

## 8 - make

“The time for half-measures and talk is over.”

– Maximus in *Gladiator*

### intro

Just the ideas in this book can bring relief and hope. But 99% of their value lies in their application. This requires a darkroom. Since darkrooms are uncommon, these last four chapters explain how to build darkrooms, usually inside existing buildings.

This chapter provides basic information that applies to all components of a darkroom. The next three chapters provide blueprints and instructions for components related to three elements: air, darkness, water. They are vents, silencers, seals, blinds, and kitchen and bathroom fixtures. Designs are low-cost, low-tech, and work off-grid.

A darkroom is a real thing you see and touch, make, use, and offer others. It is not a metaphor. It takes a knowledge, imagination, design, measurement, plans, materials, craftsmanship, construction, testing, and improvement.

These are normal human activities. Everyone does them to some degree. and get help with the rest. If you can walk down stairs without falling, slice a loaf of bread, hit a plate when you aim food at it, hold a pencil, cognize sentences, tell light from dark, and feel a breeze, you are mechanically sufficient to begin. As Jack Nuckols, an engineer and my grand-elder, once told me when my time came, “Become a craftsman.” Perhaps your time has come. Become a craftsman. Become a maker.

I suggest that, your first time through these chapters, you read everything in this one. But just read the prose parts of the next three. Save the lists of instructions for the next time and again when it comes time to build. They make dense read-

ing. Eventually, they'll be replaced with graphical assembly instructions like IKEA's. For now, slog through with me.

All components rely on the basic instructions in the following sections: **metric**, **tools**, **plans**, and **fabrication**. Each component has special instructions and design constraints in its own section in later chapters:

[9 air](#)

[10 darkness](#)

[11 water](#)

After improvising darkness to sleep in [tonight](#), the [instant sleeping mask](#) probably comes next. Thus initiated, you can begin your training as a darkroom-building ninja. You will become invisible to everyone for a while. And you won't be able to see anything, either. Haha.

If you need more specific advice for darkening your space, I provide [design consultation](#). I guide people through text, voice, and image on a chat app toward a completed darkroom and successful retreat. Likewise, feel free to use these [open-source](#) designs and my consultation to darken other people's spaces as a service for money. See [license](#) for my liberal terms.

## metric

I give all measurements in metric, mostly millimeters. Are you used to the inches, pounds, and gallons of the imperial system? Get a handle on the brain-descrambling metric system in a split-minute:

1. understand that, with metric, you will simply be counting to 10 and multiplying by 10 like normal. You will not be wrangling fractions and multiple conversion factors as in the imperial system.
  - basic metric conversions:
    - length: 1m=100cm=1000mm (meter, centimeter, millimeter)
    - volume: 1L=10dL=1000mL (liter, deciliter, milliliter)

- mass:  $1\text{kg}=10\text{hg}=1000\text{g}$  (kilogram, hectagram, gram. Mass is like weight. But it uses a balance, not a spring scale, so it does not depend on Earth's gravity. Build a darkroom in space!)
  - cool intra-conversions:
    - $1\text{L}=10\text{cm} \times 10\text{cm} \times 10\text{cm}$  ( $1000\text{cm}^3$ )
    - $1\text{L water}=1\text{kg}$
    - thus,  $1\text{mL water}=1\text{cm}^3=1\text{g}$
    - brilliant! simple! humane!
2. use these imperial near-equivalents to practice the metric system, visualize my descriptions, and make estimations. Not for precise conversions or large quantities. (\*My favorites):
- length
    - $*25\text{mm} = 1''$  (inch)
    - $*100\text{mm} = 4''$
    - $30\text{cm} = 1'$  (foot)
    - $1\text{m} = 1 \text{ yard} \ \& \ 4''$
    - $3\text{m} = 10'$
    - $1\text{km} = 0.6 \text{ mile}$
  - area
    - $1\text{m}^2 = 11'^2$
    - $4' \times 8' \text{ sheet} = 120\text{cm} \times 240\text{cm}$  ( $\sim 3\text{m}^2$ )
    - the genius A0-A8 paper size system. A sheet's  $1:\sqrt{2}$  proportion remain the same when cut in half the short way.  $\text{A0} = 841 \times 1189 = 1\text{m}^2$ .  $\text{A1} = 595 \times 841 = 0.5\text{m}^2$ .  $\text{A4}$ , the metric counterpart to North American letter size paper, is  $210 \times 297 = 0.0625\text{m}^2$ ,  $1/2^{(A)}4$  of a square meter
  - volume
    - $*4\text{L} = 1 \text{ gallon}$
    - $1.7\text{cmh} = 1\text{cfm}$  (cubic meter per hour to cubic feet per minute; for airflow)
  - mass
    - $28\text{g} = 1 \text{ oz}$
    - $*1\text{kg} = 2.2 \text{ lb}$

## tools

Making components requires most or all of these tools:

1. table or desk
2. measure
  1. Note: before purchase, test tools for accuracy, which can vary between identical tools, even of good brands. Instructions below.
  2. metric ruler, 30cm, clear plastic. If reproducing plans by hand rather than printing them, then get an [Incra ruler](#). For its effortless marking precision, I recommend it for making anything at all ever. It's the greatest hand tool I have ever used.
  3. meter stick, steel with engraved marks
    1. put marked edges of two sticks together so 40cm mark of one meets 60cm mark of other
    2. push ends of both against a wall and check how well marks line up
    3. repeat with other sticks till you find a match
    4. buy one of them
  4. metric measuring tape, 5m
    1. use a tape whose case length is easily and accurately added to the figure on the tape itself. Some measuring tapes are designed to give highly accurate internal measurements, eg, between sills
    2. hook tape on end of meter stick and compare marks for accuracy of external measurement
    3. push end of meter stick against a wall, put tape on top of meter stick, and compare marks for accuracy of internal measurement
3. mark
  1. 0.5mm mechanical pencil
  2. ballpoint pen, black or blue ink
  3. black marker
  4. straight pin with colored plastic head or masking tape handle

5. magnifying glass (even a tiny plastic one works, like the one in a Swiss Army knife)
4. crease, score, cut
  1. straight edge 200mm longer than your longest piece will be. 1-2mm-thick steel is best. An aluminum door or window frame member also works well. A board less than 12mm thick with a perfectly straight edge (check it!) is fine.
  2. table knife: use back of tip for creasing
  3. razor knife with new blade: use for scoring and cutting. To score is to cut halfway through thickness of material with razor knife so it remains one piece and folds very easily
  4. scissors for both paper and fabric
5. join
  1. masking tape
  2. wood glue, unthickened, any grade
  3. glue syringe, 20-50mL for precise, efficient gluing
    - available at:
      - as kitchenware along with 2-3mm stainless needles
      - pharmacies. Also get a 2mm x 40-50mm needle. Perhaps cut off the tip. If unavailable, use a cartridge from ballpoint pen, the fat (4-5mm) tapering type. Clean it out and trim it down to point in taper that fits over nipple of syringe
      - woodworking shops, with needles
    - remove needle and plunger. Cover nipple with finger and fill from back, leaving 10mm unfilled. Replace plunger barely. Point nipple upward and uncover it. Wait for air bubble to rise to top. Then push plunger in till air is cleared from syringe. Replace needle and use.
6. for [roller blind](#):
  1. drill
  2. screwdriver

3. gluing clamp (for roller blind)
  - 2 straight, flat 35 x 90 boards, non-rounded edges
  - 1.5x as long as long edge of paper sheets
  - every 300mm, 8mm holes, an 8x80mm bolt, 2 washers, and a wingnut holding boards together
4. hack saw (for roller blind), even just a hack saw blade is enough. Cover teeth at one end with tape as a handle so you can cut on the pull stroke

## plans

I have drawn the plans on a computer for precision, clarity, and ease of modification. However, at first, they can be baffling to look at.

1. use the **key** to understand the symbols and marks
2. compare drawings to photos.
3. read the instructions through a couple times in the days before making begins.
4. then *follow the instructions*, one step at a time, and you ought to end up with the intended component.
5. dimensions are either H x W x L (height, width, length) or X x Y x Z (left-right, up-down, in-out or width, height, depth) with newer components: helix vents, silencer, fan mount, sleeping mask Understanding often comes through doing. If this does not work, write me and I'll try to sort out the confusion and maybe improve the instructions and drawings for others, too.

A drawing has one or two *views*, depending on the best way to communicate its information:

- *plan*: from above, two dimensional (2D). Default view if unlabeled.
- *elevation*: from the side (2D)
- *section*: a cutaway or slice of the object showing all parts when assembled (2D)

- *perspective*: from a non-right-angled point of view to capture more sides (3D)
- *exploded*: all parts separated but in correct order and linear relation (3D)

For example, the [helix vent](#) has plan views of its flat parts and one section view showing how parts are assembled. The [toilet frame](#) has both plan and elevation views, while the [shower](#) has an exploded view.

All plans can be reused except [sleeping mask](#) plan, which is destroyed as you make it. So make as many prints of it as masks you intend to make.

Images in this book are only for reference and hand-reproduction. They are reduced to fit book pages. Thus they are neither full-scale nor in proportion to each other. If reading on a screen while online, you can zoom in. Click each image to open the corresponding full-size plan as an individual PDF.

1. download all plans at once with the darkroom retreat [zip file](#). Extract (decompress) the file. Contents:
  - plans: a complete set of PDF plans
  - all photos below plus extras from website
  - SVG source files of plans for modifying them, originally drawn in [Inkscape](#).
  - I would love it if someone made
    - 3D versions of these drawings with Sketchup
    - assembly instructions for the components like IKEA
2. print
  1. large format
    1. large format printing is cheap, extremely accurate, and much faster and easier than desktop printing. Most print shops, including Staples and Office Depot, now offer large format printing.
    2. email your files to print shop or take them on a USB flash drive
    3. paper
      1. specify cheapest option

2. if print shop has 300gsm acid-free black paper on a roll for large format printing, print the helix vent's channels and walls directly onto it. Yes, black ink on black paper is visible enough to work with.
4. have files printed in actual size, with no scaling. Before paying, check measurements with ruler or measuring tape. Distortion should not exceed 1mm over a 250mm span.  
After resigning myself to 2mm distortion per 250mm (0.8%) with desktop printers, I was shocked to find almost no distortion with large format printing, maybe 0.5mm/500mm (0.1%). But then it made sense because architects, engineers, and builders depend on this service for their blueprints.
2. desktop
  1. only do this if you are absolutely broke or can't find a large format printing service on your desert island. Desktop printing of plans takes a lot of time and yields imperfect results.
  2. print
    1. open file with Adobe Reader (not Adobe Professional)
    2. in print dialogue, select: "Poster"; Tile Scale: 100%; Overlap: 1.0in; Cut marks: yes; Labels: yes
    3. use A4, letter, or legal size, possibly A3
    4. Distortion over 250mm span should not exceed 1mm.
    5. after printing one file, check measurements against ruler to 1mm tolerance.
  3. join sheets
    1. cut a small wedge out of overlapping cut mark to align it with matching cut mark on sheet below
    2. align cut marks at perimeter of plan first, then the one(s) in the middle.
    3. use masking tape to join sheets
3. by hand



1. ruler and magnifying glass
  1. get large white paper to make a reusable pattern with. Don't measure directly on materials.
  2. to keep drawing orthogonal, use some combination of graph paper, drafting table, and extra careful measurement and marking. An [Incra ruler](#) will help a lot with this.
  3. use magnifying glass to see small words and numbers in the book
  4. plans are as symmetrical and uniform as possible. If two similar-looking areas of a plan look the same size, they are. So from measurements given in plans, infer the rest. There is some redundancy so you don't have to figure out everything and can double-check essential measurements with arithmetic.
  5. use grey-numbered cumulative measurements in plan to quickly mark lines
2. trace
  1. trace directly from a flat screen monitor
  2. zoom image till stated measurements match a ruler both horizontally and vertically
  3. tape paper to the screen
  4. mark ends, corners, and intersections of lines precisely and lines just well enough to know what you are looking at later
  5. you will have to overlap multiple sheets of paper for most plans, as with a desktop printer. On each new piece of paper, repeat the last set of marks from the previous so you know where to overlap and tape the sheets together.

### 3. key



Here is a key to the computer-drafted plans. Find further explanation of symbols, especially dash-dotted lines, in **fabri-cate** section below.

# key

## l i n e s

<i>dashed</i>	---	crease & fold forward
<i>dotted</i>	.....	crease & fold backward
<i>solid</i>	—	cut
<i>dash-dotted</i>	- . - . -	guide
<i>dash-dotted-arrow</i>	- . . . →	dimension
<i>asterisk-dashed</i>	- * -	score back & fold forward
<i>asterisk-dotted</i>	. * .	score front & fold backward
<i>sausage</i>		glue

## s y m b o l s

<i>zigzag-arrows</i>		stretch shrink
<i>crosshairs</i>		hole (pin, 2, 3, 4, or 8mm)
<i>letter</i>	A	joint
<i>black number</i>	72	mm between lines, corners, & hole centers
<i>grey number</i>	72	mm from B or L edge
<i>number with tilde</i>	72~	adjustable measurement

## l a b e l

part or SHEET  
 dimensions (height x width x depth)  
 material  
 type, weight  
 amount (as paper size)  
 view (plan, elevation, section, etc)

plan: key [get pdf](#)

## fabricate

These instructions apply to all components, or as indicated. Read special instructions for each component in its respective section afterward.

### 1. prepare plans

1. for fabric parts ([sleeping mask](#), [roller blind seals](#))

1. using ruler and razor knife, cut out parts at outlines (except roller blind seals: cut around group of 8 seals)
2. cut out tape holes on dash-dotted lines
3. skip to step "3. make parts" (about two pages below)
2. customize [roller blind plans](#)
  1. cut out parts, leaving as much paper around them as possible
  2. measure variables ( $h$ ,  $w$ ,  $t$ ) and derive measurements for parts. Measure sill where it meets wall or trim. Write measurements on parts next to variables.
  3. cut lines running through stretch arrows. Rejoin with a couple small pieces of tape to keep them together until transferring plans to material.
3. customize [threshold vent](#)
  1. using straight edge and razor knife, cut vertical lines running through shrink arrows in grey areas
  2. shrink left and right sections (push them inward, overlapping center section) until cut edges match center section's top and bottom mm marks equal to  $h$
  3. draw vertical lines through mm marks in corners of plan equal to  $h$
  4. cut horizontal line running through center shrink arrow
  5. shrink top and bottom sections until cut edges match center section's left and right mm marks equal to  $t$
  6. adjust point C (at both left and right):
    - downwardly so its distance from point D equals  $t/2$
    - horizontally so it lies on new vertical line
  7. cut vertical line running through center stretch arrow
2. transfer plans to material
  1. tape plans to materials
    1. [helix vent shell](#): align plan roughly diagonally to corrugations (or edges or folds) of cardboard

2. where necessary, cut out small wedges from outlines of plans to align them with edges of materials. With some roller blind frame parts, dash-dotted extensions of outlines aid in this step.
  3. parts with stretch arrows
    1. tape one half to edge of material
    2. using derived measurements and tape measure, mark material where opposite edge of part should be and tape it there
  4. lay out other plans on materials and tape opposite corners
2. put three layers of cardboard on work surface
  3. transfer plan with straight pin
    - use magnifying glass for ease of marking and geeky precision thrills
    - poke straight pin through
      - all black lines close to ends (not grey glue sausages)
      - centers of holes
  4. remove plan from material
  5. label drawing, words oriented the same as in plan
    - dashed lines: circles
    - dotted lines: double circle
    - solid lines: squares
    - dash-dotted lines: triangle
    - holes: star
  6. mark the marked holes again
    - draw short lines from circles, triangles, and squares in the same direction as lines in plan
    - circles/double circles: add asterisk where indicated
    - copy joint labels (A, B, C, etc)
3. make parts:
    1. keep scrap cardboard on work surface
    2. fabric parts (sleeping mask, roller blind seals)
      1. tape plans to fleece over tape holes
      2. roller blind locking seals: cut 8mm slits through plan with razor knife

3. cut parts exactly around plan outline with scissors
4. leave plans taped to sleeping mask side seals
5. remove plans from other parts
6. repeat steps 1-4 to make
  - 2 sleeping mask center seals
  - 4 sleeping mask covers. For the 4th cover, use optional cotton fabric, add 20mm on side for seam allowance, and leave plan taped to fabric.
  - 4 roller blind locking seals
7. skip remaining steps 2-4 and resume special instructions
3. cardboard shell of helix vent
  1. trim excess cardboard around pattern but don't cut its edges (between squared holes) yet
  2. lightly crease between circled holes with back of table knife tip, avoiding breaking the surface of cardboard
  3. press the straight edge into creases to deepen them
  4. turn cardboard over and repeat steps 2 & 3 with double-circled holes
  5. cut between squared holes
  6. fold cardboard at creases, bending it well past 90°
4. paper parts
  1. between holes with asterisks
    - circled pairs, score back, fold forward
    - double-circled pairs, score front, fold backward
  2. between circled and double-circled holes
    - crease front side with back of table knife tip
    - fold at creases forward
    - then, fold double-circled creases backward
  3. between squared holes: cut with razor knife
  4. between starred holes
    - expand to diameter indicated in plan
    - use a pointed dowel of appropriate diameter
    - spin it with your fingers or a power drill as you gently push it into hole

Voila. Now that we've covered the basics that apply to all darkroom components, let's look at those in the air, silence, and warmth department.

## **9 - air**

The tricky part of making a darkroom is not darkening it but ventilating it. After all, now its windows and doors are sealed. Ventilation requires planning. We'll look at it first and darkness in the next chapter.

Silencing a room is even trickier. We can install filters against air pollution. But noise puts us at the mercy of our surroundings.

Ventilation most affects the silence of a darkroom. It also affects temperature. We will examine each condition and see how they work together in a mechanical system.

### **ventilation**

Below, I will give design constraints and describe various systems of ventilation. But first, I will address its physiological importance.

### **breathe**

Nature gives us a constant, abundant supply of fresh air. Our buildings should, too.

I have observed a shocking number of people who seem oblivious to their own need for fresh air. Everyone knows we die within minutes without air. Yet the importance of a continuous fresh supply of it has escaped many.

I can only attribute this negligence to mass psychosis. It is my stock explanation for the appalling features of civilized life. The need for fresh air is one of the most basic, most obvious facts of life. At the risk of insulting your intelligence, I am bound to address it.

Fresh air is always important. It is a normal condition of life. Along with warmth and safety, it is one of our most urgent necessities. Every second of our lives, quintillions of organic processes occur. Virtually all of them require oxygen. It is the

most important nutrient we consume. We can live days without water and weeks without food. Not so, air.

Just like food, air becomes a part of one's organism. It affects quality of life to a very great degree. It seems like nothing. But the amount of air you breathe masses twice as much as the food you eat. In a darkroom, you have little to do besides breathe. If you haven't paid attention to air quality, you will notice it in darkness.

Even if you don't, poor air quality cancels most benefits of a retreat. Intermittently airing the room out *does not work*. I mean opening the door a couple times a day with eyes covered. Put this approach out of your mind. This is darkness, not the dark ages. Whatever it takes, no matter where you are or what you are doing, always provide yourself with continuous fresh air.

For a darkroom retreat, this means:

1. following the instructions below
2. hiring an HVAC contractor to clean, repair, replace, or install ventilation in your home
3. moving somewhere the ventilation system just works (like the tropics or a new house in northern Europe)
4. using houseplants: [high oxygen producers](#) and [air-purifiers](#)
5. a combination of these

Somehow, it must be done. Forget darkness a moment. We have few more urgent concerns in life than arranging to breathe fresh air continuously and comfortably. Keeping it foremost in your thinking about darkroom design and construction will help ensure a successful retreat.

Not freezing to death and avoiding danger are more urgent than continuous fresh air. Building systems that meet these needs can all work in harmony. But unconsciously, fear and ignorance result in design conflicts between them. We have largely eliminated open fires in uninsulated buildings, which require massive inputs, labor, and maintenance. But we still often depend on windows for ventilation instead of a proper, separate system. The rest of this chapter will help you avoid such errors.

## constraints

- system provides plenty of fresh air
- absolutely lightproof
- silent: absolutely no hum or harmonics from fan and exterior noises mostly extinguished
- comfortable temperature: no undesired cold drafts
- economical: ie, no wasted heat to the outdoors. This is more involved and a lower priority than retreating itself, so don't get stuck on it. It requires a heat recovery ventilator (HRV). Besides significantly lowering heating costs, an HRV improves air quality and comfort in nearly all climates. More about it below.

## system

Somehow, fresh air has to get into the darkroom and stale air has to get out, without letting in noise or light.

In the terms of the HVAC industry (Heating, Ventilation, Air Conditioning), the fresh air vent is the *supply* and the stale air vent is the *return*.

Sometimes, supply and return vents exist in the same room. This is the fanciest version of *balanced* mechanical ventilation. If your place has it, thank your lucky stars. Just make sure it runs continuously. Unless your room is huge, intermittent is not good enough.

More commonly, balanced systems put supplies in bedrooms and living rooms, and returns in kitchens and bathrooms. This means air escapes a bedroom around the door. Unless the space outside the door is totally dark, this calls for a *threshold* lightproof vent (plans below).

Balanced systems are rare. More common are negative pressure systems: bedroom and living room windows act as passive supplies and bathroom and kitchen exhaust fans as active returns. In this case, a lightproof multi-purpose *helix* vent, built into a window blind, is the supply. Or a silencer if noise surrounds your dwelling. A threshold vent is the return, letting stale air escape the bedroom to the exhaust fan.

Rooms with totally passive ventilation rely on open windows, exterior vents, and infiltration through cracks. These



will get sealed against light. Such rooms will need helix vents in blinds at different heights to take advantage of convection. But they probably call for a fan and a silencer, maybe ducting.

By closely observing buildings I have discovered some simple ways to ventilate them. Sometimes rooms have lightproof and sound-dampened holes built into them in unexpected places:

- unused holes for pipes, wires, chimneys, and ventilation.
- behind a cupboard or inside a closet
- a removable panel or piece of trim that could be temporarily replaced with a panel with a hole in it.

For example, I once found a cosmetically damaged door in the garbage at a building supply store exactly the same size as my darkroom's door. So I stored the original door and cut holes in the damaged door for ventilation.

Another darkroom had no ventilation or suitable holes anywhere. Except it had no door. So we built a frame inside the doorway with a narrow door on one side and a narrower panel on the other. We cut holes in the panel for ventilation ducts. We fixed the frame in the existing doorway with metal straps screwed into old hinge holes. So we left no trace when dismantling the darkroom.

Similarly, we hung 7m of ducting that ran through three rooms; attached a silencer to it; made three window panels; and imperfectly covered five more windows with only one new screw hole in the entire rented house. And that hole was invisible behind a loose piece of trim. "Leave no trace" is a fun game that often improves design.

Sewage pipes drain downward but are ventilated upward. Once, friends and I replaced a flush toilet with a composting toilet. The exposed drain pipe, being oversize and in a single-story house, wasn't subject to backflow. So it proved a perfect exhaust duct for a case fan at floor level. Imagination conquers all obstacles (and renews itself in darkness).

If you are building a new house, separate ventilation from fenestration (windows). This improves many attributes of a shelter: security, economy, comfort, quietness, control, and darkenability.

## lightproof

Here are further design constraints, photos, plans, and instructions for making and installing lightproof vents.

### constraints

(helix / helix-z specifications in parentheses)

{threshold-vent-specifications-in-curly-braces}

- durable (protected by cardboard shell or silencer){subject-to-damage-by-kicking-but-easily rebuilt and can be made of sheet metal or shielded with cardboard or thin wooden boards}
- thin enough to fit between blind and window (80mm) or door and threshold {adjustable}
- cross-sectional area  $>75\text{cm}^2$  ( $90\text{cm}^2$ ){ $60\text{--}120\text{cm}^2$ }
- fully traps light, sending light around at least 5 corners (7 corners / 5 corners){6-corners}
- short airway (240mm / in-silencer version, 160){140mm}
- minimal size (87 x 220 x 216 / in-silencer version 87 x 148 x 260){fits-under-door,-sticks-out-20mm-each side and up 60mm}
- easy to make (so-so){yes}
- elegant (yes: simple compact form, uses common materials, zig-zag-shaped passage accommodates natural helical movement of air){yes}
- cheap (\$4 in materials, 2-hour assembly time){\$2-in-materials,-1-hour-assembly-time}

**helix vent**

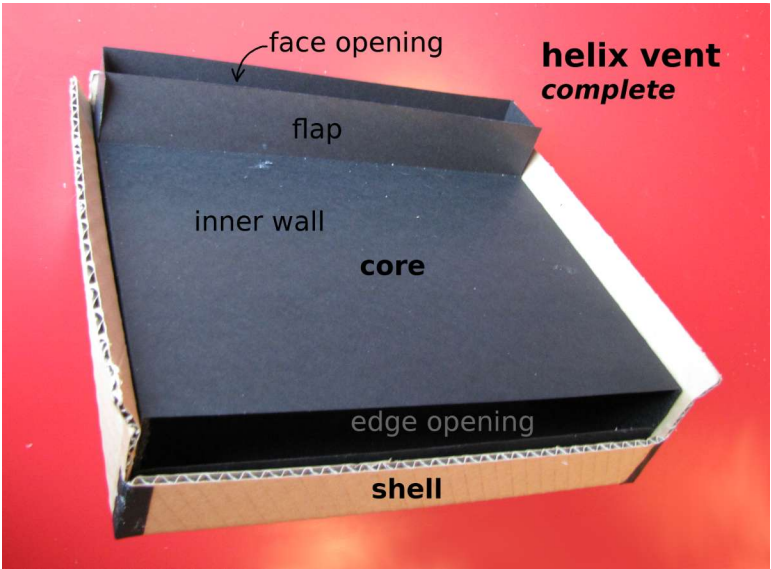


photo: helix vent, complete

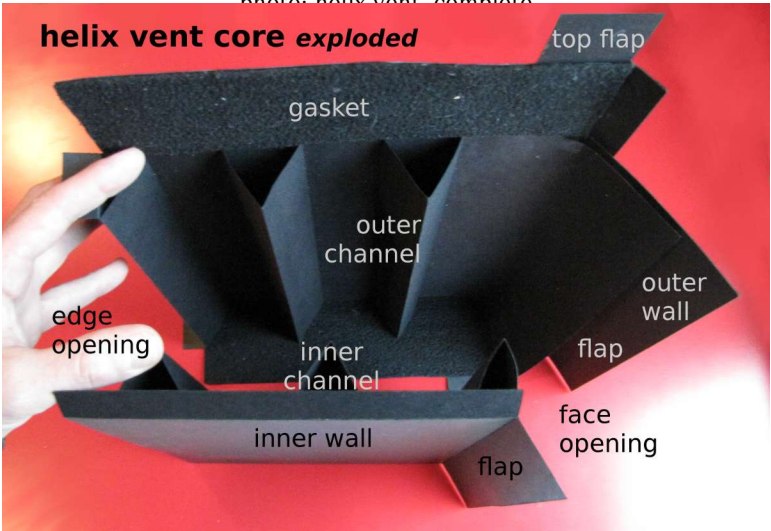
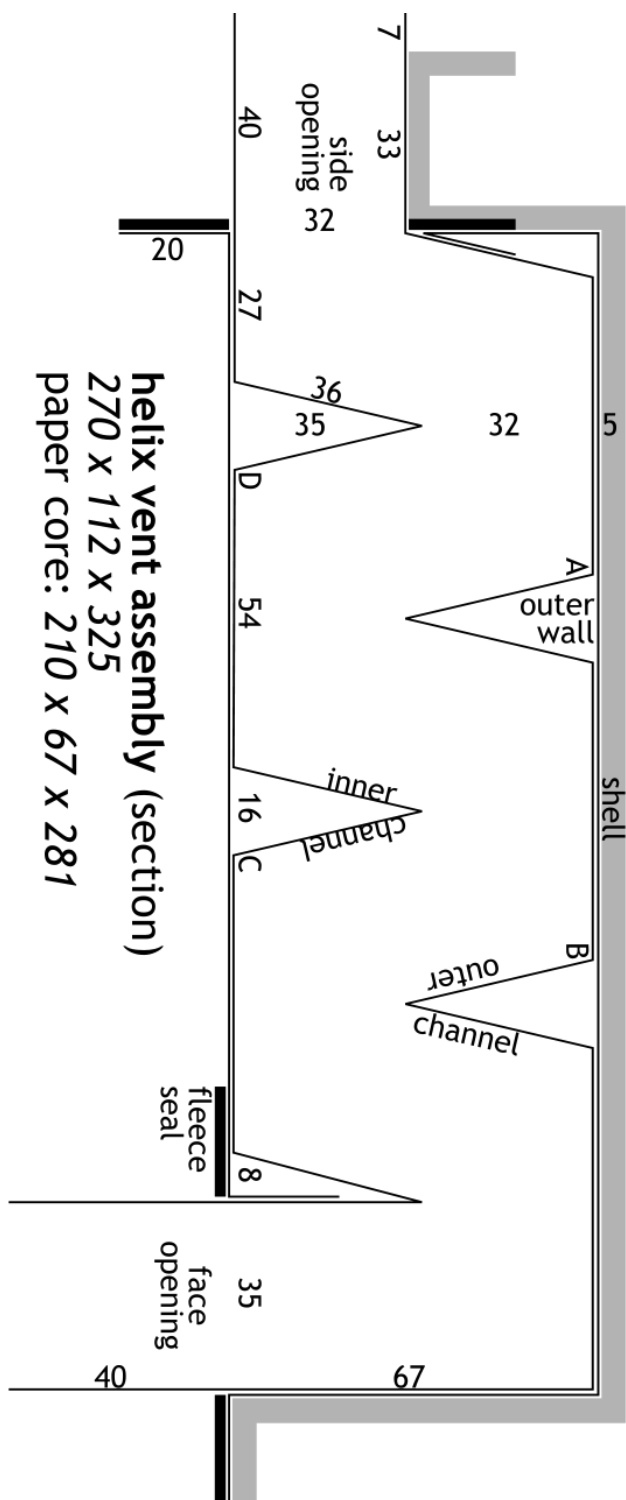


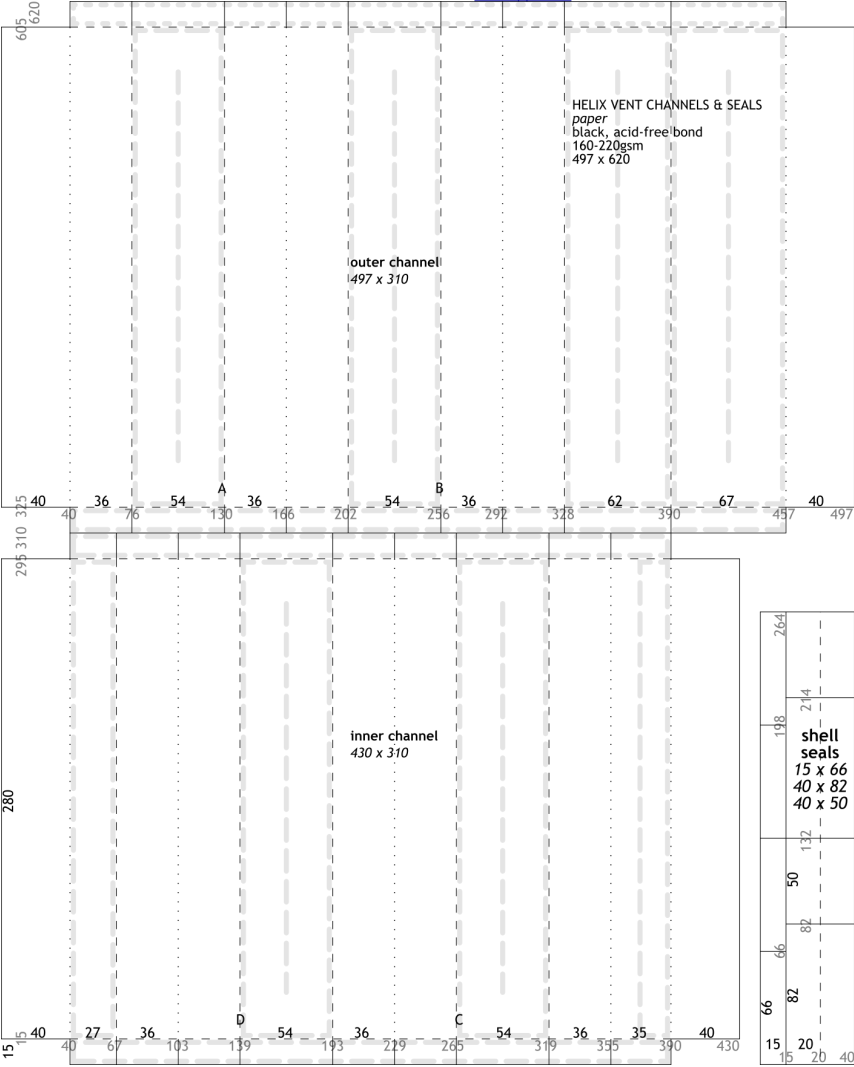
photo: helix vent, exploded core

This photo is of the old helix vent. The new one is similar but: a bit narrower; triangles inside are more pointy; their edges have flaps; there is no fabric; at the side opening, the cardboard has a lip and the core has flaps.

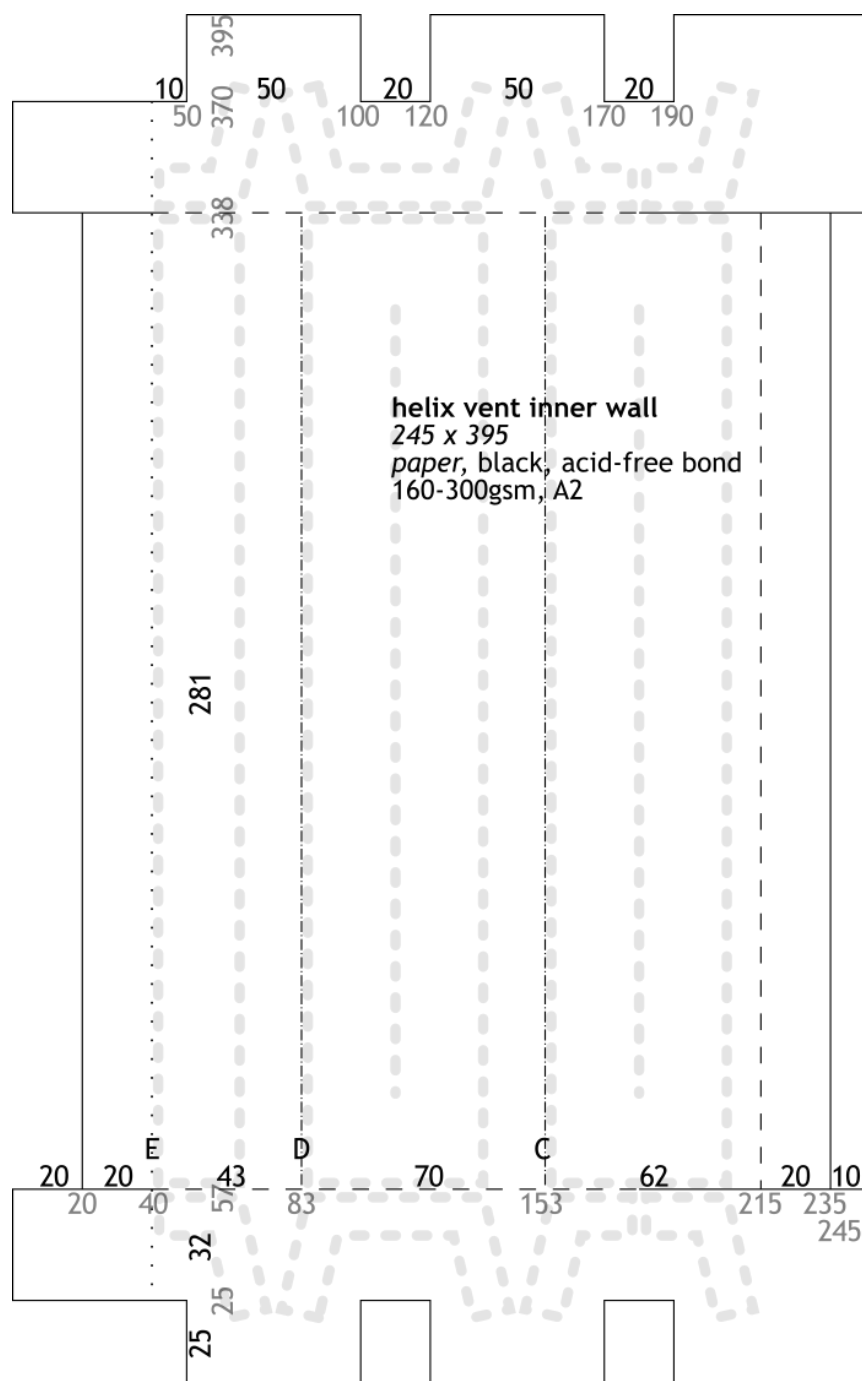


**helix vent assembly (section)**  
 270 x 112 x 325  
 paper core: 210 x 67 x 281

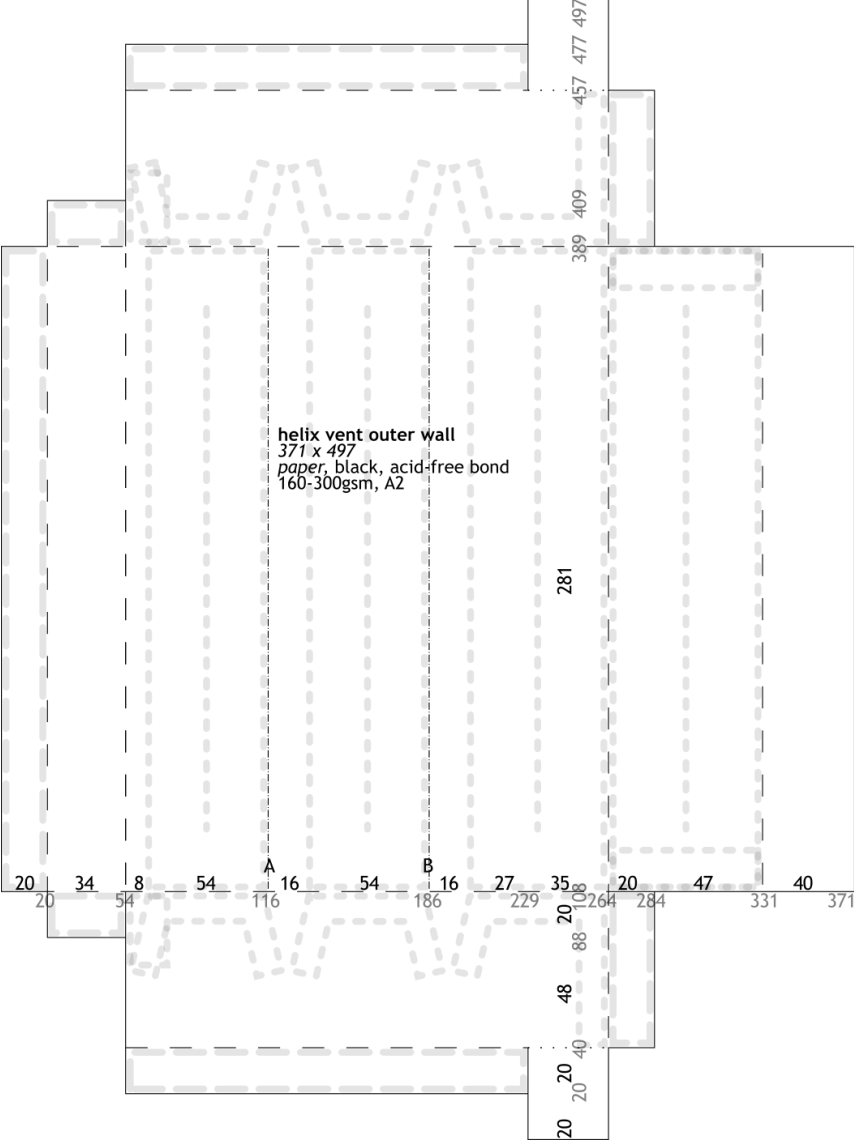
plan: helix vent assembly [get pdf](#)



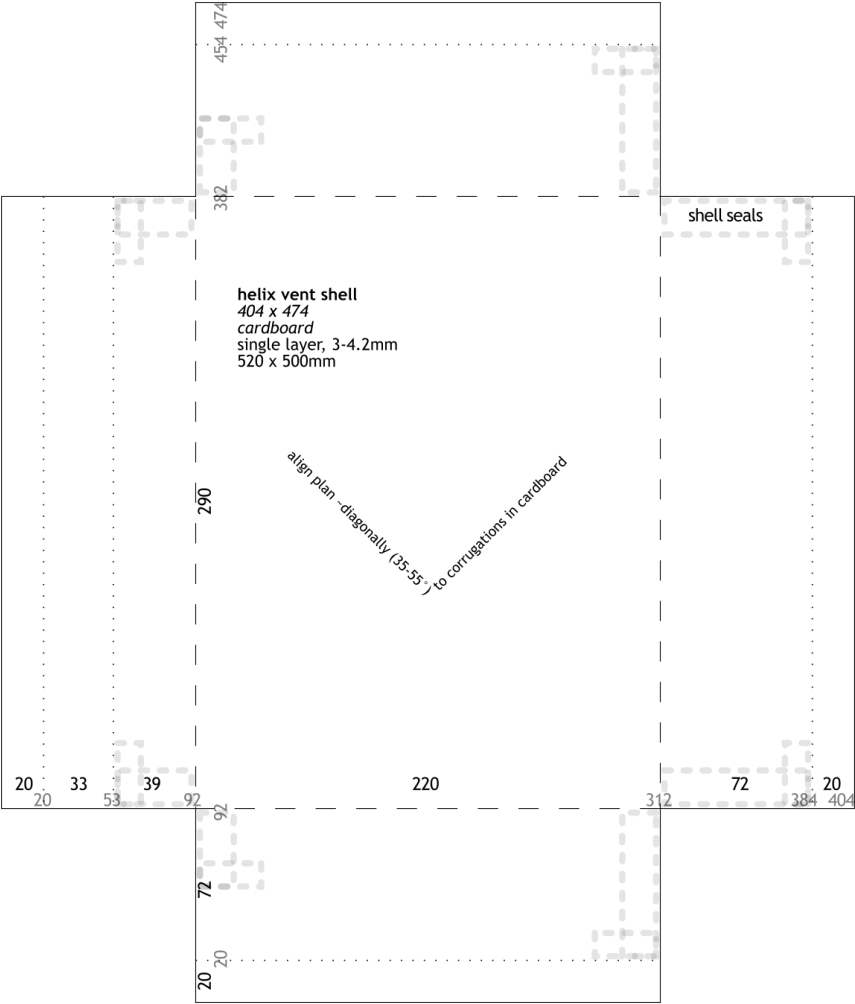
plan: helix vent channels [get pdf](#)



plan: helix vent inner wall [get pdf](#)

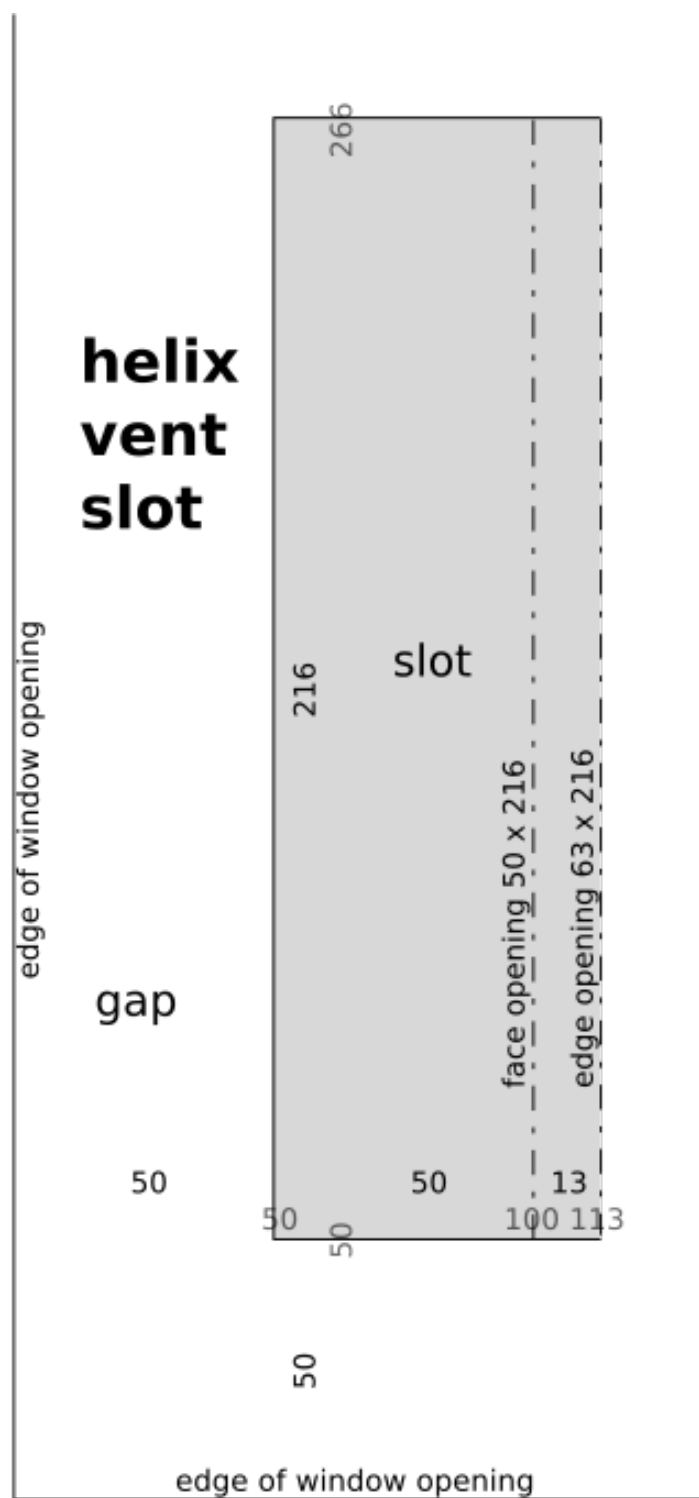


plan: helix vent outer wall [get pdf](#)



plan: helix vent shell [get pdf](#)





plan: helix vent slot [get pdf](#)

I call it a helix vent because of how air actually moves through it: like a corkscrew. It might look like air would zigzag through like light. But air is a fluid like water and takes the path of least resistance. Which is to maintain the same curved trajectory by *helixing* through. Because the helix is the natural form of fluids in motion under any circumstance, this minimizes friction within the airstream as well.

The helix vent can go anywhere. Flaps of either its edge or face opening poke through a slot and get taped or glued down to the other side.

- blind: attach it to the back of a blind and crack the window behind it.
- door: cut slot(s) in it and use helix vent instead of a threshold vent.
- wall (leading outside or to another room): attach vent to a flat cardboard box and attach box to the wall over the vent. Vent can be either supply or return
- silencer
  - outside: with shell, attached at face opening
  - inside: without shell, attached at face or edge.
  - Z version: simpler, more efficient, higher capacity version especially for the silencer. Attaches at the side opening. Short and straight, it has fewer light-stopping corners and no shell. It is only for installing inside the silencer or other enclosure with two or more corners for light to go around. See drawings in next section.

If your darkroom's ventilation is passive, put vents both low and high in room to enable convection. This works better the greater the inside and outside temperature difference; the greater the vertical distance between vents; and the more vents.

Do you need a more compact vent? I used the 3-4-5 triangle ratio in the channels, so it can be shrunk to make a narrower, shorter air passage. Do you wish to manufacture vents? A set of simple wooden or sheet metal templates and jigs can

speed production tremendously while keeping equipment and investment to a minimum. Start in your garage.

Materials are simple and non-toxic: heavy black acid-free paper, cardboard, fabric, and wood glue. Look in art or office supply shops for the paper. North Americans, use this paper weight and size [conversion chart](#). If large sheets are unavailable, glue small sheets together between folds in plan. Wood glue has high tack and quick drying time, easing assembly. School glue will work, too.

Read through instructions once while studying plans.

# 1. materials (see plans for quantities)

## 1. paper (for channels and walls)

- black, acid-free bond, coverstock
- available at art supply, stationery, and book shops. In Europe, common posterboard is often acid-free.
- two posterboard-size sheets (498 x 648 minimum) per vent
- weights
  - channel: 120-300gsm (200 ideal)
  - wall: 180-400gsm (200 ideal)
  - total: 350-600gsm

## 2. cardboard, single layer, 3-4.2mm thick (for shell, unnecessary inside silencer)

## 3. fabric: polar fleece, black, medium weight (for seal. Quality check: 10 layers of it in a stack should measure 30-35mm high)

# 2. follow instructions in [make > fabricate](#)

3. glue channels to walls 1. refer to plans and key to get a clear idea of how parts go together. Keep plans right side up, marks visible, wall on bottom, channel on top. Test joints with masking tape till you've got everything right. 2. fat grey glue lines: long-dashed areas mate with short-dashed areas 3. glue joints - outer wall/channel: left to right in assembly plan - inner wall/channel: right to left - use as little glue as possible to minimize warping, ~2mm bead - match lettered lines 4. glue channel flaps to tops and bottoms of walls

#### 4. assemble core

##### 1. orient sections

1. stand them right side up, channels facing you, outer section behind inner section
2. flip over inner one, so it is upside down and channels face each other

##### 2. test joints

- work inner and outer sections together
- note how cut-out areas of inner wall's top and bottom butt up against outer channel's triangles
- curl middle flaps between cut-out areas outward so they will contact outer top and bottom when glued
- note how flaps help align sections
- practice using table knife to press tops together when glued

##### 3. separate sections then glue back together, one end at a time

- use table knife
- use flaps to align them

##### 4. glue down flaps of outer wall to outer and inner walls

#### 5. shell

- glue joints of shell together with shell seals
- put core inside and attach fleece seal with glue. This is a 20mm wide double-layer strip of fleece that goes around the flaps of the face opening. Three sides of the seal attach to the shell flaps. The fourth side goes across the core. Double-layers overlap at corners.
- when not in use, store core inside shell, taping up flap by side opening. Cover exposed part of core with scrap piece of cardboard to protect core from being crushed.

#### 6. installation

##### 1. determine vent location

- in blind, panel, or silencer
- whether it will attach at edge or face opening
- shell is unnecessary when installed inside silencer or other enclosure

- vent should not touch window handles, locks, or frame
2. mark slot with slot plan
    - the slot plan spaces slot correctly on most blinds and panels
    - face opening, 35 x 281, on blinds, panels, or outside silencer, with shell
    - side opening, 32 x 281, inside silencer or other enclosure, without shell
  3. cut out slot
  4. position vent over slot and fit vent flaps through it
  5. when attaching to soft window covering like fabric, plastic sheeting, or cardboard, pull long flap snug, use back of table knife tip to crease the outside of it right where it passes through slot
  6. fold flap at crease and tape it to cover. Tape is removable for vent reuse in another configuration later if you like. Only glue it in place if you are certain of not moving it for years.
  7. repeat with other long flap, then with short flaps
  8. attach shell to cover with tape, glue, or screws going through cover, into wooden braces if cover is soft
  9. cover shell with foil and/or white paper to minimize warping by sun

## **helix vent-z**

For inside silencer or other enclosure with two or more corners for light to go around. Follow helix vent instructions above, adapting as necessary.