No Router, No CNC

A complete neon flex sign, made by hand with tools you already have at home. Which tube to buy, how to design so the tube can actually follow the line, which backing to use and how to cut it, six ways to fix the tube without a channel, what to glue it with (and what not to), how to hide the jumps between letters, and how to wire it, hang it, photograph it and sell it — plus what to do when something goes wrong.



A sign made without a single machine: a rectangular acrylic panel, tube glued along the line and four standoffs. Everything you see here is covered in this guide.

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PART 1

Before you start

What you can do without a machine, what you can't, and which tube to buy so everything else goes right.

1 · Yes, you can: what changes without a channel

In the lessons, the instructor sets the tube into a channel cut by a small CNC router. He does it that way because he works in volume: the machine gives him a perfect line and hides the glue, and he can repeat the same sign ten times over. But in lesson 16 itself, *Bending, Cutting and Fixing Neon Flex to an Acrylic Base*, he mentions it in passing: before they had the machine, they simply drew the design and glued the neon flex on top. That's the route this guide takes.

It isn't a hack. Neon flex manufacturers list several ways to mount the tube without a channel in their own installation guides: glued to a smooth surface, held with mounting clips, or tied down with zip ties. And it's how the vast majority of the homemade signs you see online are built. A Spanish-language tutorial showing a 60 × 20 cm (24 × 8 in) sign made with acrylic, super glue and a soldering iron has more than two million views, and one of its top-voted comments reads *"today marks two years that I've made my living from neon signs."* A hobbyist who has made dozens of signs says on a forum that his first forty were all on rectangular panels he cut by hand, and sums it up: *"no one cared."*

What the channel did, and how you handle it instead

A routed channel does three jobs at once. Without it, those three jobs fall to you, and each one has its own fix:

WHAT THE CHANNEL DID	HOW YOU DO IT BY HAND	WHERE
Guide the tube	A full-size printed template taped under the clear acrylic. You follow the line like tracing.	Sections 11 and 12
Hold it in place	The right adhesive for your tube's jacket, plus clips or zip ties wherever you need more grip.	Sections 14 and 15
Hide the glue and the wires	A small amount of clear adhesive, wires run at the back and, if you like, a black backing.	Sections 15 and 16

> **The three honest trade-offs**
> On clear acrylic, in daylight you can see how the tube is held down; once it's lit, the eye goes to the light and you barely notice. You have to hold the tube while the adhesive cures, so assembly takes longer than with a channel. And cutting the panel to the outline of the letters is very hard by hand: the practical choice is a rectangular panel — which, conveniently, is what most customers ask for anyway.

> **What doesn't change at all**
> The tube, the power supply, cutting on the marks, soldering, polarity and testing before you finish are exactly the same as in the lessons. Everything electrical from Module 1 applies here too, and this guide points you back to it when needed.

2 · How to use this guide

It's laid out in the same order you build a sign: first you pick the tube, then you design, then you prepare the backing and the power supply, and finally you assemble and finish. If this is your first sign, read the whole thing once before you buy anything; if you've done this before, use the table of contents.

If it's for you or a gift
Read Parts 1 to 4 and section 25, *Your first sign, step by step*. With 6 × 12 mm tube, a rectangular panel and silicone, you'll have a sign in a day.

If you want to sell them
On top of all that, take your time with section 23, *If you're going to sell it*: market prices, which rules apply and what the label needs to say. And section 22, so your photos do them justice.

This guide builds on other bonuses in the course: **Wiring & Power Pack** (the electrical side in depth), **Measuring a Sign Before You Buy**, **Letterforms That Work in Neon**, and **From File to Wall** (printing, tracing and projecting your design).

3 · Know your tube before you buy it

The tube is half the sign, and almost everything that can go wrong starts here: a tube that won't bend in the right direction, a jacket nothing will stick to, or a 120 V tube you can't cut where you need to. Five minutes reading the seller's spec sheet can save you the whole reel.

Size and voltage

WHAT	WHAT YOU WANT	WHY
Profile	**6 × 12 mm**	The most common size for lettering: a visible stroke without looking clunky. There's 4 × 8 mm tube for small letters and 8 × 16 mm for large signs (section 4).
Voltage	**12 V**	Cuttable every 2.5 cm (1 in) — some models every 1 cm (0.4 in), which is even better for lettering. One run can be powered from a single end for up to about 3.6–5 m (12–16 ft), depending on the manufacturer.
Density	120 LEDs per meter or more	The more LEDs per meter, the more the light reads as one continuous line instead of a row of dots. Good-quality 6 × 12 tube has 120/m; COB tube has hundreds, with no visible dots at all.
Power draw	8–10 W per meter	That's what typical 12 V 6 × 12 spec sheets list. You'll need it to choose the power supply (section 8).
Ingress rating	IP65 or IP67	IP65 handles dust and water jets; IP67, brief immersion. Indoors, either one is fine; outdoors, go IP67 (section 19).

> **Never the mains-voltage kind**
> Neon flex that plugs straight into the wall (110–120 V in North America, 220–240 V in the UK, Europe and Australia) runs at mains voltage and can only be cut every 50 cm (20 in) or more. You can't make a single letter with that, and you can't touch it while it's plugged in. For signs, always 12 V with its own power supply. And the other way around: a 12 V tube hooked up to a 24 V supply will burn out.

How it bends: the table test

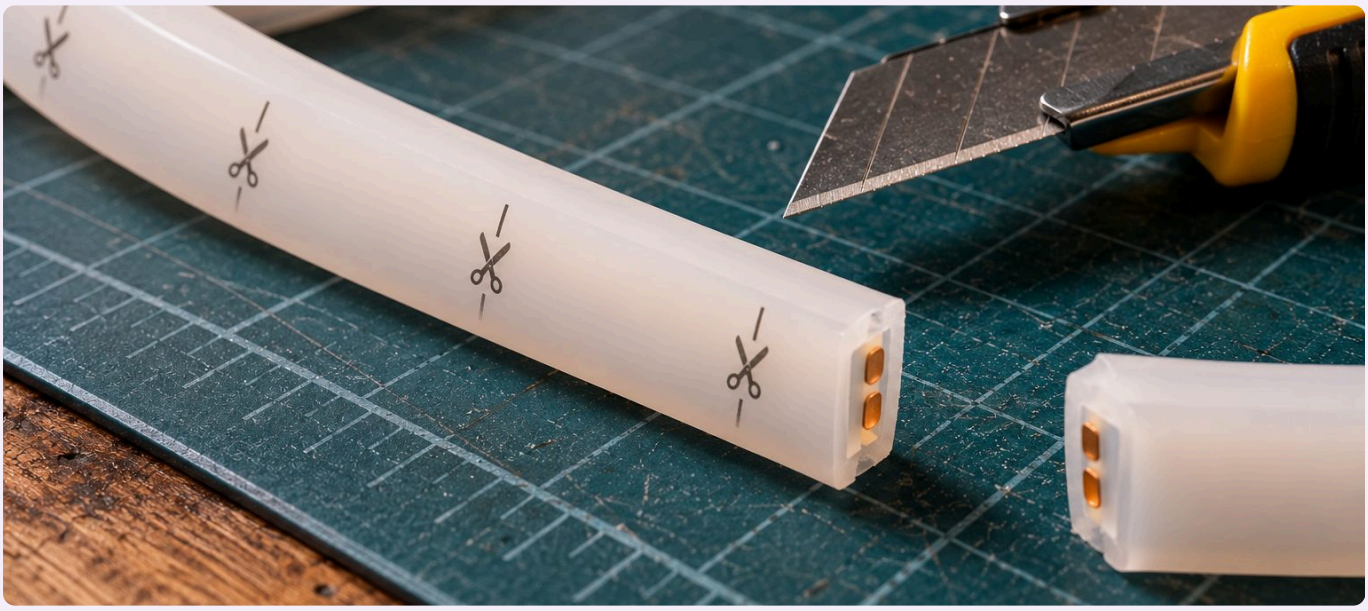
A flat tube can bend either sideways or up and down, and to write on a panel you need the first kind. Sellers call it "side bend," "top bend," "horizontal" or "vertical," and they don't agree with each other: what one calls "side bend" another calls "top bend." So don't trust the label — do the test.



Lay the tube on the table with the lit face pointing up. If it curves easily left and right, it's the right tube for lettering on a panel.

If it only bends up and down, it's a tube for profiles and outlines, not for writing. Do this as soon as the reel arrives, before you cut anything: if it's the wrong kind, you can still send it back.

The cut marks



Every 2.5 cm (1 in) the tube has a mark. That's the only place you can cut: inside are two copper pads you solder to.

Between one mark and the next is a group of LEDs wired together. Cut outside the mark and that whole group stays dark. Cut right on the line, straight, without crushing: one manufacturer says most failures on the job come from bad cuts or poorly sealed ends. Cut halfway between two marks, as one hobbyist did on his first sign, and *"there's nothing left to connect to."*

The jacket: silicone or PVC

This is the spec people forget most often, and it's the one that decides what you'll glue with (section 15).

	SILICONE	PVC
Temperature	−40 to +80 °C (−40 to 176 °F)	−20 to +50 °C (−4 to 122 °F)
Over the years	Doesn't yellow. Outdoors, 8–10 years.	Can yellow within 2–3 years. Outdoors, 3–5.
Price	30 to 50% more per meter	Cheaper
To the touch	Smooth, pure color, feels dense	Slightly greasy, heavier, leaves a white mark when bent and has a chemical smell
For gluing	Hard: almost nothing sticks to it	Easier

Figures from one neon flex manufacturer; exact ranges vary by brand. If the listing doesn't say what the jacket is made of, ask the seller before you buy.

Color: white jacket or colored jacket

There are two ways to get pink neon. The first is a milky white jacket with pink LEDs: it looks white when it's off and gives a slightly softer pink when it's on. The second is a pink jacket with pink LEDs: it already looks pink when it's off, and the color is more intense when it's lit. For a sign that will sit switched off in plain view for hours (a daytime wedding, a shop window), the colored jacket looks better. For whites, check the color temperature: **warm white** is around 2700–3200 K and looks like a household bulb; **cool white or daylight**, 5000–6500 K, is bluish.

How long it lasts

Spec sheets claim 30,000 to 50,000 hours, and some sign shops talk about 100,000. Treat that as a ballpark, not a promise: on four hours a day, 30,000 hours is about twenty years. What shortens a sign's life usually isn't the LEDs — it's a bend that's too tight, a bad solder joint, an unsealed end or a power supply running at its limit.

PART 2

Design

Without a machine, design matters even more: the tube has to be able to follow the line in your hands, with no impossible curves and no crossovers.

4 · Designing for neon

A design that looks gorgeous on screen can be impossible to build in tube. Neon flex is a stroke of fixed width that can only be cut at its marks and won't do sharp corners. Designing for neon means drawing with that in mind from the very start.

Minimum letter size

Every tube profile has a minimum bend radius, and that sets the minimum letter height: go smaller and the curves of an "e," "a" or "s" get tighter than the tube can handle, so it kinks.

TUBE	APPROXIMATE BEND RADIUS	MINIMUM LETTER HEIGHT
4 × 8 mm	about 15 mm (0.6 in)	about 5 cm (2 in)
6 × 12 mm	about 25 mm (1 in)	**about 8 cm (3 in)**
8 × 16 mm	about 40 mm (1.6 in)	about 12 cm (4.7 in)

Figures from a UK manufacturer; others give a 4–6 cm (1.6–2.4 in) radius for 6 × 12. Your tube's spec sheet has the final word.

Beyond the tube, think about who's going to read it. One sign shop recommends making script lettering 50 to 100% bigger than a plain sans-serif so it reads well from a distance. And keep the inside openings of the letters (the eye of the "e," the bowl of the "a") at least 10–12 mm (about ½ in) wide; if they close up, the glow fills them in and the letter turns into a blob.

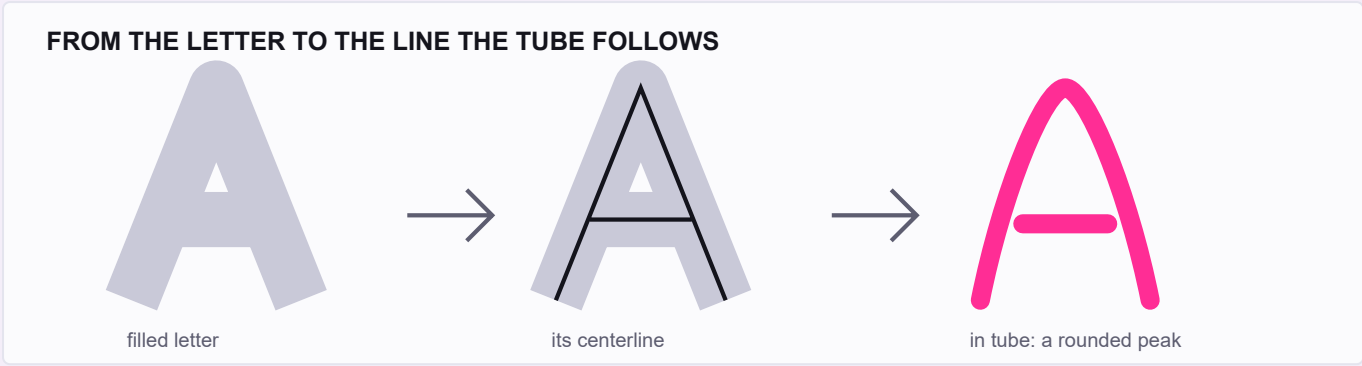
Example: a 60 × 20 cm (24 × 8 in) sign with six letters

From a Spanish-language tutorial with more than two million views

The sign maker leaves a 2 cm (¾ in) margin on each side, which leaves 56 cm (22 in) of usable width, and divides it among six letters: about 9.3 cm (3.7 in) per letter. With 6 × 12 tube, that's comfortably above the 8 cm (3 in) minimum. Another tutorial, for a four-letter sign, used letters 9 cm (3.5 in) tall with 3 cm (1.2 in) between them.

The centerline and the path

The tube follows a line, not an outline. What you need to draw is the **centerline** of each stroke — the letter's skeleton: that's where the center of the tube goes. Single-stroke fonts (section 5) already come that way; with any other font, you'll have to redraw the center.



The top of the "A" can't be a sharp point: the tube rounds it off. Draw it rounded from the start and you'll avoid the surprise.

Six rules from people who've already done it

1. **No sharp corners.** The tube won't make a 90° point. Either round it off, or cut at a mark and make two runs that meet.
2. **A U-turn needs room.** One manufacturer allows 5 to 7 cm (2–2¾ in) of width for the tube to make a full turn without folding.
3. **No crossovers.** Two runs can't cross over each other on a flat panel. If the design crosses itself, cut the tube at the crossing and continue with wire at the back (section 16).
4. **Every run a multiple of 2.5 cm (1 in).** Since the tube only cuts at its marks, the length of each run has to land on a mark. If a letter ends halfway between cuts, stretch or shrink it a little so it fits. As one hobbyist puts it: on small letters the cuts show more.
5. **Count the runs before you start.** A professional sign maker with more than a thousand signs under his belt always does this: how many runs the design has, which ones are identical, and he cuts those together. Every run means two solder joints and one jump to hide.
6. **Start and finish at the back.** Decide where each run begins and ends, and make it a spot where the wire can disappear through a hole to the back without being seen.



For your first sign, pick a word in connected script: it can come out of a single run.

5 · Free fonts you're allowed to sell

What works: **single-stroke** (monoline) lettering, rounded and with few corners — especially connected scripts. What doesn't: fonts with thick-and-thin strokes, serifs, or several parallel lines.

> **Free doesn't always mean you can sell it**
> Many fonts on sites like DaFont are free for personal use only. One very popular homemade-sign tutorial uses one of them, "Better Grade," which requires buying a commercial license before you can sell anything made with it. If the sign is going to a customer, use a font whose license allows commercial use.

These have open licenses (SIL Open Font License or Apache), which allow you to use them in work you sell. The Google Fonts ones are a free download at fonts.google.com:

FONT	STYLE	BEST FOR
Sacramento	Monoline script	Names, short phrases, weddings. It's practically neon already.
Neonderthaw	Neon-style script	Phrases with a retro feel.
Tilt Neon	Sans-serif, designed for neon	Business signs: "OPEN," "BAR," "CAFÉ."
Quicksand · Varela Round · Nunito · Comfortaa	Rounded sans-serif	Readable separate letters; round off the corners by hand.
Relief SingleLine	Sans-serif, true single stroke	Already comes as a centerline: ideal for templates. Download it from its GitHub page.
Pacifico · Yellowtail · Damion · Allura · Great Vibes	Scripts	Not strictly monoline, so you'll need to redraw the center, but they make really eye-catching signs.

Licenses checked in the official Google Fonts repository (each font's METADATA file). "Monoton" is open-licensed but made of multiple lines, so it won't work as a path.

6 · Design and measure on your computer, for free

You don't need any paid software. With these tools you can make the design, pull out the centerline, measure how much tube it takes and print it at full size.

Inkscape (free, Windows and Mac)

- **Writing with single-stroke fonts:** Extensions › Text › Hershey Text turns text into single-stroke lines. Hershey fonts are made of straight segments and can look a bit stiff at large sizes; for scripts, use a monoline font from section 5 instead.
- **Measuring the path:** select the lines, join them with Ctrl + K (Cmd + K on a Mac) and use Extensions › Visualize Path › Measure Path. It gives you the total length in whatever unit you choose: the most accurate way to know how many meters of tube to buy.
- **Previewing a shape as a line:** if your design is made of shapes (a heart, a star), use the path as an axis and give it the width of your tube to see how it'll look.

See how it looks lit

Before you cut any tube, show the customer what it'll look like. Canva has a "Neon" text effect with adjustable intensity, and there are online neon preview generators where you type the word, pick a font and a color, and get an image back. They're great for settling on colors and for closing the order.

Printing at full size

Rasterbator (rasterbator.net) and PosteRazor split a large image across Letter or A4 sheets with marks for taping them together. The two best-known homemade-sign tutorials both use Rasterbator. The printing steps and how to check the scale are in **From File to Wall**.

7 · How much tube to buy

Running out on the last letter is one of the most common mistakes. One hobbyist tells it about his second sign, a Saturn: *"I ran out of strip and it looks a bit stretched to one side."*

1. **Measure the path** in Inkscape (section 6), or on the printed template by running a piece of string along the line and measuring the string once it's pulled straight.
2. **Add 10–15%** for cutting at the marks and for mistakes. That's what manufacturers recommend.
3. **Cut each run a little long.** One tutorial warns: if a run comes out short, you may have to start over; if it's long, you just trim it at the next mark.

> **As a rule of thumb**
> There's no reliable meters-per-letter formula: it depends on the font, the size and how much the word connects. That's why you measure. A hobbyist who made a one-word sign plus a Saturn used "about 2 m (6½ ft) at most." Almost everyone buys the 5 m (16 ft) reel: it's enough for a first sign, the mistakes and one practice piece.

PART 3

Materials and backing

The power supply, the wire, the panel, and how to cut and drill it with hand tools.

8 · Power supply and wire

The power supply is the only part of the sign that works at mains voltage. Everything else runs at 12 V, which won't shock you or burn you. Choosing the right one comes down to a single multiplication. The full electrical walkthrough is in the **Wiring & Power Pack**; here's just what you need for a handmade sign.

How big a power supply you need

1. **Work out the draw:** meters of tube × watts per meter from the spec sheet. With 3 m (10 ft) of 8–10 W/m tube, that's 24–30 W.
2. **Check by measuring:** in the lessons, 2.5 m (8 ft) of tube drew 1.01 A measured with the multimeter — quite a bit less than the math on paper said. Trust the measurement over the calculation.
3. **Add a 20% margin:** the manufacturers' rule is never to load a power supply past 80%. For 30 W, a 36 W supply or bigger; in practice, a 12 V 5 A (60 W) supply has plenty of headroom and lasts longer.

TYPE OF POWER SUPPLY	FOR	EXAMPLE
12 V wall adapter, 1–2 A	Small signs, a short word.	Any electronics store. In the US, look for a UL or ETL mark; in the UK, CE or UKCA.
12 V desktop adapter, 5 A	The most versatile option for indoor signs.	Mean Well GST60A12: universal input and a swappable power cord, so it works in the US, UK, Canada and Australia. About US$18. Generic 12 V 5 A adapters with a 5.5 × 2.1 mm barrel plug cost less; if you're selling, make sure they carry a UL/ETL (US) or CE/UKCA (UK) mark.
IP67 waterproof driver	Outdoors or damp locations.	Mean Well LPV-60-12, 12 V 5 A, about US$14–17.
Enclosed (bench-style) power supply	Large signs, more than 5 A.	See the Wiring & Power Pack: it connects to mains through screw terminals and should be installed by someone who knows what they're doing.

> **In the US: a "Class 2" power supply**
> Low-voltage, power-limited supplies are called Class 2 there (up to 100 W). If you're going to sell in the US, look for a supply marked Class 2 that also carries the UL or ETL mark (section 23).

The wire

Thin wire heats up and makes the far end of the sign glow dimmer. Here's the maximum wire length at 12 V to keep voltage drop under 3%, from one manufacturer's chart:

GAUGE (AWG / APPROX. MM²)	AT 30 W (2.5 A)	AT 60 W (5 A)
22 AWG · 0.33 mm²	1.4 m (4.6 ft)	—
20 AWG · 0.52 mm²	1.8 m (5.9 ft)	0.9 m (3 ft)
18 AWG · 0.82 mm²	3.4 m (11 ft)	1.5 m (4.9 ft)
16 AWG · 1.3 mm²	5.5 m (18 ft)	2.7 m (8.9 ft)

In practice: **thin wire (22–24 AWG) for the short jumpers between letters**, so it's easy to hide, and **18–20 AWG from the power supply to the sign**. One hobbyist used 16 AWG for the jumpers and regretted it: it was so thick you could see it from the front. Silicone-jacketed wire is more flexible and stands up better to the soldering iron.

Switch and dimmer

An inline switch or a 12 V dimmer with a remote is the thing customers notice most, and it costs very little: dimmers with a 5.5 × 2.1 mm barrel connector and an RF remote run US$8–19 and plug in between the adapter and the sign. They always go on the 12 V side. Make sure it can handle your sign's draw with room to spare (they come in 2 to 12 A ratings).

> **Solderless connectors: indoors only**
>
> There are clip-on connectors for 6 × 12 tube that let you skip soldering. They work, but one manufacturer rates them IP65 and indoor-only; for anything permanent or outdoors, solder. They also come in 2-pin and 3-pin versions: one hobbyist got the 3-pin ones by mistake and couldn't use them.

9 · The backing: which material

MATERIAL	WHEN TO USE IT	WHAT YOU NEED TO KNOW
Clear acrylic	The classic: the sign seems to float on the wall.	The template goes underneath and shows through. In daylight you'll see the glue if you overdo it.
Black acrylic	Hides the glue, the clips and the jumps.	Several hobbyists recommend it precisely so the wires don't show. The template goes on top (section 11).
Opal or colored acrylic	Backgrounds that glow a little too.	Same work as clear.
Wood or plywood	A warm look: bars, coffee shops, clothing stores.	Takes screwed-in clips, zip ties and headless brads (section 14). Paint it matte black if you want the tube to pop.
Wire grid	Industrial look, no panel.	Tied on with zip ties. The grid shows, and that's part of the style.
Foam board	Practice, or a one-day event.	Don't sell it: it doesn't last.

Cast or extruded acrylic

Acrylic (also sold as Plexiglas, Perspex or plexiglass) comes in two kinds. **Cast** has less internal stress: it's less likely to crack when you drill it and handles chemicals better. **Extruded** is cheaper and good enough for an indoor sign. If you have the choice, buy cast for your first sign: it's more forgiving of drilling mistakes.

Which thickness

- **3 mm (⅛ in):** signs up to about 45 × 60 cm (18 × 24 in). It's the thickness that's comfortable to cut by hand and the one most homemade tutorials use.
- **5 mm (3/16 in):** the sign-shop standard. Stiffer; much harder to cut by hand.
- **6 mm (¼ in) or more:** medium and large signs. Have it cut to size.

At 6 mm or less, add a standoff every 30–45 cm (12–18 in) along each side so the panel doesn't sag.

Where to buy it cut to size

This is the easiest way to avoid cutting anything at all: many plastics suppliers cut to size, polish the edges and will even drill the holes.

WHERE	EXAMPLES	BALLPARK PRICE
US	Canal Plastics, TAP Plastics, Home Depot	3 mm, 12 × 24 in (30 × 60 cm), about US$14; an 18 × 24 in sheet around US$13 at big-box stores
UK	Cut Plastic Sheeting, Plastic Sheets Shop	3 mm from about £9–11
Canada	Local plastics suppliers and sign shops	Most cut to size; ask for 3 mm cast acrylic and compare a couple of quotes
Australia	Local plastics suppliers and sign shops	Same approach: ask for 3 mm cast, cut to size, edges finished

> **Tip: shop offcuts**
> A comment with more than six hundred upvotes on one tutorial recommends it: sign shops throw out or sell acrylic offcuts cheap. For a first sign of 40–60 cm (16–24 in), that's more than enough.

10 · Cutting and drilling acrylic by hand

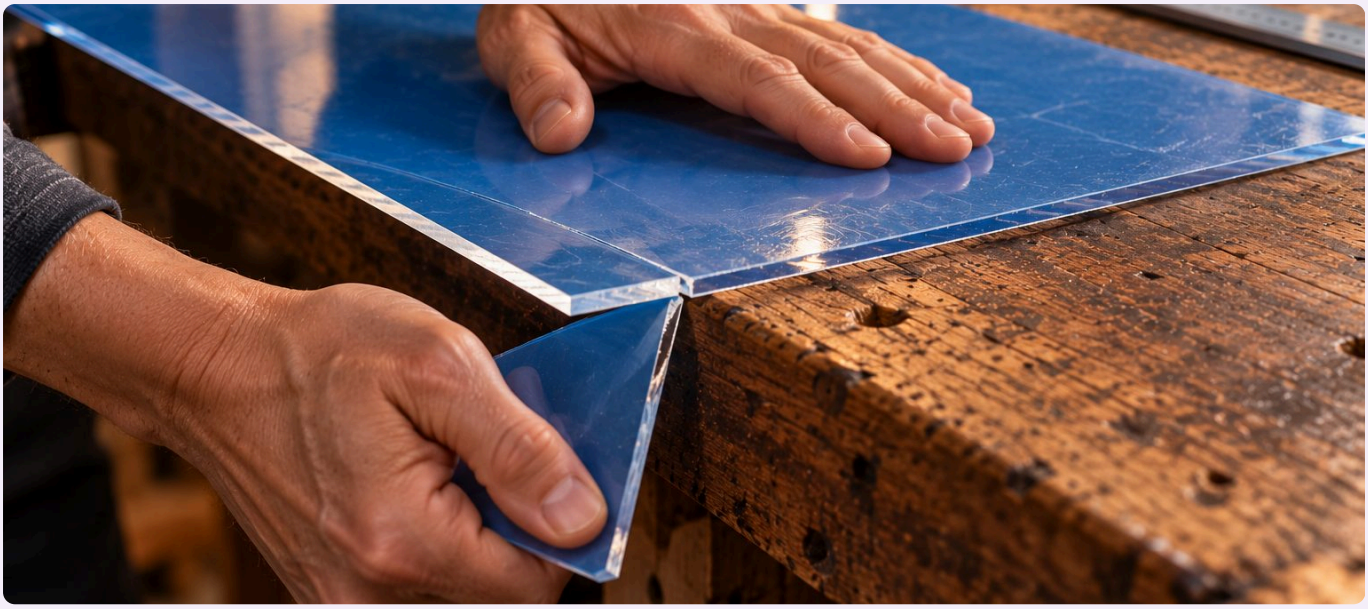
If you don't buy it pre-cut, you cut it at home. For straight cuts you don't need any power tools.

Score and snap, step by step



An acrylic scoring knife, a metal straightedge and the protective film left on. Always in the same groove.

1. **Leave the protective film on:** it protects the sheet from scratches while you work, and you can mark on it with a marker.
2. **Hold a metal straightedge** along the line and draw the acrylic scoring knife (the one with the hooked tip, like the Olfa PC-L, about US$6–11) toward you, always in the same groove.
3. **How many passes:** for 1.5 mm, 3–5; for 3 mm, 8–12; for 6 mm, 15–20. By hand, up to 3 mm (⅛ in) is comfortable; any thicker, you're better off having it cut.
4. **Line the groove up right on the edge of the table**, facing up, with the part you're removing hanging over the edge.
5. **Hold the panel down against the table** with one hand and give the overhanging part one sharp push downward. It snaps along the groove.



The groove over the edge of the table and one sharp push: it breaks clean.

One hobbyist made his own scoring tool from an old saw blade ground into a hook, and it worked fine: what matters is that the tip scores, not that it cuts.

Curves and outlines

Score and snap only works for straight lines. For curves, use a jigsaw or scroll saw with a fine-tooth blade for plastic or metal, at medium speed and with light pressure: if it goes too fast, the acrylic melts and sticks to the blade. Put packing tape over the line so it doesn't chip. One sign maker cuts outlines with a rotary tool (a Dremel-type handheld) and cleans them up with a sharpening stone. It can be done, but it's the hardest part to do by hand: for your first sign, stick to a rectangular panel.

The edges

If the edge comes out rough: wet-sand with 180–320 grit, then 400, then 600, always wet. For a glossy finish, use a plastic polish and a cloth. Flame polishing exists, but manufacturers warn that the piece then has to be annealed or fine cracks show up over time: don't do it at home.

Drilling without cracking



The panel resting on a wood block, low speed, no pushing. The film is still on.

- **Drill first,** while the panel is clean, flat and has nothing glued to it: the wire holes and the mounting holes.
- **Rest the panel on a block of wood or MDF** so the bit doesn't blow out the acrylic on its way through.
- **The bit:** ideally an acrylic bit (90° point and an edge that scrapes instead of biting). A regular, slightly worn metal bit at medium speed works too.
- **Don't push:** go slowly going in and, above all, coming out. Push hard and the acrylic cracks; it happened to one hobbyist on his first sign.
- **Stay away from the edge:** at least twice the hole's diameter from the edge.
- **Stay away from the tube:** if you drill with the tube already in place nearby, you can damage an LED. That same hobbyist says so: *"I hurt an LED and that's why it doesn't fully light up."*

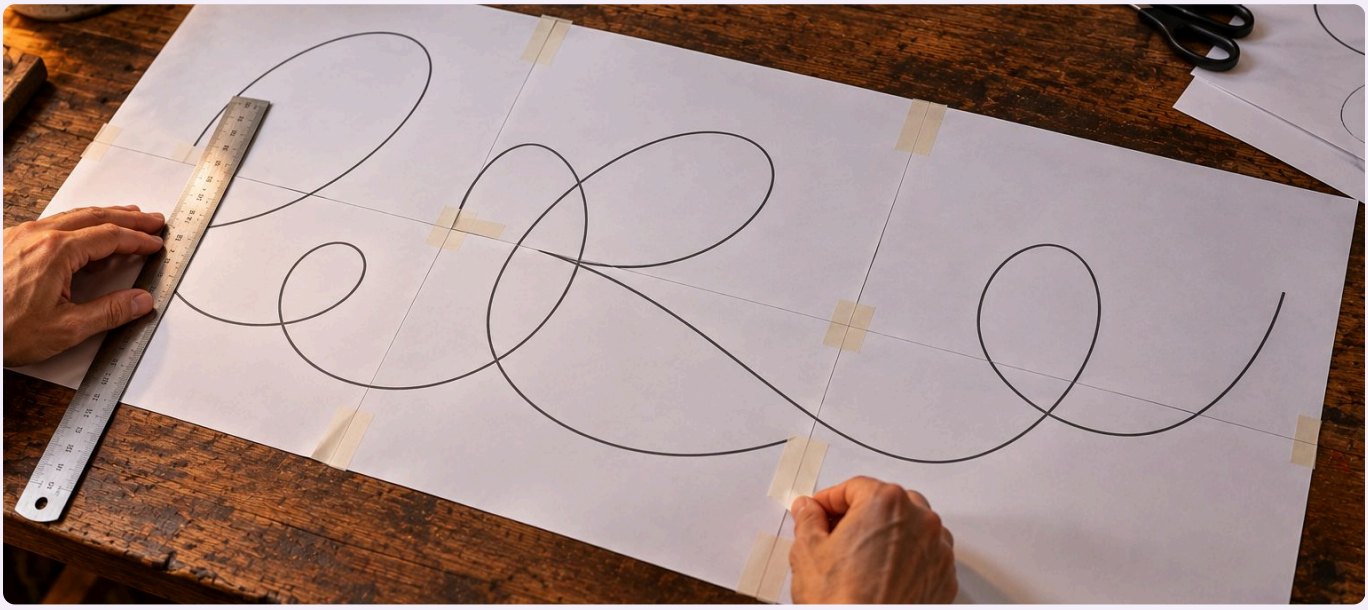
For screws in acrylic: a hole 0.2 to 0.4 mm larger than the screw, a washer, light tightening, and never self-tapping screws — they crack it.

PART 4

Assembly

From the template to the tube fixed in place: the order of work, six ways to hold the tube without a channel, and which adhesive to use with each jacket.

11 · The template and the line

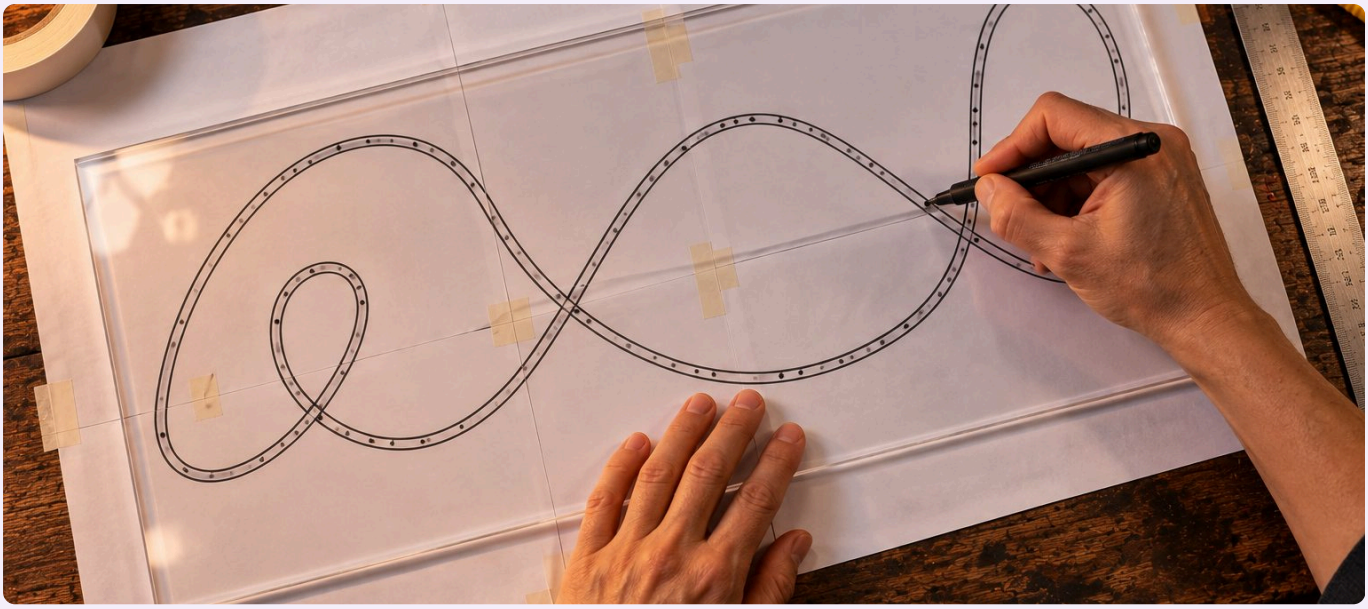


The design printed at full size on Letter or A4 sheets, taped together from the back. Before printing all twenty sheets, measure a known line on the first one.

Print the design at full size (the steps are in **From File to Wall**). Where the template goes depends on the panel:

Clear panel
The template goes **underneath**, taped to the back face. You see it through the acrylic and follow the line without drawing anything on the panel. A top-voted comment on one tutorial sums it up: print the sign, tape it behind, and you never have to redraw it.

Opaque panel or wood
The template goes **on top**. Prick the line through the paper with a pin every centimeter (about every ½ in), lift the paper off and join the dots with an erasable marker. Another option: rub the back of the paper with a soft pencil and trace the line from the front.



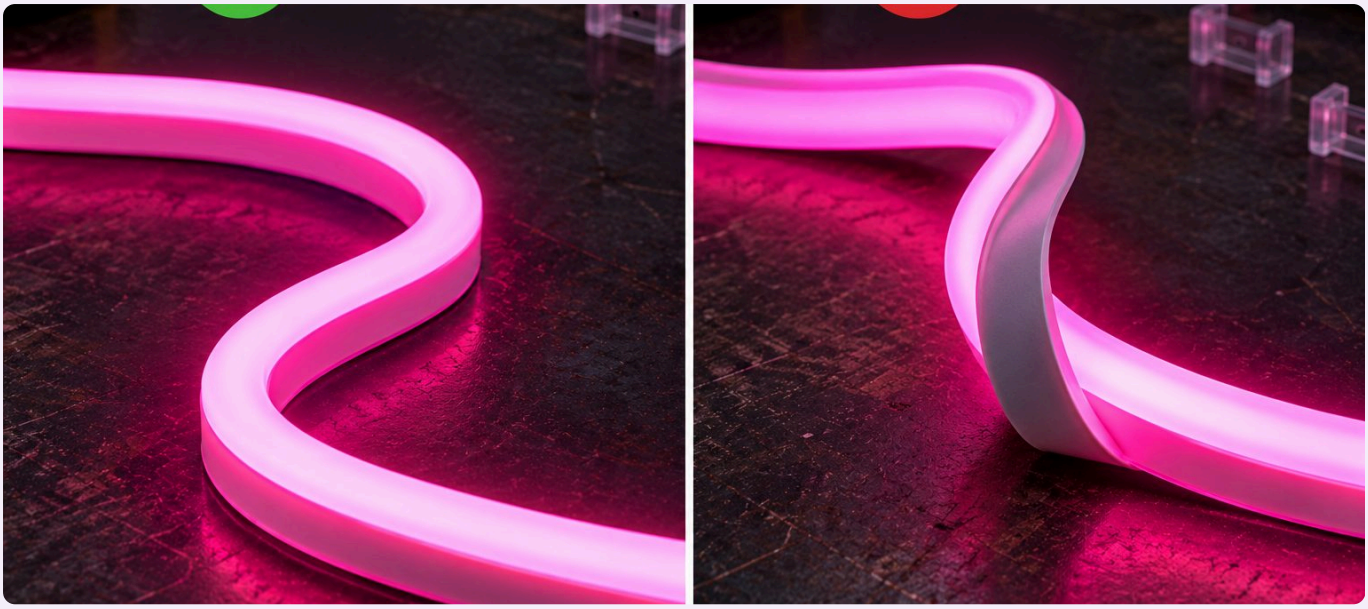
With the template under the acrylic, all you need to mark are the start points, the cut points and the holes.

- **Make the template lines a little thicker than the tube.** A hobbyist who has made dozens of signs recommends it: that way you can tell if the tube wanders off the line anywhere.
- **Mark on the template** where each run starts and ends, where the wire holes go and, if you're using clips, where each clip goes.
- **Another option for clear panels:** one sign maker draws the design in permanent marker on the back of the acrylic, with the protective film still on. When he's done, he peels off the film and the drawing goes with it.

12 · Bending the tube

12 V neon flex bends cold, by hand, and you can bend it while it's lit to see the effect before you fix it down. Four things you need to know:

- **The lit face always points out.** If the tube twists on itself, you see the back face: a dark patch in the middle of the letter.
- **Respect the minimum bend.** Bend tighter than the spec sheet says and the circuit board inside cracks. Sometimes you won't notice right away: the run fails days or weeks later.
- **If the tube is stiff,** especially in winter, warm it with a hair dryer on low. You don't need a heat gun.
- **Angled corners:** the tube won't make points. A professional sign maker uses the "bisector method": he cuts both runs at the mark, brings them together to form the angle, and glues the joint with a drop of super glue (cyanoacrylate).



Left, correct: the lit face points up through the whole curve. Right, the tube has twisted and you can see the back face.

13 · The dry run and the order of work

If one piece of advice comes up in every real build, it's this: **test every run lit before you glue it.** One beginner tells it in a comment: he built his whole first sign with 6 × 12 tube and thin wire, plugged it in at the end *"and nothing happened"*; next time, he says, he'll test each piece as he joins it. Another hobbyist puts it simply: "Check each one before you glue anything."



The tube laid on the line, without a drop of glue, and lit with its power supply. This is the moment to find out you've got 4 cm (1½ in) too much.

The order that works

1. **Drill** the wire holes and the mounting holes while the panel is clean.
2. **Dry-fit the run** along the line from start to finish, and mark where to cut. Cut a little long.
3. **Solder the wires** at the start and feed them through the hole (section 17).
4. **Light it up.** If it doesn't light, the first thing to do is swap the wires: the tube only works one way round. More than one hobbyist's first run didn't light for exactly that reason.

5. **Fix the start:** the first 2–3 cm (1 in) next to the hole, and let it grab well. Everything else pulls from there.
6. **Work forward in short sections,** fixing only what you've already bent onto the line.
7. **When you reach the end,** cut at the nearest mark, solder or seal, and light it up again.
8. **Repeat with the next run.**

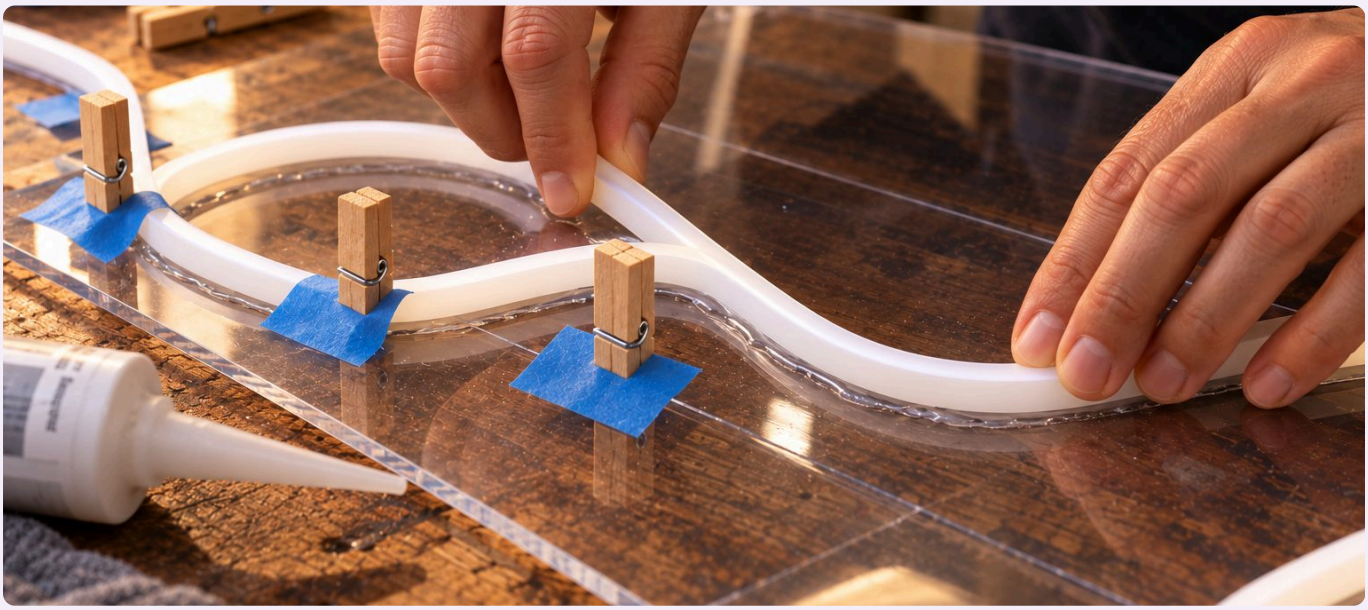
14 · Six ways to fix the tube without a channel

METHOD	HOLD	VISIBLE IN DAYLIGHT	COST	BEST FOR
A · Glued	**Good**	Barely, if kept thin	Very low	Indoors, gifts, weddings, decor
B · Clips	**The strongest**	Yes	Low	Signs that get hung, moved or go into a business
C · Glue + clips	**Very high**	Barely	Low	**Our recommendation** for selling
D · Zip ties	**Very high**	Yes	Next to nothing	Wood, prototypes
E · Headless brads	**High**	Barely	Next to nothing	Wood backings
F · Wire grid	**High**	The grid is the look	Low	Industrial style, no panel

Foam board with hot glue works too, but only for practice or a one-day event.

A · Glued to the smooth panel

the cleanest | indoors | silicone or super glue



A thin bead of silicone along the line, the tube on top, and clothespins or painter's tape holding it while it cures.

1. **With silicone:** a thin bead along the line, 10–15 cm (4–6 in) at a time. Lay the tube on top and hold it with wooden clothespins or strips of painter's tape crossed over the tube until it cures. Whatever

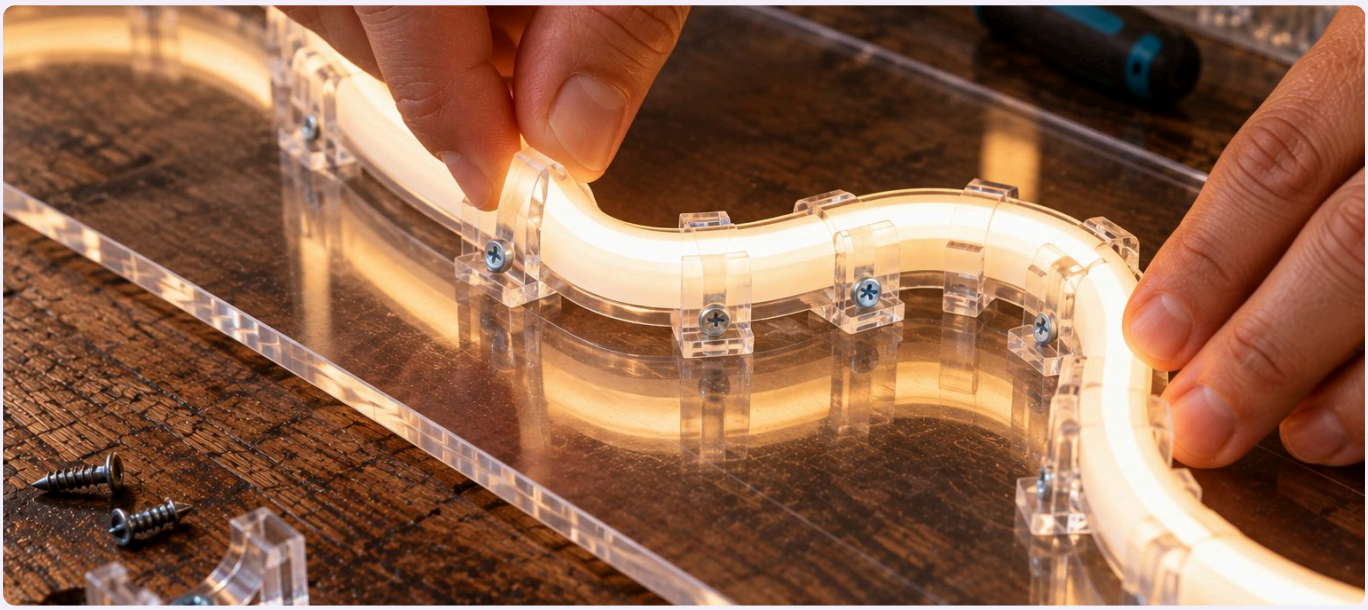
squeezes out, you peel off with your fingers once it's dry: that's why one hobbyist prefers it, because *"you can literally peel off the excess."*

2. **With super glue (cyanoacrylate):** small drops every 2–2.5 cm (about 1 in) on the panel (one tutorial does it every 20–25 mm) and the accelerator wiped on the underside of the tube. It grabs in seconds. Several tutorials agree: use very little, because *"a little goes a long way,"* and hold for about 20 seconds.
3. **Combined:** silicone for the whole path and a drop of super glue on the tight curves, where fresh silicone wouldn't hold against the tube's springback while it cures.

> **Silicone alone is a weak bond**
> An adhesives manufacturer tested silicone on acrylic and it was one of the weakest bonds in its chart. It works because the tube is light and sits on a lot of surface area, but a knock or a trip in a car can pop it loose. For a sign you're going to sell or move around, combine it with a few clips (method C).

B · Mounting clips

the strongest | removable | clips for 6 × 12



Clear clips screwed to the panel. The tube snaps in and can be taken out and put back.

These are U-shaped pieces sized to the tube, with a screw hole. For 6 × 12 they're sold in clear plastic, about 15 × 13 mm with a 3–3.5 mm hole, in packs of 100 for US$10–25, or in metal, sold individually.

1. **Mark the position** of each clip on the template. For lettering, space them closer than you would in an installation: one clip every 5–10 cm (2–4 in) on straights and every 3–5 cm (1¼–2 in) on curves. (Manufacturers say 15–30 cm, or 6–12 in, but that's for tube running straight along a wall, not for letters.)
2. **Fix them down:** with a small screw in a drilled hole (section 10), or glued to the panel with hot glue or super glue if you'd rather not drill. Here hot glue does work, because it's holding the clip, not the tube.
3. **Press the tube in** with your thumb, from one end to the other, without forcing it: pressing too hard crushes the LEDs.

With clips only at the corners, the tube waves between them: one workshop that tried it ended up holding down practically the whole path. Buy 10–15% more than you calculate. Clear clips for clear acrylic; black ones for dark backings.

C · Glue + clips (recommended for selling)

the best of both | survives shipping

Glue the whole path with silicone or super glue, as in method A, and add a clip at every start, every end and on the tightest curves. The glue keeps the tube on the line; the clips hold the points where the tube pulls hardest. This is what survives being shipped by courier and the customer taking it down to clean it.

D · Zip ties through paired holes

almost free | very strong | wood or prototype



Two holes, one on each side of the tube, and a zip tie that wraps around it and fastens at the back.

1. Mark a pair of points every 5–10 cm (2–4 in), one on each side of the line, just far enough apart for the tube to fit between them.
2. Drill with a fine bit, at low speed.
3. Feed the zip tie from the back, wrap it around the tube and close it at the back without pulling it all the way tight.
4. Once the whole path is in place, tighten them all and trim the tails flush.

Clear zip ties on acrylic; wood-colored or black on painted wood. It's less clean than clips, but it costs almost nothing.

E · Headless brads in wood

wood backings | very strong

A large sign published on Instructables, on 10 mm (⅜ in) plywood painted black, holds the tube with headless brads 1.2 × 20 mm (about 18 gauge × ¾ in) driven in along the sides of the tube, one on each side, like a pincer. The author used nearly a thousand brads for a huge sign; on a 60 cm (24 in) sign it's a few dozen. Drive them at an angle toward the tube without touching it: if a brad goes through the jacket, it damages the LED.

F · Wire grid

industrial look | no panel



A neon cactus tied with clear zip ties to a black metal grid.

The tube is tied to a metal grid with clear zip ties. A UK manufacturer did this with a cactus using 2 m (6½ ft) of tube; their advice: tie it loosely, shape the whole thing, and only then tighten all the zip ties. If the tube fights you, a little hair dryer. The grid hangs from two hooks through the mesh itself.

15 · Adhesives, in depth

> **Why silicone is so hard to glue**
> Silicone has very low surface energy: adhesives don't "wet" it and can't get a grip. What sticks well to silicone is, above all, more silicone. That's why hot glue, regular double-sided tape, epoxy and most adhesives fail on silicone tube. With PVC tube you have more leeway.

And not all silicone tube is the same: a hobbyist with dozens of signs says one brand of tube bonds great with super glue, while another *"doesn't work well with CA."* Before you assemble the whole sign, glue down a test piece and pull on it the next day.

Clear neutral-cure silicone: the safest bet

It has to be **neutral cure**. If it smells like vinegar when you apply it, it's acid cure (acetoxy) and it corrodes the copper at the ends of the tube. Some that say on their data sheet that they're neutral and clear:

WHERE	PRODUCT	FROM THE DATA SHEET
US	GE Silicone 2 Glue, clear	Neutral cure, dry to the touch in 30 min, fully cured in 24 h. About US$6–9 at Home Depot or Amazon.com.
UK	No Nonsense 291 Builders Silicone, clear	Neutral cure, about £5.50 at Screwfix.
Canada	GE Silicone 2 is widely sold there too	Same product; check the cartridge says neutral cure and clear.
Australia	Any clear silicone labeled "neutral cure"	Read the cartridge: avoid anything marked acetic, or that smells of vinegar.

Silicone manufacturers warn in their data sheets that adhesion to many plastics has to be tested: that's exactly the test-piece check we recommended above. Let it cure for 24 hours before you move the sign.

Super glue with accelerator: the fast one

- **Gel or thick, not thin:** it doesn't run on vertical surfaces and fills the gap between tube and panel a little.
- **On acrylic it grabs very hard:** in one adhesives manufacturer's test, the acrylic broke before the bond did.
- **Plastic-bonding kits with an activator** sold at hardware stores: Loctite Plastics Bonding System in the US (Home Depot, Amazon.com), Loctite All Plastics in the UK (about £5 at hardware stores or Amazon.co.uk). They come with a primer pen for hard-to-bond plastics.
- **The primer goes on the tube only,** never on the acrylic: in that same test, primer lowered adhesion on acrylic.
- **Wipe off the excess right away:** uncured super glue can craze acrylic, and too much leaves a white haze around the tube (blooming). Small drops, good ventilation, and a light mist of accelerator from a distance.
- **To clean up marks:** one tutorial removes squeezed-out glue with a cotton swab dipped in olive oil, left to work for about 20 minutes.

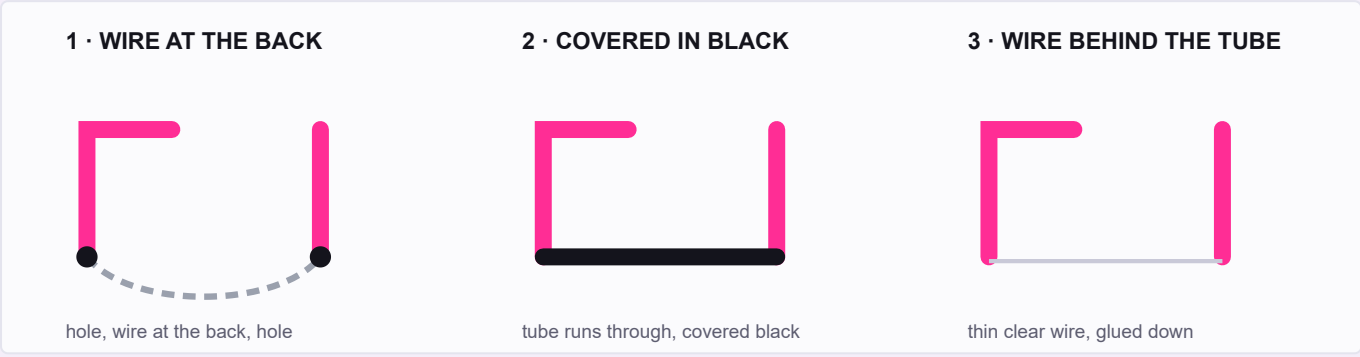
Whether super glue with primer holds on your tube's silicone depends on the brand: sources contradict each other, and the primer's own manufacturer doesn't mention silicone on its data sheet. Do the test-piece check.

What not to use

ADHESIVE	WHY NOT
Hot glue on the tube	It softens with very little heat (about 49 °C / 120 °F according to the manufacturer) and doesn't stick to silicone. For gluing clips, it's fine.
Regular double-sided tape	Doesn't bond reliably to silicone. There is a 3M tape with silicone adhesive on one side and acrylic on the other (9731), but it's an industrial product.
Clear MS polymer adhesives ("Fix All," "mounting" adhesives)	The maker of one of the best sellers warns that it can cause cracking on acrylic, and doesn't recommend it.
Epoxy	Doesn't bond to silicone.
Mineral spirits, alcohol or solvents for cleanup	They attack acrylic (section 20).

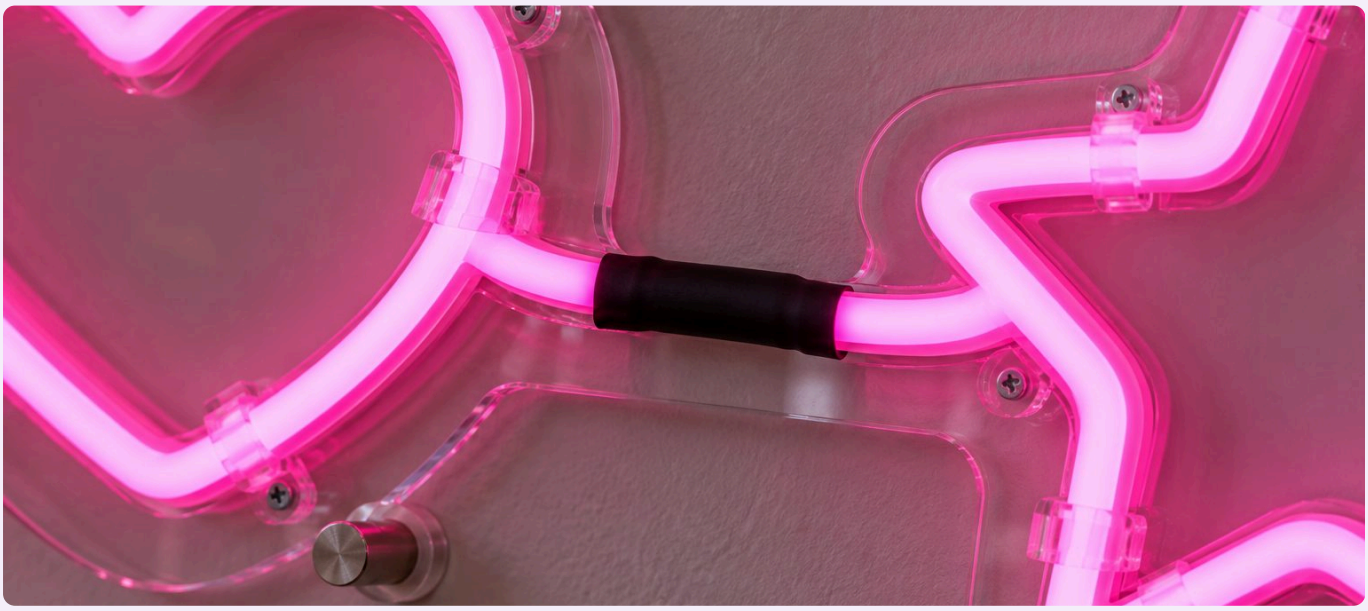
16 · Jumps between letters and wiring at the back

When the design has separate letters, two colors or a crossover, the tube has to get from one place to another. If it crosses the front while lit, you get a streak of light that isn't part of the design. What sign makers do is never leave lit tube in the jump: they cut the tube at the end of the letter and carry on with wire at the back.



Option 1 is the cleanest and the one shops use. Option 2 is the fastest. Option 3 works when you don't want to drill any more holes.

1. **Wire at the back:** cut the tube at the mark at the end of the letter, solder two wires on, feed them through a hole to the back, run them across the back to the start of the next letter and bring them out through another hole. That's what the three most thorough tutorials do. As one comment puts it: "I'd rather do the wiring at the back: cleaner, and it hides the wires."
2. **Covered:** leave the tube continuous and cover the jump section with **black heat-shrink** or a black silicone sleeve (some neon manufacturers sell them). On a black backing it disappears; on clear, you'll see a dark line in daylight. Heads up: most paints don't stick to silicone, so painting the tube isn't reliable.
3. **Thin wire at the front:** one sign maker runs the jump with clear two-conductor wire glued behind the tube itself, on the panel side. Another uses 24 AWG wire or enameled magnet wire, which are almost invisible.



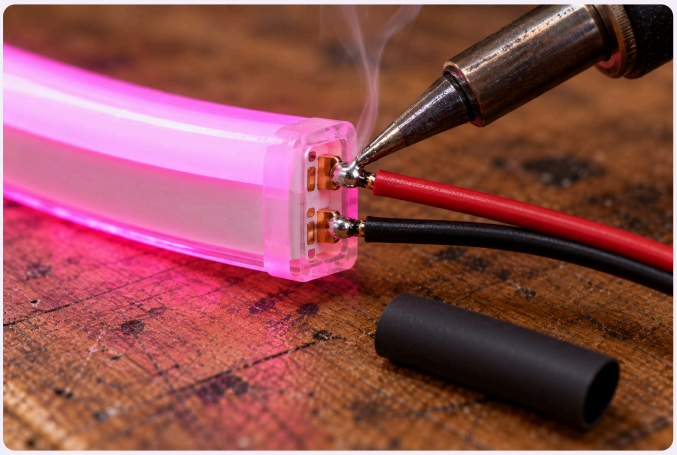
Between two shapes, the section that shouldn't glow is covered with black heat-shrink.

> **Keep the wires at the back tidy**
> Tack the wires at the back with dots of silicone or super glue, not a continuous bead, so you can still make corrections. A comment with hundreds of upvotes suggests putting a vinyl sheet on the back of the acrylic to hide all the wiring. With black acrylic, the problem goes away.

17 · Cutting, soldering and sealing

Same as in the Module 1 lessons. Here are the essentials, with tricks from people who do it every day:

1. **Cut only on the mark,** straight, with a sharp utility knife and without crushing. One sign maker makes a small diagonal cut to expose both copper contacts.
2. **Strip back a little silicone** from the end until you can see the two copper pads.
3. **Tin first:** put a little solder on the pads and on the wire ends, separately. Then all you have to do is bring them together and touch them with the iron.
4. **2–3 seconds at about 320 °C (610 °F),** with a soldering iron of around 60 W. A good joint is shiny and smooth; if it's dull or grainy, redo it. Don't carry solder on the iron tip over to the joint: the flux burns off before it gets there.
5. **Polarity:** before you close anything up, light it. If it doesn't glow, swap the wires.
6. **Insulate** with heat-shrink.
7. **Seal each end** with its silicone end cap and a little neutral-cure silicone, with the wires coming out through the cap.



Shiny, smooth solder on the copper pads.



Silicone end cap and a dab of neutral-cure silicone: the end is sealed.

> **If soldering scares you**
> The author of one very popular tutorial didn't solder because, when she tried, the strip kept melting, so she used clip-on connectors. That works for indoor signs (section 8). Another maker puts it bluntly: for a professional finish, you have to solder. Practice on a scrap piece: after two or three tries you'll get the hang of it.

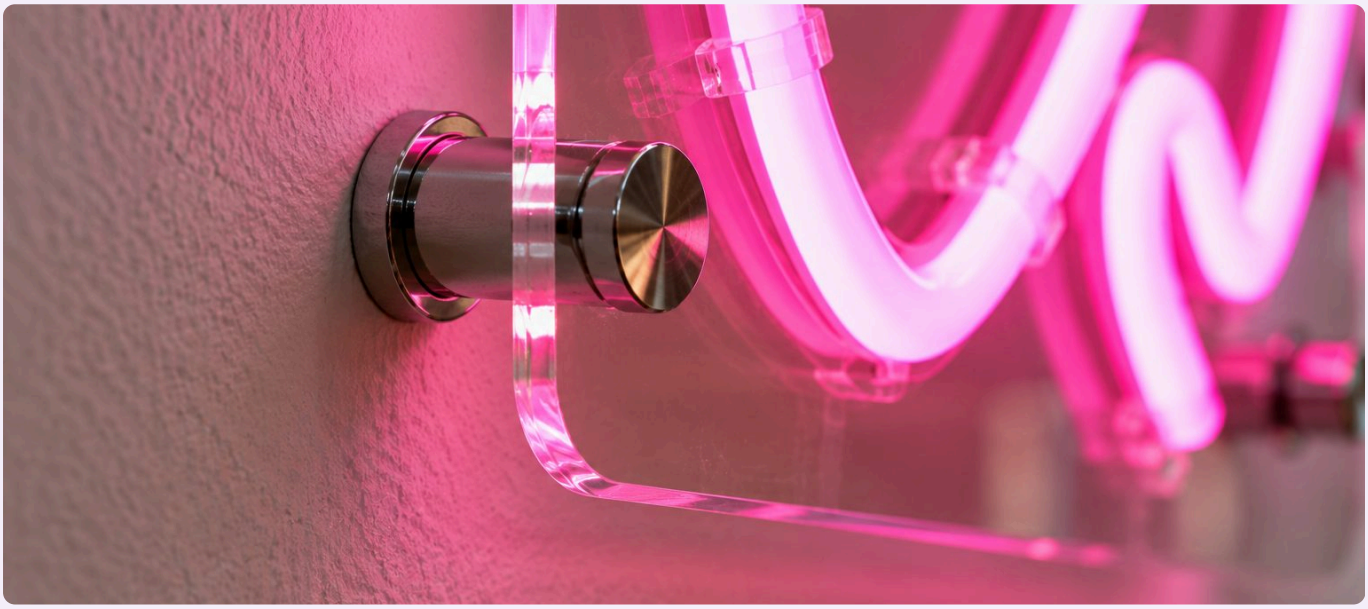
PART 5

Finish, maintain and sell

Hanging it, protecting it, fixing it when it fails, photographing it to show it off, and what you need to know before you charge for it.

18 · Hanging it

Standoffs: the store-bought finish



One standoff in each corner: the sign floats 2–3 cm (about 1 in) off the wall and the wire stays hidden behind it.

Standoffs are steel barrels that screw into the wall and hold the panel through its holes, leaving it floating. They're what almost every sign shop uses.

- **Size:** 13–25 mm (½–1 in) in diameter with 15–25 mm (⅝–1 in) of standoff are the usual ones. In the US they're sold individually from about US$4 (Canal Plastics lists them at US$3.99 each); in the UK, packs of four start at just a few pounds from sign-fitting suppliers.
- **The hole in the panel:** the standoff maker specifies it; for medium sizes it's usually around 8–10 mm (5/16–⅜ in). Drill it first thing (section 10), 2–3 cm (about 1 in) in from the corners.
- **How many:** four at the corners, plus one more every 30–45 cm (12–18 in) along each side if the panel is thin or large.
- **Anchors, depending on the wall:** a standard 6 mm (¼ in) wall plug holds a lot in solid brick and concrete, but much less in hollow block or drywall (plasterboard). An acrylic sign is light, but don't hang it from just any plug in drywall: use proper drywall anchors.

Other options

- **Steel cable:** two holes at the top and two cables up to the ceiling or wall. For shop windows and behind bars. Kits with ceiling fittings cost about US$10–25.
- **Tabletop:** resting in a wooden base with a slot as wide as the panel is thick.

- **Wire grid:** from two hooks, through the mesh itself.

Before you drill into the wall, decide how the wire will run down to the outlet and leave plenty of slack. The adapter goes on the floor or behind a piece of furniture, never hanging off the sign.

19 · Outdoors: what changes

A handmade sign can go outside if it's under cover and out of direct rain, but several things change:

- **Silicone tube, IP67,** not PVC: it stands up to sun and cold and doesn't yellow.
- **Soldered, never clip-on connectors,** which are rated for indoor use only.
- **Every end sealed** with an end cap and neutral-cure silicone, and every joint covered in heat-shrink.
- **An IP67 waterproof power supply,** or the supply kept indoors, under cover.
- **No dimmer:** one sign manufacturer warns that there are no outdoor-rated dimmers.
- **Clips rather than glue:** in UV-resistant plastic, with stainless steel hardware.

> **What you shouldn't do by hand**
> Signs exposed directly to rain, hardwired into a building's electrical system, or hung over a walkway. Those need to be done or checked by a licensed electrician.

20 · Cleaning, maintenance and repair

Cleaning the acrylic

Acrylic scratches and crazes with products that do nothing to glass. According to the manufacturers:

DO	DON'T
Cold water with a little mild soap and a soft cloth or chamois, always damp. If you need to disinfect, isopropyl alcohol diluted to 30%.	Glass cleaner (especially with ammonia), straight alcohol, mineral spirits, acetone, degreasers, scouring pads, or wiping it dry: they scratch it or cause fine cracks.

To remove stickers, use a hair dryer — never a utility knife or a scraper.

Replacing a run

1. Cut out the damaged section at the nearest marks.
2. Remove that section (with silicone it peels off; with clips it pops out).
3. Cut an identical new section, solder the wires on (red to positive, black to negative), test it and seal it.
4. Fix it down the same way as the original.

21 · When something goes wrong

SYMPTOM	LIKELY CAUSE	WHAT TO DO
Nothing lights	Reversed polarity, or the power supply isn't putting out	Swap the wires. Check the power supply with the multimeter on DC volts.
One 2.5 cm (1 in) section is dark	Cut outside the mark	Cut at the next mark and re-solder.
A whole run is dark	Cold solder joint, loose wire, or a clip-on connector not making contact	Check that joint. With connectors, try seating it on a different cut mark.
It flickers	A bad joint or a loose wire	With the sign on, gently wiggle each wire: wherever it flickers, that's the culprit.
The far end is dimmer than the start	Run too long, or wire too thin	Feed power from the other end too, or split it into two runs. Check the wire chart (section 8).
One LED dark in the middle of the tube	A knock, pressure from a clip, or the drill	Replace that section (section 20).
It went dark days or weeks later	A bend tighter than the spec sheet	Replace the section and open up the curve.
It's coming unstuck	An adhesive that doesn't grip that jacket, or hot glue	Neutral-cure silicone, or clips on that section.
White haze around the tube	Too much super glue or accelerator	Barely visible when lit. Next time, tiny drops and good ventilation.
Fine cracks in the acrylic	A cleaning product, uncured super glue or an overtightened screw	There's no fix: avoid the cause on the next one.
Dark patch on a curve	Twisted tube	Lift that section and turn it so the lit face points out.
The power supply runs very hot	Supply too small for the load	Measure the draw and fit one with at least a 20% margin.

22 · Photographing your sign

Neon shot on a phone in auto mode comes out as a white smear: the light blows out the photo and you lose the color and the shape of the tube. If you're going to show it off or sell it, the photo is half the sale.

1. **Tap the lit letters** on the screen to focus and meter the light on them.
2. **Lower the exposure** by dragging the slider down (0.3 to 1 stop) until you can see the shape of the tube and its color.
3. **Leave some light on in the room:** in total darkness all you see is neon floating in space. With soft light you also see the wall, and the sign looks real.
4. **Turn the sign's brightness down** if you have a dimmer: it photographs better at half power than at full.
5. **Brace the phone** or use a tripod, and take one shot a little darker and one a little brighter.
6. **Careful with night mode** if there are people in the shot: anyone moving comes out blurry.



Soft ambient light, exposure turned down and the sign at half power: you can see the color, the shape of the tube and the wall.

23 · If you're going to sell it

What the market pays

Prices vary a lot depending on size, complexity and whether it's custom. As a reference, here's what we've seen listed (October 2026):

WHERE	CUSTOM SIGNS OF 50–60 CM (20–24 IN)
US	On Etsy, many sit at or above US$200; one manufacturer prices an 18 × 24 in (45 × 60 cm) sign at US$270–535.
UK	Online custom-sign shops start at around £50, with standard text signs typically from £80–100; signs from UK workshops run considerably higher.
Europe (for reference)	In Spain, €55–99 from individuals and second-hand, from €99–130 in online shops. In France, from about €50 in gift shops to €150 or more from workshops.

The toughest competition is factory-made signs sold online for US$30–90. What sets you apart isn't price, it's what they don't do: custom design, the exact color, hand delivery and being able to fix it if it fails. One hobbyist who sells at craft fairs admits he hasn't sold much there; the people who make a living at this sell custom orders (names, weddings, business logos).

What it has to comply with

> **This is guidance, not legal advice**
> Rules change and depend on how you sell. Before you sell in volume, check with an accountant, a compliance consultant or the relevant agency in your country.

United States

- **UL or ETL listing isn't required by federal law** for a sign like this, but Amazon and other marketplaces can require it, and the National Electrical Code (NEC 600.3) requires signs that are installed in a building to be listed.
- **The standard for signs is UL 48.** Full certification for a handmade sign is expensive and rarely worth it at the start; what you can control is the power supply.
- **Use a Class 2 power supply with a UL or ETL mark.** It's the simplest way to cut your risk, since the supply is the only part working at mains voltage.
- **The label:** your name or business, 12 V and wattage, and indoor use only (or the IP rating). If you sell the sign without a power supply, state on the label and in the instructions: "Supply with Class 2 power source only."

United Kingdom

The UK accepts the CE marking for most consumer products; the UK's own marking (UKCA) is optional. In practice: a CE- or UKCA-marked 12 V power supply from a recognized manufacturer, and a label with your name and address, 12 V and wattage, and indoor use only (or the IP rating).

European Union (summary)

If you ship to EU customers: the sign needs **CE marking for the whole product** — a 12 V sign falls under the EMC and RoHS directives, and sold with its power supply the set also falls under the Low Voltage

Directive, so you need a declaration of conformity for the whole set, not just a CE-marked supply. The **General Product Safety Regulation (GPSR)**, in force since December 13, 2024, applies to every consumer product, handmade included: product identification (type or batch), the name plus postal and email address of the responsible person, and safety warnings. And anyone placing electrical products on the market has to register as a **WEEE** (electrical waste) producer in each country — Etsy, for example, asks French sellers for their number.

Warranty and customer care

Sign shops give 1 to 3 years of warranty on the electrical side. Ship every sign with a short care sheet: how to clean it (section 20), that the power supply must not be covered, that it's for indoor use only (or its IP rating), and how to reach you if something fails. It's very little work, and it's what gets you the repeat call.

PART 6

Let's build it

The kit and what it costs, your first sign in fifteen steps, eight real signs made without a machine, and the checklist to tick off.

24 · The kit and what it costs



Everything you need for a sign without a machine fits on one table.

WHAT	NEEDED	BALLPARK PRICE (US · UK)
12 V neon flex, 6 × 12, 5 m (16 ft) reel	**Yes**	US$13–39 a reel · cut to length, about £4–10/m
12 V power supply with 5.5 × 2.1 mm barrel connector (2–5 A)	**Yes**	US$6–25 · £5–15 · Mean Well GST60A12, about US$18
60 W soldering iron with solder	**Yes**	about US$16 for the iron · about US$28 with wire strippers
22–24 AWG silicone wire and 18–20 AWG two-conductor power wire	**Yes**	a few dollars
Heat-shrink (assorted) and 6 × 12 end caps (10)	**Yes**	a few dollars
3 mm (⅛ in) acrylic, cut to size	**Yes**	US$12–15 · £9–11 (or shop offcuts)
Acrylic scoring knife + metal straightedge	**Yes**	US$6–11 for the knife
Clear neutral-cure silicone	**Yes**	US$6–9 (GE Silicone 2) · about £5.50 (No Nonsense 291)
Super glue with plastics activator	**Very handy**	US$4–21 depending on the kit · about £5
Clips for 6 × 12 (100 pcs)	**Very handy**	US$10–25
Wooden clothespins and painter's tape	**Very handy**	whatever's in the house
Multimeter with a 10 A range	**Very handy**	inexpensive
Steel standoffs (4)	For hanging	about US$4 each · a few pounds a pack of four
Clear zip ties (100)	Depending on the method	a few dollars
Dimmer with remote	Optional	US$8–19
12 V cordless drill/driver	For clips, zip ties and hanging	about US$43 (or borrow one)
The essentials		**about US$95–120**
With everything "very handy" plus hanging		**about US$145–210**

You don't need a heat gun: a hair dryer is enough to soften the tube. Real builds back this up: one wedding sign cost about US$60 in materials; another, between US$87 and US$124; an experienced hobbyist puts a complex sign at about US$50. What weighs most on the bill is the tool kit, and you only buy that once.

Prices from US and UK stores (Amazon.com, Home Depot, Canal Plastics, Amazon.co.uk, Screwfix and others) in October 2026, before tax and shipping. They change often.

25 · Your first sign, step by step

One word in connected script, about 50–60 cm (20–24 in) wide, on 3 mm (⅛ in) clear acrylic, glued with silicone and with clips at the stress points. Based on real builds, it takes a hobbyist 3 to 6 hours; a pro does it in under two. Set aside a weekend: day one to prepare and test, day two to fix it down calmly and let it cure.

Day 1 · Prepare

1. **Choose the word and the font** (sections 4 and 5). Letters 8 cm (3 in) or taller with 6 × 12 tube.
2. **Make the preview** and, if it's a commission, get the customer to approve it (section 6).
3. **Print the template** at full size and check the scale with a ruler.
4. **Measure the path** and add 10–15%. Buy the tube and do the table test (section 3).
5. **Cut the panel** with about 5 cm (2 in) of margin around the design, with the film still on (section 10).
6. **Drill** the wire holes and the four mounting holes.
7. **Tape the template underneath** the panel.
8. **Dry-fit the tube** along the line, mark where to cut and cut a little long.
9. **Solder the starting wires,** feed them through the hole and **light it up.** If anything's wrong, now is the time to find out.

Day 2 · Fix and finish

10. **Fix the start** and let it grab well.
11. **Fix it in 10–15 cm (4–6 in) sections,** holding with clothespins or tape, with the lit face always pointing out.
12. **Add a clip** at the start, the end and on tight curves.
13. **Cut the end at the mark,** seal it with its end cap and neutral-cure silicone, and light it up again.
14. **Let it cure for 24 hours.** Remove the clothespins, tape, template and film; clean with soap and water.
15. **Fit the standoffs,** connect the power supply and hang it. Take the photo (section 22).

26 · Eight real signs made without a machine

All of them are published online, and none uses a router or a laser to hold the tube. We've summarized them because each one teaches something different — especially what went wrong.

1 · A 60 × 20 cm (24 × 8 in) custom order, six letters

Spanish-language tutorial with more than 2 million views

3 mm acrylic. He divides the usable width among the six letters (about 9.3 cm / 3.7 in each) and draws the design in permanent marker on the back, with the film still on. He cuts the tube diagonally at the marks, glues it with super glue and joins the runs with clear two-conductor wire; 12 V 1 A power supply. He insulates the solder joints with silicone applied from a syringe. **What went wrong:** the first run didn't light — the polarity was reversed. **The lesson:** warn the customer that it won't be identical to the on-screen design, "just as close as possible."

2 · A wedding sign on a 30 × 120 cm (12 × 48 in) panel

Instructables, 2022

3 mm cast acrylic, 6 mm (¼ in) holes for the wires and for hanging. 12 V tube on a 5 m reel, a 12 V 5 A power supply, clip-on connectors, and gel super glue — "a little goes a long way" — with 20 seconds of pressure. Template printed on letter-size sheets with Rasterbator. About US$60 in materials versus US$300–500 to buy one. **What went wrong:** when she tried to solder, the strip melted, so she switched to connectors. She cleaned off squeezed-out glue with olive oil. **Heads up:** the font she used is free for personal use only.

3 · Another wedding sign, with silicone

Home decor blog

Clear acrylic or, as a cheap alternative, a thick plastic sheet from the hardware store. Glued with silicone because the excess peels off once it's dry. Design tested in Canva and redrawn by hand. Cost: between US$87 and US$124; the tube alone was US$22. **The lesson:** "for a professional finish you have to solder, there's no way around it"; and since the tube only cuts at its marks, some letters are limited.

4 · "hunny," four letters on 60 × 90 cm (24 × 36 in)

Home decor channel

Letters 9 cm (3.5 in) tall with 3 cm (1.2 in) between them. Glued with a strong-hold instant glue, working section by section and holding with metal clips while it dried. A hole above the "h" to take the wire to the back, and standoffs for hanging. **The lesson:** simple measurements (9 cm letters, 3 cm gaps) make a balanced sign.

5 · A word and a Saturn, first attempt

Spanish-language video with nearly a million views

3 mm acrylic scored and snapped with a homemade cutter made from an old saw blade. 12 V tube with marks every 2.5 cm (1 in), "about 2 m at most," and a 12 V 3 A power supply. Glued with super glue applied with a toothpick. **What went wrong, and it's gold:** he damaged an LED while drilling; he pushed too hard and cracked the acrylic; on the Saturn he ran out of strip and it came out lopsided; the thick wire was visible from the front. His conclusion: the more cuts, the more solder joints and the more work.

6 · Dozens of signs, all without a machine

A hobbyist on a forum

Hardware-store acrylic in rectangles, cut with a utility knife and a straightedge: "the first forty had square backings, no one cared." Medium-viscosity super glue, 24 AWG silicone wire and clear silicone over the joints. Template blown up with Rasterbator and taped to the back, with lines a little thicker than the tube. A simple four-run sign takes him an hour; a forty-run one, a weekend; the most complex, about US$50 in materials. **The lesson:** the adhesive depends on the tube brand: with one brand super glue grabs, with another it doesn't.

7 · A large sign on plywood

Instructables

10 mm (⅜ in) plywood cut with a jigsaw and painted black. 8 × 16 mm tube held with headless brads along the sides. **The lesson:** his design rules apply to any sign: no sharp corners, line width equal to the tube's, every line a multiple of the cut interval, and no crossovers.

8 · Two signs by a beginner with no electrical experience

English-language crafts channel

18 × 24 in (45 × 60 cm) Plexiglas, Gorilla glue ("nothing has moved") and clip-on connectors. She made them because similar signs on Etsy were going for around US$200 or more. **What went wrong:** one connector wouldn't light because it was on backwards, and she was sent 3-pin connectors instead of 2-pin. Her advice: "double check each one before gluing." In the comments, people recommend black acrylic so the wires don't show.

What all eight have in common

1. Cut only at the mark, right on the line.
2. Test every run lit before gluing it.
3. Buy extra tube and cut runs a little long.
4. A full-size template taped behind the acrylic.
5. Design around the 2.5 cm (1 in) cut interval and count the runs.
6. Big, monoline lettering: the smaller the sign, the more the cuts show.
7. Little glue, in dots, and hold it while it sets.
8. If it doesn't light, swap the wires before you take anything apart.
9. Thin wires, run at the back; drill well away from the tube.
10. Insulate the joints and clean up excess glue.

27 · If you ever want a machine

The router in the lessons is a small desktop CNC, the kind known as a 3018. They cost **between US$115 and US$150**; a 40 × 40 cm (16 × 16 in) model runs around US$480. With one, the channel cuts itself, the glue stays hidden and you can repeat the same sign as many times as you like. If you start selling in volume, it's the first purchase that makes sense. To get started, you don't need one: the eight signs above prove it.

> **Watch out for cheap lasers**
>
> Budget diode laser engravers (from about US$120) **can't cut clear acrylic**: the beam passes straight through it. You'd have to paint it or use colored acrylic. For this kind of sign, if you ever buy a machine, make it a router.

28 · Printable checklist

Before you buy

- [ ] Sign width decided (and approved by the customer)
- [ ] Letters 8 cm (3 in) or taller with 6 × 12 tube
- [ ] Monoline font with a commercial license
- [ ] Runs counted; no crossovers or sharp corners
- [ ] Path measured + 10–15%
- [ ] 12 V tube, never mains voltage
- [ ] Table test: it bends sideways
- [ ] Jacket: silicone or PVC (to choose the adhesive)
- [ ] 12 V power supply with a 20% margin

Prepare

- [ ] Print scale checked with a ruler
- [ ] Panel cut with margin, film still on
- [ ] Wire and mounting holes drilled
- [ ] Template underneath (or line marked on top)
- [ ] Jumps between letters planned
- [ ] Adhesive tested on a piece of tube

Assemble

- [ ] Run dry-fitted
- [ ] Cuts only on the marks
- [ ] Solder joints shiny and insulated
- [ ] Polarity checked: it lights
- [ ] Start fixed and cured
- [ ] 10–15 cm (4–6 in) sections, held while curing
- [ ] Lit face always pointing out
- [ ] No bend tighter than the spec sheet
- [ ] Clips at starts, ends and curves

Finish

- [ ] Ends sealed with cap and neutral-cure silicone
- [ ] 24 h cure before moving
- [ ] Template and film removed; cleaned with soap and water
- [ ] Final test with the actual power supply
- [ ] Standoffs fitted, wire run to the outlet
- [ ] Photo taken with exposure turned down
- [ ] Care sheet for the customer

THE NEON TRADE

From File to Wall

You have the design on a screen. Here is how it becomes a line on a board that you can bend tube along — with a printer, with tracing paper, or with nothing but a pencil.

> **You do not need a laser or a CNC**
> The lessons show the machine route because that is how a busy shop works. But the machine only does one thing: it puts the line on the board. You can put that line there by hand, and the sign comes out the same. This sheet is the hand route.

1 · Two files per design, and what each is for

FOLDER	WHAT IT IS	WHAT YOU DO WITH IT
01 · CUT FILES	Black lines on white, nothing else.	This is the one you print, trace or send to a machine.
02 · COLOUR PREVIEWS	The same design glowing on a dark ground.	Send it to the customer. Never cut from it.

Open a preview file in a text editor and near the top you will find a line like `tubo sugerido: warm white (#FFF1D6)`. That is the tube colour the design was drawn for, in the words your supplier uses.

2 · Decide the real size first

Everything after this depends on the size, so settle it before you print anything. Ask the customer for the width in centimetres or inches, and check it against the wall it is going on.

Then read the curve length at that size, so you know how many metres of flex to buy — the method is in **EXTRA 4, Measuring a Sign Before You Buy**. Do it now, not after you have started.

> **The shape files are centrelines**
> In the shape packs, what you get is the path the tube follows — not the outline of a channel. Set the stroke width to your real tube diameter, then use **Object › Expand** (Illustrator), **Outline** (CorelDRAW) or **Path › Stroke to Path** (Inkscape) and you have the channel to route or cut. One click. The word designs are already outlines.

3 · Getting the design to full size

Three ways. Pick by what you have on the bench.

A · Print it and tile it

The usual route, and the most accurate.

1. Open the cut file in any program that prints — a browser will do.

2. Set the print scale so the design comes out at the finished size. Most print dialogs have a **Poster** or **Tile** option that spreads one big image over several sheets.
3. **Print one test sheet first** and measure something on it with a ruler. If a line that should be 100 mm comes out 97 mm, your scale is wrong — fix it before you print twenty sheets.
4. Trim the margins, line the sheets up on the overlap marks, and tape them together on the back.



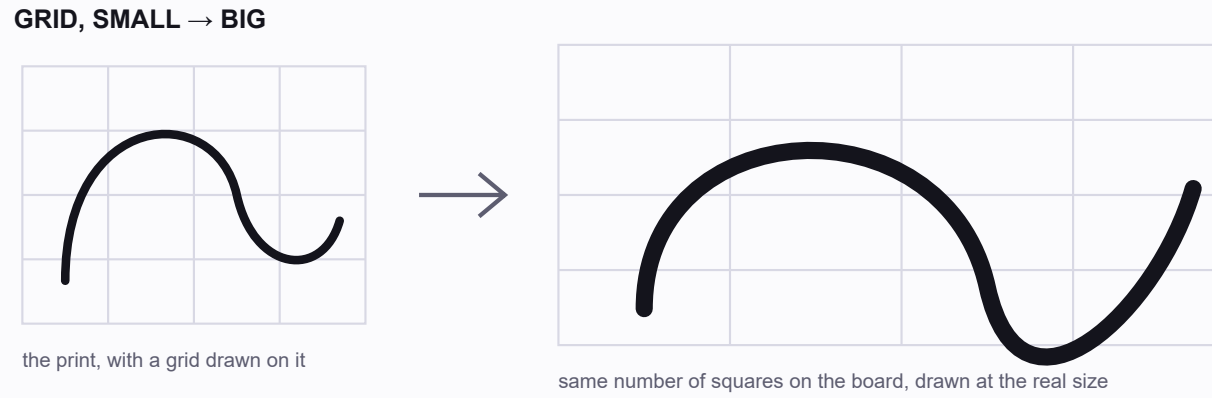
Measure a known line on the first sheet before printing the rest.

A sign wider than your printer is still one drawing. Tile it, check the scale on sheet one, tape from behind.

B · Trace it

No large printer? Trace from a screen or from a small print.

- **From a tablet or laptop:** tape tracing paper over the screen, turn the brightness up, and trace. Works for small signs only — you cannot go bigger than the screen.
- **From a small print, scaled up by grid:** draw a grid of squares over the print, draw the same grid at the bigger size on your board, and copy the line square by square. Slow, free, and it works at any size.
- **With a projector:** if you have one, point it at the board, scale the image until a measured line reads right, and draw straight onto the board. Fastest of the three.



the print, with a grid drawn on it

same number of squares on the board, drawn at the real size

Same grid, bigger squares. Copy what crosses each square. It is how sign painters worked long before there were plotters, and it costs nothing.

C · Draw it freehand

For simple shapes — a heart, a star, a word in one stroke — you may be faster drawing straight onto the board with a marker and fixing the shape by eye. Use the print as a reference beside you. Nobody

measures a neon sign on the wall.

4 · Getting the line onto the board

1. **Tape the full-size print onto the board**, face up, with the design where you want it. Check the margins on all four sides before you commit.
2. **Prick the line through.** Run a pin, an awl or a compass point through the paper along the line every centimetre or so. You end up with a dotted line on the board.
3. **Take the paper off and join the dots** with a marker. That is your tube path.

Two alternatives that also work: rub the back of the print with a soft pencil and trace over the front, which transfers graphite onto the board; or use repositionable spray adhesive to stick the print down and work directly on top of the paper, peeling it away as you go.

> **Mark the entry point before anything else**
> Decide where the power wires leave the sign and drill that hole first, while the board is still clean and flat. It is miserable to drill it once the tube is glued on.

5 · The order of work

1 · Mark	Transfer the line. Mark the entry hole and drill it.
2 · Dry-fit	Lay the tube along the line loose, without glue, all the way round. This is where you find out the design is 40 mm too wide, and it costs you nothing.
3 · Feed the wires	Solder the leads on and pass them through the hole **before** you glue anything down.
4 · Anchor the start	Glue the first two or three centimetres and let them set properly. Everything after that is held by this.
5 · Work round	Bend and glue in short runs, following the line. Do not glue ahead of where you have bent.
6 · Cut to length	Only at the marked cut points on the tube. Trim the excess silicone and tuck the end in.
7 · Test before you finish	Power it up while you can still fix it.

Steps 3 to 6 are shown end to end in **lesson 16, Bending, Cutting and Fixing Neon Flex to an Acrylic Base**. Watch it once before your first sign, and again with the tube in your hand.

6 · Where people get it wrong

THE MISTAKE	WHAT TO DO INSTEAD
Printing without checking scale	Measure a known line on the first sheet. Always.
Gluing before dry-fitting	Lay the whole run loose first. Always.

Forgetting the tube has width	The printed line is the centre of the tube. Half a tube sticks out each side of it — check your margins against that, not against the line.
Cutting anywhere	Flex cuts only at the marked points. Round each run up to the next mark.
Drilling last	Drill the wire hole first, on the clean board.
Cutting from the colour file	Those are for the customer. Cut from the black ones.