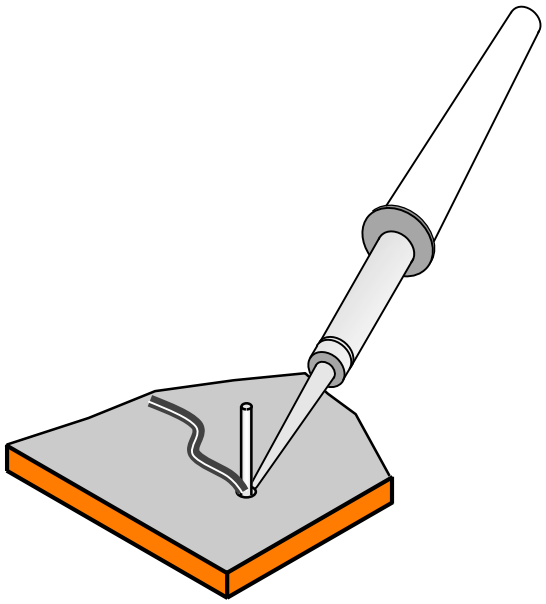
centre de développement pédagogique
pour la formation générale en science et technologie

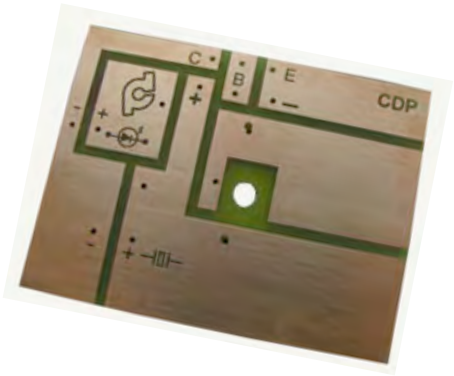
Working document

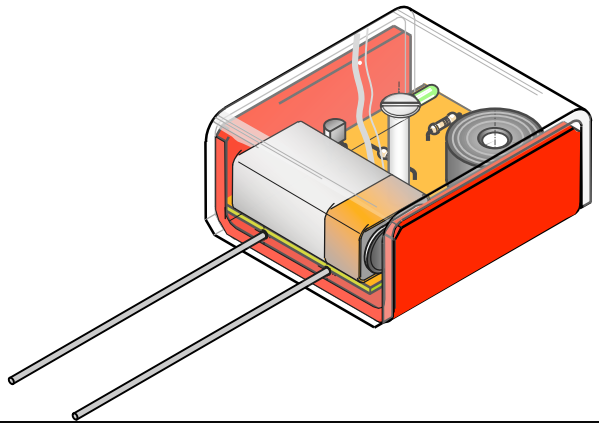
TRAINING ON PRINTED CIRCUITS AND SOLDERING TECHNIQUES

- ANNEXES -

This technical file is intended for technical or teaching personnel.







APRIL 2012

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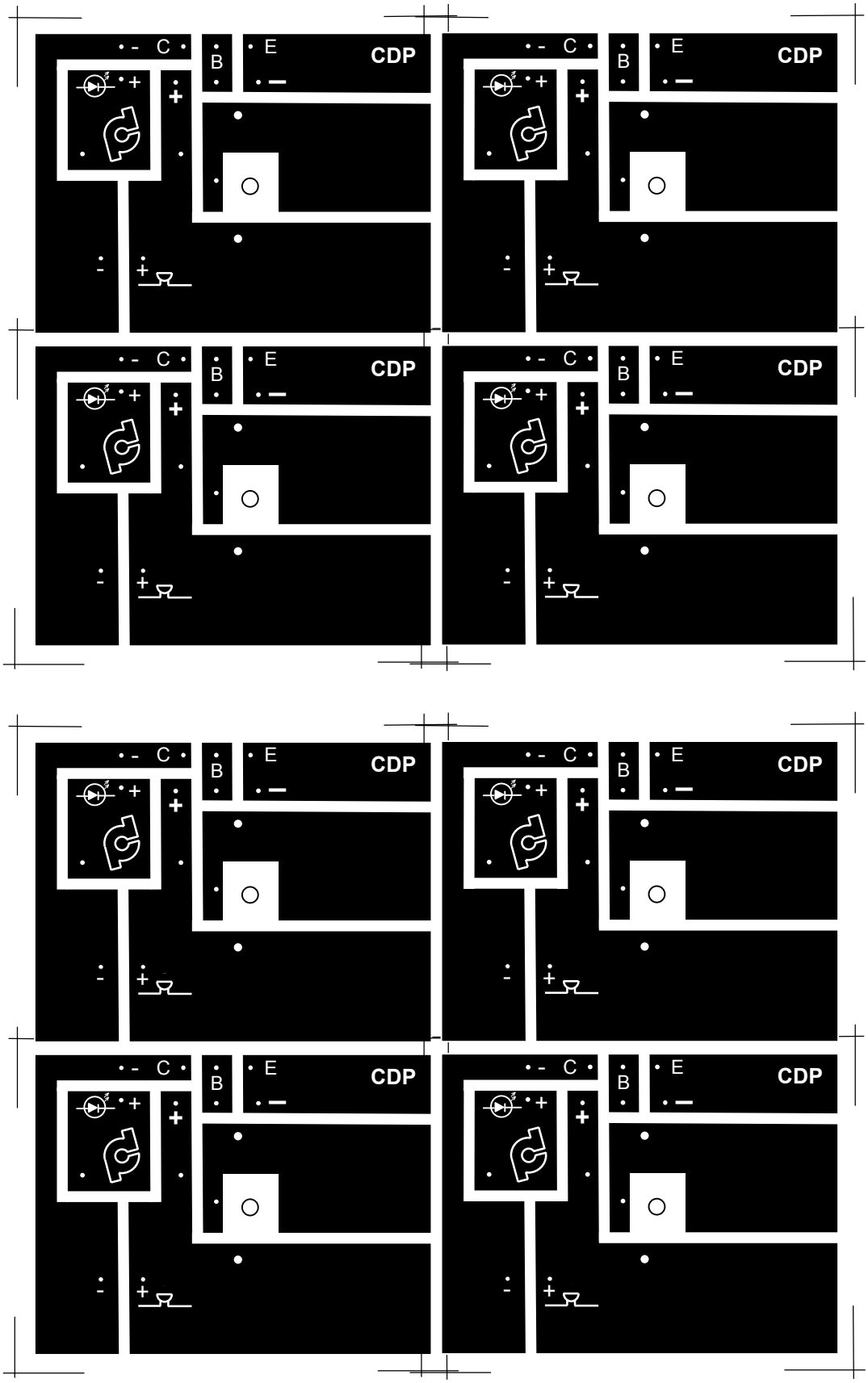
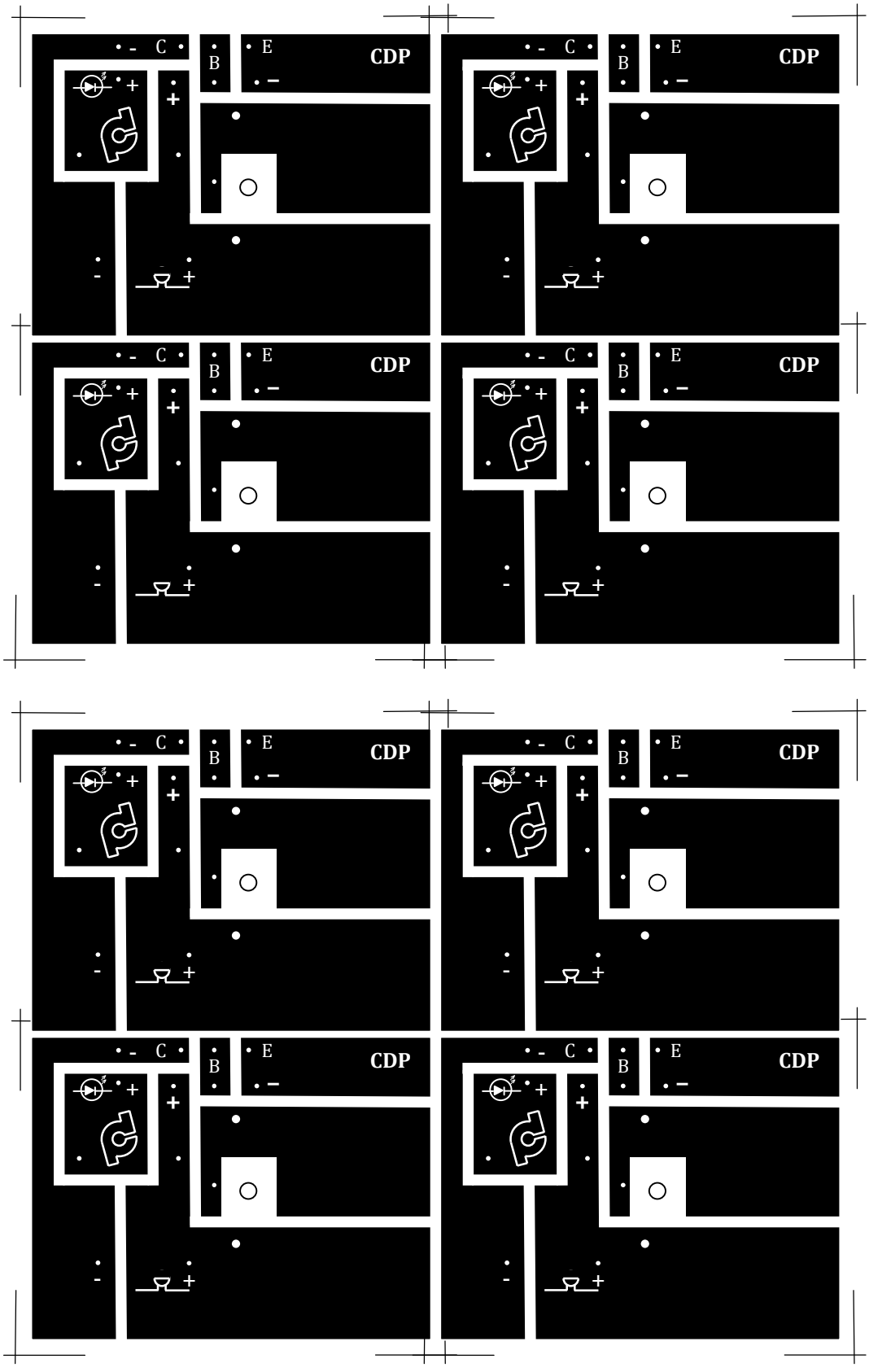
Printed circuit mask "Humidity detector"
(Small buzzer)



Printed circuit mask "Humidity detector"
(Large buzzer)



METRIC EQUIVALENTS TO IMPERIAL BITS

No.	Imperial diameter (in.)	Imperial diameter in (mm)	Metric diameter (mm)
1	1/16"	1.59	1.5
2	5/64"	1.98	2
3	3/32"	2.38	2.5
4	7/64"	2.78	3
5	1/8"	3.18	3
6	9/64"	3.57	3.5
7	5/32"	3.97	4
8	11/64"	4.37	4.5
9	3/16"	4.76	5
10	13/64"	5.16	5
11	7/32"	5.56	5.5
12	15/64"	5.95	6
13	1/4"	6.35	6.5
14	9/32"	7.14	7
15	19/64"	7.54	7.5
16	5/16"	7.94	8
17	21/64"	8.33	8.5
18	11/32"	8.73	8.5
19	23/64"	9.13	9
20	3/8"	9.53	9.5
21	25/64"	9.92	10
22	13/32"	10.32	10.5
23	27/64"	10.72	11
24	7/16"	11.11	11
25	29/64"	11.51	11.5
26	15/32"	11.91	12
27	31/64"	12.30	12.5
28	1/2 "	12.70	12.5

Resistance of a resistor

The resistance of a resistor shows its capacity to resist the passage of an electrical current. The greater the resistance, the greater the voltage required to force the electrical current through the resistor. Ohm's law describes this phenomenon perfectly.
As to the colour code[1], it is made up of four bars. The first three indicate the resistance in Ohms (Ω), while the last indicates the precision of the resistance. Needless to say, the greater the precision, the higher the price of a resistor.

		1er anneau gauche	2e anneau gauche	Dernier anneau gauche	Anneau droite
Couleur		1er chiffre	2e chiffre	Multiplicateur	Tolérance
	noir	0	0	10^0=1	
	marron	1	1	10^1	± 1 %
	rouge	2	2	10^2	± 2 %
	orange	3	3	10^3	
	jaune	4	4	10^4	
	vert	5	5	10^5	± 0,5 %
	bleu	6	6	10^6	± 0,25 %
	violet	7	7	10^7	± 0,10 %
	gris	8	8	10^8	± 0,05 %
	blanc	9	9	10^9	
	or			0,1	± 5 %
	argent			0,01	± 10 %
	(absent)				± 20 %

[1] www.Wikipedia.org (electronic colour code)

Color	Significant figures	Multiplier	Tolerance	
Black	0	$\times 10^0$	–	
Brown	1	$\times 10^1$	±1%	F
Red	2	$\times 10^2$	±2%	G
Orange	3	$\times 10^3$	–	
Yellow	4	$\times 10^4$	(±5%)	–
Green	5	$\times 10^5$	±0.5%	D
Blue	6	$\times 10^6$	±0.25%	C
Violet	7	$\times 10^7$	±0.1%	B
Gray	8	$\times 10^8$	±0.05% (±10%)	A
White	9	$\times 10^9$	–	
Gold	–	$\times 10^{-1}$	±5%	J
Silver	–	$\times 10^{-2}$	±10%	K
None	–	–	±20%	M

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Safety capsule

(1) Lead, tin and other soldering





1. Watch out for burns that can be caused by the iron at more than 200°C. (Do not wear rubber or latex gloves, these substances could melt on your hands.)
2. Wear safety glasses to protect yourself from solder projections.
3. Use a soldering iron rest to avoid setting fire to your clothing, hair, paper or plastic etc.
4. Do not shake the iron to clean it: use the sponge designed for the job.
5. Avoid touching the solder to your mouth or teeth - it is extremely toxic. (You must neither eat nor drink while soldering.)
6. Never solder components under tension.
7. Use in a well aired room or solder under the hood designed for this use in order to limit inhaling the vapours, since they are toxic.
8. Use a desoldering bulb to remove a faulty solder.
9. Wash your hands after your work, and clean the work table to avoid any risk of intoxication.

Ensure that any modification to this capsule does not compromise student safety. Any person at fault will bear the consequences of his choices.





Interesting links for teaching and technical personnel

Advice about tin soldering
http://www.interface-z.com/conseils/soudure.htm

In case of minor injury (Info santé)
http://wpp01.msss.gouv.qc.ca/appl/m02/M02RechInfoSante.asp

Information sheets about chemical substances
http://www.reptox.csst.qc.ca/RechercheProduits.asp

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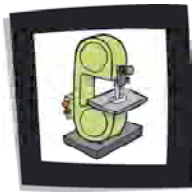
Safety capsule

(7) Band saw



1. Wear safety glasses to protect against projections.
2. Tie long hair and roll your sleeves to avoid them becoming entangled in the mechanism.
3. Do not wear bracelets, necklaces, jewellery, etc.
4. Clean the work surface of any debris that could lead to dangerous movements or that could hamper the proper operation of the saw.
5. Use a sharp blade, otherwise unnecessary effort could cause injuries.
6. Take the time to think about each of your gestures. Keep your hands further than 5 cm. from the cut line at all times.
7. Use a pusher for small parts in order to keep your hands far from the blade.
8. Respect the security perimeter on the floor. The proximity of another person could distract the user.
9. Activate the dust hood or wear a dust mask.
10. Wear acoustic protection to avoid auditory problems if the exposure to noise attains 85 decibels for a period of 8 consecutive hours.

Ensure that any modification to this capsule does not compromise student safety. Any person at fault will bear the consequences of his choices.

Interesting links for teaching and technical personnel

The band saw
http://www2.cslaval.qc.ca/star/La-scie-a-ruban
In case of minor injury (Info santé)
http://wpp01.msss.gouv.qc.ca/appl/m02/M02RechInfoSante.asp

The dangers of wood dust to our health
http://www.reptox.csst.qc.ca/documents/plusencore/poussieresbois/htm/poussieresbois.htm

Find the mistakes (CSST)
http://www.csst.qc.ca/asp/securite_machines/Flash/cherchez_erreur.html

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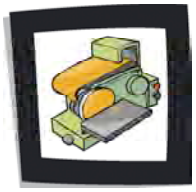
Safety capsule

(8) Disk and band sanders





1. Wear safety glasses to protect against projections.
2. Tie long hair and roll your sleeves to avoid them becoming entangled in the mechanism.
3. Do not wear bracelets, necklaces, jewellery, etc.
4. Clean the work surface of any debris that could lead to dangerous movements or that could hamper the proper operation of the sander.
5. Take the time to think about each of your gestures.
6. Respect the security perimeter on the floor. The proximity of another person could distract the user.
7. It is compulsory that the dust hood be activated when using the disk or band sander. If you are in the presence of a cancer causing contaminant (such as silica) the mask is also mandatory.
8. Call the workshop supervisor if the belt becomes misaligned.
9. Wear acoustic protection to avoid auditory problems if the exposure to noise attains 85 decibels for a period of 8 consecutive hours.




Ensure that any modification to this capsule does not compromise student safety. Any person at fault will bear the consequences of his choices.

Interesting links for teaching and technical personnel

Disk and band sanders
http://www2.cslaval.qc.ca/star/La-ponceuse-a-disque-et-a-ruban

In case of minor injury (Info santé)
http://wpp01.msss.gouv.qc.ca/appl/m02/M02RechInfoSante.asp

The dangers of wood dust to our health
http://www.reptox.csst.qc.ca/documents/plusencore/poussieresbois/htm/poussieresbois.htm

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Safety capsule

(9) Press drill

1. Wear safety glasses to protect against projections.
2. Tie long hair and roll your sleeves to avoid them becoming entangled around the chuck.
3. Do not wear bracelets, necklaces, jewellery, etc.
4. Careful! Risk of serious injury! Firmly affix materials to the table using clamps to avoid a part being hooked to the bit and spun around at great speeds.
5. Adjust the height and depth of the table and tidy the work surface before starting the drill.
6. Use a well sharpened bit, otherwise unnecessary effort could cause the bit to break and cause injury.
7. Remove the chuck key immediately after having tightened the drilling tool.
8. Take the time to think about each of your gestures.
9. Respect the security perimeter on the floor. The proximity of another person could distract the user.
10. Unplug the tool from the power source before changing a bit.

Ensure that any modification to this capsule does not compromise student safety. Any person at fault will bear the consequences of his choices.

Interesting links for teaching and technical personnel

The press drill
http://www2.cslaval.qc.ca/star/La-perceuse-d-etabli

In case of minor injury (Info santé)
http://wpp01.msss.gouv.qc.ca/appl/m02/M02RechInfoSante.asp

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Safety capsule

(10) Hot plate

1. Know where to find the first aid kit and safety equipment and learn how to use it (fireproof blanket, fire extinguisher, eye rinse, fire alarm, etc.)
2. Watch out for burns: the plate stays hot for quite a while.
3. Tie long hair and roll your sleeves to avoid them coming into contact with the hot plate and catching fire.
4. Wear safety glasses to protect against projections.
5. Wear protective clothing to guard against accidental projections.
6. Never direct the opening of a test tube towards yourself or someone else.
7. Use the appropriate tongs to manipulate laboratory glassware (beaker or test tube tongs etc.)
8. Take the time to think about each of your gestures.
9. Never use flammable substances close to a flame or hot plate.

Ensure that any modification to this capsule does not compromise student safety. Any person at fault will bear the consequences of his choices.

Interesting links for teaching and technical personnel

Safety rules in the laboratory
http://rea.decclic.qc.ca/dec_virtuel/Chimie/202-NYA-05/Chimie_generale/Laboratoires/Masse_volumique/La_securite_au_laboratoire.doc

In case of minor injury (Info santé)
http://wpp01.msss.gouv.qc.ca/appl/m02/M02RechInfoSante.asp

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Safety capsule

(12) Acid solutions





1. Careful! Acids are corrosive substances.
2. Wear safety glasses to protect against splashing. In case of contact with the eyes, rinse them immediately using the eye wash in the classroom.
3. Tie long hair and watch your sleeves to avoid any contact with the acid and to avoid spilling.
4. Never smell emanations directly. Direct the vapours towards your nose with your fingers.
5. Wear protective clothing in case of accidental projections.
6. In case of contact with your skin, wash it off with water and always wash your hands at the end of manipulations.
7. Take the time to think about each of your gestures.
8. Clean the work surface after manipulations to pick up any possible spillage.

Ensure that any modification to this capsule does not compromise student safety. Any person at fault will bear the consequences of his choices.





Interesting links for teaching and technical personnel

Safety rules in the laboratory
http://rea.decclic.qc.ca/dec_virtuel/Chimie/202-NYA-05/Chimie_generale/Laboratoires/Masse_volumique/La_securite_au_laboratoire.doc

In case of minor injury (Info santé)
http://wpp01.msss.gouv.qc.ca/appl/m02/M02RechInfoSante.asp

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Safety capsule

(13) Basic solutions





1. Careful! Basic solutions are corrosive substances.
2. Wear safety glasses to protect against splashing. In case of contact with the eyes, rinse them immediately using the eye wash in the classroom.
3. Tie long hair and watch your sleeves to avoid any contact with the base and to avoid spilling.
4. Never smell emanations directly. Direct the vapours towards your nose with your fingers.
5. Wear protective clothing in case of accidental projections.
6. In case of contact with your skin, wash it off with water and always wash your hands at the end of manipulations.
7. Take the time to think about each of your gestures.
8. Clean the work surface after manipulations to pick up any possible spillage.

Ensure that any modification to this capsule does not compromise student safety. Any person at fault will bear the consequences of his choices.



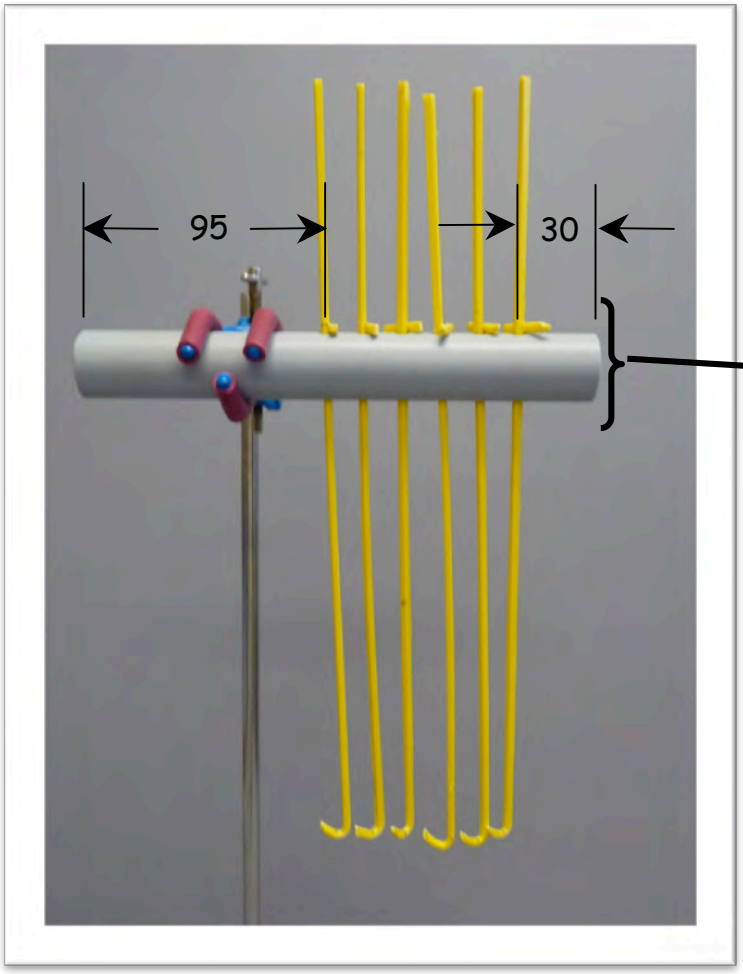


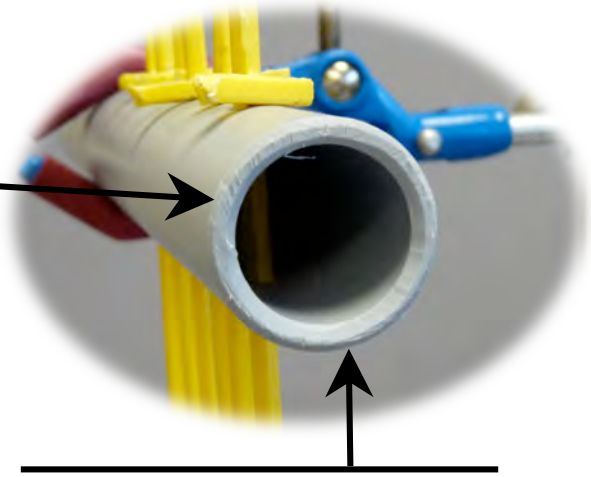
Interesting links for teaching and technical personnel

Safety rules in the laboratory
http://rea.decclic.qc.ca/dec_virtuel/Chimie/202-NYA-05/Chimie_generale/Laboratoires/Masse_volumique/La_securite_au_laboratoire.doc

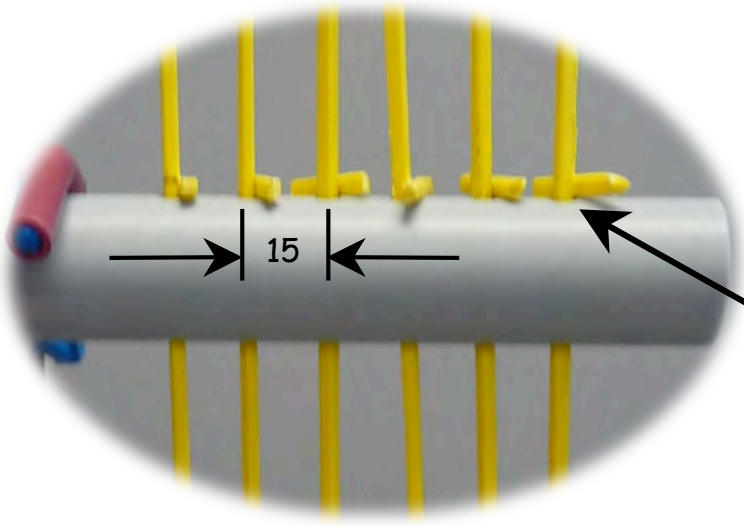
In case of minor injury (Info santé)
http://wpp01.msss.gouv.qc.ca/appl/m02/M02RechInfoSante.asp

ASSEMBLING THE SUPPORT FOR THE PLATES AT THE ENGRAVING STAGE





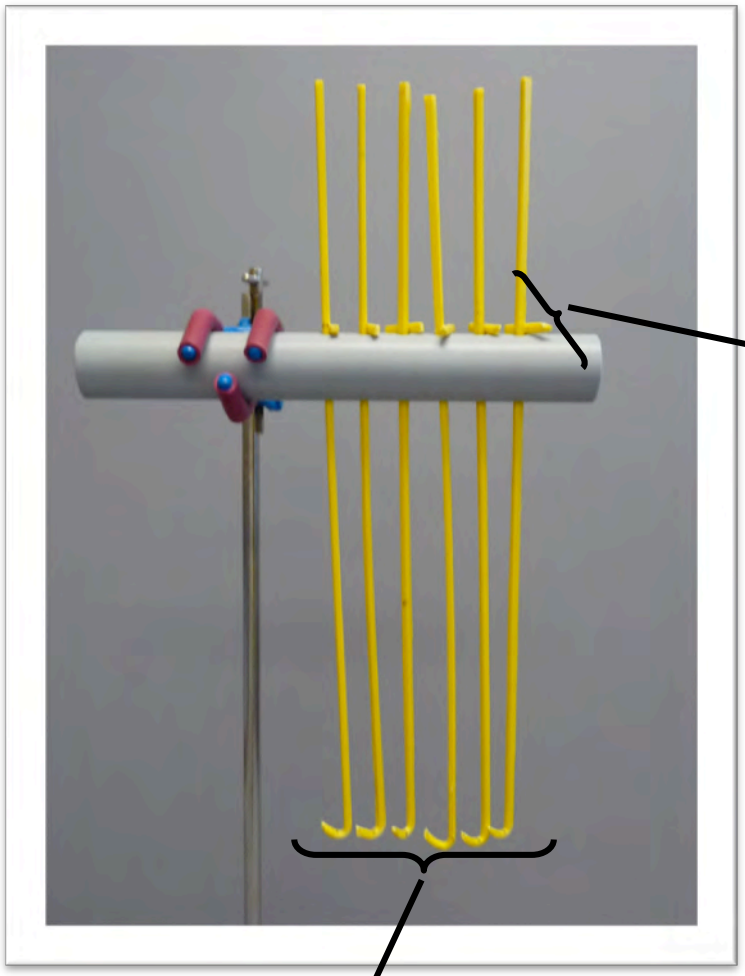
PVC pipe
21 mm int. (3/4 in. int.) diameter
200 mm long

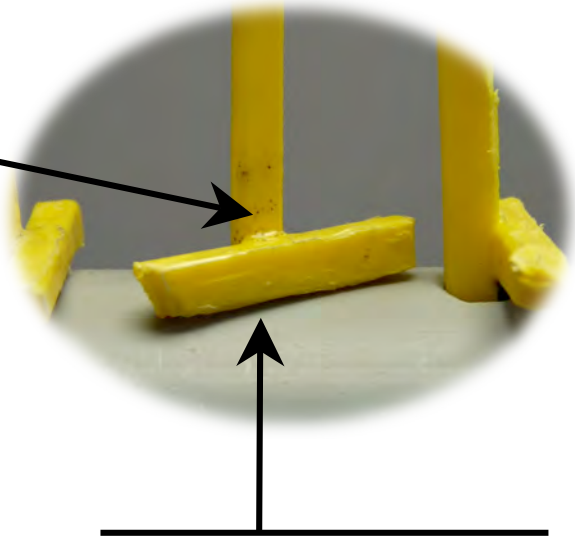


Drill the pipe through and through with a 5 mm (3/16" in.) hole.

Make 6 holes.

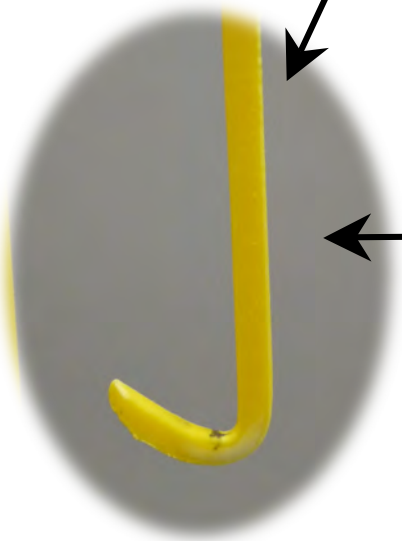
ASSEMBLING THE SUPPORT FOR THE PLATES AT THE ENGRAVING STAGE





Cut pieces of polystyrene about 15 mm. long. These will be used as butts.

Glue the butt pieces about 210 mm. from the elbow in the shaft.



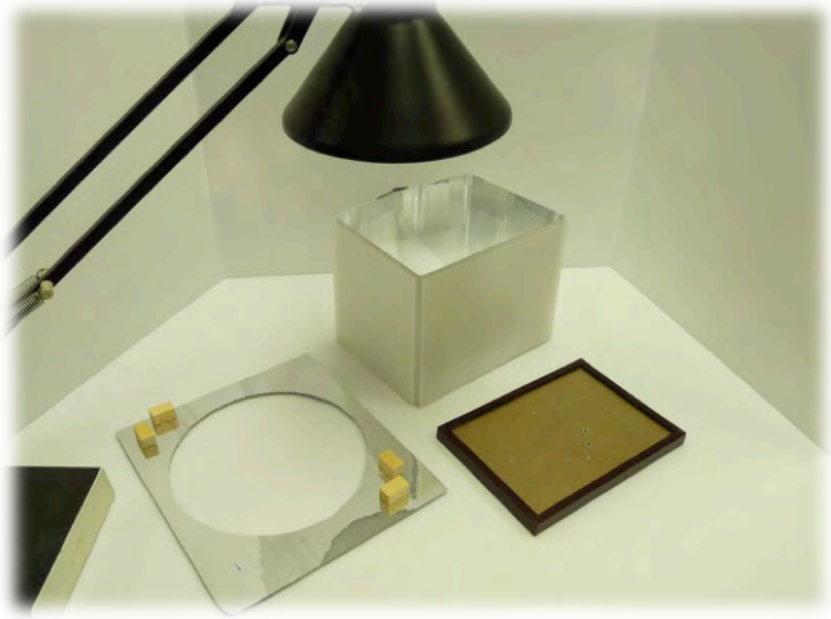
Polystyrene shaft dimensions:
350 mm X 3 mm X 3 mm

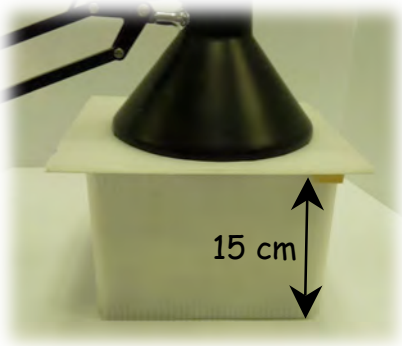
Bend the shaft at 25 mm from the bottom end, using the linear heating element.

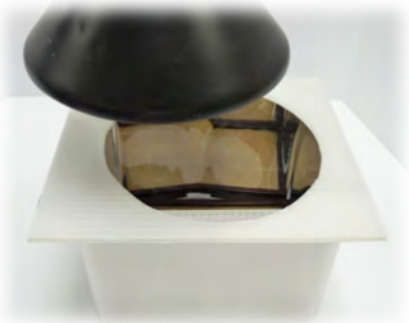
The angle of the bend should be about 45°

Sand the end to make it thinner.

REFLECTOR FOR TABLE LAMP

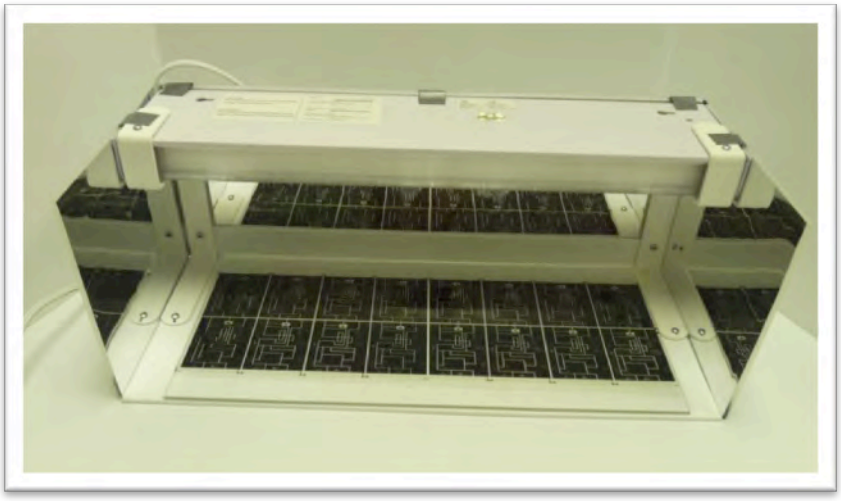


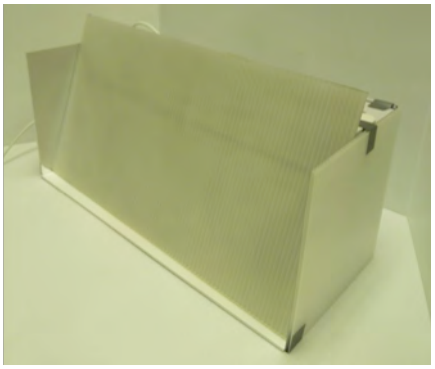




Using a reflector allows you to move the light further away, which produces a more precise, uniform exposure.
The reflector is made from a Coroplast box adapted to the size of the frame. The inside of the box is lined with a reflective material (aluminium foil or Mylar).

REFLECTOR FOR FLUORESCENT





The ideal height between the fluorescent and the masks is 15 cm.

SOME SUPPLIERS

Pre-sensitised photosensitive circuit plate (single side):

Description: thickness 1/16 po (1.60 mm) – dimension 8 x 12 " (200 x 300 mm)

#630

M.G.Chemicals
http://www.mgchemicals.com/products/600.html

Abra electronics Inc.

http://www.abra-electronics.com/products/MG-Positive-Presensitized-Single-Sided-1%7B47%7D16%22-CCB.html

ELECTRO-5 INC
http://www.electro5.com/

Soduium persulfate (low quality, about $30/kg):

Same suppliers as for the plates, electronics retailers or chemical products suppliers

Liquid tin (about $40/500 mL):

Same suppliers as for the plates, electronics retailers or chemical products suppliers

1 inch Chicago screw:
Hudson Supplies Inc, 2940 Halpern, Saint-Laurent (Québec) H4S 1R2
Telephone: (514) 337-5005
http://www.hudson4supplies.com/fr.ca/product-7135