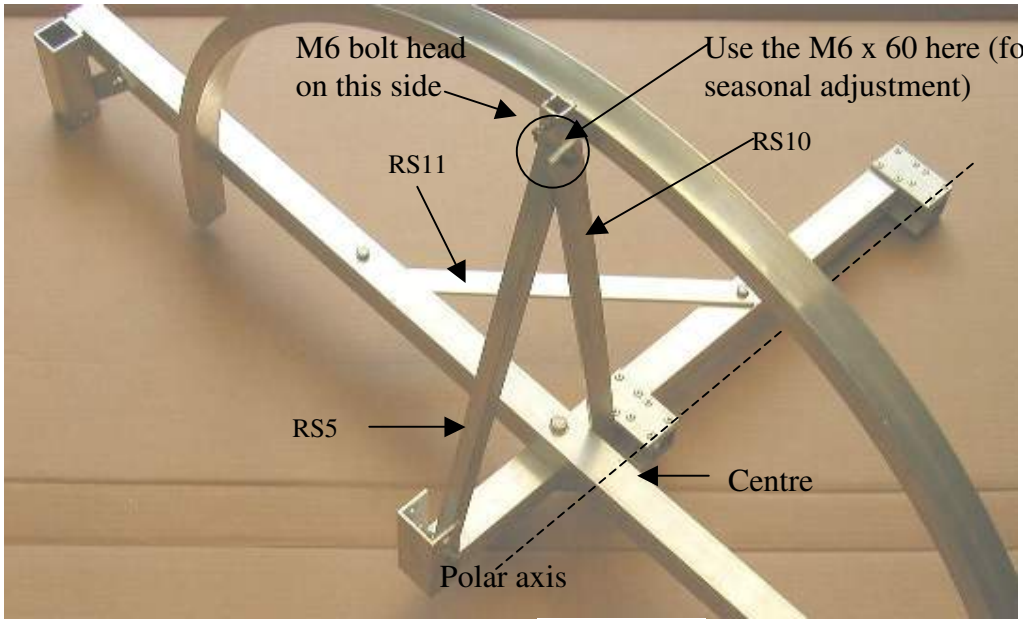




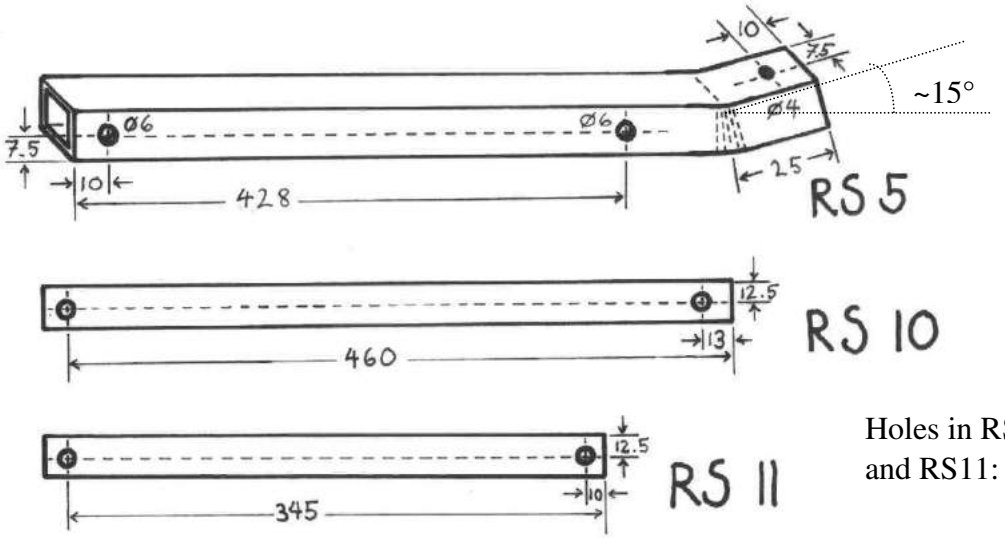
RS12 RS7 RS3 RS13 RS2



Assembly of Axle with Tracking Channel



It is advantageous to begin with RS11 so you can make sure that Axle and Tracking Channel are rectangular one to each other.
Then add RS5 and in the end RS10.



Holes in RS10 and RS11: ∅6

Name	Diameter/ Dimensions [mm]	Length [mm]	Pieces
Pop rivets	4	8	4
Pop rivets	4	12	30
Bolt M4	4	30	1
Bolt M6	6	15	4
Bolt M6	6	30	1
Bolt M6	6	50	6
Bolt M6	6	60	1
Bolt M8	8	80	3
Nut	4		1
Nut	6		17
Nut	8		5
Spring	See in drawings		2
Bicycle chain	1/2`` x 1/8``	112 links	1

Plus washers and spring washers.

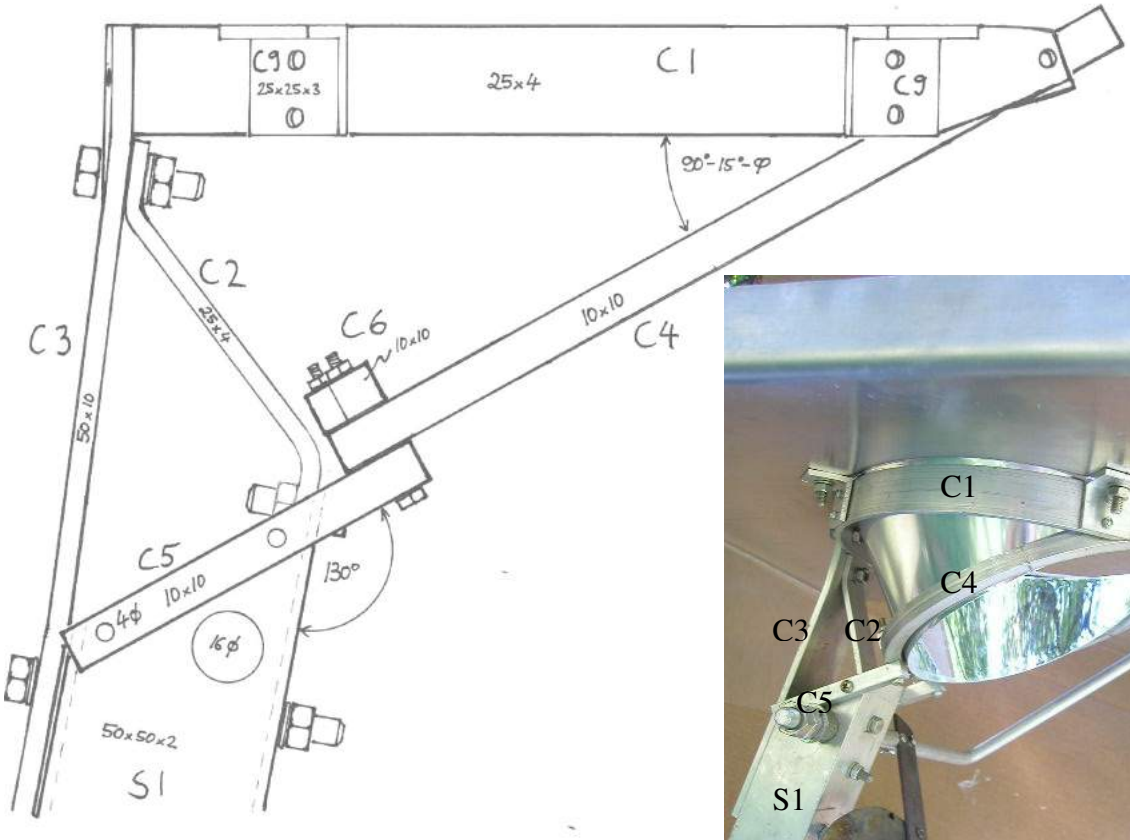
Cooking Place

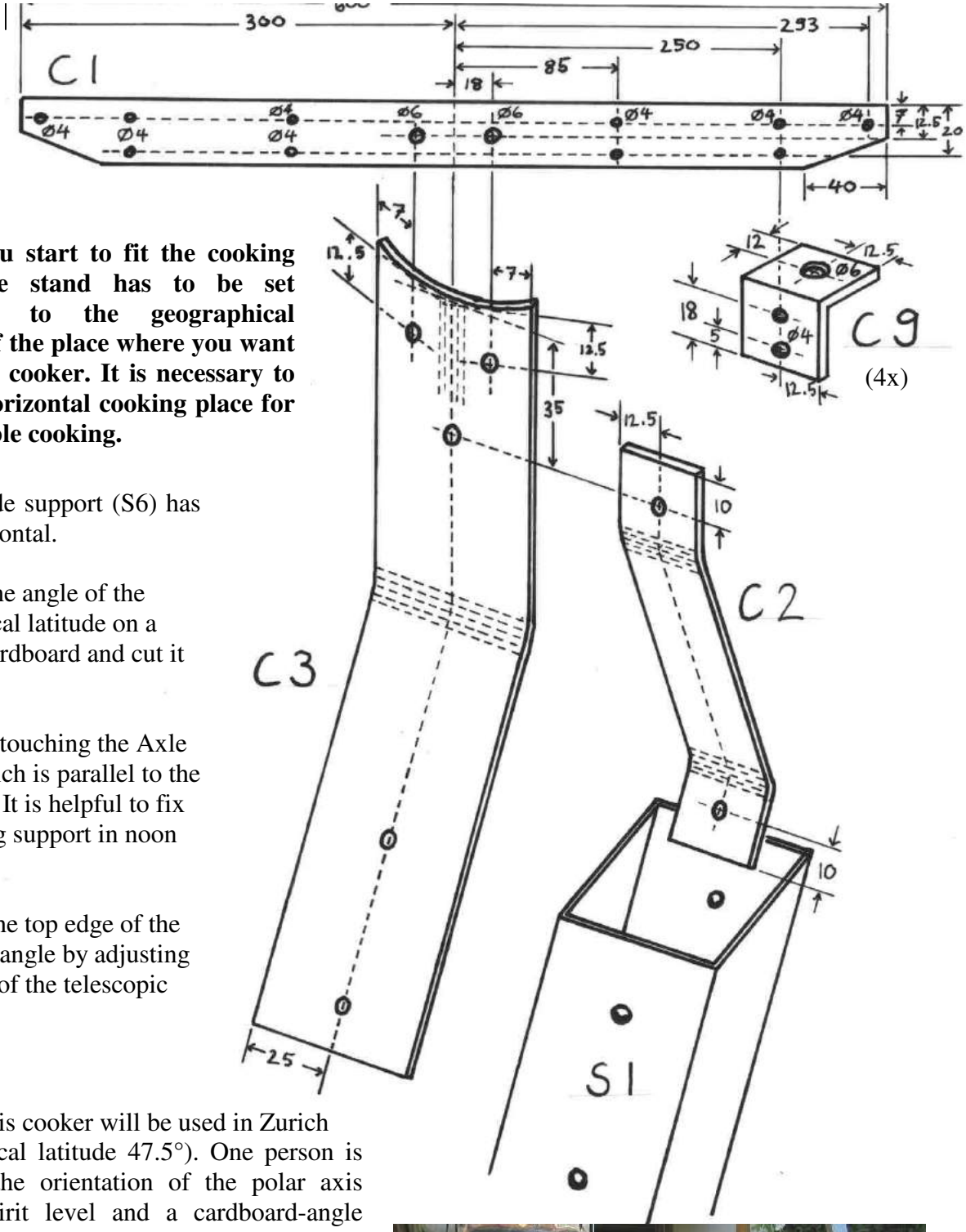
Name	Dimensions [mm]	Length [mm]	Pieces
C1	25x4	599	1
C2*	25x4	120	1
C3*	50x5	260	1
C7	12dia	700	1
C8	16dia x2 0º 30º ˜	long side 44	1
C9	25x25x3	25	4
C10	aluminium sheet 666x500x2		1
C11	steel sheet 0.6mm (stainless)	200dia	1
C12	steel bar 25x3	240	1
C13	steel pipe 15dia x1 (stainless)	56	1

˜ check the orientation of the angel on C8 in the drawing on page 22
* The length or position of these parts depends on the geographical latitude. If the cooker is not for Central Europe view page 53 before attaching these parts.

Name	Diameter/ Dimensions [mm]	Length [mm]	Pieces
Bolt M4	4	20	7
Bolt M6	6	15	8
Bolt M6	6	70	2
Washer	12		3
Nut	12		2
Pop rivets	4	12	8
Spring			2

Plus washers and spring washers.





Before you start to fit the cooking place, the stand has to be set according to the geographical latitude of the place where you want to use the cooker. It is necessary to build a horizontal cooking place for comfortable cooking.

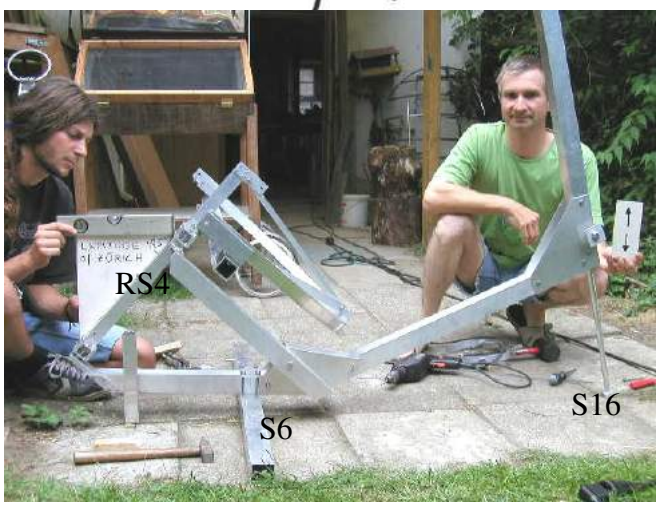
A) The side support (S6) has to be horizontal.

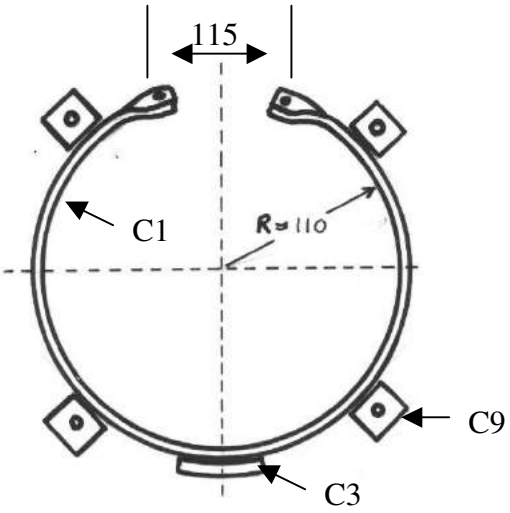
B) Draw the angle of the geographical latitude on a piece of cardboard and cut it out.

C) Hold it touching the Axle (RS4), which is parallel to the polar axis. It is helpful to fix the rotating support in noon position.

D) Level the top edge of the cardboard-angle by adjusting the length of the telescopic foot S16.

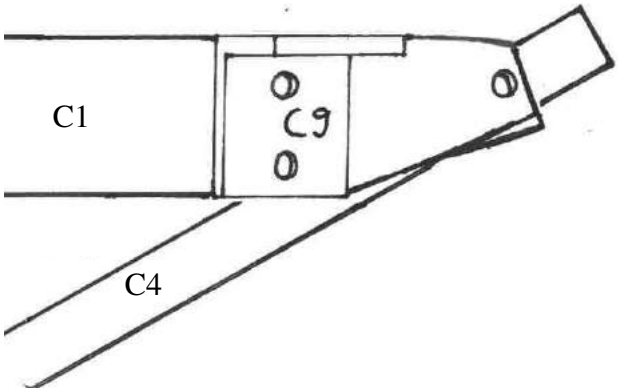
Photos: This cooker will be used in Zurich (geographical latitude 47.5°). One person is checking the orientation of the polar axis with a spirit level and a cardboard-angle while another nice fellow is adjusting the telescopic foot.

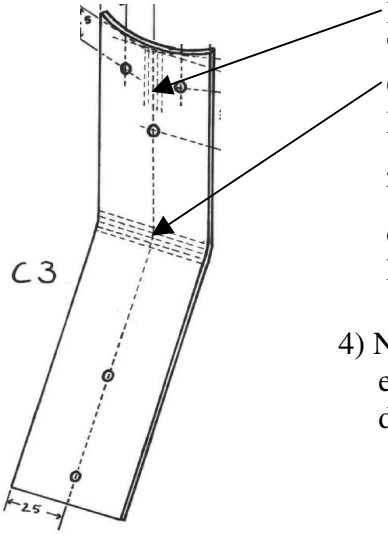




1) Bend C1 (after drilling!) to an open circle and fix C9 (4x) with rivets.

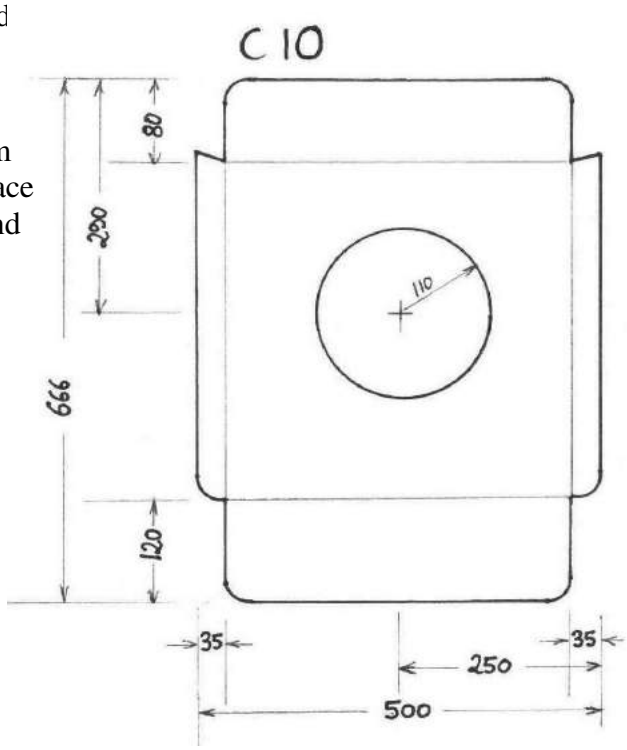
2) Bend the ends of C1 so that they touch the focal ring (C4) closely when you hold C1 horizontal. Clamp C1 to the focal ring and then drill the two holes already existing in the ends of C1 through the focal ring at the correct position (distance: 115 mm from hole to hole!) and fix it. Check with spirit level!





3) Now you have to fit C3.
First bend the top end where it will be joined with the ring C1. The next step is tricky: You must estimate where and how much C3 has to be bent so that its lower end can be bolted to S1. Maybe you have to bend it at two points - this depends on the geographical latitude.
When C3 is in the right shape, bolt it to the ring (C1) first and check the horizontal with the spirit level before you drill the holes through S1 to fix it definitely. It must fit without tension.

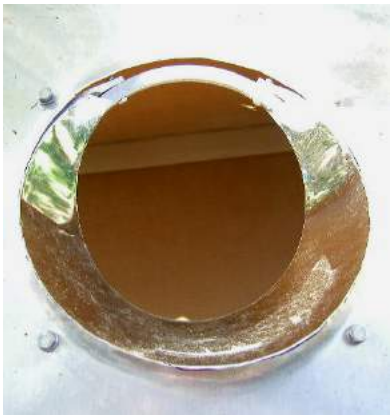
4) Now attach C2. Again you must bend it according to your estimation. It is difficult to meet with its lower hole as you drill from the outer sid



5) Cut the hot plate (C10) and fold it. Bend up the rim of the hole a little bit with a pair of pliers. Then place it on the ring (C1), drill the holes through all C9 and fix it.

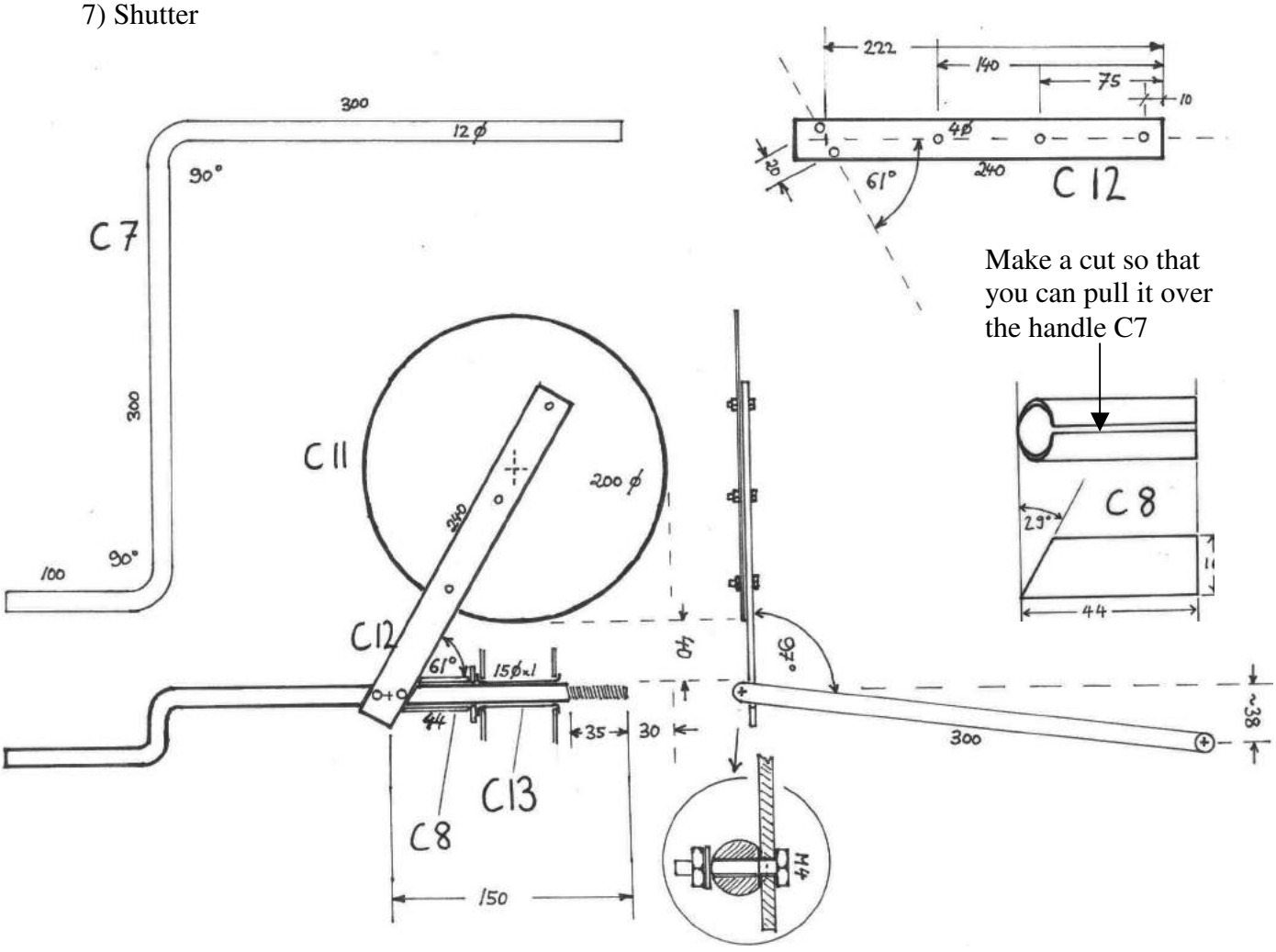
You get very nice bends if you clamp down the aluminium sheet to the edge of the table with a square tube. Then you can easily bend it with a piece of wood and a hammer.

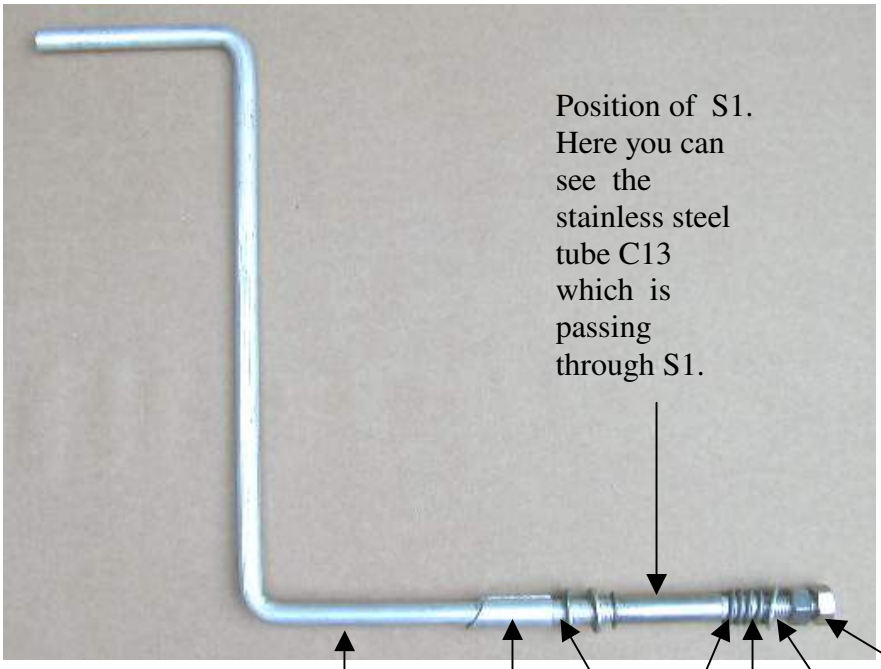
6) Secondary Reflector

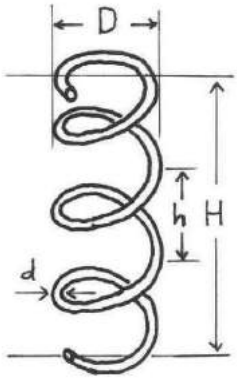


Take a piece of strong paper. Cut it with scissors to the right shape so that it will fit between the two rings C1 and C4 touching both all the way round (like the secondary reflector shown above). It will have a similar shape like a banana. Use this piece of paper as a template to cut the reflective aluminium sheet. Make small holes near to the lower side and tie it to the focal ring C4 with wires. Instead of shiny aluminium sheet you could also use aluminium sheet covered with aluminium foil.

7) Shutter







D = 20
d = 3
H = 25
h = ~8

To put pressure on the spring you need two nuts. Therefore you have to cut a thread (M12) onto the end of C7 (35mm long).

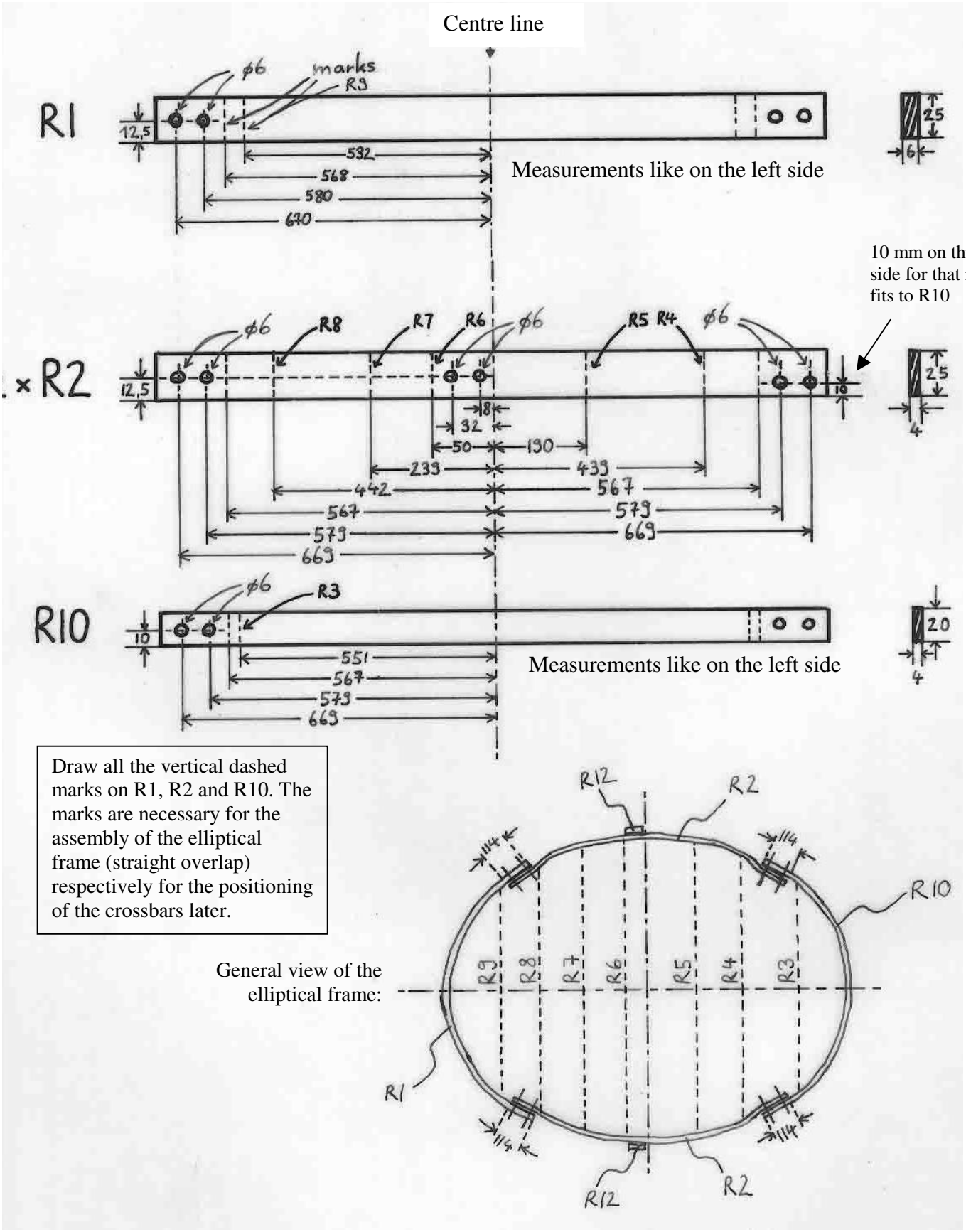
Reflector

Name	Dimensions [mm]	Length [mm]	Pieces
R1	25x6	1364	1
R2	25x4	1362	2
R3	25x4	1001	1
R4	25x4	1270	1
R5	25x4	1408	1
R6	25x4	1428	1
R7	25x4	1378	1
R8	25x4	1242	1
R9	25x4	964	1
R10	20x4	1362	1
R11	15x15x2	1850	1
R12	40x5	192	2
R13	40x5	15	1
R14	steel sheet (stainless) 0.6mm	50x20	13
R15	steel sheet (stainless) 0.6mm	50x20	3
R16	steel sheet (stainless) 0.6mm	30x20	10
R17	steel sheet (stainless) 0.6mm	30x20	4

Name	Diameter / Dimensions [mm]	Length [mm]	Pieces
Bolt M6	6	30	8
Nuts M6			8

Plus washers and spring washers

Ellipse



Draw all the vertical dashed marks on R1, R2 and R10. The marks are necessary for the assembly of the elliptical frame (straight overlap) respectively for the positioning of the crossbars later.

General view of the elliptical frame:

How to draw the Ellipse

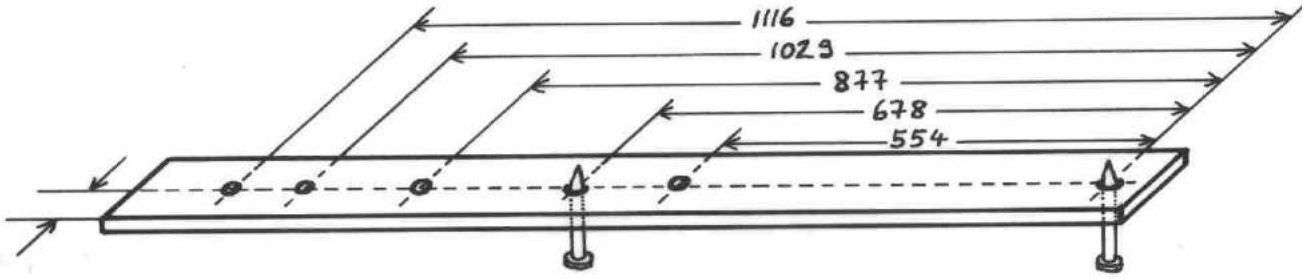
Necessary:

* Flat table (1500 x 2000 mm) to draw the ellipse. Better: on top an aluminium sheet (1500 x 2000 x 2 mm) as plane surface.
* A compass with radius up to 1116 mm. Or to build such a compass: (Aluminium) bar (25 x 4 x 1200 mm). As tips for the compass: 2 steel nails, stainless bolts or scribers.
* Pen or scriber to draw the line
* Measure tape

The ellipse has to be drawn very accurately because little faults can lead to a diffuse focus.

Building the compass:

Because strings and similar things are too flexible, it is necessary to take a bar out of a stable material like aluminium.

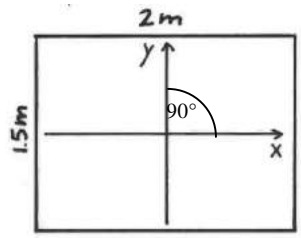


Instead of nails or scribers, also screws can be used. Then the ends of the screws have to be pointed.

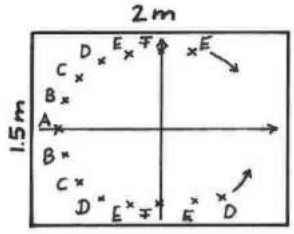
Drawing the ellipse:

To get an almost exact ellipse, we approximate the ellipse by circle segments with different radii. (Drawing the ellipse with the help of the foci and a string is not precise enough). Look at the ellipse on the next page for the measurements.

1. Construct the axes x and y with the compass (right-angled!)

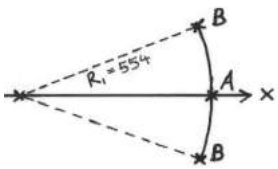


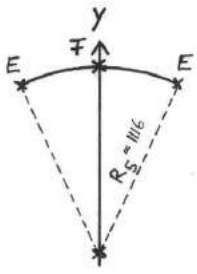
2. Draw the points A to F for all the quarters of the ellipse with the measurements given on next page. The four quarters of the ellipse are identical.



3. Around the axes x and y (between the points A,B and E,F) circle segments have to be drawn as shown:

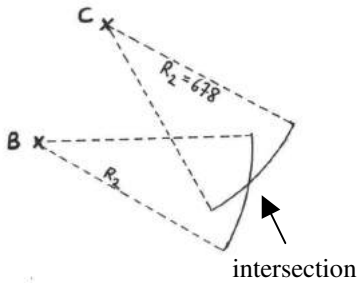
(The centre points of the circles with the radii R1 and R5 lie on the axes x and y.)



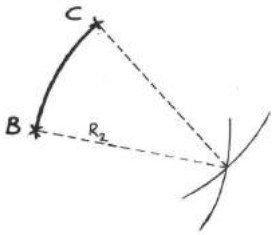


4. To construct the circle segments between the rest of the points, use the radii that are given in between two points.

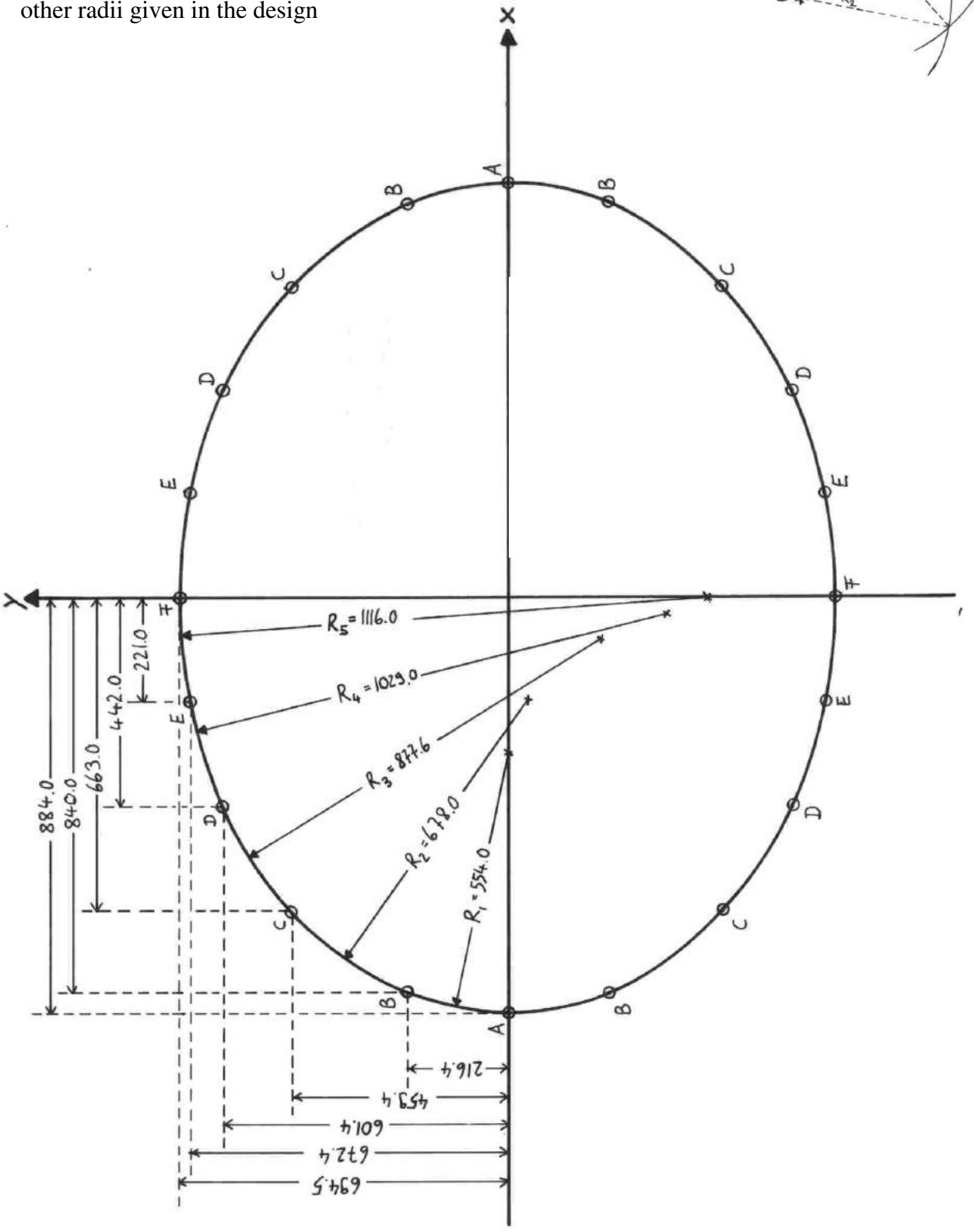
Here, the intersection between circles around B and C with the radius R_2 is constructed.



5. Then draw the segment between B and C with radius R_2 with the intersecting point from **4.** as the centre.



6. Continue the procedure for the rest of the points C to E using the other radii given in the design

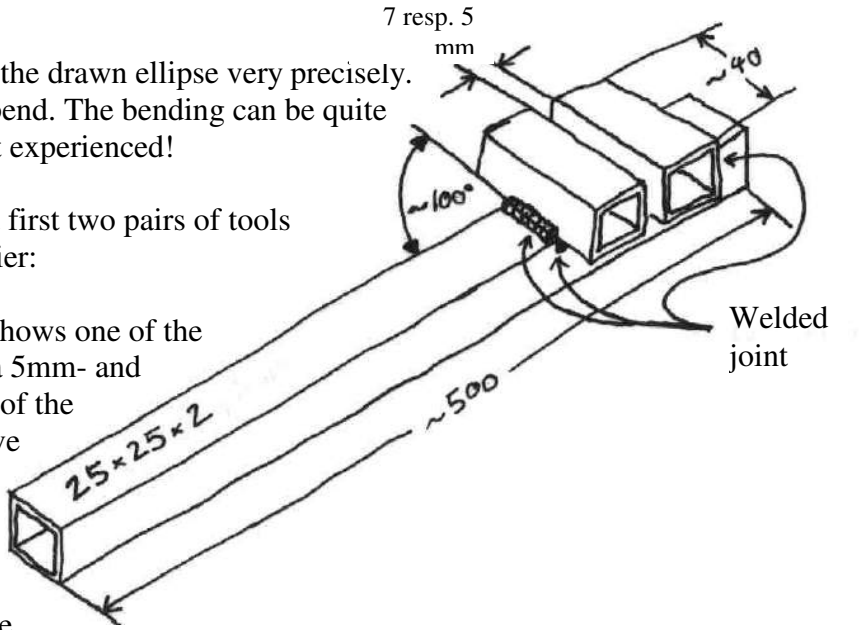


How to build the Elliptical Frame

After the four pieces R1, 2 x R2 and R10 have been prepared and the ellipse has been drawn on the aluminium sheets, the elliptical frame can be constructed.

Furthermore you need (to prepare some bending tools) :

Name	Diameter / Dimensions	Length	Pieces
square tube, (iron)	25 x 25 x 2	500	4
square tube, (iron)	25 x 25 x 2	40	8
welding equipment to fix the tubes			

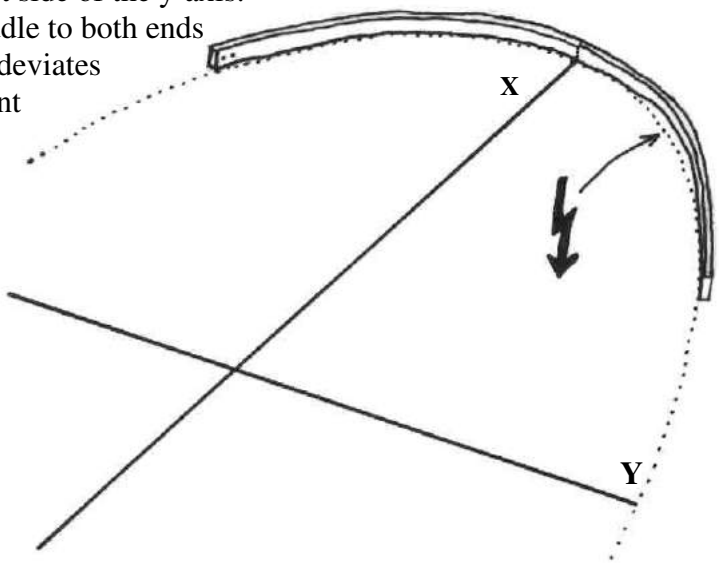


Finally the bars have to follow the drawn ellipse very precisely. To reach this, they have to be bend. The bending can be quite tricky, but after a while you get experienced!

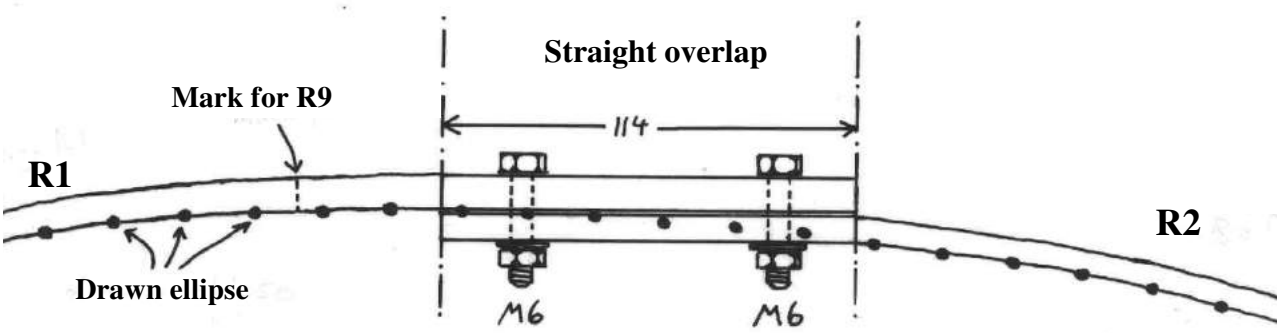
It is of great advantage to build first two pairs of tools that make bending the bars easier:

The drawing on the right side shows one of the tools. You need one pair with a 5mm- and one pair with a 7mm-gap. One of the tools from each pair should have a 100° angle (see drawing), the other should have a 80° angle. The tools engage with the flat bar (R1, R2, R10) on both sides of the point where you want to bend it.

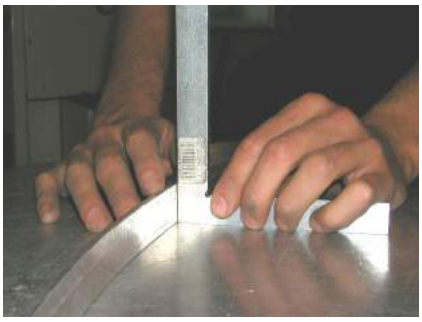
The bars (R1, R2, R10) are bend on edge. Put one with its centre line on the axis (R1 & R10 on the x-axis (the long axis), the R2's on the y-axis (the short axis)). Make sure that the 6mm-holes near the middle of the two R2-bars are on the correct side of the y-axis.
It's good to bend the bars starting from the middle to both ends like it is shown in the photograph. When a bar deviates from the elliptical form at a point, take this point between the bending tools and bend the bar into the right form.



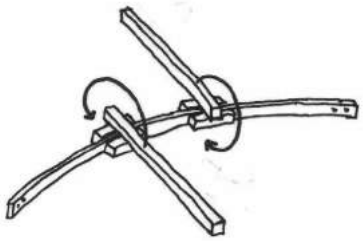
Like it is shown in the next drawing, the ends of the bars have to remain straight on the last 114 mm. Immediately after the 114 mm, the bars have to follow the drawn ellipse (dotted line). The ends of the R2's have to lie inside, the ones of R1 and R10 outside the ellipse.
As example the overlap of R1 and R2:



Often, after bending, the bars are twisted around their longitudinal axis. You have to test this with holding an angle iron against the bar:

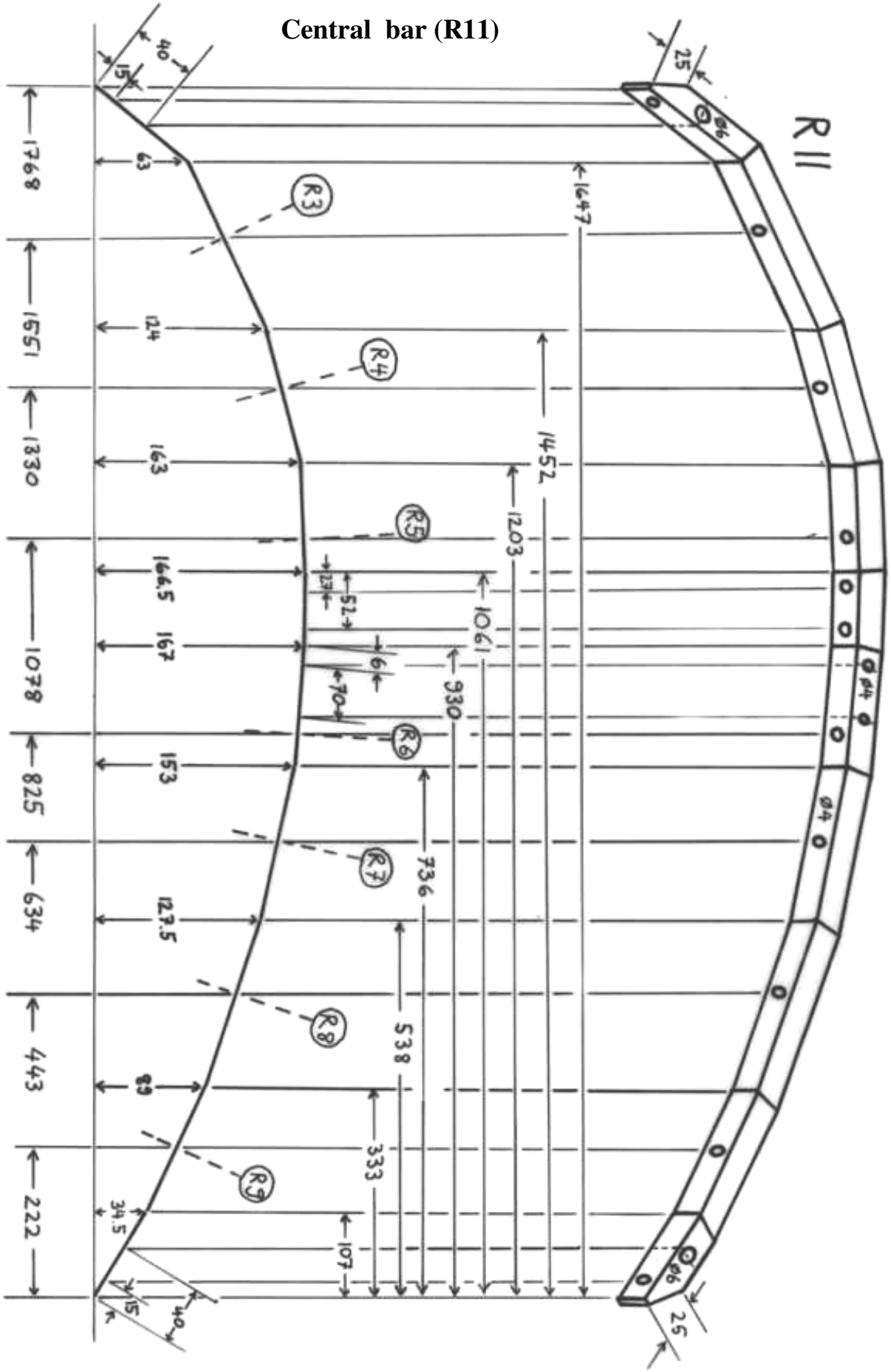


Behind a point, where a bar leaves the 90° related to the table, it has to be twisted to get it back right-angled. Do this with the bending tools or in a vice. Control after this, whether the bar still has its precise elliptical shape. It also has to lie flat on the table.



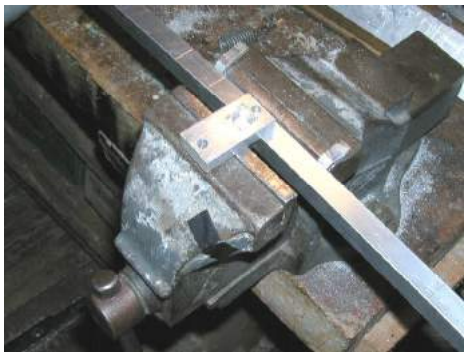
The bars are bolted together with M6 x 20 bolts.

Central bar (R11)

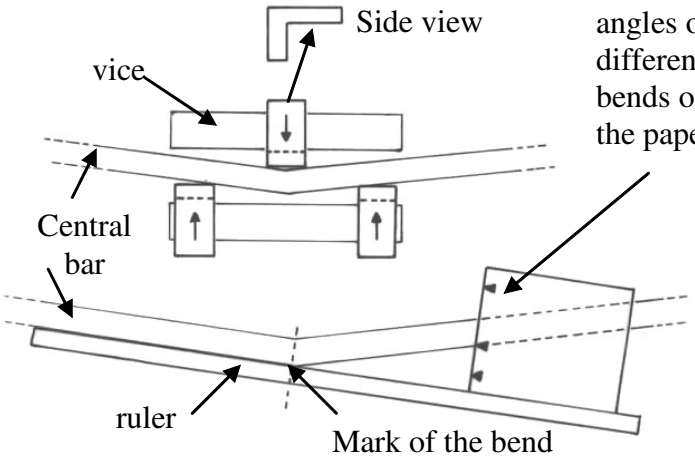


You need a jig (curved line on the left side in the drawing) to bend the Central bar. Draw it 1:1 (with the measurements given above) on a flat surface, e.g. on a big aluminium sheet. Mark the points of the bends and holes exactly. The jig is designed for the inner side of the curved bar.

How to bend the Central bar R11:



Place one end of the square tube R11 on one end of the jig and mark the first bend.
Place three small pieces of metal between the vice and the square tube as it is shown in the scheme and the photo. When you close the vice, you bend the square tube at the position of the central metal piece. In the photo, the central piece is a round pin stuck in a small plate, which prevents the pin from falling down. The round pin is advantageous because you can place it very exactly at the marked bend.



Marks for angles of different bends on the paper

You can easily make a tool, which tells you how much you have to bend the central bar:

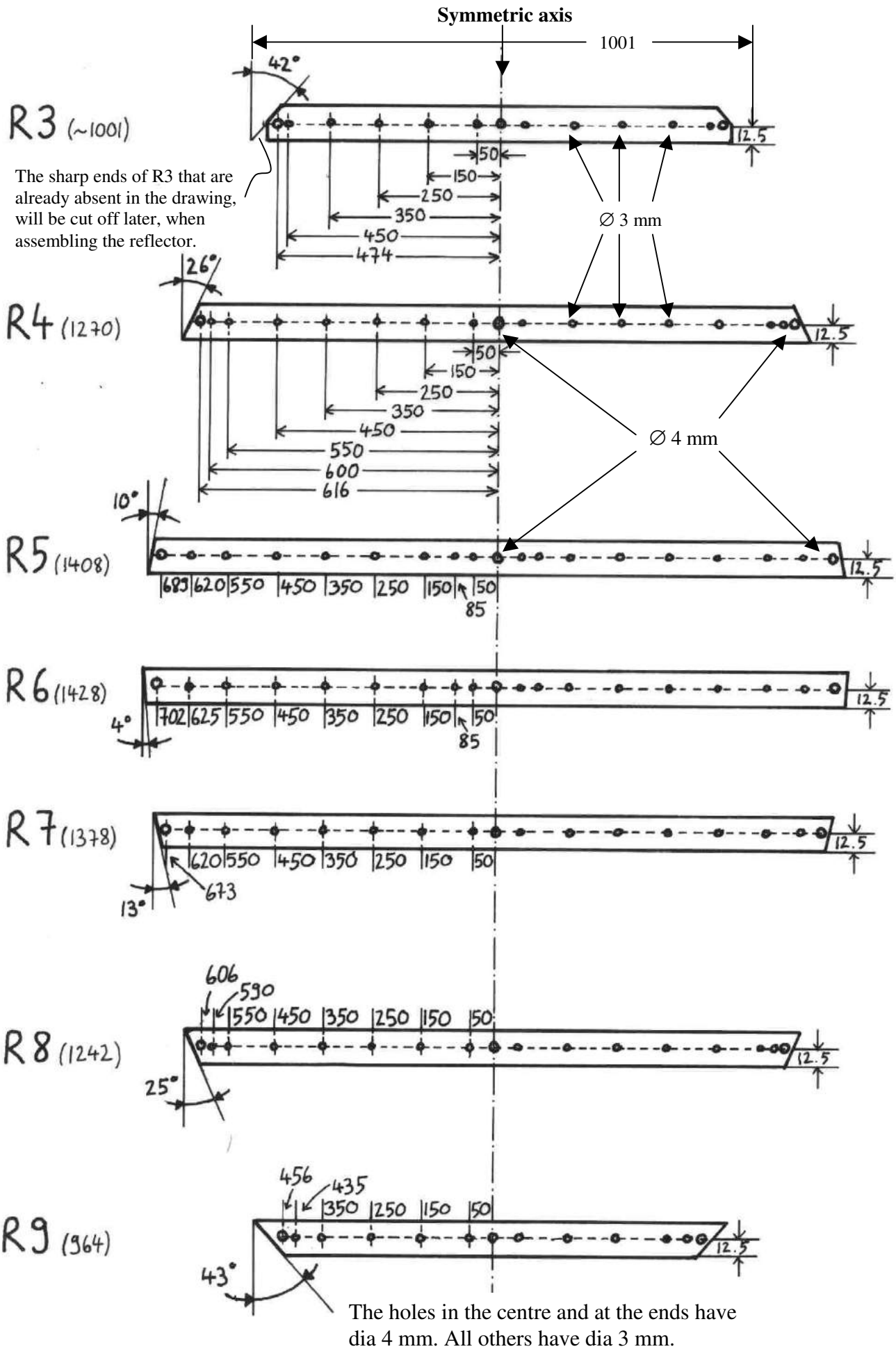
1) Take a bar as ruler and glue a piece of paper to one end.
2) Mark a point on the ruler.
3) Hold the ruler with this point matching the bend and mark the angle on the paper.

After completing the first bend, check it on the jig and then continue bend by bend along the Central bar.

Then you have to check if the bent Central bar is still plane. Place it on a flat surface. Also control with a right angle if the side of the Central bar where the Cross bars will be bolted is square with the surface. If not, correct with a hammer (photo).

After the Central bar is bent, transfer the marks of the holes from the jig, drill them and cut the ends as you see it on the right side in the drawing on the previous page.

Crossbars (R3-R9)



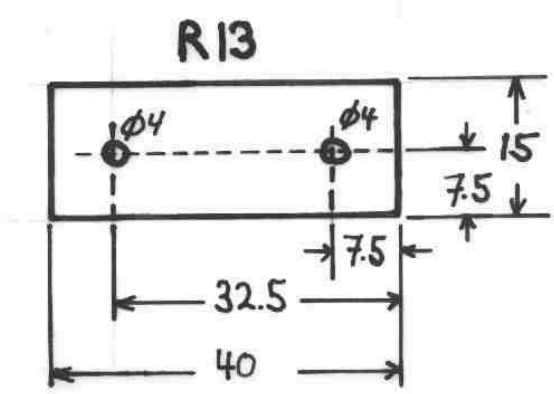
The sharp ends of R3 that are already absent in the drawing, will be cut off later, when assembling the reflector.

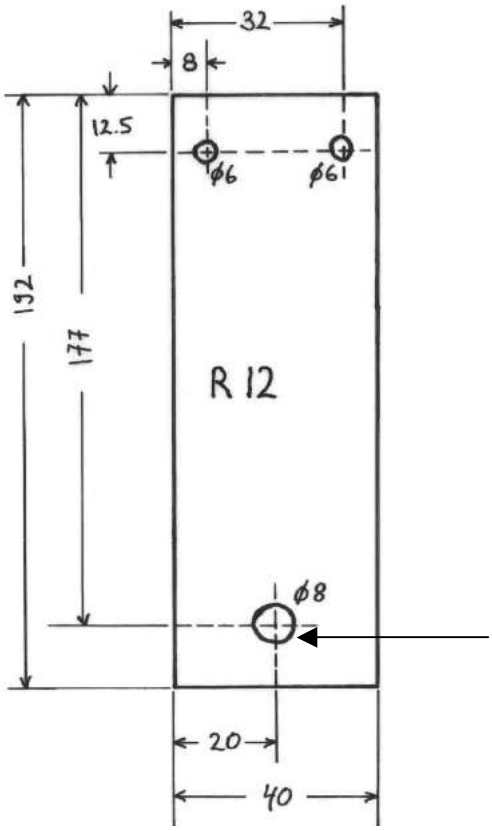
The holes in the centre and at the ends have dia 4 mm. All others have dia 3 mm.

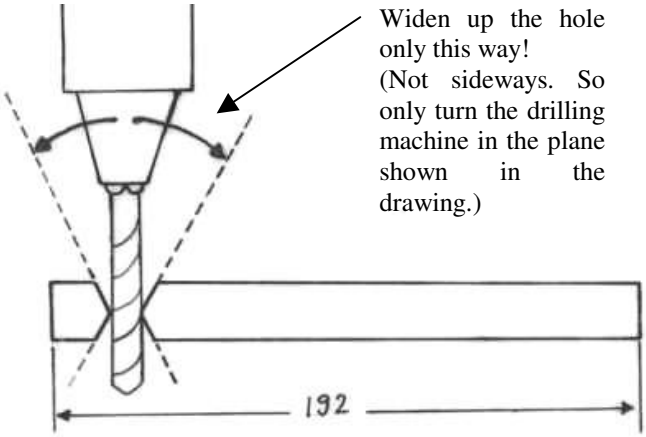
Crossbar	Radius [mm]
R3	1292
R4	1393
R5	1506
R6	1619
R7	1706
R8	1792
R9	1892

Bend the Crossbars with these radii. Draw the circles with a compass on a flat surface and use this as jig. Afterwards, check if the bent pieces are not twisted. Do this with an angle iron as you did it when you bent the ellipse (R1, R2, R10). Correct if necessary.

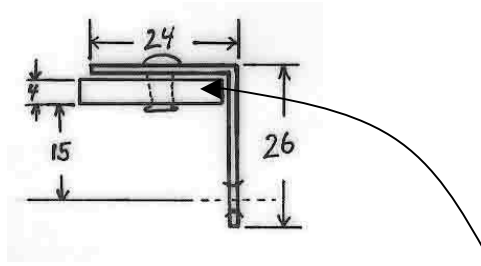
Further parts for mounting the reflector:



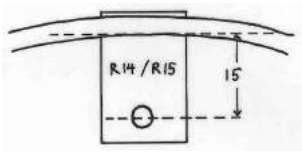




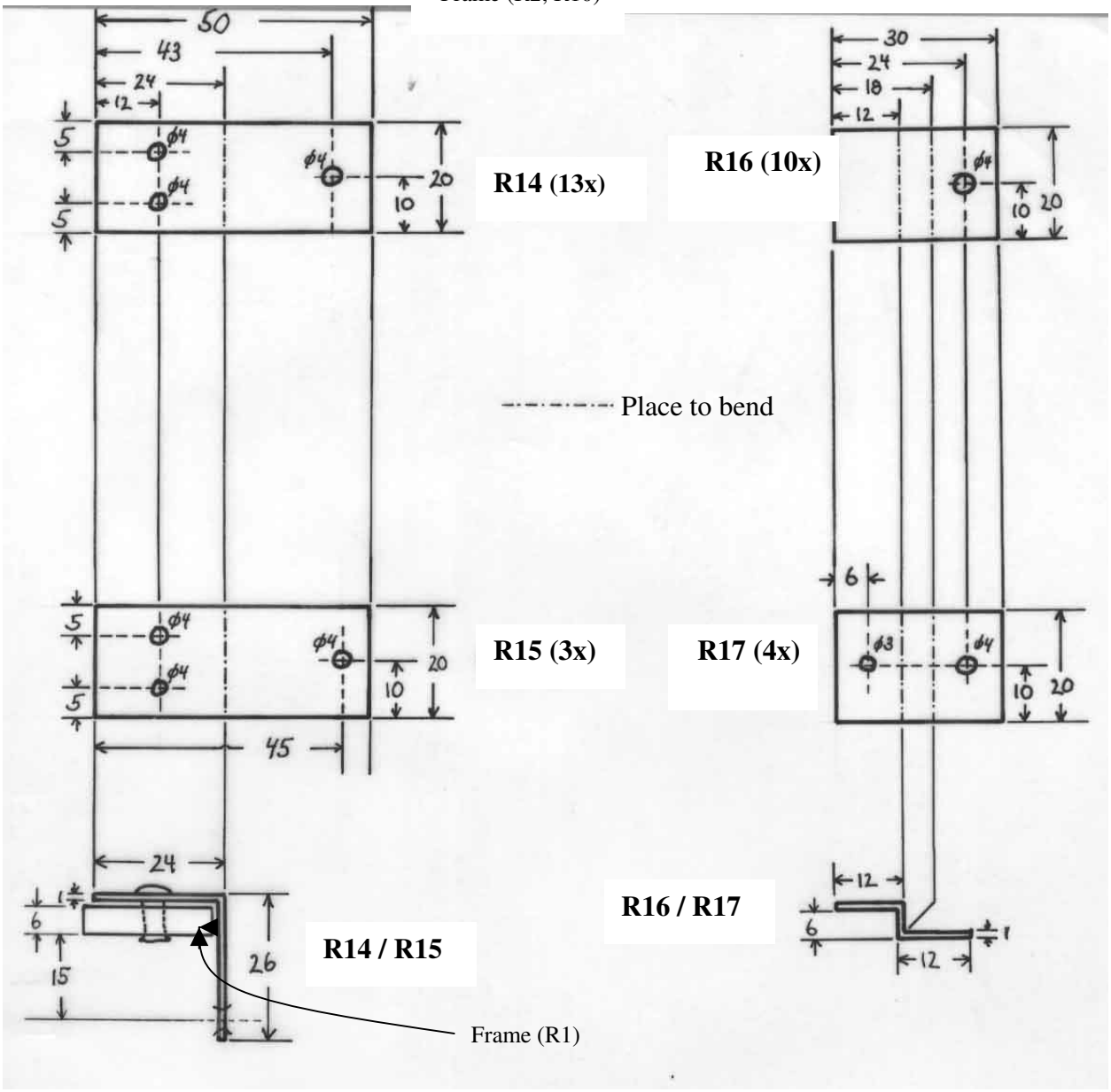
Drill this hole as shown above. R12 has to be able to incline on the bolds of the rotating support because the reflector is flexible.



Important: the distance from the inner edge of the frame to the centre of the hole must be 15mm.



Frame (R2, R10)



Bending of R16 and R17: Make the bent (90°) at 12mm first, then use a strip of the polycarbonate as a measure and make a second 90° bend. Bend with a piece of aluminium in a vice (view photos below).

How to assemble the Reflector:

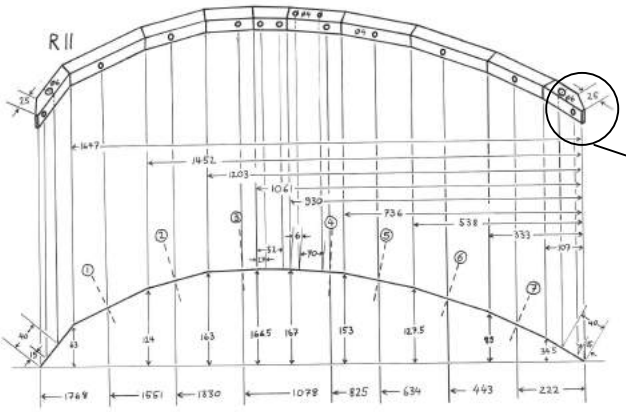
1. Bolt the crossbars (R3 – R9) to the central bar (R11) in the correct order (view drawing on page 30).

2. For the next steps place the ellipse on a flat surface.

2.1 Attaching the single folded straps (R14 and R15) to the ellipse.

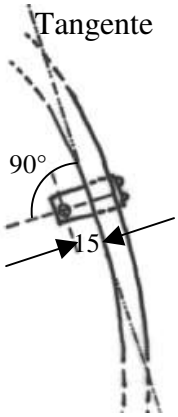
How to clamp the single Folded straps to the ellipse:

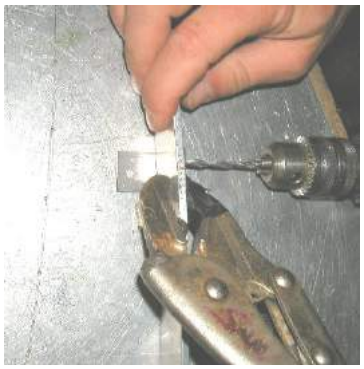
The side with two holes has to be flat on the out-side of the ellipse. The other side (one hole) has to point inwards the ellipse.



This side of the central-bar goes on R1.

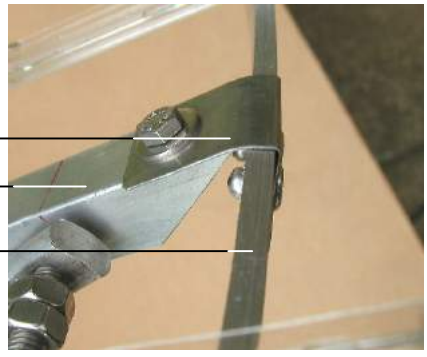
The centre of the one hole Pointing inwards the ellipse has to be at a right angle to the mark on the ellipse (view drawing). Drill the holes through the ellipse and insert pop rivets after a strap has been clamped to the ellipse like explained.





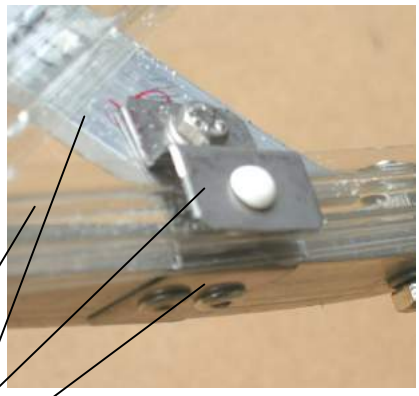
One of the 3 R15 is fixed to the centre of R1, the other two also on R1 on the marks for R9. The 12 R14 “are” fixed to the marks for the crossbars R3-R8 on R2 and R10. One R14 is fixed to the centre of R10 (for holding the central bar).

2.2 Fixing the central bar to the single folded straps attached to R10 and R1 (see drawing above). Bend the R14 / R15 to the central bar and put the bolt.



2.3 Attaching the crossbars to the single folded straps at the ellipse and to the inside of the central bar.

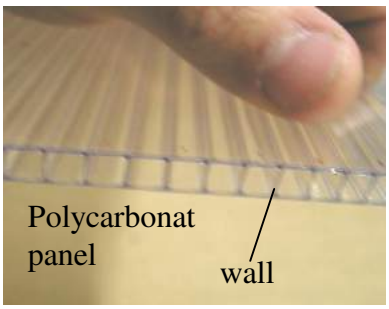
- Turn the whole ellipse over, then fix crossbar after crossbar to the single folded straps after bending the end of the straps towards the crossbar. On top of the single folded straps you have to put the double folded straps (R16 and R17). On the crossbar R3 and R9 fit the double folded straps (R17) with holes on both ends.

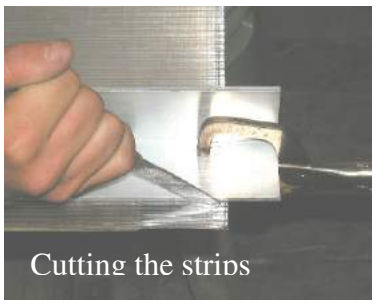


- Fix the centre of the crossbar with M4 x 30 bolts to the inside of the central bar.

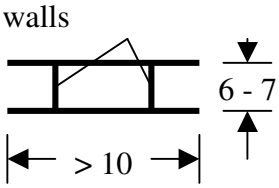
After that it should look like in the photo on the right side.

2.4 Cut the strips out of a hollow polycarbonate panel with walls. Every strip has two walls.





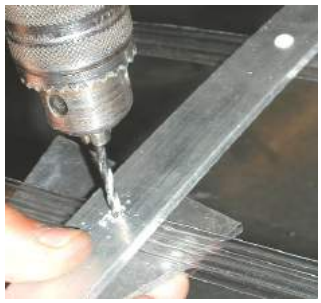
Polycarbonate strip (cross section)

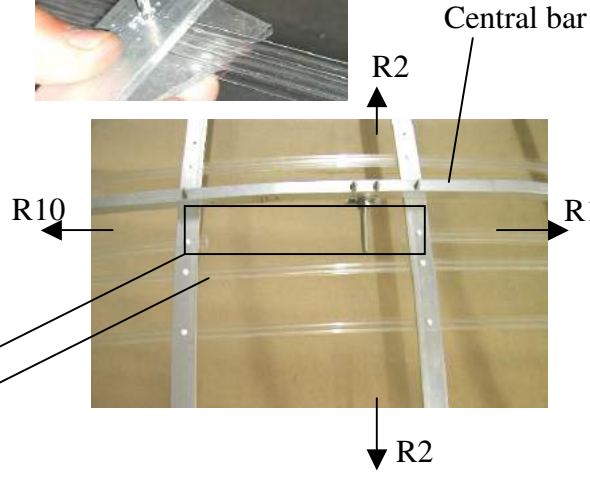


Attach the polycarbonate strips with plastic rivets to the 3mm holes in the crossbars.

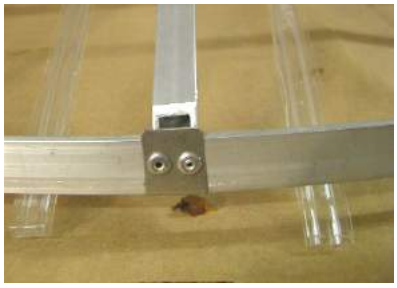
Attention: - while drilling into the polycarbonate strips, through the holes on the crossbars, support with an aluminium piece from below (in order not to destroy the flat surface of the polycarbonate stripes)

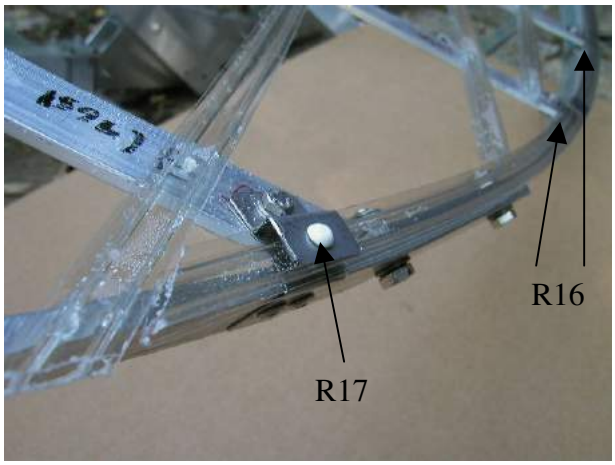
- on the right side (looking from the side of R10 over the reflector) the first strip beside the central bar needs a gap between R5 and R6. Instead place a polycarbonate strip onto the second holes in R5 and R6 over R4, R5, R6 and R7. But do not use these holes on the other half of the reflector!





- The polycarbonate strips have to extend at least 10mm over the rim of the ellipse (view photo on the right).





-Put polycarbonate strips under the R16 and R17 and fix them on the R17 with plastic rivets (view photo on the left).

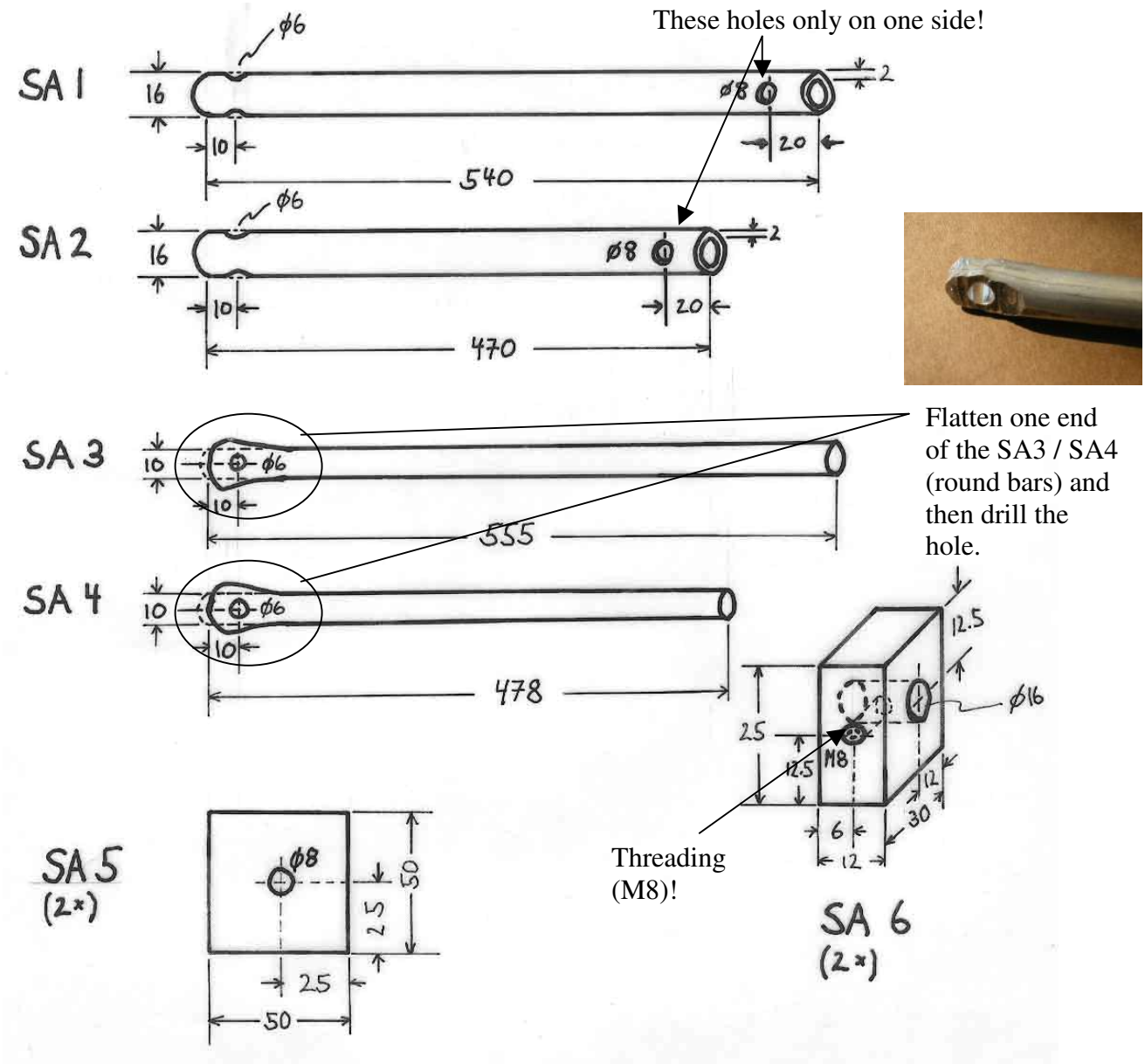
Name	**Diameter/ Dimensions[mm]**	**Length [mm]**	**Pieces**
Bolt M4	4	10	16
Bolt M4	4	30	7
Nuts	4		23
Pop rivets	4	8	24
Plastic blind rivets		4-5	92

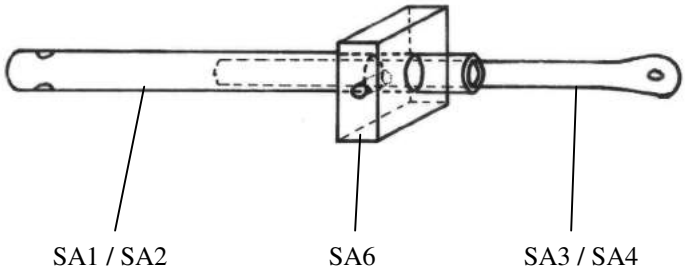
Seasonal Adjustment

Name	Dimensions [mm]	Length [mm]	Pieces
SA1	16dia x2	540	1
SA2	16dia x2	470	1
SA3	10dia	555	1
SA4	10dia	485	1
SA5	50x4	50	2
SA6	25x12	30	2

Name	Diameter/ Dimensions[mm]	Length [mm]	Pieces
Bolt M8	8	30	2
Nut	8		2

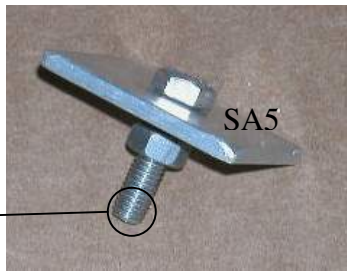
Parts:





Glue SA6 to SA1 and SA2 at a distance of about 20mm from the right end of SA1

Put a M8 bolt with SA5 in the thread in SA6 (see photo).
You have to file the end of the M8 bolt (view photo) so it will not cut into SA3 / SA4, when putting pressure on it.



Assembled it looks like this.

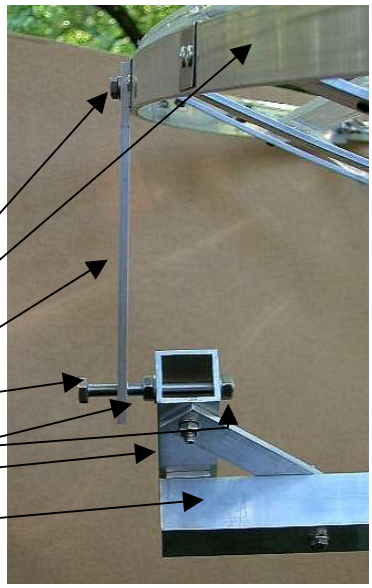
Mounting the Reflector to the Rotating Support

The reflector is mounted to the rotating support with 5 joints. It is orientated with the narrow bar **R10** of the elliptical frame towards the cooking place.
In addition to **R12**, **R13** and the seasonal adjustment you need the following:

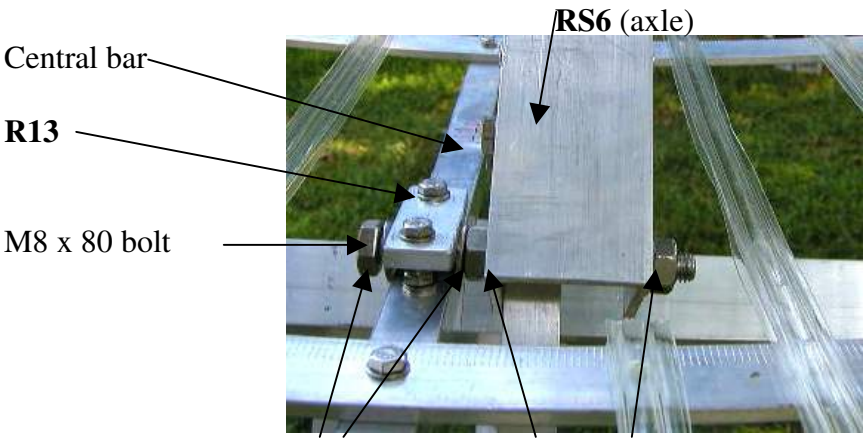
Name	Diameter [mm]	Length [mm]	Pieces		Name	Diameter [mm]	Length [mm]	Pieces
Bolt M4	4	35	2		Nut M8			16
Nut M4			~ 6					
Bolt M6	6	20	4		Bolt M8	8	80	3
Bolt M6	6	40	2		Nut M8			6
Bolt M6	6	70	1					

M4, M6 & M8 washers and spring washers

The rotating support and the elliptical frame are connected on both sides via M8 x 80 bolts that go through the **RS2** and the **R12**.
The **R12** are fixed to the outside of the elliptical frame with M6 x 20 bolts (drawing of the frame on page 25 or photo on the right).
M8 x 80 bolts on both ends of the rotating support hold the reflector and allow it to move when it's seasonally adjusted. The bolts are fixed in the two **RS2** and go through **R12** freely (view photo on the right).

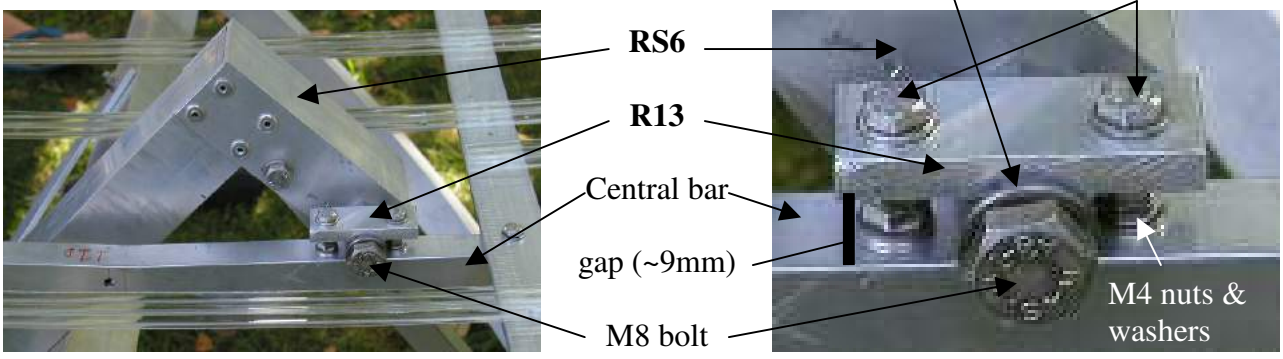


In the centre the Central bar is held with the small aluminium piece **R13** on a M8 x 80 bolt. The bolt is fixed in the rotating support (**RS6**) and also serves as rotating axis when the reflector is seasonally adjusted.



view from the cooking place

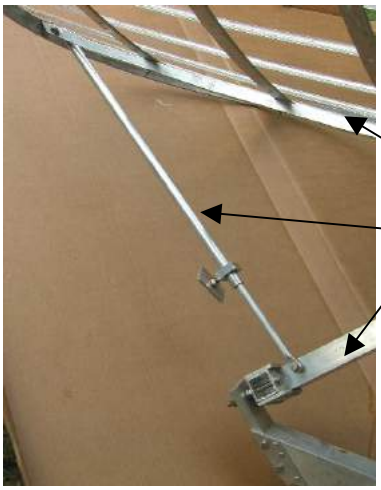
view sidewise:



The M8 bolt is fixed with nuts to **RS6**. **R13** is fixed to the Central bar with M4 bolts. To enable the reflector turning around the M8 bolt, there has to be a gap of around 9 mm between **R13** and the Central bar. You achieve this by screwing a sufficient amount of M4 nuts and washers on the two M4 bolt fixing **R13** to the Central bar.

The remaining suspension points are at the ends of the Central bar. Here the two seasonal adjustments are mounted. The long adjustment is mounted on the side of the cooking place.

Side far from cooking place:

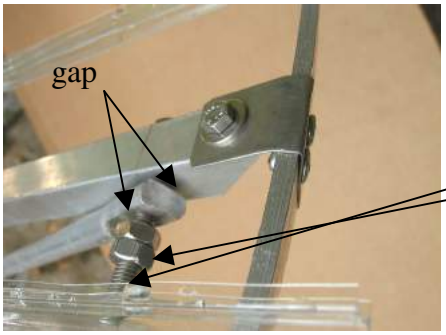


overview:

Central bar
adjustments
axle
rotating support

Side of cooking place:

details:



RS5
RS10
M6 bolt
counter nut

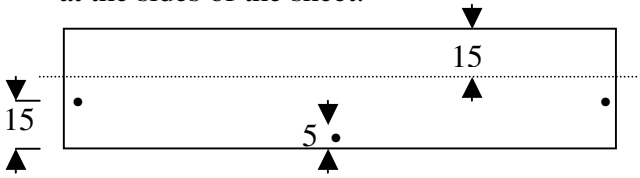
Mount both ends of each adjustment on the same side relative to the longitudinal axis of the reflector (so that they are not diagonally fixed). On all bolts holding the adjustments there has to be a gap enabling the adjustments to move: fix the bolts with one nut to their carriers, put the adjustments on the bolts and lock the bolts with a nut and a counter nut.
To connect the adjustments to the reflector, fix two M6 x 50 bolts to the Central bar at its ends. Then put the flat hammered ends of the adjustments freely on the bolts and counter lock the nuts.
The adjustment at the side of the cooking place is mounted to the rotating support via the long M6 x 60 bolt that fixes **RS5** and **RS10** together. Put the adjustment's tube on the bolt and lock it (counter nut).
The adjustment at the front side is mounted to the remaining hole in the axle of the rotating support (**RS4**) with a M6 x 70 bolt.
All is mounted correctly if you can change the inclination and shape of the reflector on the rotating support (while the bolts of the seasonal adjustments are opened).

Covering the Reflector with reflective aluminium sheets

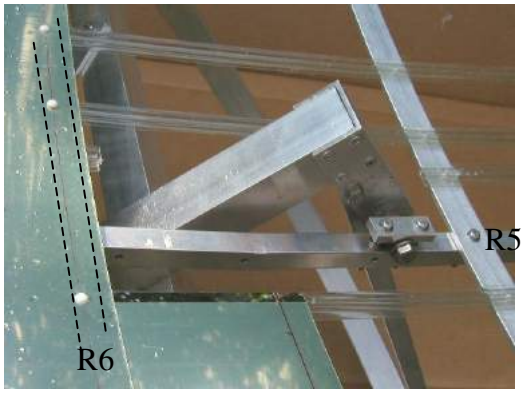
Here is described how the reflector is covered with aluminium sheets. Instead of aluminium you can also use glass mirrors, which are longer lasting and have the same quality of reflection, but they are heavier and more difficult to transport. Glass mirrors would be tied on the reflector with wires.

Attention: Tighten one seasonal adjustment (the one between tracking channel and cooking place) so that the distance from bolt to bolt is 680 mm. Then tighten the other one and keep this position until all the reflective sheets are mounted.

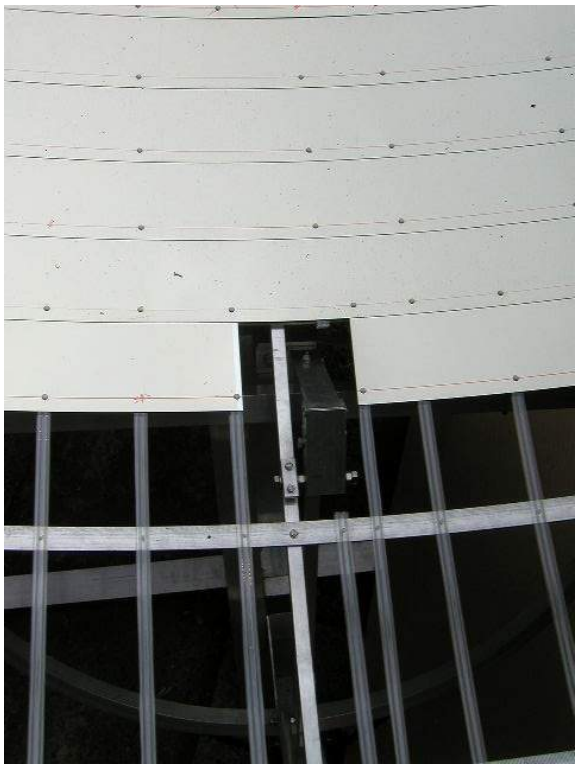
1) Mark on one long side of each sheet a line parallel to the edge in a distance of 15 mm. On this line the plastic blind rivets will be put to fix the sheets on the polycarbonate strips of the reflector.
5 mm from the other long edge of the sheet you mark a point in the centre of the sheet and 15 mm from the same edge two points at the sides of the sheet.



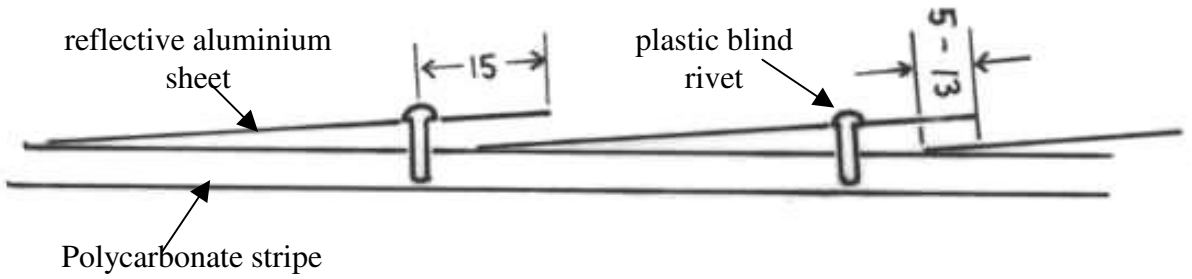
These marks are made that you see how much the sheets overlap (minimum 5 mm).



2) Place the first sheet flush with the edge of R6 (photo above). Drill 3mm holes through sheet and plastic strips on the marked line. Take care that you do not press too much while drilling because the aluminium sheet is bent very easily which causes a bigger focus. Plastic blind rivets in every second polycarbonate strip are sufficient to fix the sheet.



3) The second sheet has to overlap the first one by at least 5mm in the centre of the long side (therefore you have made the mark). On the sides, the overlapping will be more. It should not overlap more than the marked 15mm, because then the first sheet would touch the rivets of the second sheet and could not move freely anymore.



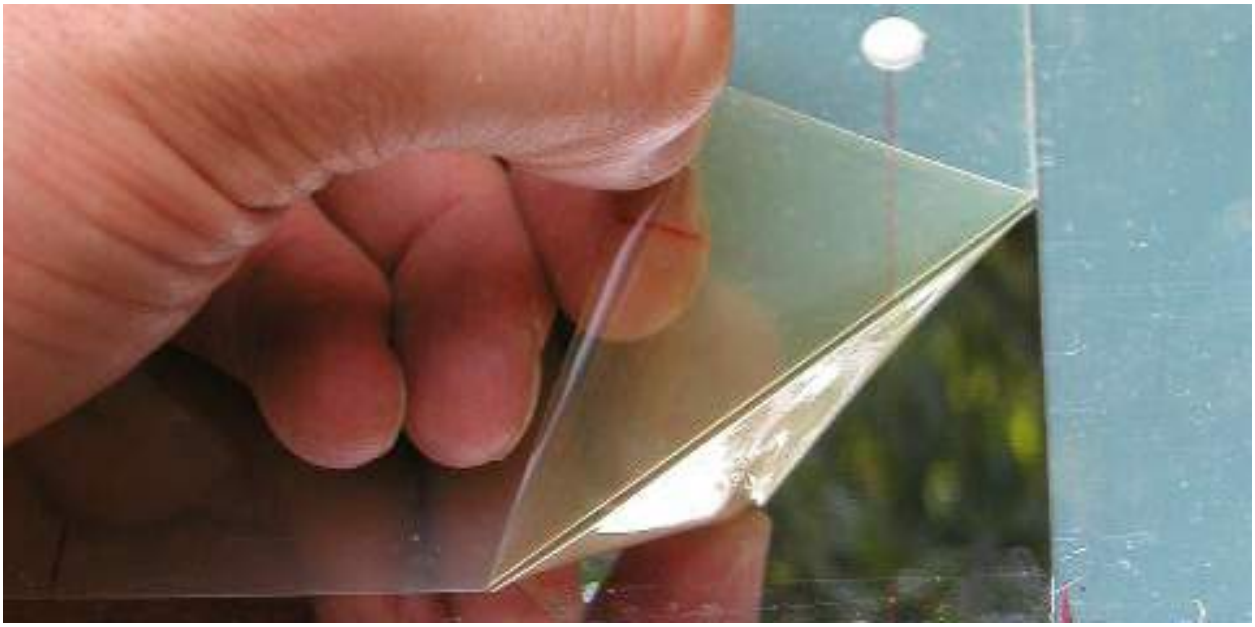
Go on until the end of the reflector. From the fifth sheet on you have to cut them at the sides according to the elliptical frame. Cut also where a double folded strap (R16, R17) is underneath which holds the outer polycarbonate strip. The flatter the sheets are lying on the polycarbonate strips the better will be the focus.

4) Put the sheets left and right from the centre mounting. On the left side (in the picture above and also picture on the previous page) you have to keep some open space for the lens holder of the tracking system.

5) Fix sheets up to the other end of the reflector.

6) Cover the free spaces at the sides of the reflector with the rests you have from the shortened sheets.

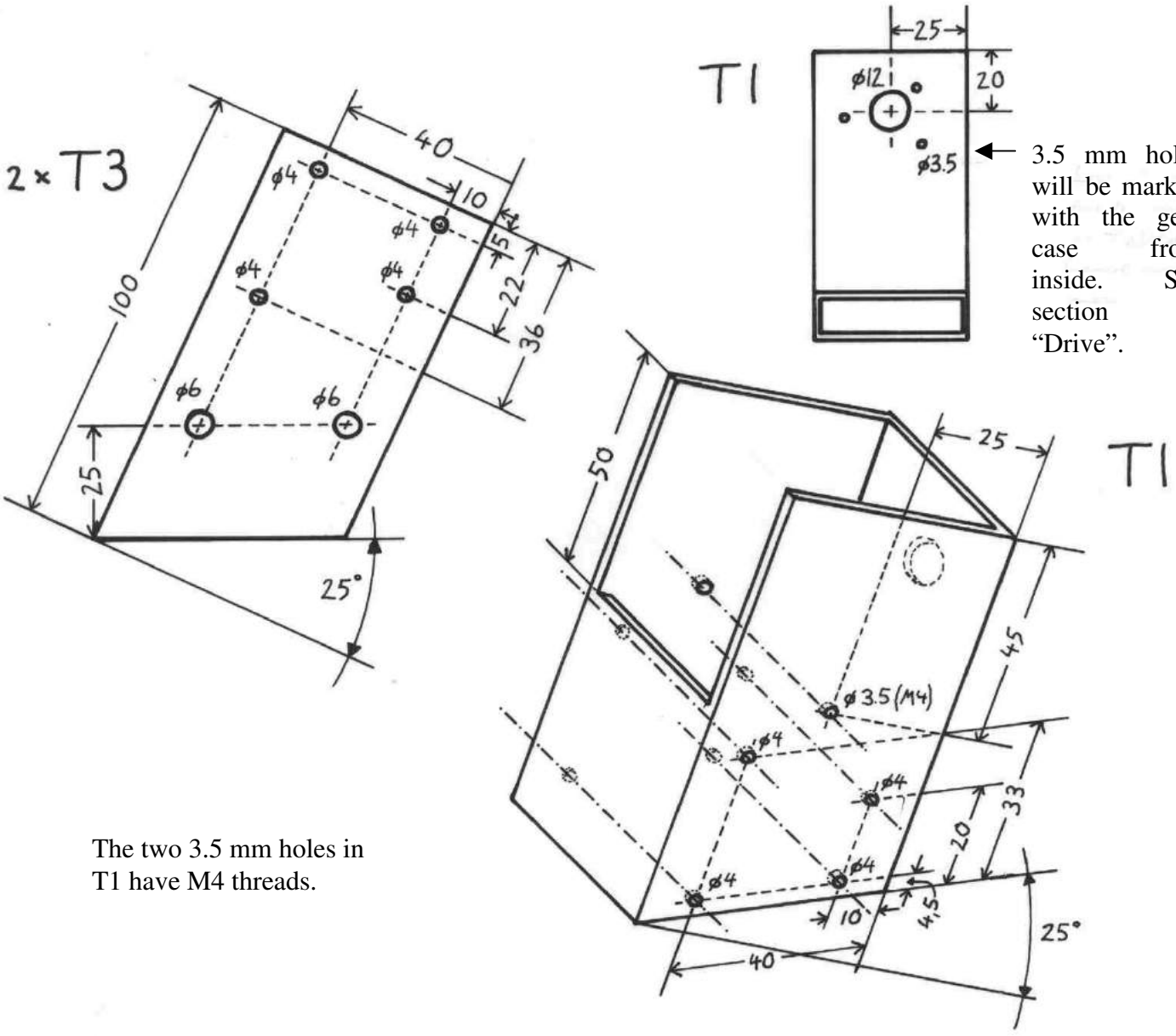
7) Remove the plastic foil from the aluminium sheets before you test the focus in the sun! Otherwise, the glue hardens and it becomes very hard to remove the foil.



Tracking System

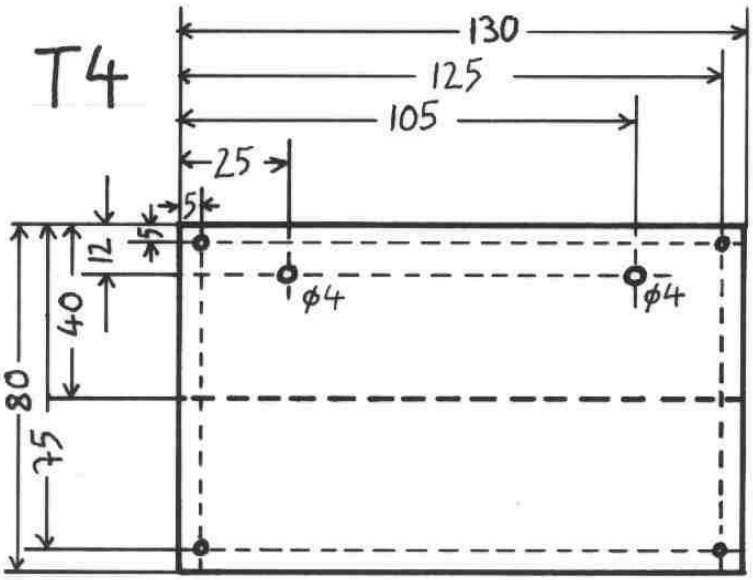
Name	Dimensions [mm]	Length [mm]	Pieces
T1	50x50x2 0° 25° ˜	short side: 79	1
T2	20dia x 1.5	23	1
T3	50x4 0° 25° ˜	longer side: 100	2
T4	aluminium sheet 2mm*	80x130	1
T5	aluminium sheet 2mm*	130x154	1
T6	aluminium sheet 1mm	245x155	1

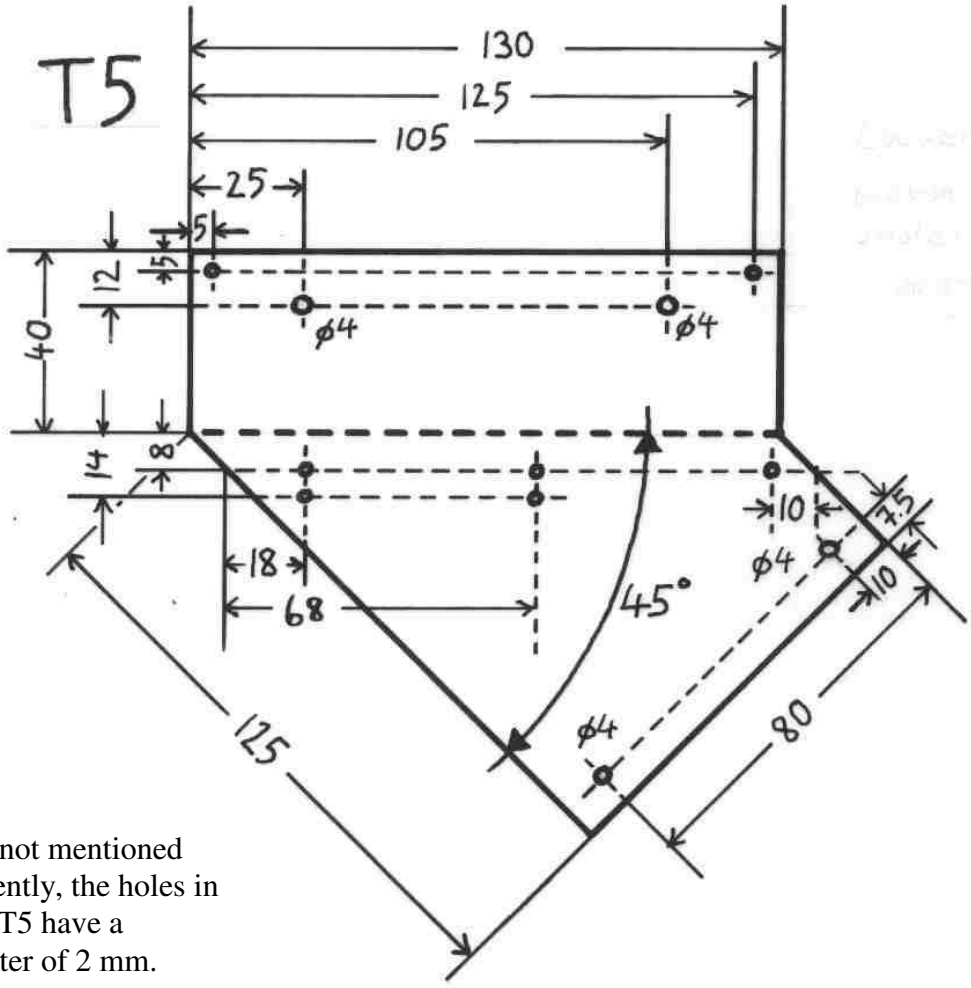
˜ check the orientation of the angles in the drawings on this page
* you can use the rest from the hot plate **C10**



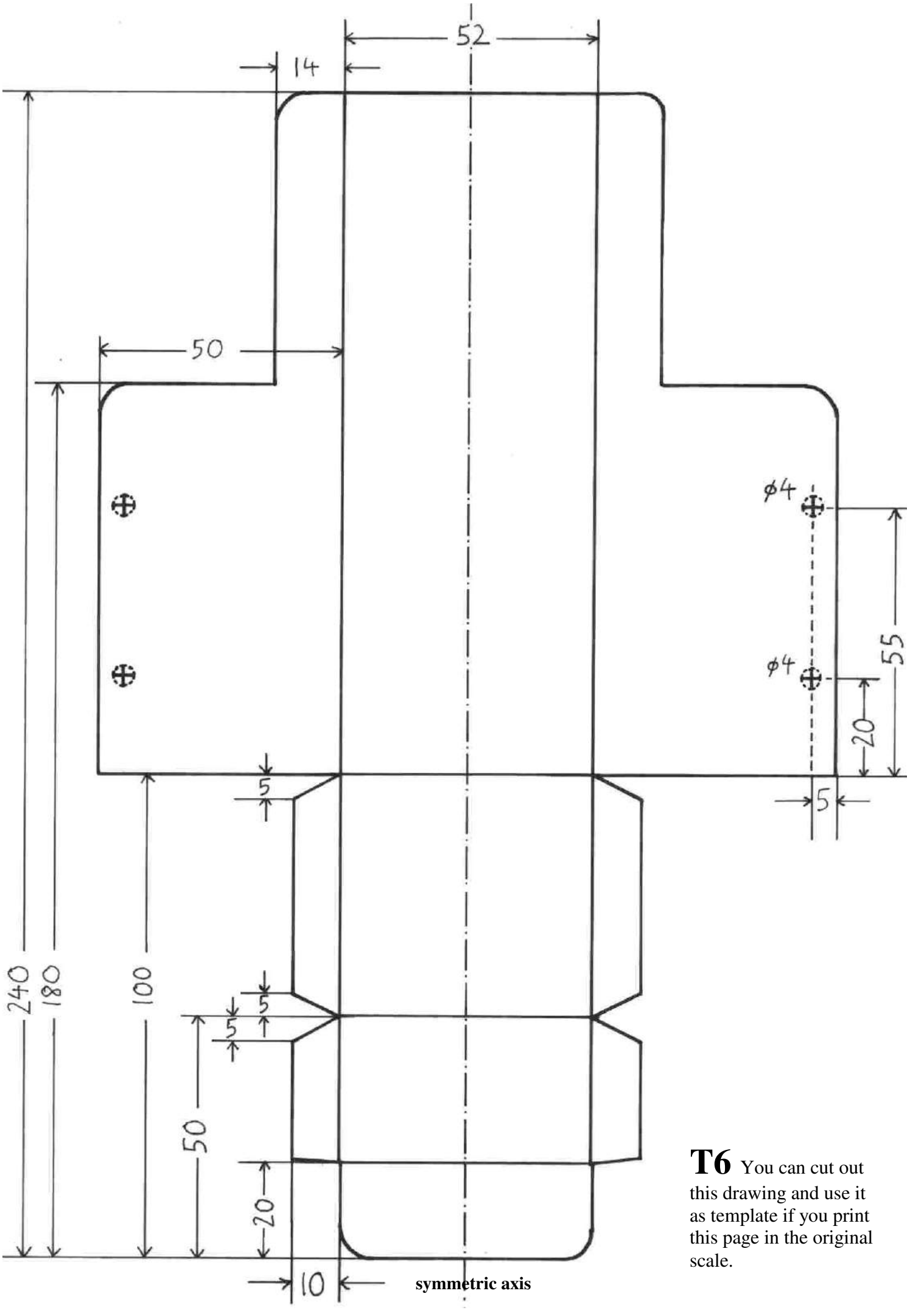
3.5 mm holes will be marked with the gear case from inside. See section "Drive".

The two 3.5 mm holes in T1 have M4 threads.





If it's not mentioned differently, the holes in T4 & T5 have a diameter of 2 mm.



T6 You can cut out this drawing and use it as template if you print this page in the original scale.

Tracker

The tracker serves for the alignment of the reflector and as an energy source for the motor. It consists of photovoltaic cells and a lens.
Beside T4 and T5 from above, the following is necessary:

Name	Dimensions	Length	Pieces
photovoltaic cell	0.5 V, 300 mA, respectively: 1.0 V, 300 mA	should fit to T4	4 respectively: 2
wire, stainless	dia ~ 0.5 mm	400 mm	
double-sided adhesive tape		200 mm	
2-core electric cable	2 * 0.75 mm^2 cross-section	1.5 m	
heat shrink tubing (hose)"	fitting to the cables	~ 150 mm	
soldering equipment			
glass-cylinder (e.g. old olive glass with screw cap)	dia: ~ 45 mm	140 mm	1
banana plug	fitting to the cable above		2 pairs
alcohol as antifreeze			~ 80 mL

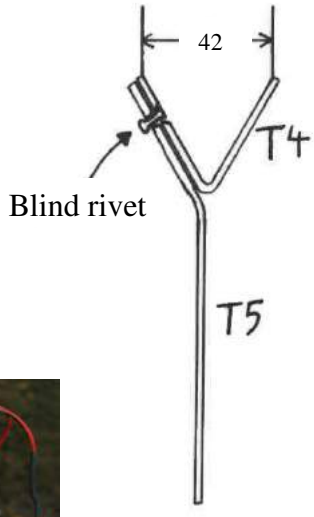
" is pushed over a wire before soldering it to another one. After soldering, the tube is shrunk onto the soldered part with heat.

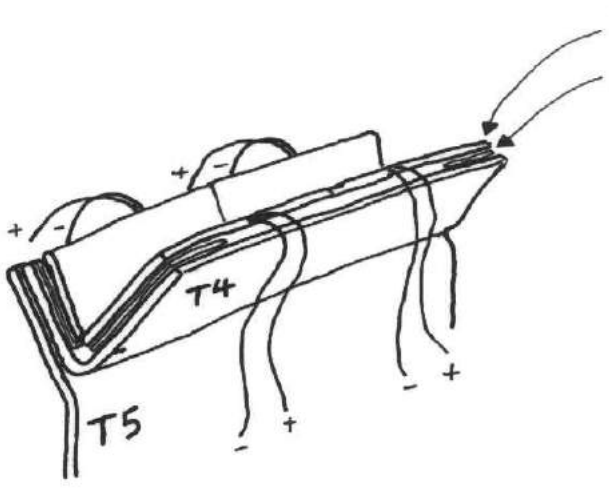
Name	Diameter / Dimensions [mm]	Length [mm]	Pieces
Bolt M4	4	20	2
Nut M4			2
Blind rivet	4	8	2

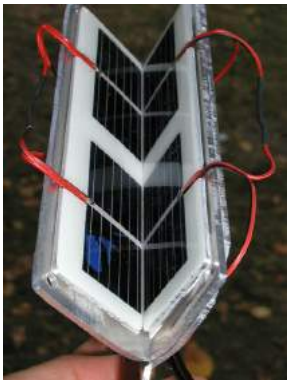
Plus M4 washers

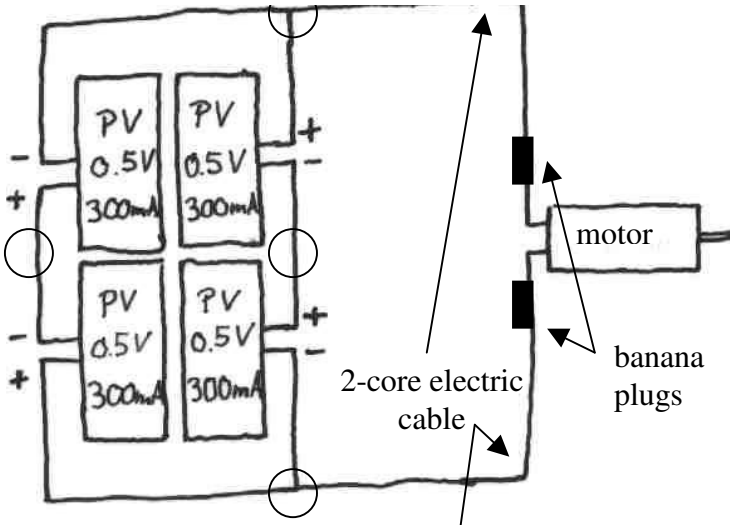
Before bending T4 along the dashed middle line (about 60°, see drawing on the right side), the two 4-mm-holes have to be countersunk, because the blind rivets combining T4 and T5 should not touch the pv-cells.

The photovoltaic cells are glued to T4 with stripes of double-sided tape at the outer ends. Take care that the long edges of the pv-cells in the bend of T4 are aligned to each other.

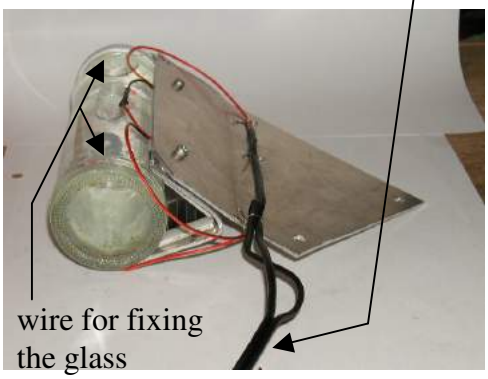








Circuit diagram of the pv-cells. The cables have to be soldered and isolated with heat shrink tubing at the positions marked by the circles.



Fill the glass with 2/3 of water and 1/3 of alcohol (as antifreeze, if necessary). Tie it carefully on top of the pv-cells with pieces of stainless wire that are passed through the 2 mm-holes at the corners of T4 and T5. Direct the cables along the three 2 mm-holes in the centre of T5 and fix them with the wire, too (see photo on the left side).

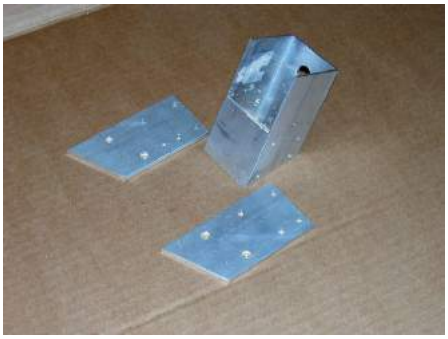
The Tracker is mounted onto the Central bar. It has to "look" towards the sun i.e. away from the cooking place. The glass is more or less parallel to the polar axis (depends on the season).

Drive

Besides T1, T2, T6 and the two T3 you need the following:

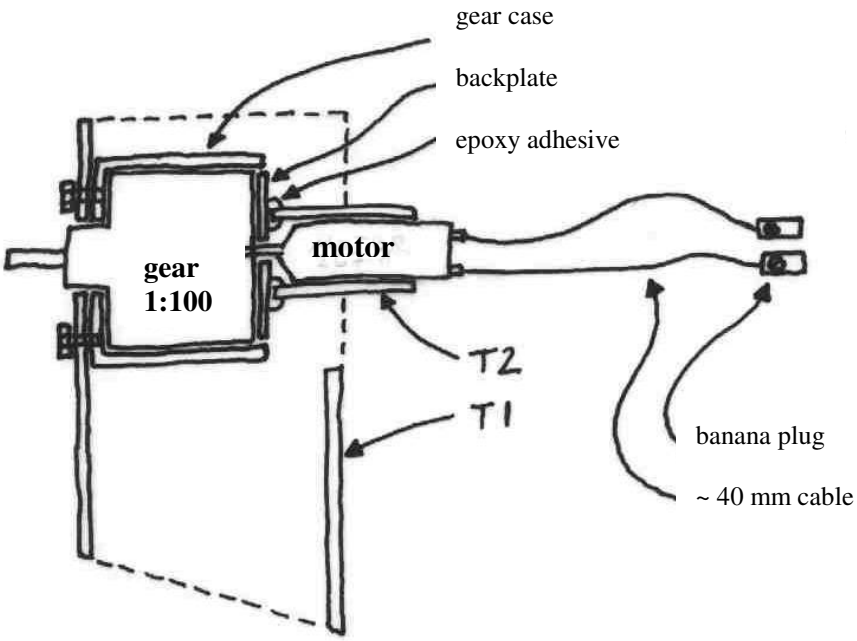
Name	Dimensions
motor	for the specifications look at the purchasing list at the beginning
gear	for the specifications look at the purchasing list at the beginning
epoxy adhesive	
alcohol (as detergent)	

Name	Diameter / Dimensions [mm]	Length [mm]	Pieces
Bolt M3	3	4	3
Bolt M4	4	5	4
Blind rivet	4	12	8
Blind rivet	4	8	2

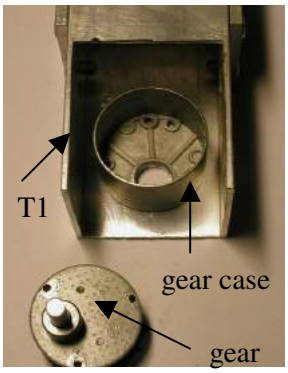


Assemble T1 and the T3's with blind rivets like it is shown on the pictures. The bevelled edges (25°) of T1 and T3 are parallel.

Cross section through the motor box as orientation:



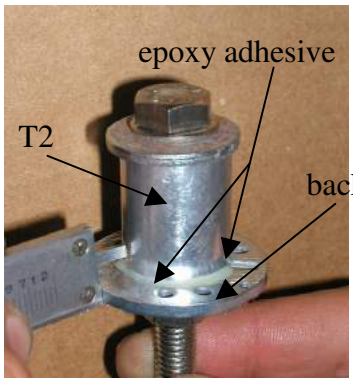
When you use the gear motor proposed in this construction manual you have to separate the gear and the toothed wheel from the motor, which is not required (the other one from "Faulhaber" has to be used).
Unscrew the gear from the motor. To separate the toothed wheel, put two flat metal stripes between wheel and motor and hang all together into an opened vice (the motor right at the bottom).
Now take a spike and a hammer and knock the axle through the wheel. Attach the wheel to the axle of the Faulhaber-motor, but pay attention not to stress the interior of the motor too much while doing that.



Drilling the holes for the gear case into T1:

Put the gear together with its case in T1 so that the axle goes through the 12 mm hole centrically and the case lies in the centre.
Clamp the case and remove the gear.
Now mark the position of the three holes (the ones that have threads inside) on T1 and drill them with a 3.5 mm drill.
Later the gear case inclusive of gear and motor can be screwed on T1 with M3 bolts from outside.

Gluing T2 to the gear's backplate:



First you may have to file the bush T2 with a round file to widen it so that the motor fits inside. Roughen also the surface of the backplate so that the adhesive can hold on the metal.
Clean the backplate and T2 (with alcohol) to remove all remains of oil. Then glue the backplate and T2 together with epoxy adhesive. Clamp them with a bolt and large washers. Control with a calliper that T2 is centered on the plate and let the adhesive dry.

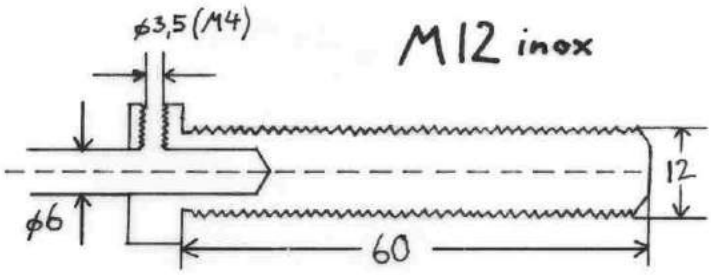
Gluing the motor in its bush (T2):

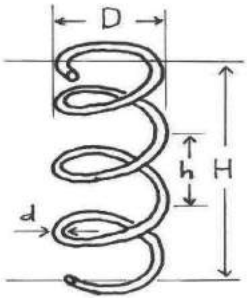
The toothed wheel of the motor axle has to reach far enough but not too far into the gear. To get the right distance take the motor with its bush as you see it on the left side and hold it against the gear (without its case). When you look sidewise inside the gear you can now determine how far the motor wheel should reach in it (the wheels must not block each other…). Now mark how far the motor has to look out of its bush, separate them, take some adhesive and glue the motor in the bush.

After soldering the electric connections to the motor, the parts can now be assembled according to the drawing on the previous page.

Drive axle

Name	Diameter / Dimensions [mm]	Length [mm]	Pieces
Bolt M4	4	9	1
Bolt M6	6	70	2
Nut M6			2
Bolt M12	12	60	1
Nut M12			2
M12 washer, galvanised			1
pinion, stainless	8 teeth, ½ inch * 1/8 (fits to normal bicycle chain)	12, inner dia 12	1
spring, stainless	approx.: D = 20, H = 20, h = 8, d = 3; 3 windings (see drawing)		1





The 6mm-hole has to lie exactly on the axis of the M12 bolt, otherwise the gear will not run centrically. For drilling the 6 mm-hole into the M12 bolt it's the best to use a turning-lathe. When there isn't one at your disposal, you can do it in the following way. (Attention: you have to take the bolt thread as a reference since the heads of the bolts are not well centric related to the threads.)

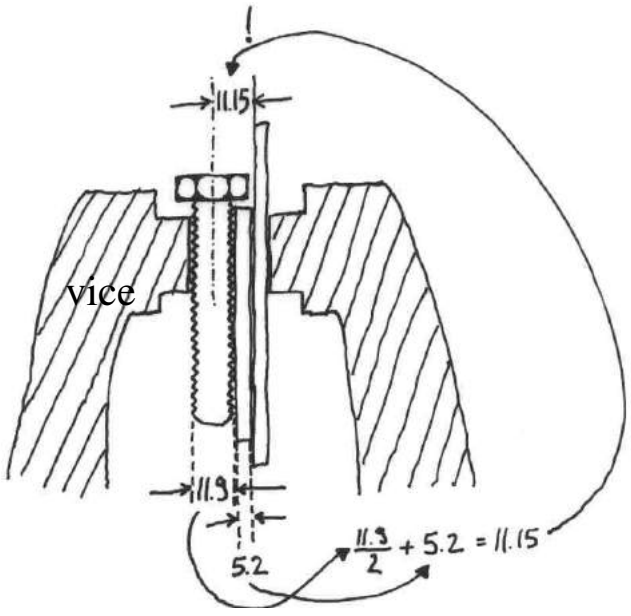
1. Paint the centre of the bolt head with a marker pen.

2. Measure the diameter of the bolt and the thickness of the plate next to the bolt (see drawing on the right) with a calliper rule.

3. Fix the bolt together with the two plates in a vice, like it is shown in the drawing.

4. Adjust the calliper to the calculated distance (axis of bolt to second plate), like it is done in the example in the drawing.

5. Now take the sharp points of the calliper and scratch carefully a line into the painted bolt head (view photo next side)



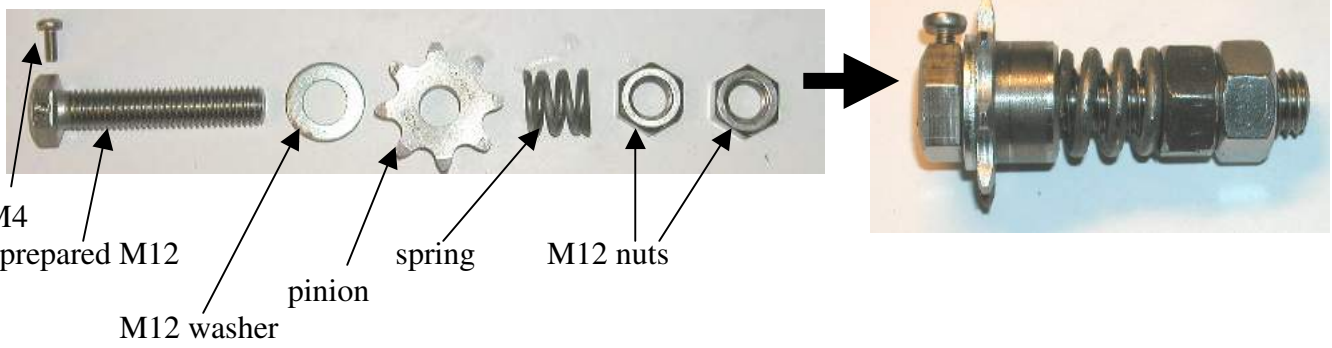
6. Turn the bolt 180° and scratch again (as control).

7. Turn the bolt 90° and scratch -> the hole is marked.

When drilling the stainless bolt, take enough oil and drill with little force, because it is very hard.

Fixing the bolt on the table of the drilling machine with nuts and washers helps drilling it right-angled.

Normally there is a 8mm-hole in the pinion, so open it by drilling with 12 mm.

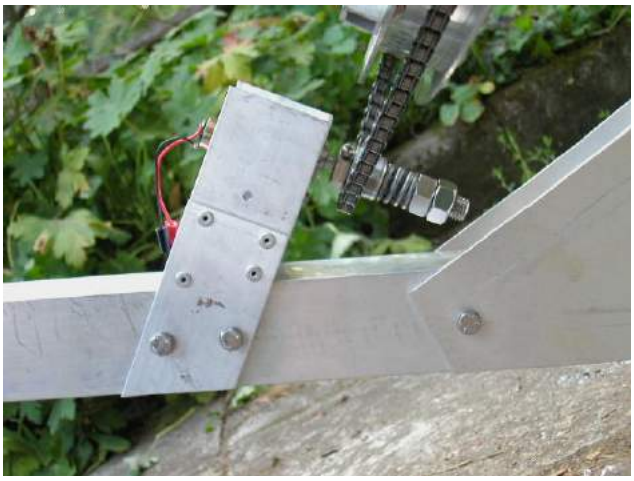


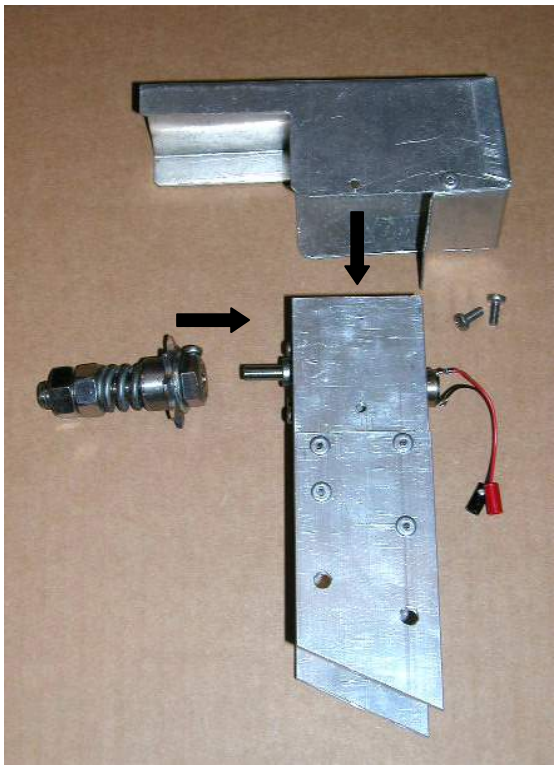
Folding the Motor Box (T6)

Bend T6 along the drawn through lines (see template and photo) around a piece of the 50 x 50 x 2 square tube.

M4 x 8 blind rivets

Joining the Tracking System





Fix the drive axle with its M4 bolt to the axle of the gear (before: file the M4 bolt's tip slightly round. If the tip keeps its sharp edge, the bolt loosens itself after a while). The M4 bolt should be tightened on the flat area of the gear's axle.
Now attach the ensemble to the stand in the way you can see on the photo above. Use M6 x 70 bolts.
The tension of the chain in the tracking channel should be just big enough so that the chain can not jump over the pinion when you turn the reflector by your hands.
The slipping clutch has to be tightened with its inner M12 nut just as hard as it is necessary to hold the reflector in its position (when it's windy and so on). With the outer M12 nut (counter nut) the clutch is locked. Watch out that you don't stress the axle of the gear too much while turning the nuts against each other.

The tracker is mounted to the Central bar via the two 4 mm holes near the middle suspension of the bar. The pv-cells have to "look" away from the cooking place. Fix the tracker with two M4 x 20 bolts.
Pass the 2-core cable through the gap of the mirror and through the 50 x 50 x 2 mm square tube of the stand (**S4**). Tie a knot at the end of the cable so that it cannot be pulled out of the motor box later. Connect the banana plugs. Now you have to test whether the polarity is correct: misalign the reflector with the sun – if the plugs are interchanged, the motor turns the reflector in the wrong direction farther away from the sun – so change the polarity.
Put the 2-core cable's knot inside the motor cavity. Pass the cable towards outside on the back side of **T1** (opposite side of the drive axle).

Finally put the motor box (T6) on T1 as rain and dust cover. Fix it with two M4 bolts.

Parts which vary with the latitude

The measurements given in the list of materials are for Central Europe. The lengths of three parts (C3, C2, S7) have to be adjusted to the geographical latitude. The nearer you are to the equator the longer they have to be. The position of side support (S6) changes as well. The telescope foot can be left away between the tropics.

1. **C3**: calculate its length with this formula:

   L = 400mm * cos φ

   L = Length of C3
   φ = Latitude

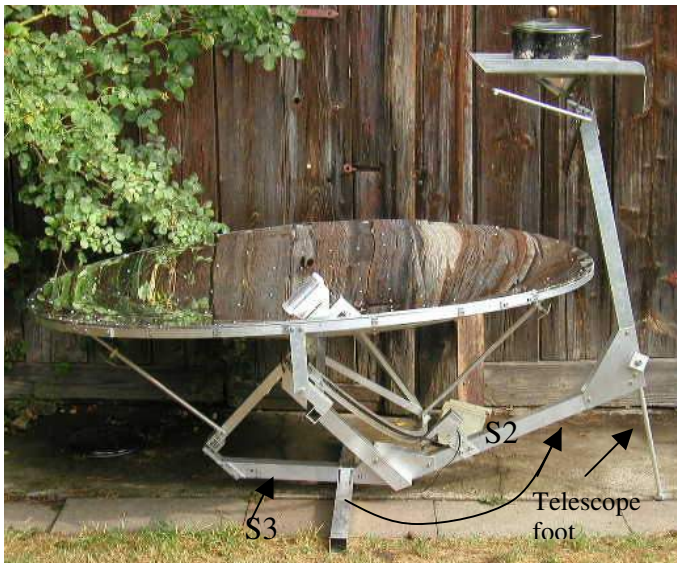
2. **C2**: Measure the length of C2 after having attached C3 and C1 on your cooking place. Cut it before you fit it. It will not be longer than 300mm.

In these photos you can see the changes in the lengths and the bends of C2 and C3 according to the latitudes.


Zürich, Switzerland: 47.5°


Santiago de Chile, Chile: 35°


Dakar, Senegal: 17°



3. **Telescope foot** (S16, S11, S9 (the one with 12mm hole)): On a latitude of ~25° S2 is lying flat on the ground. From that point up to the equator the telescope foot is not necessary.

4. **Side support** (S6): The position of the side support changes as well when you cross the tropic. You have to fit it on S2 instead of S3, like indicated with the arrow in the photo.

5. **Second foot** (S7): Adjust the length of the second foot according to the data in the table on the right.

It is advisable to add a cross beam when the second foot is very long like in the photo (Senegal).

Latitude	Length
20°	400mm
15°	500mm
10°	600mm
5°	700mm
0°	800mm

Directions for use of the 2m^2 Scheffler Solar Cooker

Security:

- In a perimeter of about 1 m around the entrance of the cooking place (focal ring) there should not be any inflammable material.
- Do not look at places with concentrated light, e.g. in the sunlight focused on the stainless steel sheet of the shutter for long with unprotected eyes. Use sun glasses!
- Close the shutter before removing the pan from the cooking place to protect your eyes.

Positioning:

- Put the cooker in the direction north – south with the help of a compass. The cooking place has to be in the north and the reflector in the south.
- Put the solar cooker horizontally, meaning the cooking place has to be levelled by adjusting the cooker with the telescope and the second foot.
- It is advisable to fix the solar cooker to the ground, so it can not be thrown over by the wind.

Adjustment:

- Spin the reflector around the rotation axis towards the direction of the sunlight, the tracking system will do the exact alignment.
- Seasonal adjustment: loosen the two telescope adjustments and change the inclination of the reflector around the lateral axis until the reflected light falls on the closed shutter. Now tighten one telescope pole to fix one end of the reflector.
  1) Keep on moving the loose end of the reflector easily up and down until you reach the smallest light spot possible. Now tighten the second bolt.
  2) Then loosen the fixed bolt on the other side so you can move this side up and down until you reach the smallest light spot. Tighten the bolt again.

  Repeat step 1 and 2 until you can not see further improvement.

Cooking:

- Put the pan on the hole in the cooking place and open the shutter.
- It is best to use pans out of a material with high heat conductivity (e.g. aluminium) and with a thick base, to prevent burning the food in the centre, where the heat is strongest.
- The base of the pan should be black on the outside.

Maintenance:

- The slipping clutch on the gear can change in its retention force. The contact pressure of the spring on the pinion can be adjusted with the M12 nut and the M12 counter nut (using two flat wrenches (19mm)).
  Caution: Do not put force onto the axle of the gear while tightening or loosening the counter nut.
- The spring on the shutter can be adjusted in the same way.
- Clean the reflecting area with water, dishwashing liquid and a sponge or a rag, flush it afterwards with water which contains one drop of dishwashing liquid (so that all water runs off).

Have fun cooking with the sun!