

TECHNICAL FILE FOR THE STIRLING ENGINE

FABRICATION RANGE

ELEMENT: Support ring

SET: Stirling engine

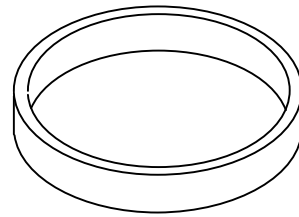
RANGE: 1

SHEET: 1 of 1

DRAWING: N° 11

MATERIAL: white
PVC

NUMBER: 1



N°

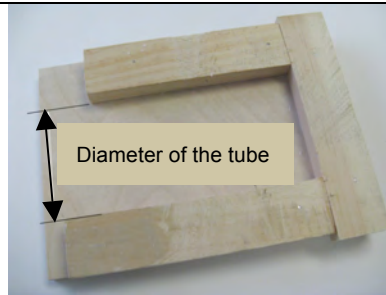
**PHASE, SUB-PHASE OR
OPERATION**

SKETCH

**MACHINE-TOOL,
TOOLS**

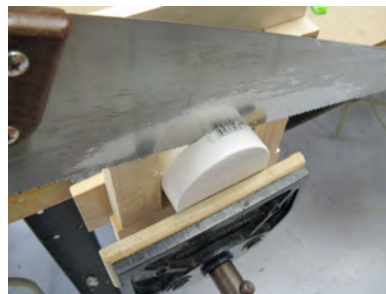
10 MAKING THE RING

11 A simple template like the one shown can greatly ease cutting the ring.



- PVC Pipe Ø 3 in

12 Insert a piece of piping perpendicular to the template and fix the whole thing with a vise as shown. Cut the ring using a hand saw.



- Hand saw
- Template
- PVC pipe Ø 3 in

Note:

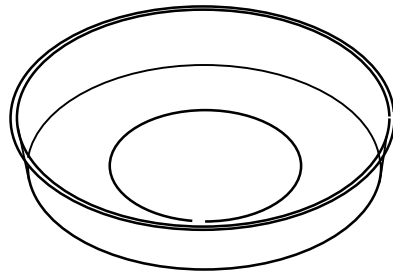
This operation will require the pipe to be turned once or twice during sawing.

13 Using the file, de-burr the edges of the ring.



- Half moon smooth file

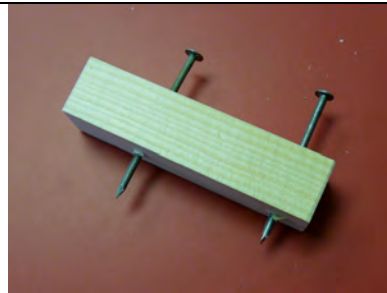




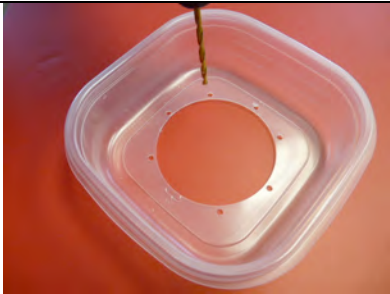
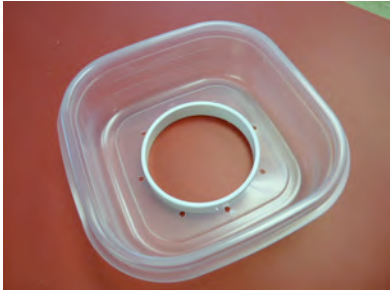
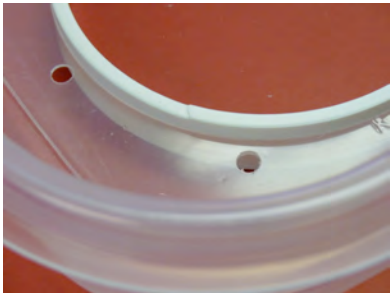


FABRICATION RANGE	
ELEMENT: Cooling container	
SET: Stirling engine	
RANGE: 2	SHEET: 1 of 3
DRAWING: N° 11	MATERIAL:
NUMBER: 1	Purchased container
N°	PHASE, SUB-PHASE OR OPERATION

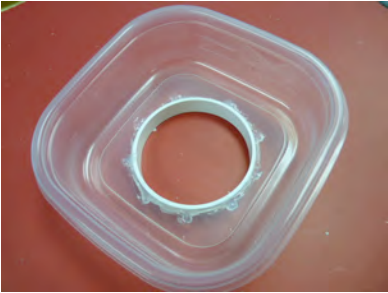
SKETCH	MACHINE-TOOL, TOOLS
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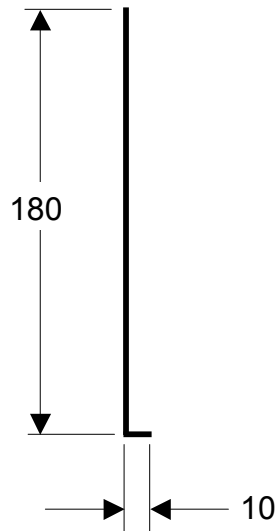
10	MAKING THE CONTAINER
11	Use a simple template made up of two nails, one of which is sharpened, with a 44 mm space between them (see drawing).
12	Using a hammer, pick the cutting template through the container which is placed on a piece of plywood.
13	Turn the container several times while maintaining pressure on it until the cut is complete.
14	Using a ruler and a pencil, find the center of the base.



<ul style="list-style-type: none"> - Plastic container approximately 180 mm in diameter. - Cutting template
<ul style="list-style-type: none"> - Ruler - Pencil

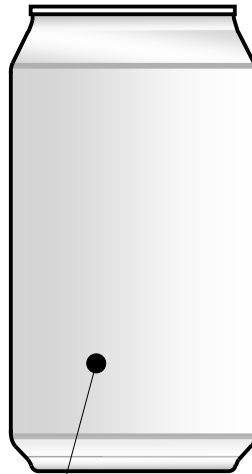
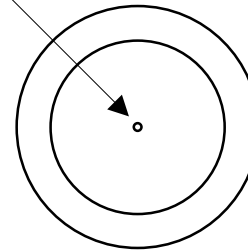
FABRICATION RANGE		FEUILLE : 2 of 3	
N°	PHASE, SUB-PHASE OR OPERATION	SKETCH	MACHINE-TOOL, TOOLS
15	Drill eight holes using a 3 mm bit.		- Drill - Ø 3 mm bit
16	Insert the ring so that it protrudes about 3 mm into the container.	 	
17	Make a hot glue joint inside the container		- Hot glue gun
18	Finish making the joint on the outside, carefully filling all the holes, which will make for a better seal.		- Hot glue gun

FABRICATION RANGE		SHEET: 3 of 3	
N°	PHASE, SUB-PHASE OR OPERATION	SKETCH	MACHINE-TOOL, TOOLS
19	The container is ready: its seal can be tested using water.		- Eau

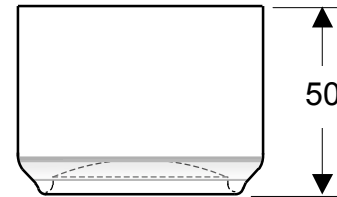


26 - LINE OUT OF DISPLACER

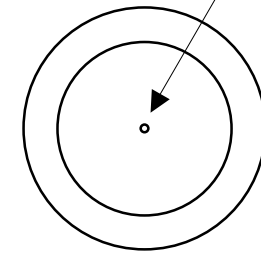
DRILL
DIA. 2.5 (3/32")



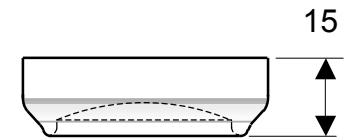
4 - GAS DISPLACER



DRILL
DIA. 2.5 (3/32")



27 - DISPLACER COVER



Note: Cut the bottoms of two soft drink cans at heights of 50 and 15 mm.

REF.	NB	MATERIALS	OBSERVATION
27	1	Displacer cover	Soft drink can
26	1	Line out of displacer	Steel rod dia. 1.57 x 110
4	1	Gas displacer	Soft drink can

FABRICATION RANGE

ELEMENT: Displacer

SET: Stirling engine

RANGE: 3

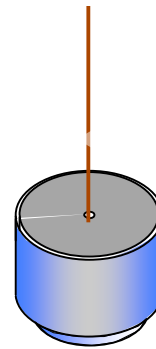
SHEET: 1 of 4

DRAWING: N° 10

MATERIAL:

NUMBER: 1





Aluminium



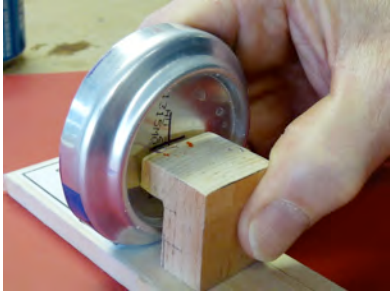









N°	PHASE, SUB-PHASE OR OPERATION
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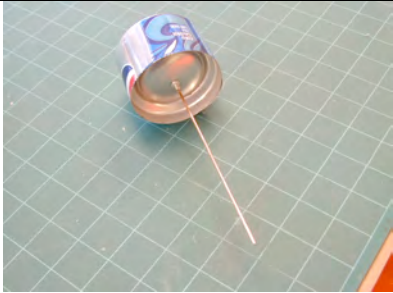


SKETCH

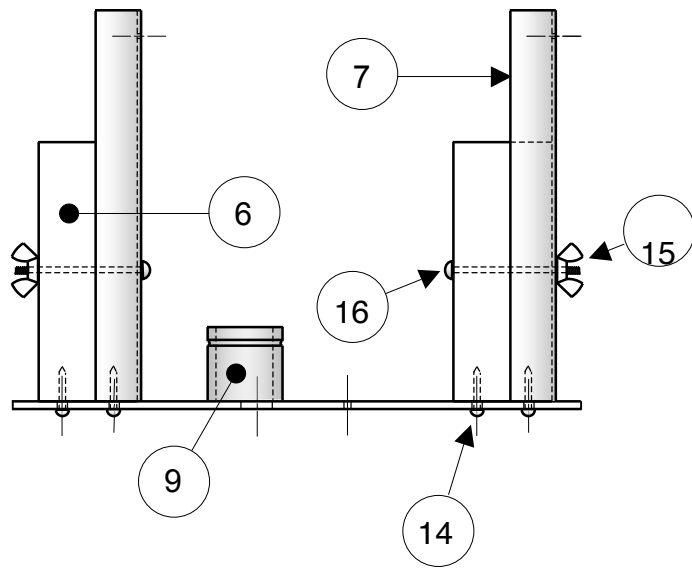
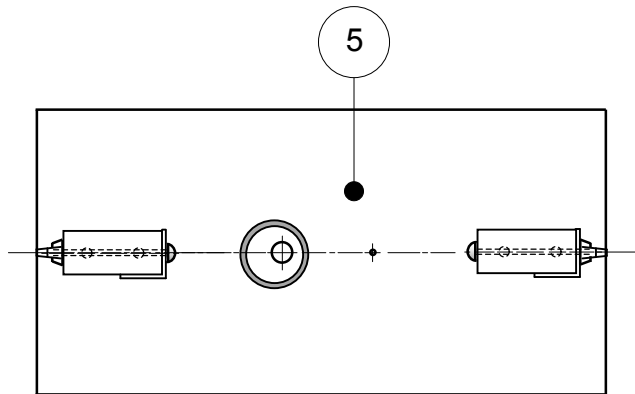
MACHINE-TOOL, TOOLS

10	MAKING THE DISPLACER		
11	Use two soft drink cans.		- 2 soft drink cans
12	Using a wooden block with a height of 50 mm, trace a line all around the can with a felt pen.		- 50 mm high block of wood - Felt pen
13	Using a wooden block with a height of 15 mm, trace a line all around the second can with a felt pen.		- 15 mm high block of wood - Felt pen
14	Roughly cut the two cans using a utility knife. Technique: Make a back and forth motion, as if sawing the can.		- Utility knife

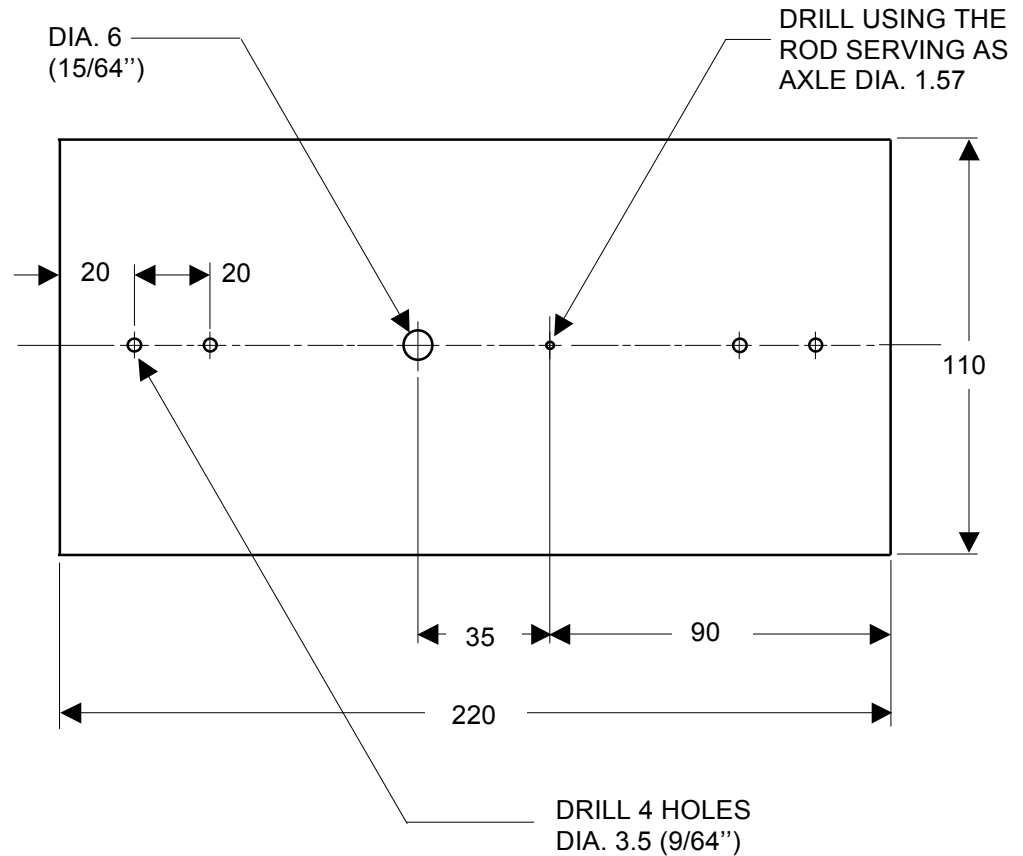
FABRICATION RANGE		SHEET: 2 of 4	
N°	PHASE, SUB-PHASE OR OPERATION	SKETCH	MACHINE-TOOL, TOOLS
15	Finish with scissors.		- Pair of scissors
16	Cut the cover of the displacer the same way.		
17	Trace the center of the two can parts using the tracing template.	 	- Ruler - Pencil - Circles template
19	Gently drill the two 2mm diameter holes.		- Drill - 2mm Ø bit

FABRICATION RANGE		SHEET: 3 of 4	
N°	PHASE, SUB-PHASE OR OPERATION	SKETCH	MACHINE-TOOL, TOOLS
20			<ul style="list-style-type: none"> - Drill - Ø 2mm bit
21	<p>Place the cover on the table as shown and gently force the body of the displacer onto the cover.</p> <p>Careful: You must be perfectly perpendicular.</p>		<ul style="list-style-type: none"> - Vise - Hammer
22	<p>Insert a 150 mm long rod, which has had the end bent to an angle of 90° at a length of 10 mm, through the two holes in the displacer, as shown.</p>		<ul style="list-style-type: none"> - 3 Ø – 6mm pop rivet - Hammer - Vise
23	<p>Take a 3 Ø, 6mm long rivet and detach it from its nail.</p>		
24	<p>Insert the rivet on the rod and using pliers, squeeze it onto the rod in order to prevent the rod from moving on the displacer.</p>		<ul style="list-style-type: none"> - Pliers

FABRICATION RANGE		SHEET: 4 of 4	
N°	PHASE, SUB-PHASE OR OPERATION	SKETCH	MACHINE-TOOL, TOOLS
23	Cut a disk of « foam-core » to the inside diameter of the displacer.	 	- « Foam-core »
24	Insert the disk as shown.		



**SUB-SET
PLATE AND POSTS**



05- SUPPORT PLATE

REF.	NB	DESIGNATION	OBSERVATION
16	2	Bolt	Screw 8 x 32 x 2-0"
15	2	Nut	Wing nut 8 -32
14	4	Round head screw	3/4" - #6 wood screw
5	1	Support plate	110 x 220 Polystyrene

FABRICATION RANGE

ELEMENT: Base

SET: Stirling engine

RANGE: 4

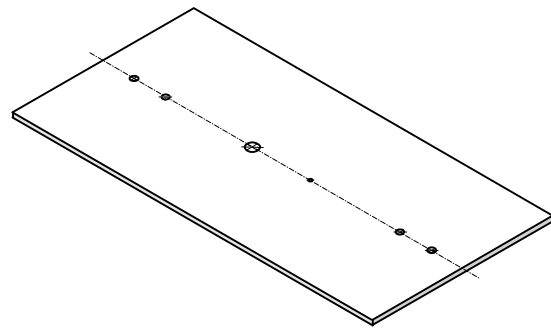
SHEET: 1 of 3

DRAWING: N°4

MATERIAL:

NUMBER: 1

Polystyrene



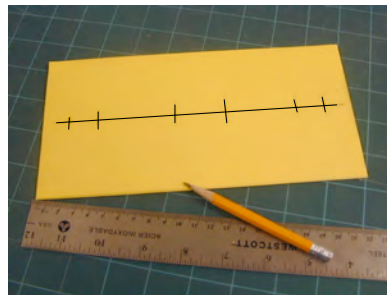
N° **PHASE, SUB-PHASE OR OPERATION**

SKETCH

MACHINE-TOOL, TOOLS

10 MAKING THE BASE

11 On a polystyrene plate, trace the plan of the base referring to detail drawing N° 3.



- Combined angle iron
- Ruler
- Pencil

12 Using a plastics knife, cut outline of the part.

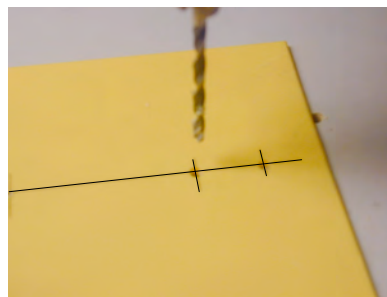


- Plastics knife
- Rules
- Scraper
- Sandpaper

13 Scrape and file the fields.

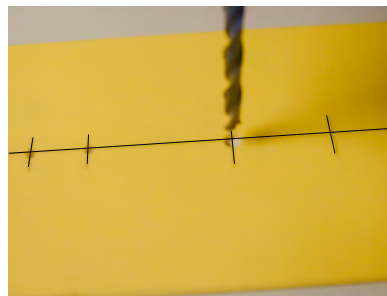
14 Point all holes

15 Drill the four 3.5 mm Ø holes



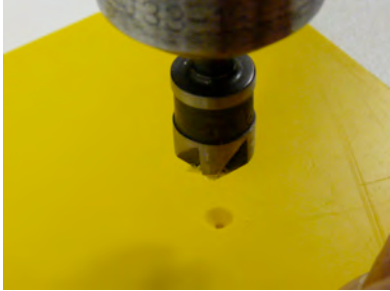

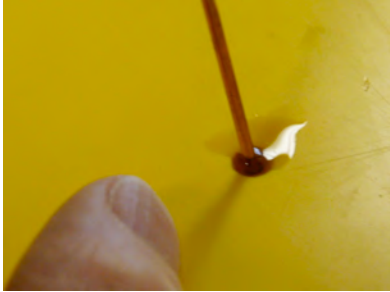



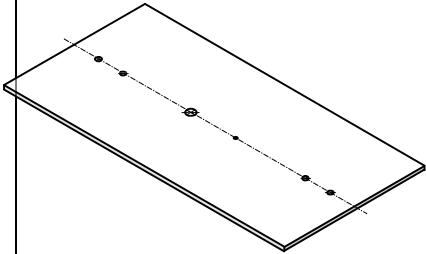
- Pointer
- Hammer
- Drill
- 3.5 mm Ø bit

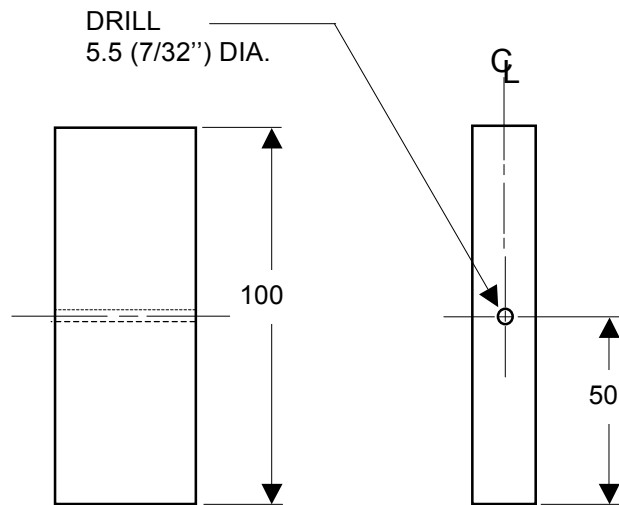
16 Drill the 6 mm Ø hole



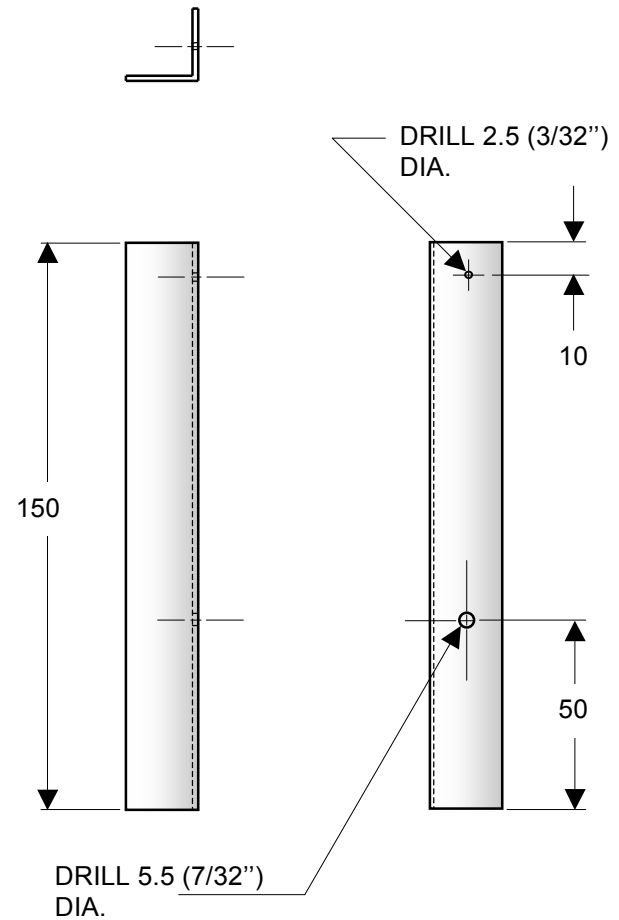
- Drill
- 6 mm Ø bit

FABRICATION RANGE		SHEET: 2 of 3	
N°	PHASE, SUB-PHASE OR OPERATION	SKETCH	MACHINE-TOOL, TOOLS
17	<p>Point and drill the hole that will receive the displacer to a diameter of 1/16 in.</p> <p>The operations that follow are crucial to proper operation of the Stirling engine.</p>		<ul style="list-style-type: none"> - Steel rod - Cutting pliers - File
18	<p>Place a counter sink on the drill press. Move the bit down as far as possible and move the table up slowly until the point of the counter sink brushes against the test plank. Lock the table in this position.</p>		<ul style="list-style-type: none"> - Drill - 1,57 mm Countersink bit - Sandpaper
19	<p>Place the part on the plank and counter sink the hole.</p> <p>The countersink will allow the displacer rod to have minimal contact with the plate.</p>		<ul style="list-style-type: none"> - Countersink
20	<p>Take a rod similar to the displacer rod and ensure that its extremity is well chamfered.</p>		<ul style="list-style-type: none"> - Sandpaper
21	<p>Insert the rod in the counter sunk hole and ensure it moves easily. A drop of oil will allow you to better ensure the success of this operation.</p>		<ul style="list-style-type: none"> - Oil

FABRICATION RANGE		SHEET: 3 of 3	
N°	PHASE, SUB-PHASE OR OPERATION	SKETCH	MACHINE-TOOL, TOOLS
22	Be sure that the rod can move in a conical trajectory.	 	



06 - POST



07 - CRANKSHAFT SUPPORT

REF.	NB	DESIGNATION	MATERIALS
7	2	Crankshaft support	Aluminum angle $\frac{3}{4}$ " x $\frac{3}{4}$ " x 1mm
6	2	Post	Pine slat $\frac{5}{8}$ " x $1\frac{1}{2}$ "

FABRICATION RANGE

ELEMENT: Post

SET: Stirling engine

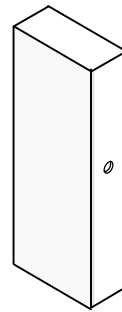
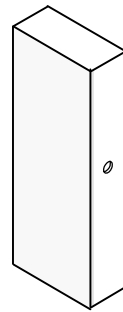
RANGE: 5

SHEET: 1 of 1

DRAWING: N°5

MATERIAL: Pine

NUMBER: 2

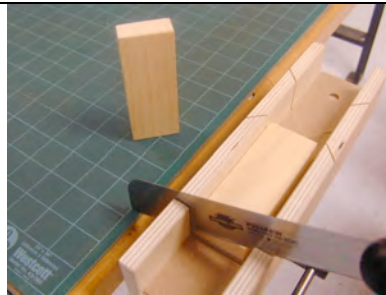


SKETCH

MACHINE-TOOL, TOOLS

N° PHASE, SUB-PHASE OR OPERATION

10 Using a mitre box, cut two 100 mm long pieces from a 5/8 in x 1½ in x 8 ft pine moulding.



- Mitre box
- Saw
- Ruler
- Pencil

11 Center and point the 5mm Ø hole.



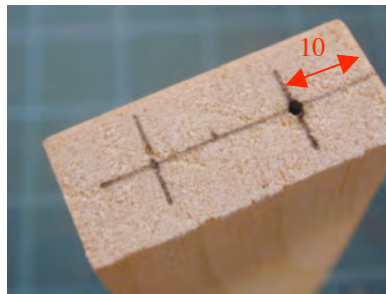
- Ruler
- Pointer
- Hammer

12 Drill a 5 mm Ø hole in both posts.

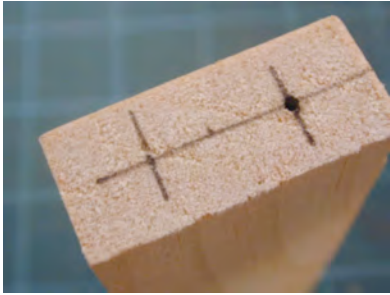


- Drill
- 5 mm Ø bit

13 Center and mark the ends of the posts. Only point one hole.



- Ruler
- Pencil
- Pointer
- Hammer

FABRICATION RANGE		SHEET: 2 of 2	
N°	PHASE, SUB-PHASE OR OPERATION	SKETCH	MACHINE-TOOL, TOOLS
15	<p>Drill a single hole in each post using a 2 mm Ø bit.</p> <p>Note: The second hole will be drilled during assembly. You will use the hole in the support plate as a drilling template.</p> <p>That way, the holes will be perfectly aligned with those in the plate.</p>		<ul style="list-style-type: none"> - Drill - 2mm Ø bit - Vise

FABRICATION RANGE

ELEMENT: Crankshaft support

SET: Stirling engine

RANGE: 6

SHEET: 1 of 1

DRAWING: N°4

MATERIAL:

NUMBER: 2

Aluminum

N°

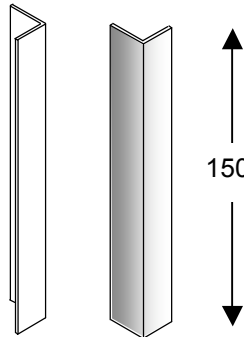
PHASE, SUB-PHASE OR OPERATION

SKETCH

MACHINE-TOOL, TOOLS



10 Using a metals saw, cut two 150 mm pieces of aluminum angle.



- Metals saw
- Ruler
- Pencil

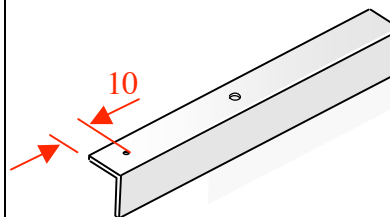
11 So that the holes on the posts and crankshaft supports are perfectly aligned, place them in the vise as shown.
The previously drilled hole in the support will serve as a drilling template to drill the crankshaft support.



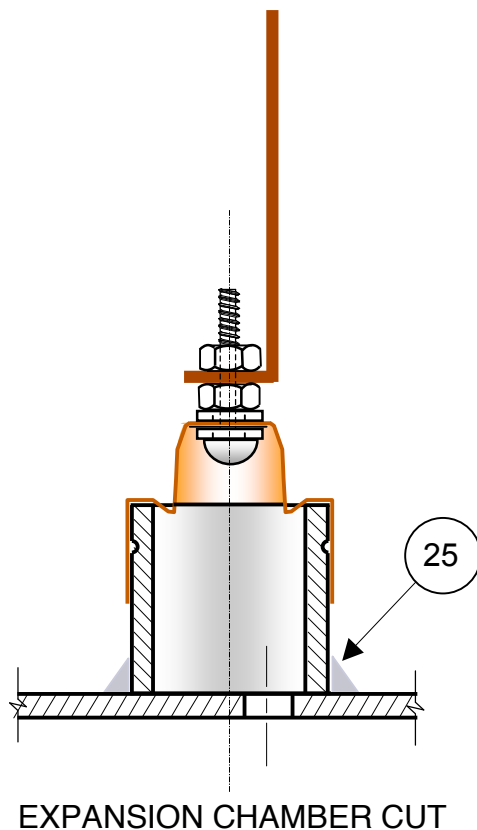
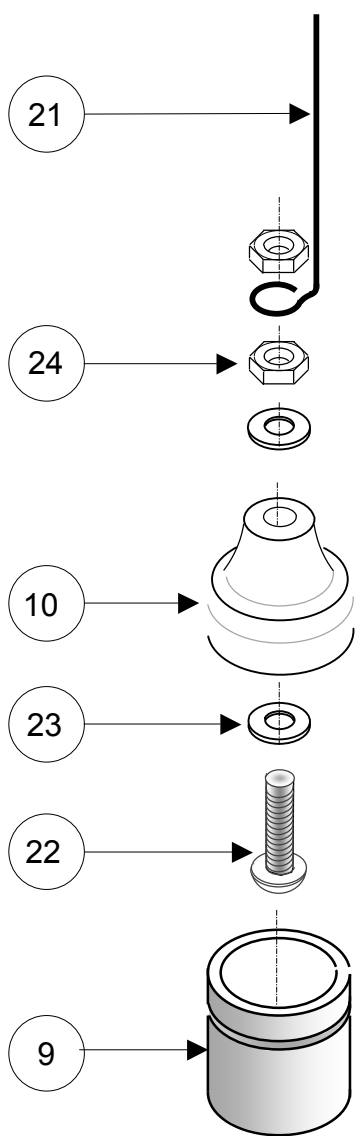
- Drill
- 5mm Ø bit

Careful: Each support corresponds to its own post.

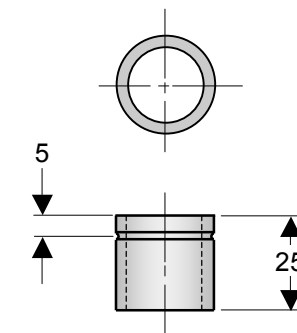
12 Center, mark and drill the 2mm diameter hole that will guide the crankshaft.



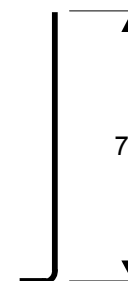
- Ruler
- Combined angle iron
- Pencil
- Drill
- 2 mm Ø bit



Scale 1 = 1



09 – EXPANSION CHAMBER

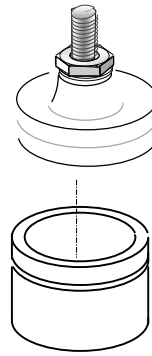


21 – LINE OUT OF THE MEMBRANE

REF.	No.	DESIGNATION	MATERIALS
25		Hot glue	
24	2	Nut	n° 6 nut
23	2	Washer	n° 8
22	1	Bolt	6 – 32 X 1/2" screw
21	1	Line out of the membrane	Steel rod 1.57 dia. x 90
10	1	Membrane	Latex glove
9	1	Expansion chamber	PVC piping 25 dia. (1")

GAMME DE FABRICATION

ÉLÉMENT : Chambre d'expansion	
ENSEMBLE : Moteur Stirling	
GAMME : 5	FEUILLE : 1 de 2
DESSIN : N°2	MATÉRIAU : PVC
NOMBRE : 1	



N°	PHASE, SOUS-PHASE OU OPÉRATION
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CROQUIS

MACHINE-OUTIL, OUTILLAGE

MAKING THE BASE

Band saw option:

Using the cutting guide on the table, groove half the depth of the pipe then gently turn the pipe.

Watch for jamming

Hand saw option:

Using the vise as a guide, groove half the depth of the pipe and turn the pipe frequently until the groove is completed.

Having completed the groove, cut the pipe to a length of 25 mm. De-burr as needed.

MEMBRANE

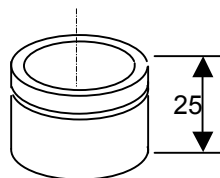
Cut one finger off a latex glove.



- Band saw





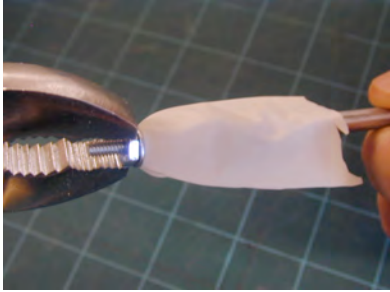

- Hand saw or metals saw

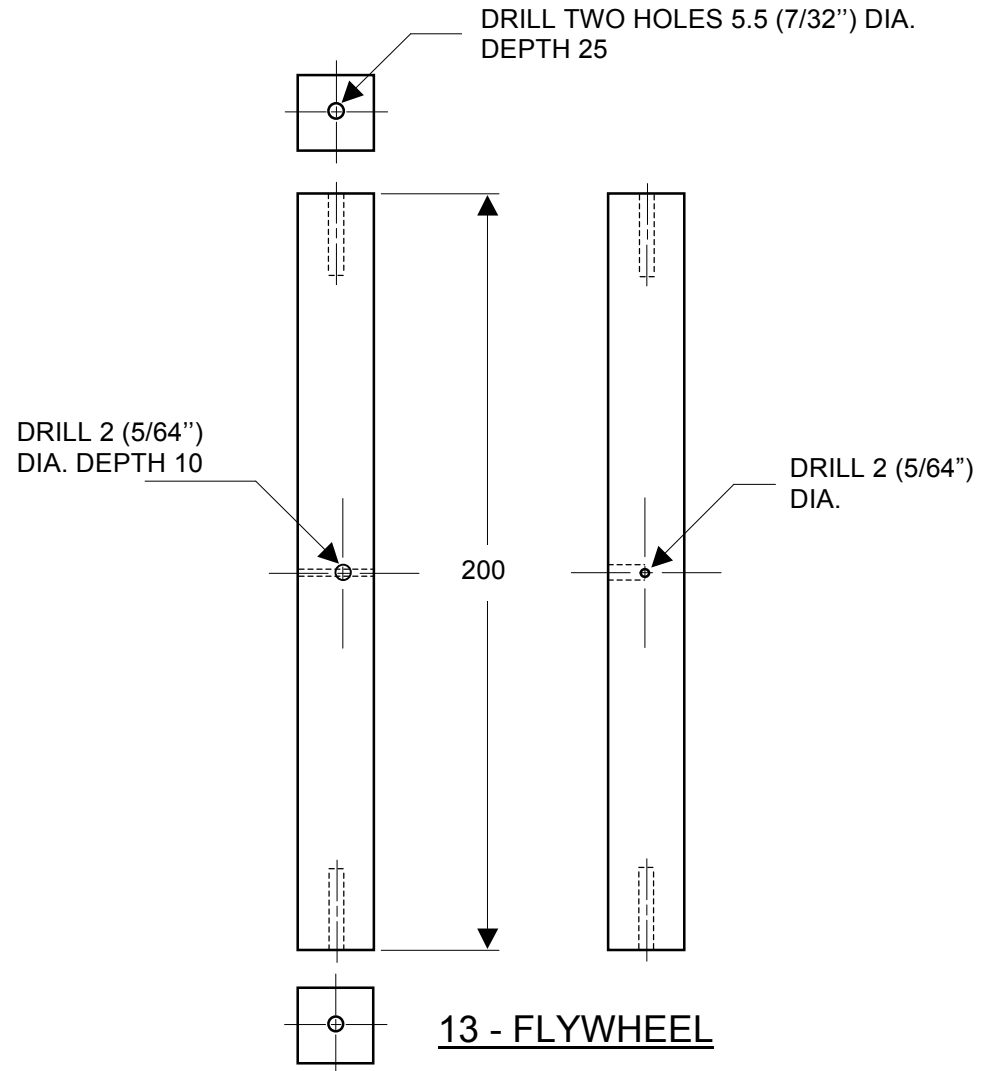
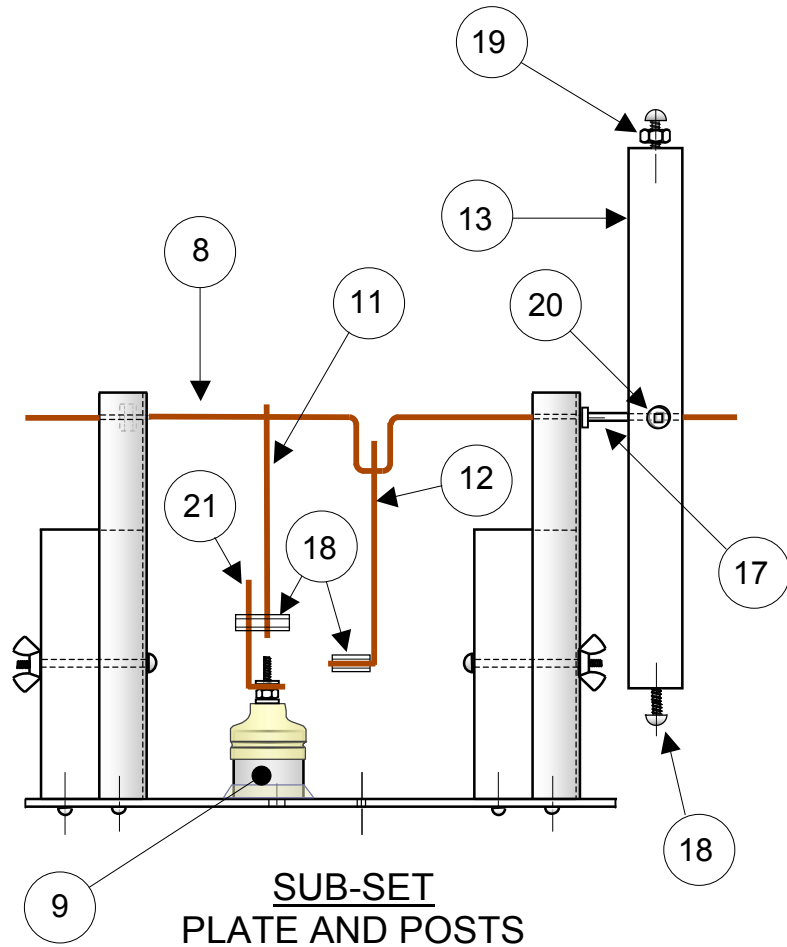


- Mitre box
- Hand saw



- Latex glove
- Pair of scissors

GAMME DE FABRICATION		FEUILLE : 2 de 2	
N°	PHASE, SOUS-PHASE OU OPÉRATION	CROQUIS	MACHINE-OUTIL, OUTILLAGE
22	Insert a 3 mm Ø punch and using a hammer, cut out the bottom.		<ul style="list-style-type: none"> - 3 mm punch - Hammer - Bloc of hard wood
23	As shown, insert a washer and 6-32 x 1/2" screw into the membrane.		-6-32 x 1/2" screw
24	Gently tighten using a pair of pliers and a screwdriver.		<ul style="list-style-type: none"> -Screwdriver - Pliers
25	Try the membrane on the combustion chamber.		



REF.	No.	DESIGNATION	MATERIALS
20	1	Blocking screw	n° 6 x 1/2 bolt
19	3	Adjustment screw and bolt	1/4 -20 x 1 1/2 bolt
18	3	Linkage tube	15 mm vinyl tubing
17	1	Flywheel butt	1/8" x 3/4" dia. rivet
13	1	Flywheel	Pine moulding (3/4" x 3/4")

FABRICATION RANGE

ELEMENT: Flywheel

SET: Stirling engine

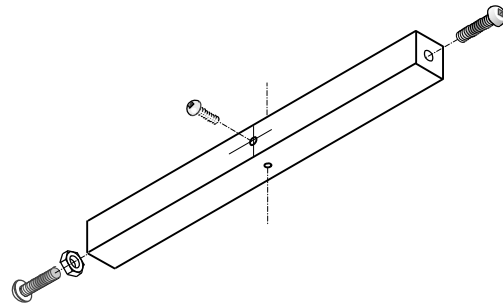
RANGE: 8

SHEET: 1 of 3



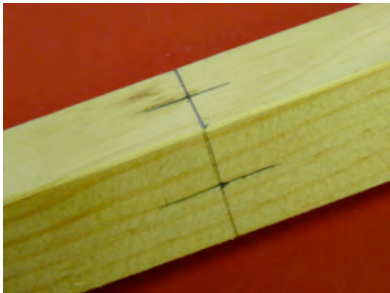

DRAWING: N°



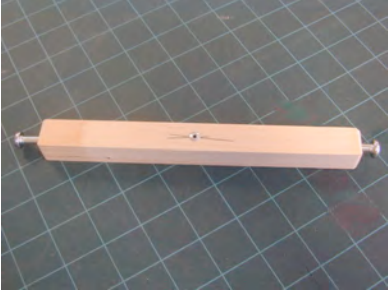


MATERIALS: Pine

NUMBER: 1

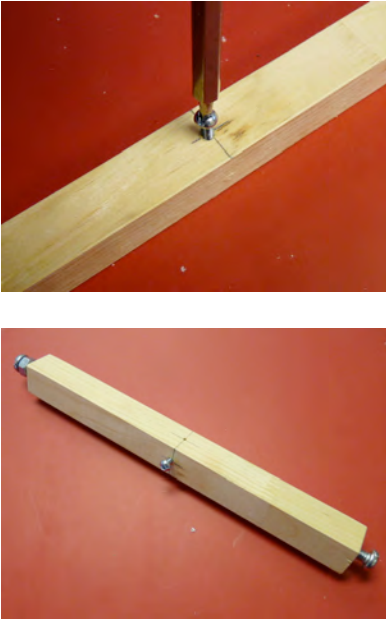


N°	PHASE, SUB-PHASE OR OPERATION	SKETCH	MACHINE-TOOL, TOOLS
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10	In a 3/4 in x 3/4 in section pine moulding, measure and trace a 200 mm length.		<ul style="list-style-type: none"> - Ruler - Pencil
11	Using a mitre box cut a 200mm length.		<ul style="list-style-type: none"> - Angle iron - Mitre box - Hand saw
12	Measure and point the middle of the flywheel.		<ul style="list-style-type: none"> - Ruler - Pointer - Hammer
13	Center and point each extremity.		<ul style="list-style-type: none"> - Ruler - Pointer - Hammer

FABRICATION RANGE		SHEET: 2 of 3	
N°	PHASE, SUB-PHASE OR OPERATION	SKETCH	MACHINE-TOOL, TOOLS
15	Drill a 5.5mm Ø hole at both ends of the flywheel.		<ul style="list-style-type: none"> - Drill - 5.5mm Ø bit - Vise
16	Using a ¼ – 20 x 1½ screw, tap the hole at each end.		<ul style="list-style-type: none"> - 5.5mm Ø bit - Screwdriver
17	The two screws will allow for a finer adjustment when the flywheel is balanced.		
18	Drill the hole for the crankshaft through at a 2 mm diameter.		<ul style="list-style-type: none"> - Sensitive drill - 2 Ø bit - Drill vise
19	Drill the 3mm diameter hole through and through.		<ul style="list-style-type: none"> - Sensitive drill - 3 Ø bit - Drill vise

FABRICATION RANGE		SHEET: 3 of 3	
N°	PHASE, SUB-PHASE OR OPERATION	SKETCH	MACHINE-TOOL, TOOLS

20	<p>Using a 6 x ½ screw, tap the hole.</p> <p>Note: This screw will be used as a link between the flywheel and the crankshaft.</p>		<ul style="list-style-type: none"> - Screwdriver - 6 x ½" screw
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FABRICATION RANGE

ELEMENT: Linkage

SET: Stirling engine

RANGE: 9

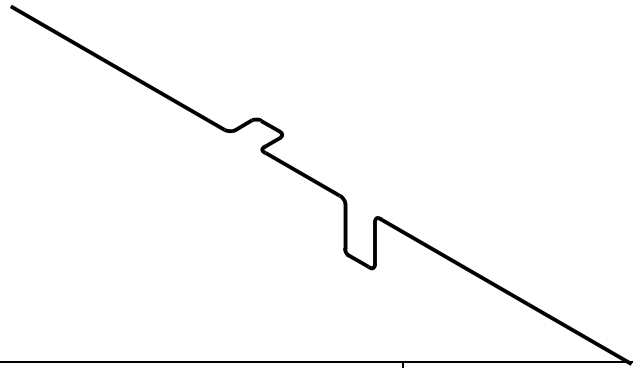
SHEET: 1 of 4

DRAWING:

MATERIAL:

NUMBER: 1

Polystyrene



N°

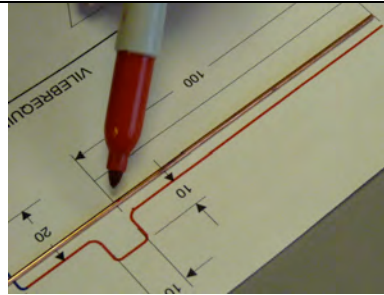
**PHASE, SUB-PHASE OR
OPERATION**

SKETCH

**MACHINE-TOOL,
TOOLS**

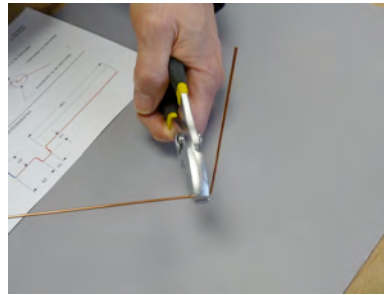
10 MAKING THE CRANKSHAFT

11 Using the drawing called "Crankshaft template" mark the first bend as shown.



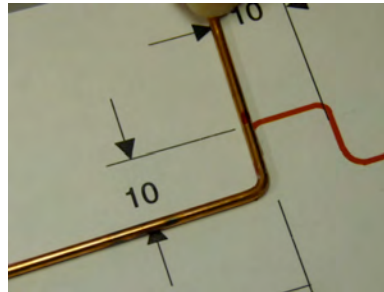
- Felt marker

12 Make the first bend using a pair of pliers



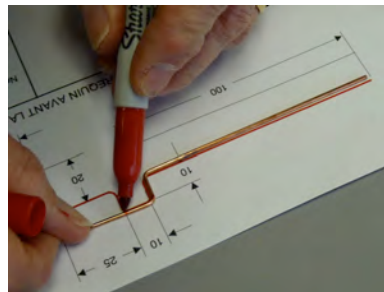
- Pliers

13 Mark, then execute the second bend.

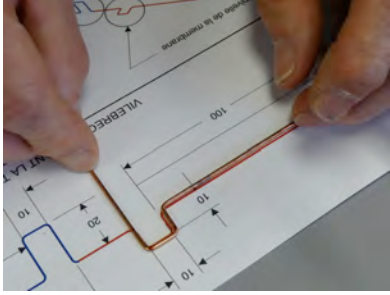
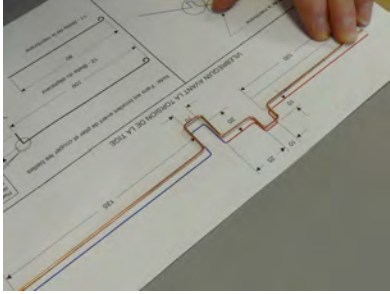
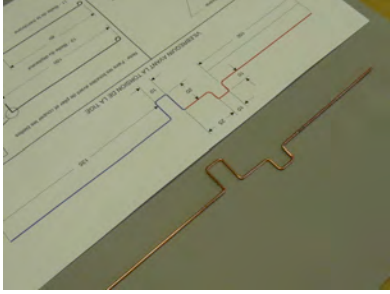

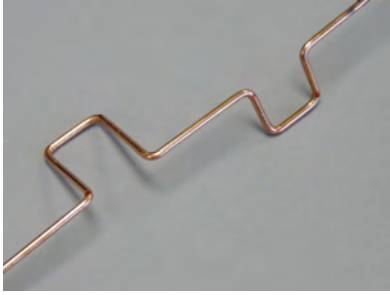


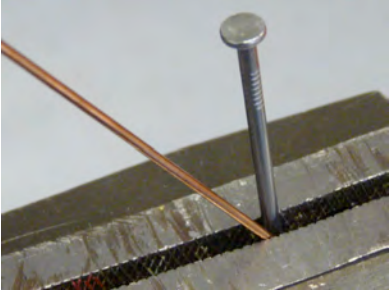
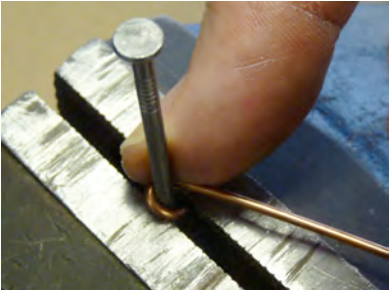

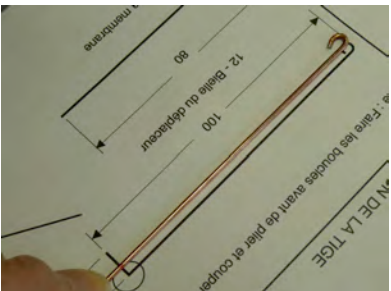
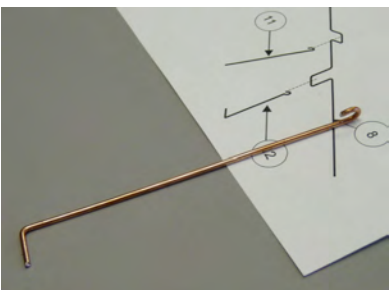
- Felt marker

14 Mark, then execute the third bend.



- Pliers

FABRICATION RANGE		SHEET : 2 of 4	
N°	PHASE, SUB-PHASE OR OPERATION	SKETCH	MACHINE-TOOL, TOOLS
16	Verify the bends on the drawing as you go along.		
17	Carry out all the bends in this manner.		<ul style="list-style-type: none"> - Perceuse - Foret Ø 5mm
18	Be sure to maintain the alignment of the central axis.		<ul style="list-style-type: none"> - Mitre box - Hand saw - Ruler - Pencil
19	Place the 20mm section of the crankshaft in the vise and bend the other section at 90° using pliers.		
20	Result.		

FABRICATION RANGE		SHEET: 3 of 4	
N°	PHASE, SUB-PHASE OR OPERATION	SKETCH	MACHINE-TOOL, TOOLS
	DISPLACER ROD		
22	Place a steel rod on a 2" nail in the vise and tighten them well.		- 2 in nail
23	Using your thumb, make a loop.		
24	Cut the excess off the loop with wire cutters and tighten with the vise.		- Wire cutters
25	Mark the length on the drawing.		- Drawing: Crankshaft template
26	Bend at 90° as shown. The extra will be cut off.		- Pliers

FABRICATION RANGE		SHEET: 4 of 4	
N°	PHASE, SUB-PHASE OR OPERATION	SKETCH	MACHINE-TOOL, TOOLS
30	MEMBRANE ROD		
31	Use the drawing to make the membrane rod the same way.		- Drawing: Crankshaft template
40	LINE OUT OF THE MEMBRANE		
40	Place a steel wire on a 3" nail in the vise and tighten them well.		- 3" nail
41	Using your thumb, make a loop.		
42	Cut the excess off the loop with wire cutters and tighten in the vise. Form the loop as shown.		- Wire cutters - Needle nose pliers
41	Bend the loop at 90° as shown.		- Vise



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*pour la formation générale
en science et technologie*

ASSEMBLY RANGE

ELEMENT: Set

SET: Stirling engine

RANGE: 10

SHEET: 1 of 7

DRAWING: 6

MATERIAL:

NUMBER: 1

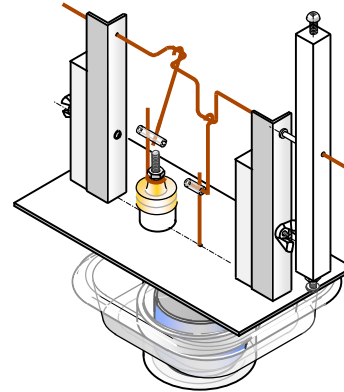
polystyrene

N°

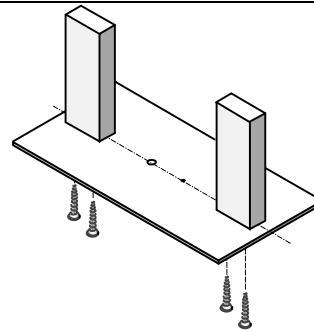
**PHASE, SUB-PHASE OR
OPERATION**

SKETCH

**MACHINE-TOOL,
TOOLS**



10 AFFIXING THE POSTS



11 Affix the post to the plate with a screw.



- Screwdriver
- N° 6 - 3/4 in. Round head screw

12 Using an angle iron, align the post correctly.

Note: You may also use the carpenter's vise to align two posts.



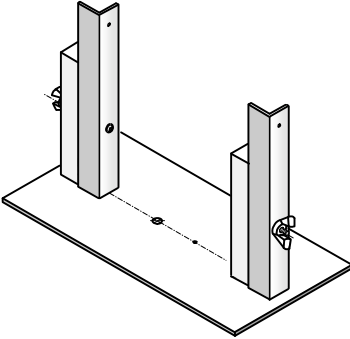
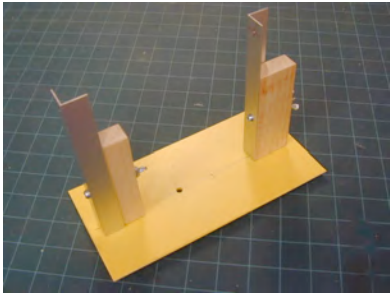
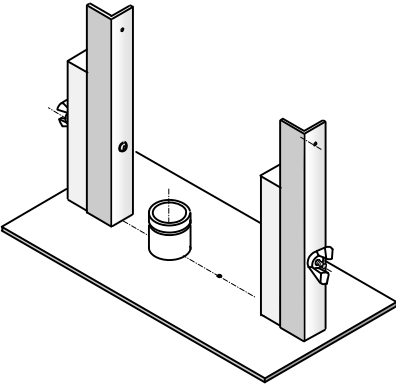
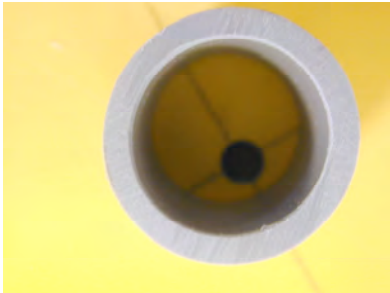
- Angle iron

13 Screw in the second screw.

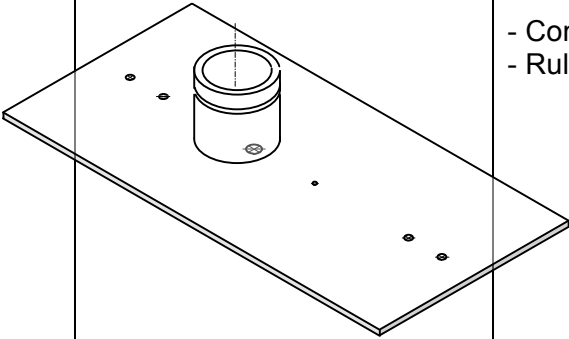

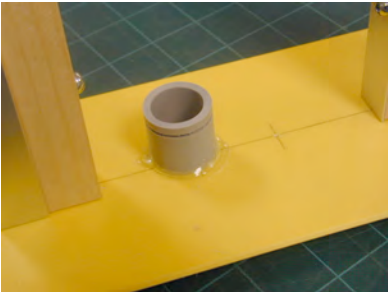
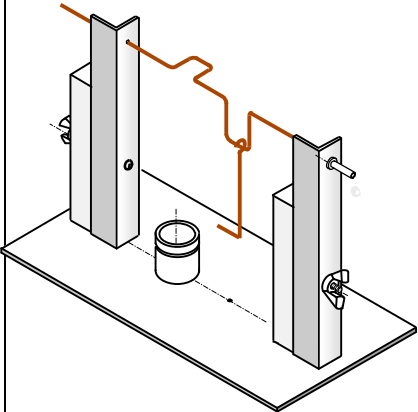


14 Repeat operations 11-12-13 for the other post.

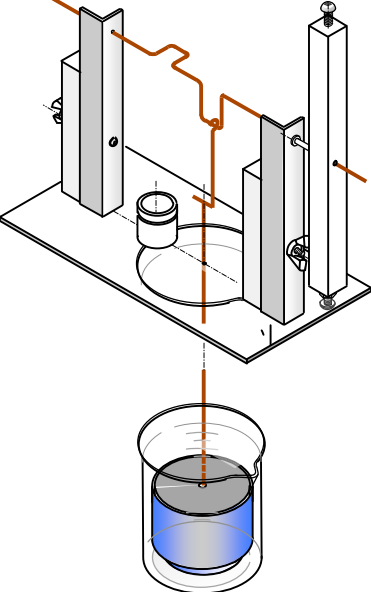
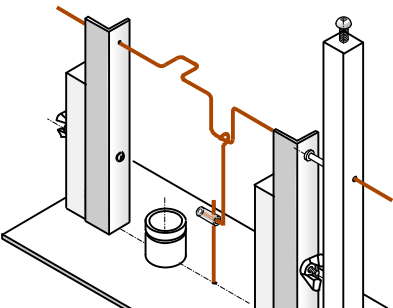
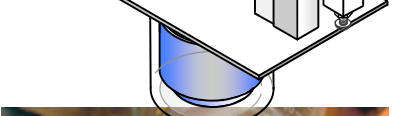


- Screwdriver
- N° 6 - 3/4 in. Round head screw

ASSEMBLY RANGE		SHEET: 2 of 7	
PHASE, SUB-PHASE OR OPERATION		SKETCH	MACHINE-TOOL, TOOLS
20	AFFIXING THE POSTS		
21	Affix the supports to the posts. Using two 8-32X2 metal bolts and two 8-32 wing nuts.		- 8-32X2 metal bolts - 8-32 wing nuts
30	AFFIXING THE CHAMBER		- Hot glue gun
31	Position the piping on the plate as shown. Note: The inside wall of the piping should touch the 6 mm Ø hole.		

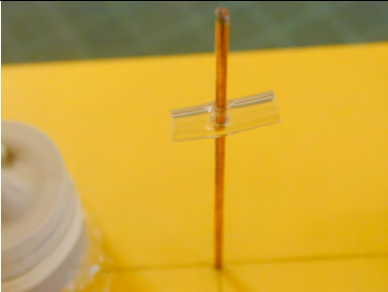


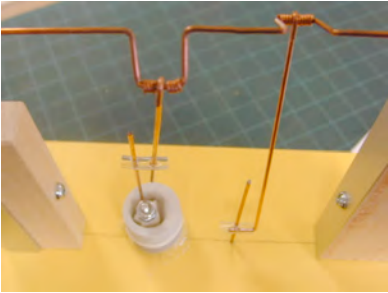

ASSEMBLY RANGE		SHEET: 3 of 7
PHASE, SUB-PHASE OR OPERATION	SKETCH	MACHINE-TOOL, TOOLS





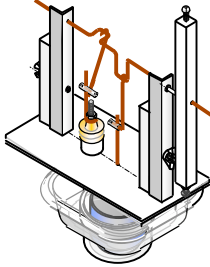
32	Using the glue gun, glue the piping solidly to the plate.	  	<p>- Compass - Ruler</p> <p>- Hot glue gun</p>
40	INSTALLING THE CRANKSHAFT		
41	Momentarily loosen one support, insert the crankshaft and re-tighten the wing nut.		
42	Place the displacer rod on the crankshaft.		

ASSEMBLY RANGE		SHEET: 4 of 7
PHASE, SUB-PHASE OR OPERATION	SKETCH	MACHINE-TOOL, TOOLS

50	INSTALLING THE DISPLACER		
51	Momentarily place the displacer and beaker as shown. Center the set as well as possible.		
52	Turning the flywheel, ensure that the motion of the displacer is not impeded by anything at all.		
53	Momentarily affix the beaker using two or three spots of glue and if everything is correct, glue all the way around. Note: It is useful to have another person's help during this operation.	 	- Hot glue gun
54	Ensure the beaker is airtight and fill the pouring spout with glue. The gluing stage is crucial because there must not be the slightest leakage.		

ASSEMBLY RANGE		SHEET: 5 of 7	
PHASE, SUB-PHASE OR OPERATION	SKETCH	MACHINE-TOOL, TOOLS	
60	INSTALLING THE EXPANSION CHAMBER		
61	Place the membrane on the expansion chamber, centering it as much as possible.		
70	LINKING THE CRANKS		<ul style="list-style-type: none"> - Utility knife - 5 mm Ø tube
71	Cut out two 15mm long pieces of vinyl tubing that will be used as links for the cranks.		
72	Drill one of the tubes with two sets of parallel holes using a 1.5mm bit.		
73	Drill through the other tube with a single set of holes.		

ASSEMBLY RANGE		SHEET: 6 of 7	
PHASE, SUB-PHASE OR OPERATION	SKETCH	MACHINE-TOOL, TOOLS	
74	Insert one tube on the displacer axle.		
75	Insert the other tube on the line out of the membrane.		
76	Install this line out on the bolt from the membrane and tighten the bolt well.		- Pliers
77	Place the two cranks as shown and using the vinyl tubes, adjust their heights.		
80	INSTALLING THE CONTAINER		
81	Cut out a latex glove and keep only the wrist part.		- Latex glove - Pair of scissors

ASSEMBLY RANGE		SHEET: 7 of 7	
PHASE, SUB-PHASE OR OPERATION	SKETCH	MACHINE-TOOL, TOOLS	
82	Insert the latex wrist on the plastic ring.		
83	Affix the wrist with an elastic band.		
84	Insert the container until it comes in contact with the base.		- Wide elastic band
85	Roll the glove and affix it to the beaker using the second elastic band. Ensure the container is airtight.		- Wide elastic band
90	STARTING YOUR ENGINE		
90	Using the Stirling engine operating guide, ensure your engine is working well.		