Beyond Basic STAINED GLASS MAKING

Techniques and Tools to Expand Your Abilities

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Contents

Introduction

The purpose of this book is to build on the basic stained glass making skills you've already learned. Inside, you will be taught how to create more complicated and advanced projects—a large hanging lamp-shade, a tabletop box, a colorful decorative mosaic—as well as incorporate complex designs into the simpler projects you know how to make. You will be trained to use new stained glass making tools—a table saw, a jig system to make repeated cuts, a lamp jig, mosaic cutters, a nugget foiler—and you will expand your knowledge of the basic tools. The book provides instruction on framing and finishing a large decorative panel. It will also show you how to make some stained glass making steps easier so you can spend more time working on the fun stuff and planning new projects.

A few key basic skills are summarized here so you can make sure you're on the right track. For a much more detailed treatment of these skills, check out *Basic Stained Glass Making*, the companion book in this series.

Stained glass manufacturers are developing new and exciting materials every day. When you've mastered basic and intermediate stained glass making skills, there's almost no limit to the variety of colorful stained glass projects you can create.

Let's get started.

1

Equipment and Materials

A glimpse at the catalog of a stained glass equipment supplier suggests that you will need very specific tools for your project. But if you have a good set of basic tools, you can create just about any project you want. The following lists the basic tools that will form a solid foundation for your tool collection. Some are everyday tools available at hardware stores. Others are more specialized and available at craft stores, stained glass shops, or online retailers. A few specific tools and materials needed for each project in this book are listed near the beginning of the project chapters.


QUALITY
SOLDER
NET
WT.
16 OZ.
(1 LB.)
MEETS
ASTM SPECS
60% TIN / 40% LEAD
THE TRADITIONAL STAINED GLASS SOLDER
SOMERVILLE, N.J.
U.S.A.
1972

SOLDER

The solder used in stained glass making is a mixture of tin and lead with a preferred ratio of 60/40 respectively—this mixture is more expensive, but flows smoothly and is easier to work with than a 50/50 blend. Approximate cost: $10 for a 1-pound spool.

SOLDERING IRON

Select an iron rated between 75 and 200 watts. Some models have an adjustable temperature control; some plug into a separate rheostat that adjusts temperature; and others use interchangeable tips to regulate temperature. All work equally well. Carefully follow the instructions that come with the model you buy. Approximate cost: $25–$75.

You should also buy a sturdy soldering-iron stand, which usually includes a holder for a moist sponge. Approximate cost: $7–$10.


RINSES
OFF
Glass
Cutter
Oil
inland
WARNING
on back panel.
4 oz./118 ml.

CUTTER OIL

Specially made for use with glass cutters, cutter oil is needed no matter what type of cutter you use. It reduces friction between the cutting wheel and the glass surface and helps keep small flecks of glass from impeding the wheel's rotation. Approximate cost: $5.

GLASS CUTTER

A quality glass cutter is a stained glass crafter's most important tool. This book uses a self-lubricating pistol-grip wheel cutter for hand cutting. Such a cutter is a favorite among hobbyists; it reduces hand fatigue more than other cutters and offers greater control. Approximate cost: $35.

"Low-tech" cutters (made from carbide steel or tungsten carbide) are less expensive and work well too, but require a little more practice to use successfully.

GROZING PLIERS

Grozing pliers have narrow, serrated jaws for gripping and breaking off small chunks of glass left after hand cutting. One jaw is typically curved and the other is straight. The tips are perfectly flush when the jaws are closed. These pliers (sometimes called grozing-breaking pliers) can also be

used to snap glass along a scored line. Approximate cost: $8–$30.

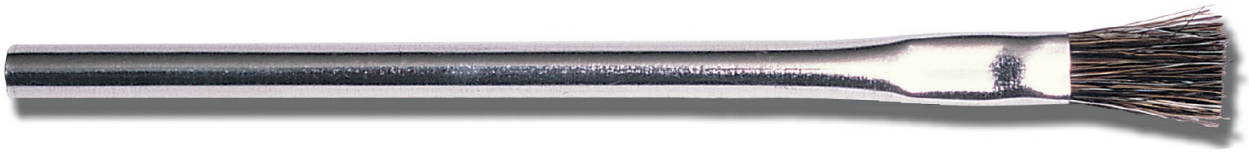
RUNNING PLIERS

Thicker than grozing pliers, running pliers more effectively break glass along a scored line. One jaw has a narrow, raised section in the center; the other has a narrow, raised section on each side. The single raised portion is positioned under the scored line—when the pliers are squeezed, the force causes the glass to break evenly along the score. Approximate cost: $8.

FLUX

Flux cleans oxidation and other dirt from metals so melted solder will adhere rapidly. It comes in a liquid, gel, or paste, but each works equally well. Because flux is corrosive, you must be careful when working with it. Some brands emit less smoke and fumes than others. Approximate cost: $5–15.


STAINED GLASS FLUX
FUMELESS, NON-ACID,
NON-EVAPORATING,
WATER WASH OFF
FLUXOMATIC™-SG
FOR COPPER FOIL,
ZINC AND LEAD CAME
CONTENTS: 8 fl. oz. (.236 liters)
DANGER: KEEP OUT OF REACH OF CHILDREN
MAY BE FATAL IF SWALLOWED.
MAY CAUSE SEVERE BURNS.
READ CAUTION ON BACK PANEL
Manufactured in U.S.A.
RECTORSEAL
2601 Spenwick Drive
Houston, Texas 77055-1035



FLUX BRUSH

A metal craft brush with medium or firm bristles works well to apply flux. Approximate cost: 25¢.

SAL AMMONIAC

A block of ammonium chloride reacts to the heat of a soldering iron and keeps the tip clean and free of residue. Approximate cost: $5.

ELECTRIC GLASS GRINDER

An electric grinder can be used instead of a Carborundum stone to smooth glass edges. Get a model that includes an eye guard and a reservoir that holds water to lubricate the grinding wheel when it's spinning. Approximate cost: $80–$250.

CARBORUNDUM STONE

A trademarked name for an abrasive tool used to smooth the jagged edges of cut glass. Water applied to the stone as you work reduces friction and

makes smoothing easier. Approximate cost: $6.

A Good Work Environment

For most stained glass projects, a simple clutter-free surface such as a workbench or sturdy table will work fine. Glass cutting and other work should be done on top of a firm but cushioned surface, not a hard wooden or metal tabletop. The gray-colored work surface shown here is a piece of fire-resistant Homasote fiberboard about 2 feet long and 3 feet wide. It has a firm surface with a slight spring to it. Tacks and nails can be driven into it easily, and a single section will last for years. Check your local hardware store, home center, or online retailer for the material's availability. If you can't find Homasote board, ask for a similar material.


WIZARD
RAINBOW VISION

Keep in mind that many stained glass projects involve lead-based solder or metal framing material, neither of which should ever be used in areas where food is stored. Melted solder and patinas release harmful vapors and should not be used in enclosed spaces. Make sure your work area has adequate ventilation.

Stained glass making also produces large quantities of glass shards that tend to get into every nook and cranny and are difficult to clean up completely. Many crafters have been surprised by the sharp sting of one of these hidden shards. A handheld brush and dust-pan can be used to sweep up glass chunks.

One specialized glass-cutting system developed by the Morton Company includes a tabletop board made up of recessed squares designed to catch and hold glass shards so they don't scatter. This system also uses trademarked measuring and gripping tools for cutting glass. Contact your local stained glass supplier or craft store for more information about the Morton glass-cutting system, or look for details online.

A handy supply of water—either from a faucet or large basin—is usually needed for stained glass projects to wash away bits of glass, chemical residues, and the like. You also need to fill the table glass saw with water.

Keep a rag within reach for wiping oil off your hands while cutting glass.

Sheets of stained glass should be stored vertically for easy access and safety. You can carefully prop them upright against a wall in an out-of-the-way location with an old towel or blanket or piece of cardboard to cushion the bottom edges. Using old wooden crates or building a simple narrow rack with two sides and an open top to hold the glass are also good storage methods. Don't put the glass flat on the ground—it is diffi-cult to handle that way and easily broken.

You will use quite a few tools when working with stained glass, so you might find that a toolbox or small cabinet helps organize them and makes them easier to find when needed.

FID

Fids can be wooden or plastic and come in a variety of shapes and sizes. They are used to smooth foil after the latter has been applied to the glass. Approximate cost: $1–$2.

NEEDLE-NOSE PLIERS AND WIRE CUTTERS

Pliers are helpful with detail work. Wire cutters can trim what a craft knife can't. Approximate cost: $10.

HAMMER OR MALLET

A hammer with one head made of rubber is a good choice for stained glass making. It reduces the risk of cracking when used to tap glass gently into place. Approximate cost: $10.

ROLLING BURNISHER

Efficiently smooths the foiled edge of glass with just a few passes. The rollers are springy so you can squeeze stained glass between them. Approximate cost: $17.

Stained Glass Safety

Keep these safety tips in mind when making stained glass projects.

- Be careful and use common sense when working with cames and solder containing lead. Generally, stained glass crafters are exposed to only very low levels of lead while making their projects. However, any time lead is present in the environment, it must be handled and used responsibly. Prolonged exposure to high levels of lead can pose significant health risks: It has been linked to brain and nerve damage in children, and can cause such problems as high blood pressure, nerve disorders, and memory and concentration problems in adults, according to information from the United States Environmental Protection Agency.
- Pregnant or nursing women should avoid contact with all stained glass materials containing lead.
- Never eat, drink, or smoke when working with lead.
- It is a good idea to wear the same work clothes each time you make stained glass projects. Keep these clothes in your work area, because lead dust can collect in your clothes and be carried throughout your living space.
- Wear enclosed shoes, such as boots that lace up, to prevent lead dust from collecting on your feet.
- Do not allow pets into the work area.
- Always wear rubber gloves when working with patinas and

etching creams. These substances can cause chemical burns on exposed skin and can be harmful if absorbed into the blood stream.

- Keep a supply of adhesive bandages handy for small nicks and cuts that are virtually unavoidable when working with glass. A first-aid kit containing antiseptic, gauze pads, a few butterfly-style bandages, and similar supplies is a good thing to have within easy reach.
- Stained glass making requires your full attention. You should avoid working on projects when you are fatigued or distracted.
- Frequently brush away glass shards from your work surface and into a dustpan. This will help reduce the risk of cutting your hands and forearms when you lean on the table. Never try to wipe away glass bits or dust with your bare hand.
- Use care when handling large sheets of glass. Grip the sheet by its top edge and hold it perpendicular to the floor, moving it slowly to avoid jarring it. Never hold a large sheet of glass horizontally because it might crack from the strain. Never hold a sheet of glass above your head. Never try to catch a sheet of falling glass—let it go and move quickly out of the way.
- Always wear safety glasses or goggles when cutting or polishing glass, even if the task takes only a few seconds.
- To avoid burns, place a hot soldering iron in an appropriate stand away from the work surface when not in use. Do not put the soldering iron down on the work surface, where it might roll or get bumped. Do not inhale fumes produced by hot flux and solder, and read the labels on these products.

X-ACTO KNIFE OR CRAFT KNIFE

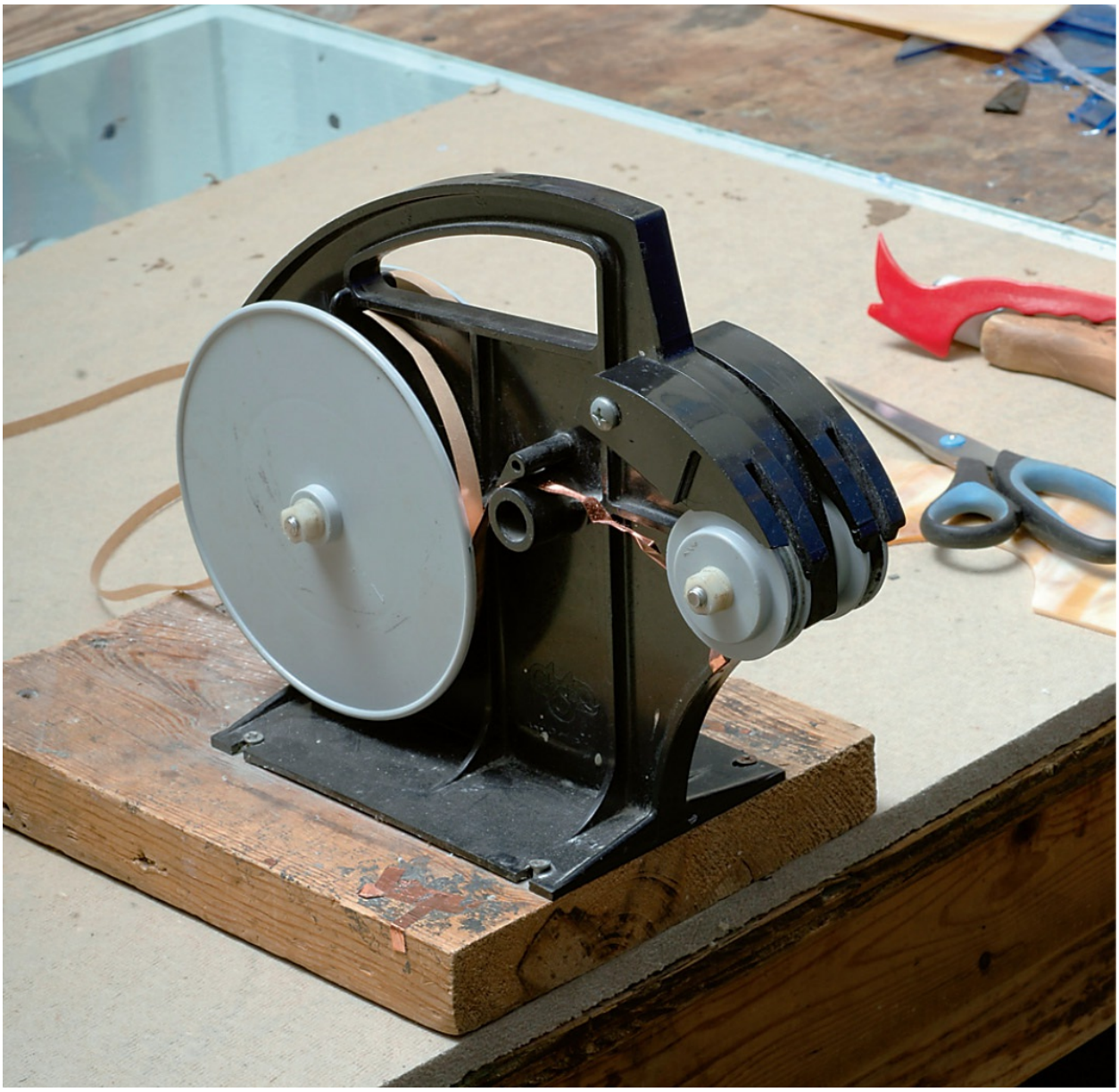
Used to trim foil. An X-Acto knife is smaller and makes finer cuts. A craft knife is bigger and stronger. Approximate cost: $5.

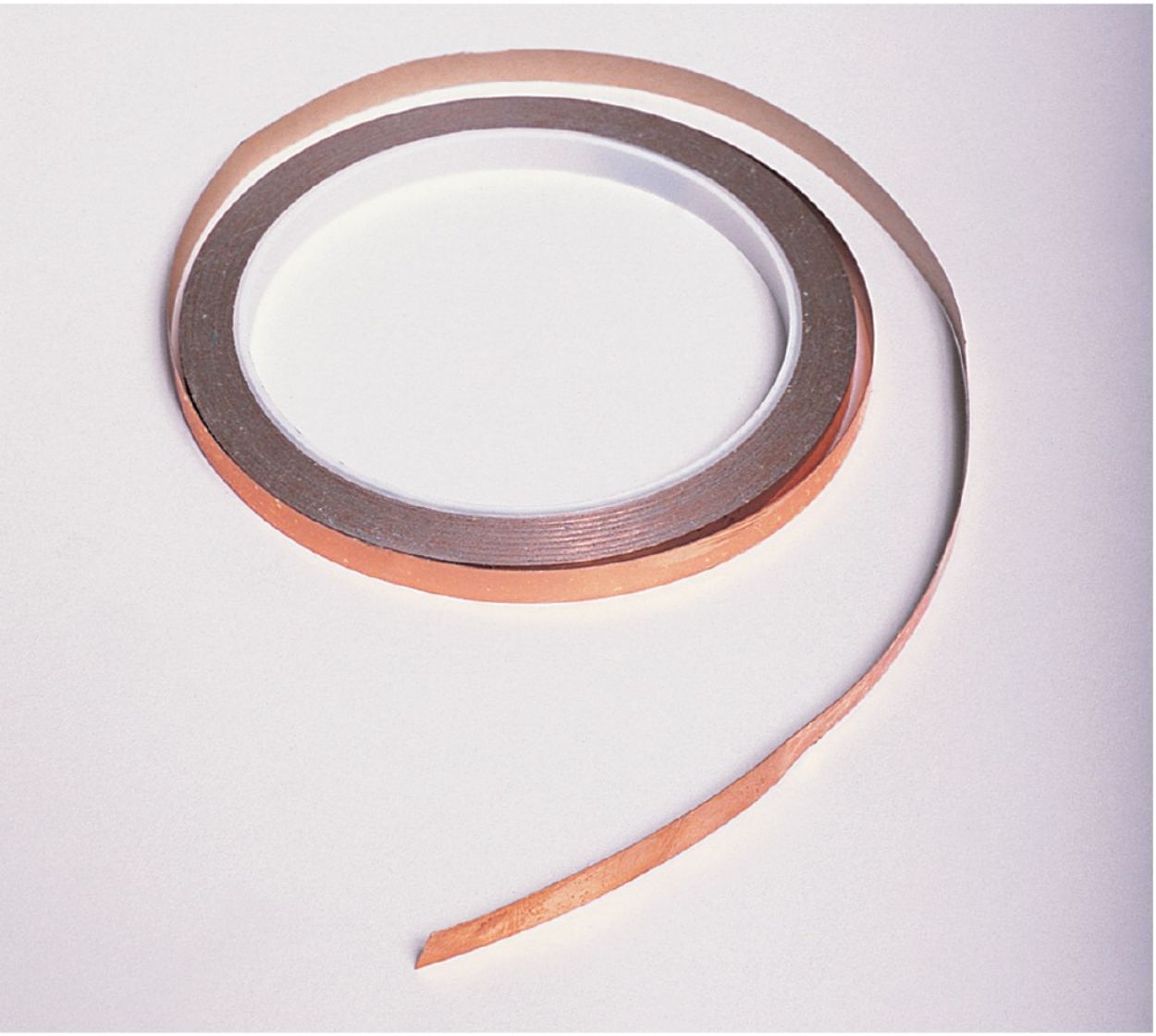
SAFETY GOGGLES

Always wear eye protection when cutting, breaking, or grinding glass.

TABLE FOILER

A table foiler helps you quickly foil glass pieces by rolling their edges along a cushioned reel that guides the foil into place. If you mount the foiler onto a block, you can then clamp the block to any suitable work surface. Approximate cost: $40–$75.



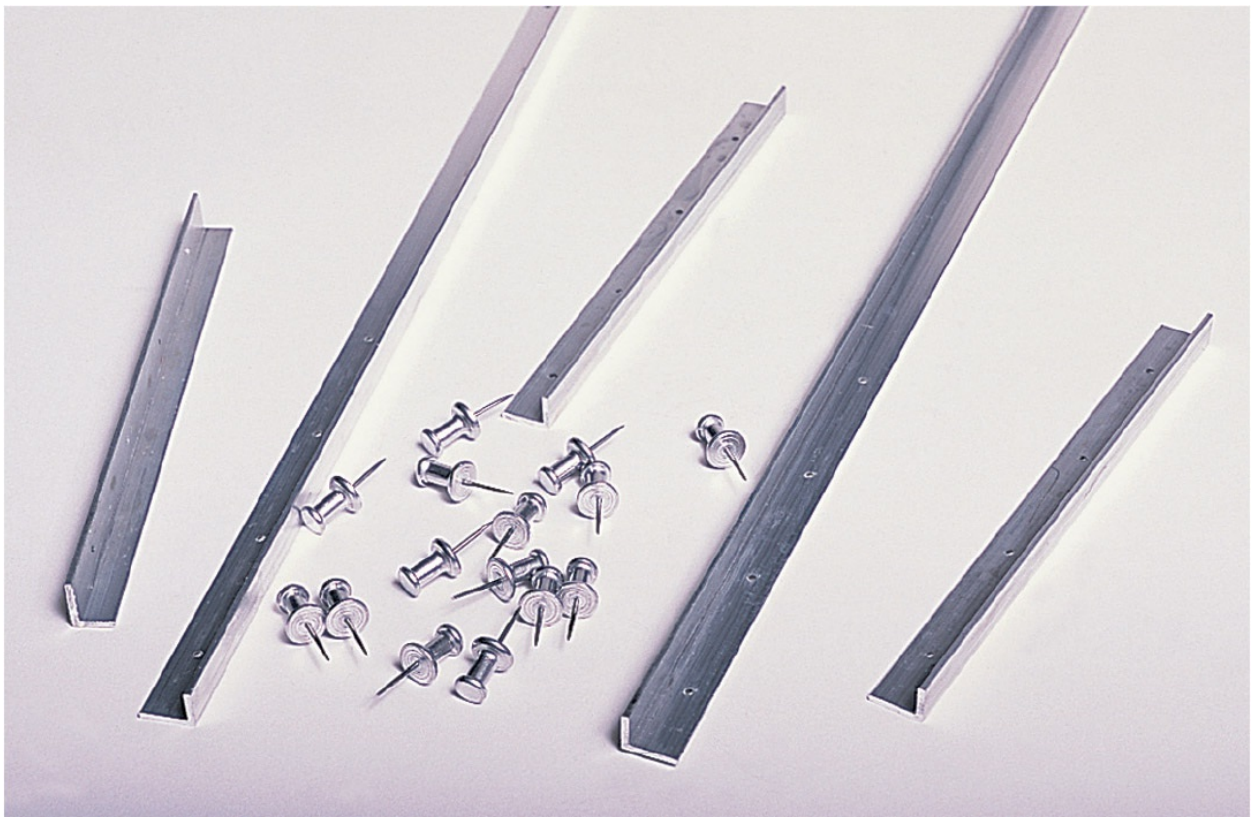


COPPER FOIL

Ribbonlike copper foil provides a surface to which solder can bond. It usually comes in 36-yard rolls and includes a removable adhesive backing. Standard foil widths are $^{3}/_{16}$ inch, $^{7}/_{32}$ inch, and ¼ inch. Foil with silver and black backing is also available. Approximate cost: $5–$10 per roll.

JIG MATERIAL AND PUSH PINS

These items are needed to hold projects together and to the work surface as you assemble them.



COPPER WIRE

Usually “tinned” (coated with silver), copper wire is used to reinforce seams that will be under stress. It can be readily soldered after it has been fluxed.

DUSTPAN AND BRUSH

Needed to sweep away shards and dust from the work surface to reduce the risk of injury.

PATINA

A liquid that changes solder from silver to da25 gray or black (some specialty patinas create a copper color). Because they contain harmful chemicals, patinas must be used with caution. After a patina is applied to a project, rinse it with warm, soapy water to neutralize the chemicals. Approximate cost: $5 for an 8-ounce bottle.


NOVACAN
BLACK
PATINA
FOR SOLDER • LEAD
POISON CAUSES SEVERE
BURNS • VAPOR HARMFUL
READ CAREFULLY CAUTIONARY
INFORMATION ON SIDE PANEL
237 ml
8 fl. oz.

GLAZING CEMENT AND WHITING

Glazing cement strengthens panels by bonding glass and lead came. It also seals panels against water. It must be well mixed before use. Approximate cost: $10 for a 1-pound tub. Whiting is used to dry glazing cement, allowing it to set. Approximate cost: $3 for a 1-pound bag.

STIFF BRUSH

Use a brush about 6 inches wide, like the kind used for scrubbing floors, to apply glazing cement.


KEM·O·PRO
STAINED GLASS
FINISHING COMPOUND
Insures a bright, even, durable finish on solder seams treated with copper patina or electro-plating. Polishes and protects against tarnish for a professional finish.
Polishes glass to a brilliant shine.
Restores shine to already tarnished finishes.
Adds lustre and protects lead, brass, chrome, copper, raw solder and most patina finishes.
Net: 12 fl. oz. (354 ml.)
CAUTION: Harmful if swallowed. See back panel.

FINISHING COMPOUND

A polish for completed projects that prevents oxidation and tarnish buildup.

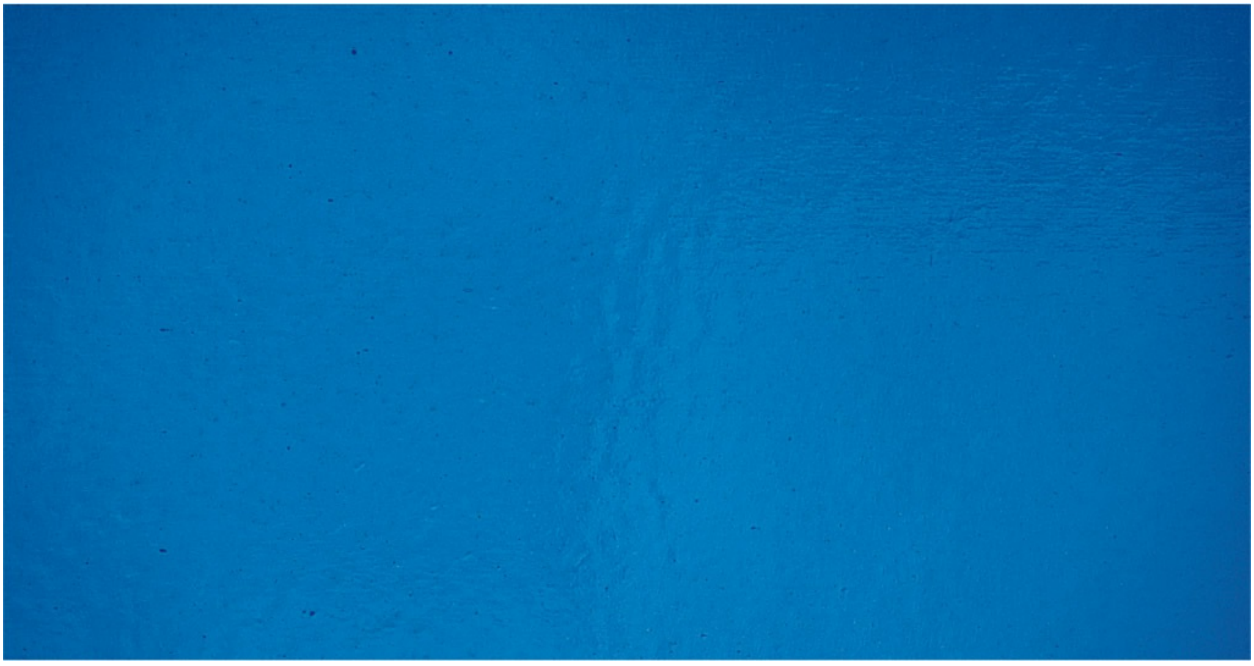
2

Selecting Glass

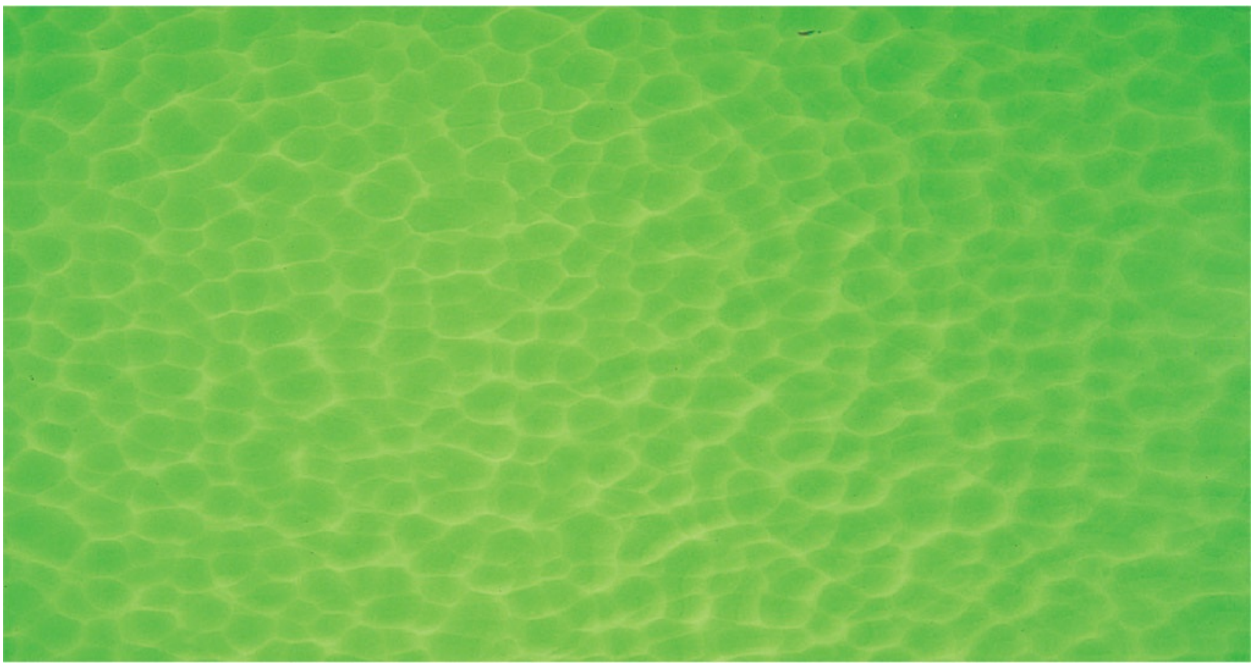
There is an incredible variety of stained glass available to the crafter, and more styles and colors appear on the market each year. Stained glass suppliers can be great resources for information about the different kinds of glass that will work best for your projects. Don't be afraid to ask a

lot of questions. You can also find good information about styles, uses, and properties of specific glasses online, as well as their prices. Stained glass prices can vary considerably; in most cases, the price eflects how difficult the style is to manufacture.

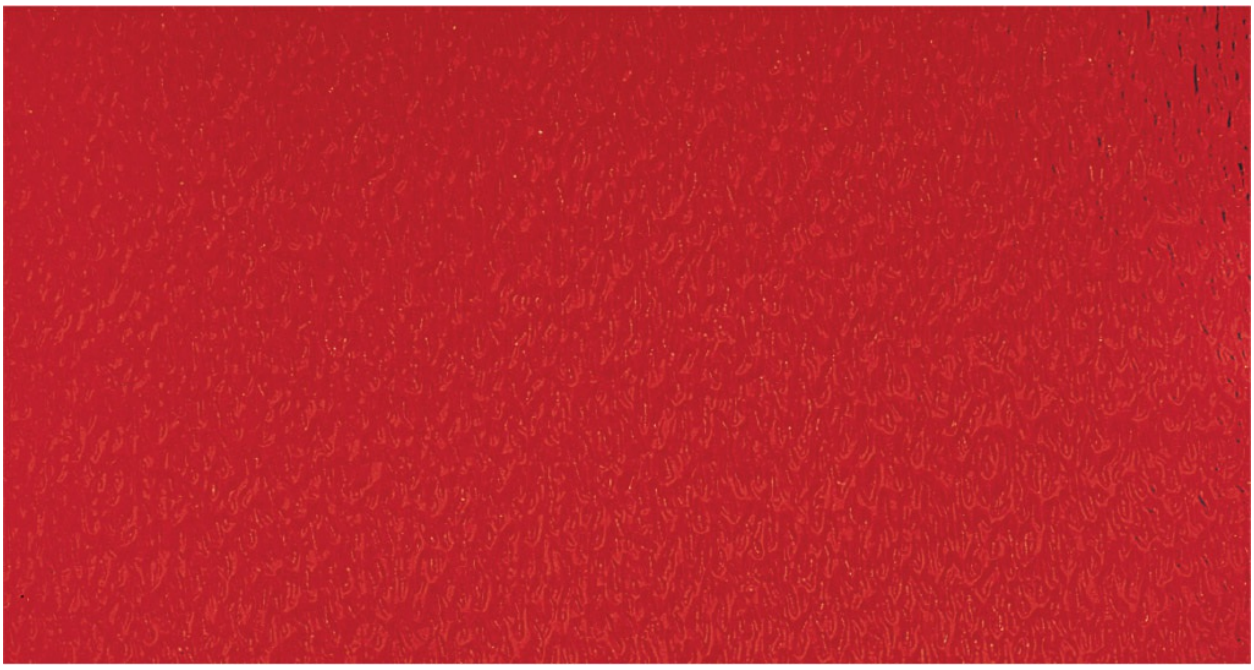
Experts place glass into one of two categories: cathedral (transparent or translucent glass that allows light to pass through easily) or opalescent (glass with a milky or dense quality that doesn’t transmit a large amount of light). These can be further subcategorized as:



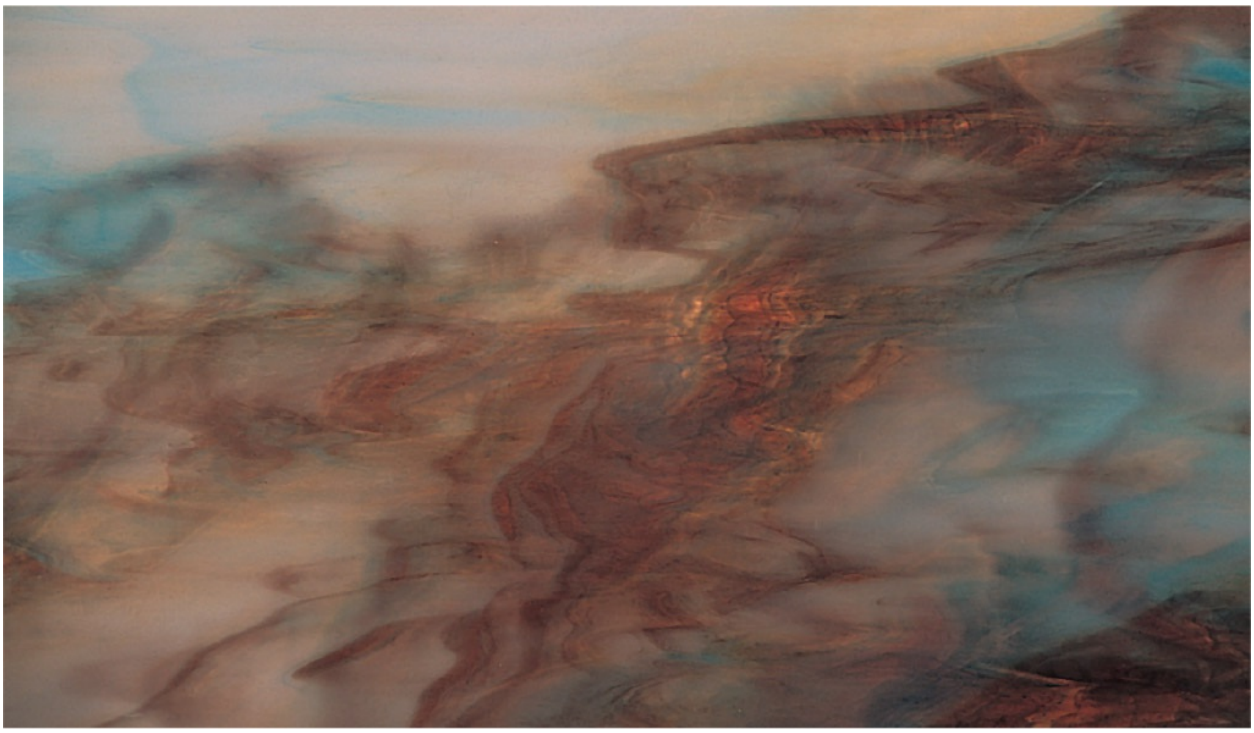
Smooth cathedral



Hammered cathedral



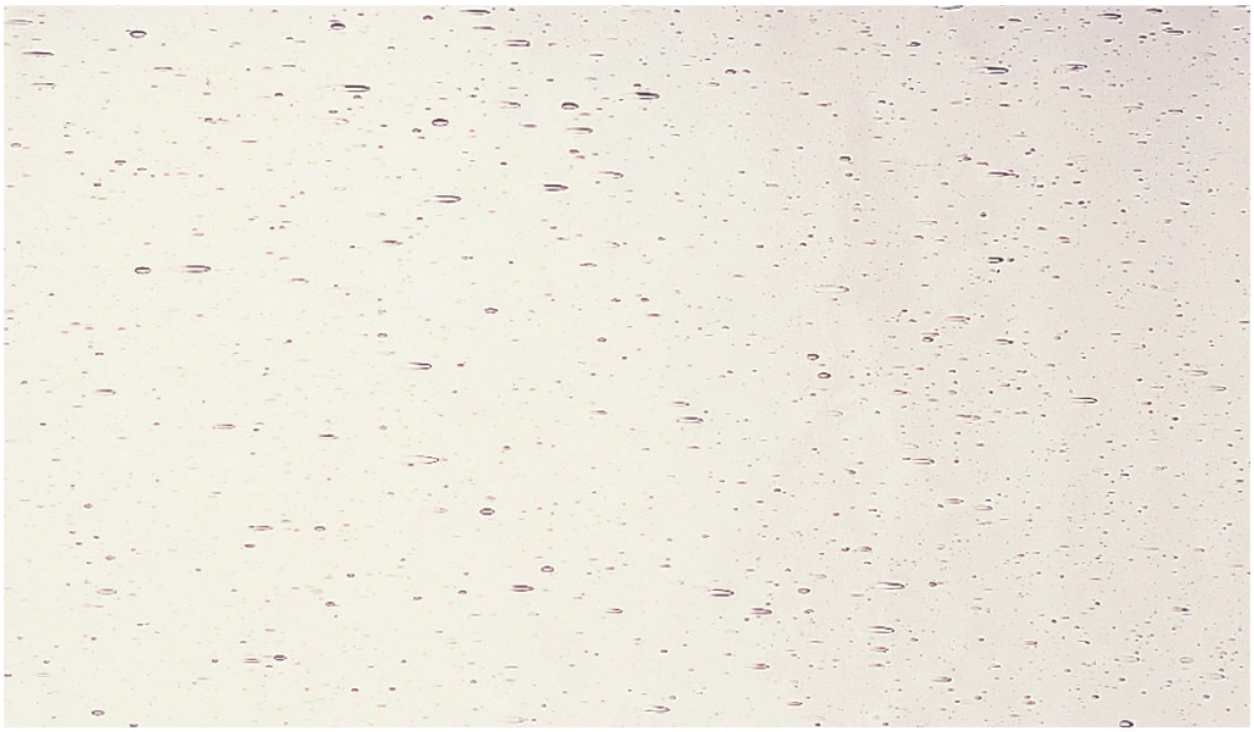
Granite cathedral



Multicolor opal

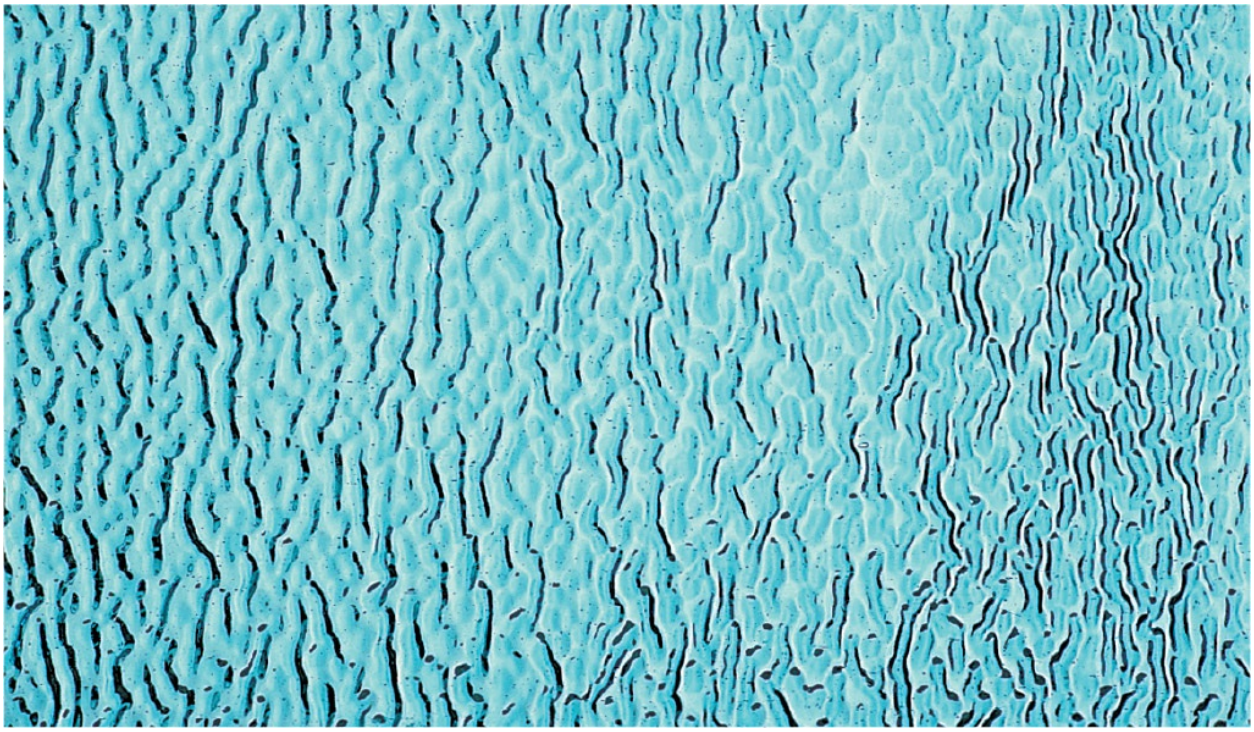
Solid opal

Within these broad categories exists a nearly limitless variety of colors, textures, patterns, and properties.



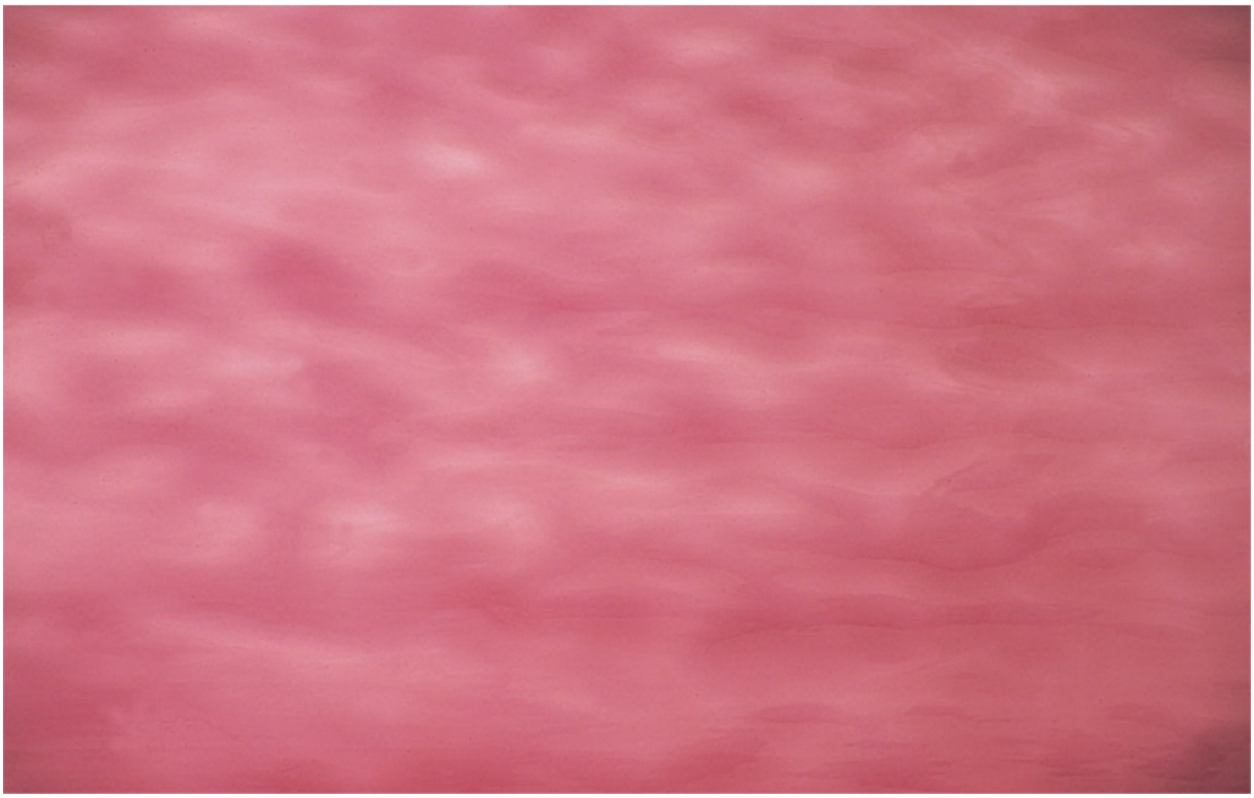
Seedy glasses

Glue chip glass



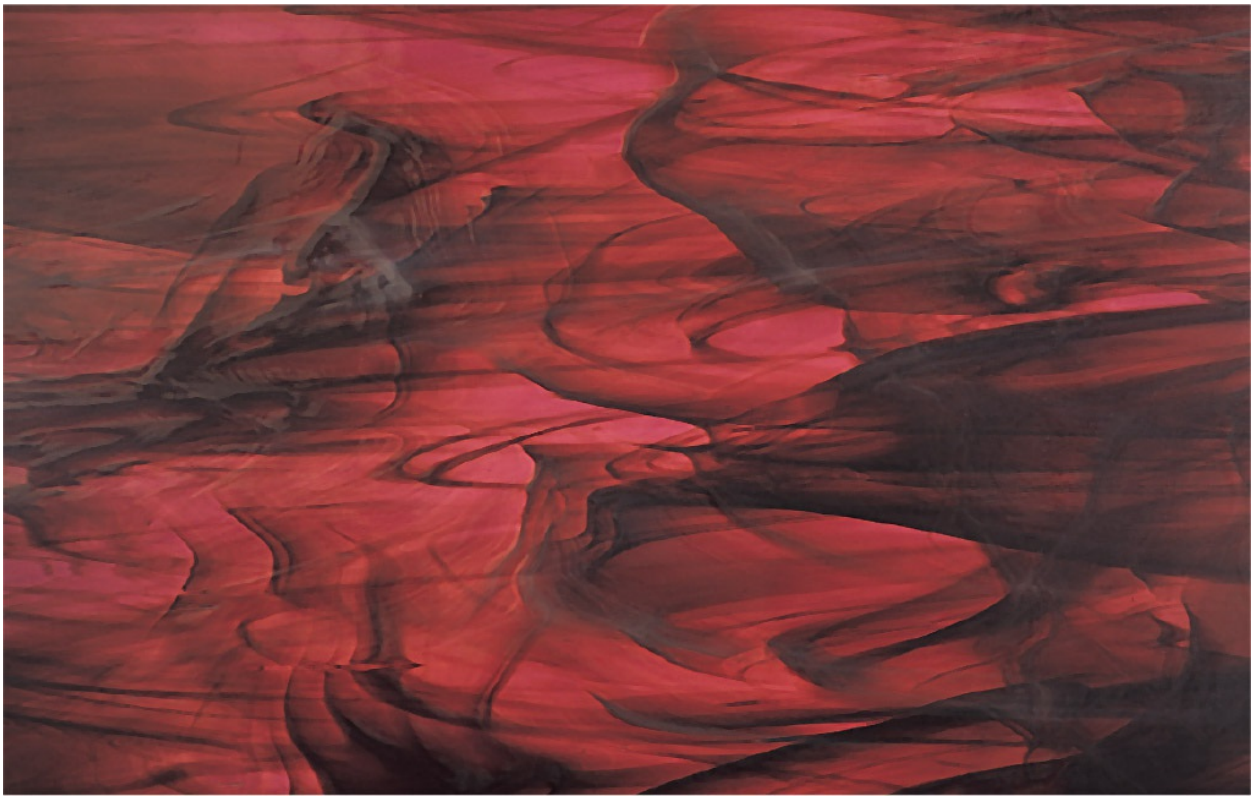
Ripple glass

Reamy Baroque



Water glass

Streaky glass



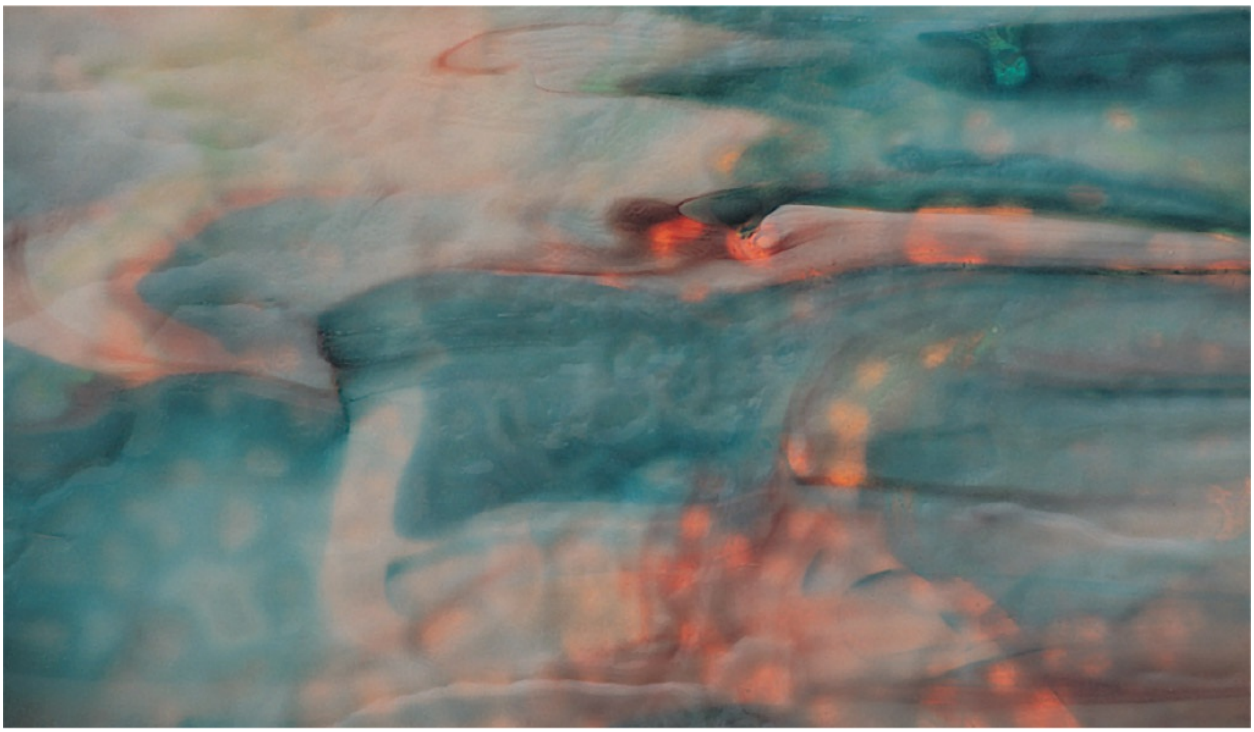
Wispy glass

Antique glass

Iridescent opal

Iridescent clear Krinkle

Multicathedral art glass

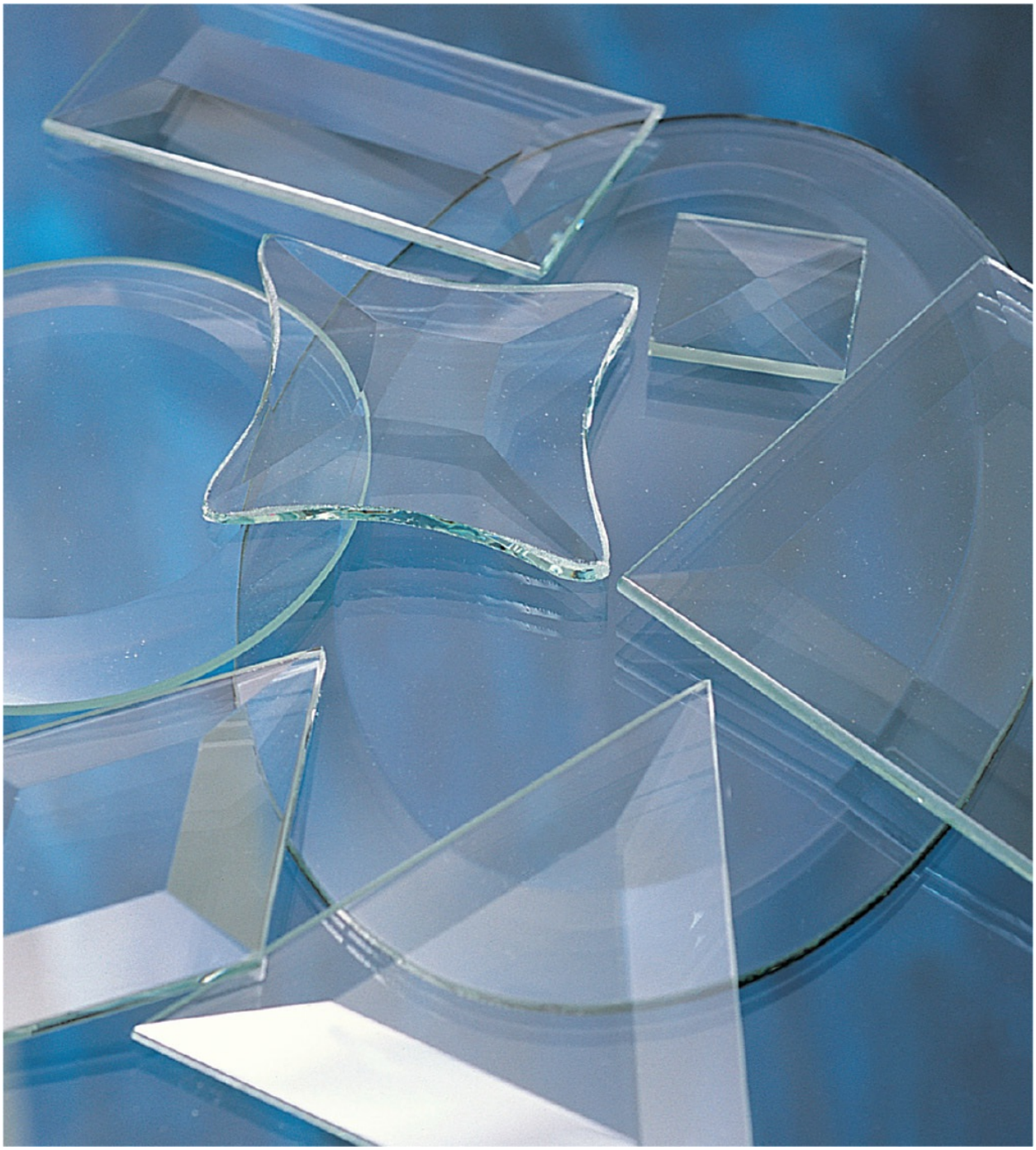


Mottled art glass

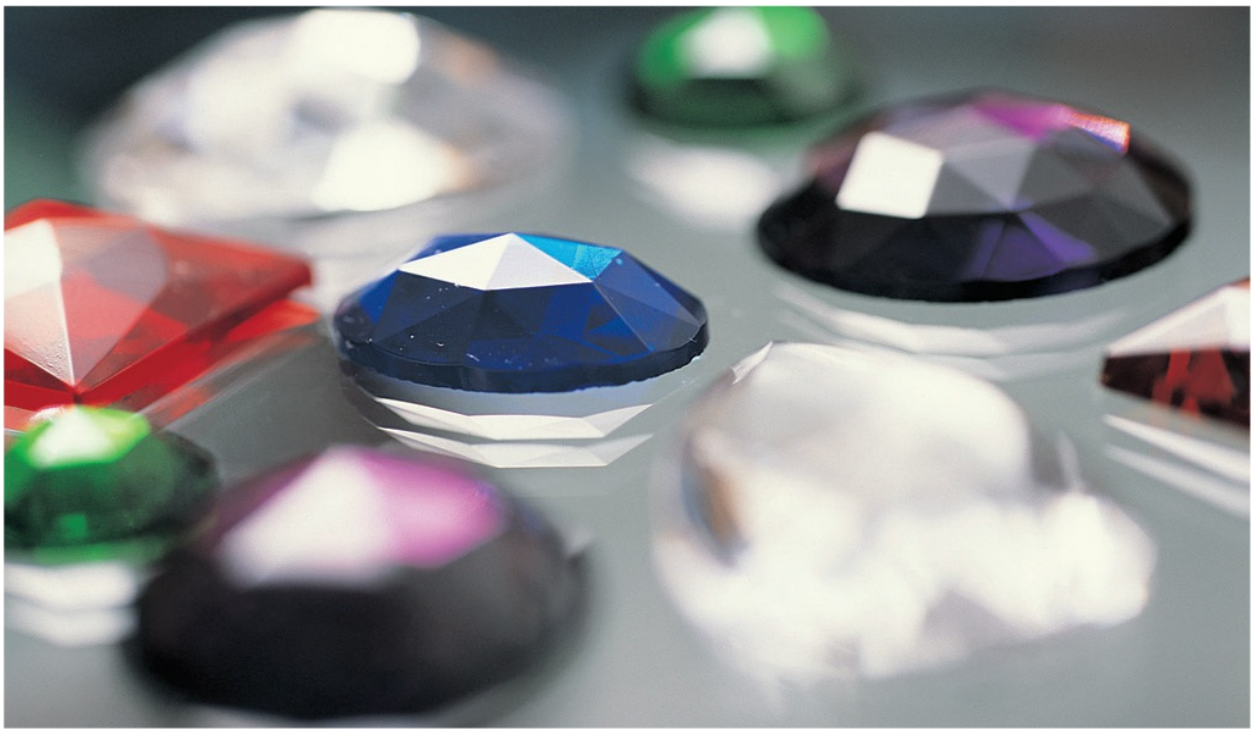
Granite back art glass

Stipple art glass

Fracture and streamer art glass



Bevels are pre-cut chunks of glass with angled edges. They are usually clear and difficult to cut.



Jewels are hunks of glass that have been manufactured to simulate precious stones. They come in many shapes and sizes. A single large jewel is used in the stained glass box project in chapter 6, as is a sheet of mirrored glass.

Nuggets are smooth, rounded, somewhat flat “drops” of glass. They are

used in the hanging lamp project in chapter 5.

3

Basic Skills Review

It's important to have a good foundation on which to build your knowledge of stained glass making techniques. Mastering the basics will allow you to more easily develop intermediate and advanced skills.

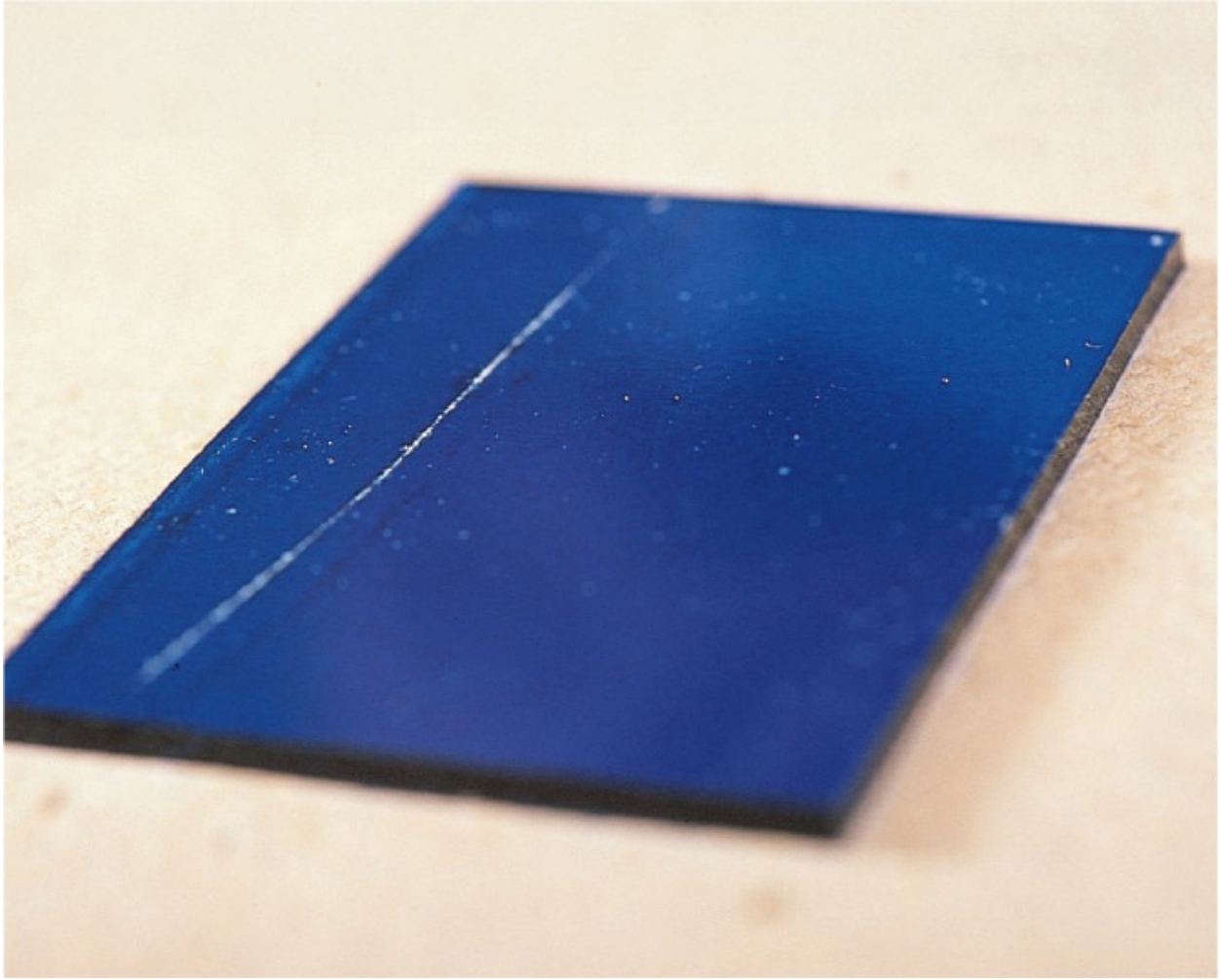
Cutting the Glass

Always wear safety glasses when breaking glass. Remember that a glass cutter simply scores the glass, weakening it enough so that it will break where you've scored it. To score the glass, place the cutter wheel on the line you want to cut but about $^{1}/_{16}$ inch away from the edge of the glass. Apply firm pressure and slowly push the cutter forward so the carbide wheel turns against the glass. Move the tool at a steady, even pace to make the score line consistent. Keep the cutter perpendicular to the glass—do not lean it to the right or left; keep the cutter level, not tilted too far backward or forward. The cutting action should make a gritty sound, like a piece of paper being ripped in half.

Stop your cut about $^{1}/_{16}$ inch from the edge of the glass.

Cutting all the way to the edge of the glass can cause it to break and splinter.

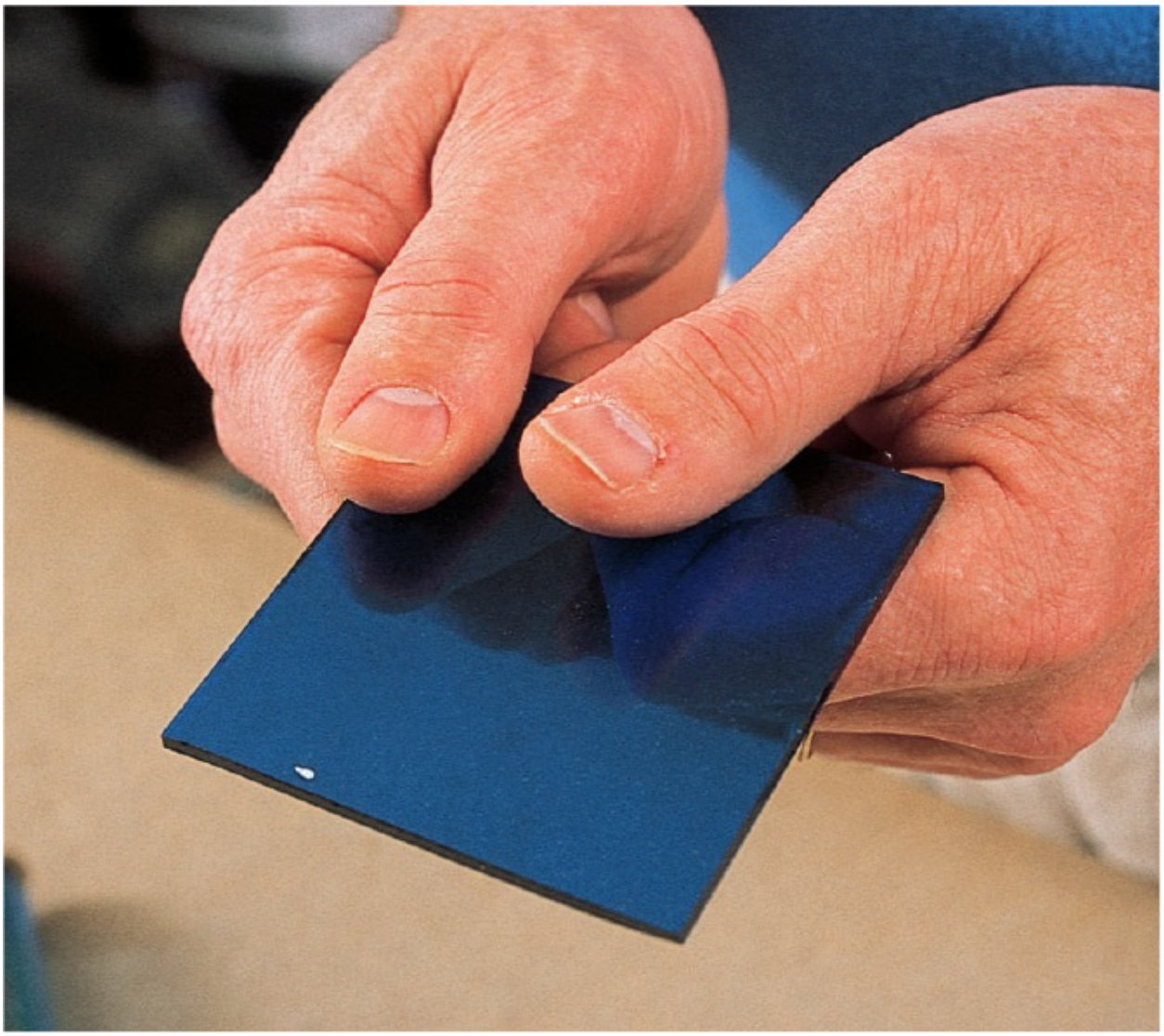
If your scored line is white and powdery, you’re pressing too hard.



Take Note

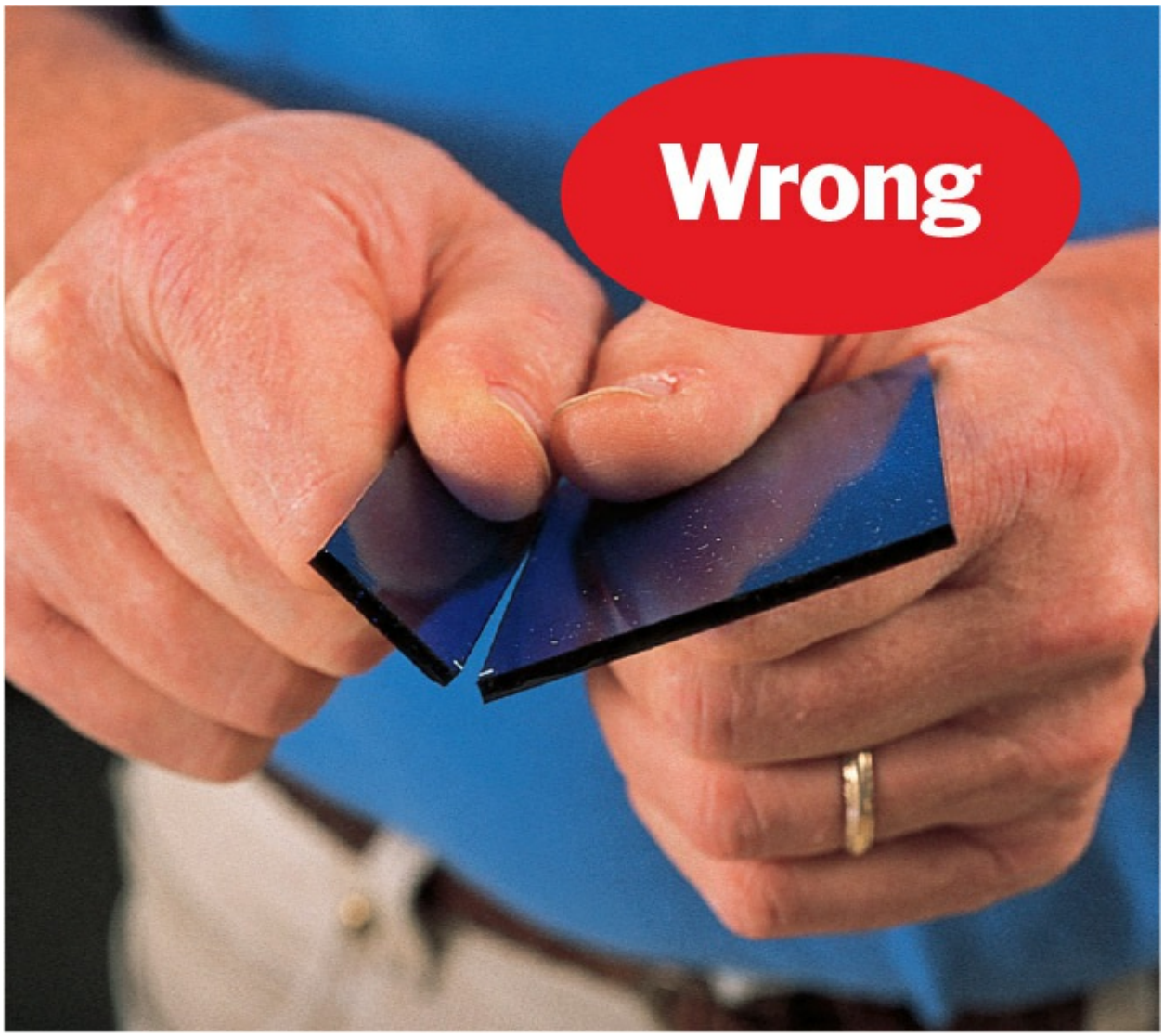
Never go back and try to score a cut you have already made. The glass could break unpredictably, and you could risk damaging the cutting wheel. Just make a completely new cut.

To break the glass along the scored line, grip it so that your thumbs rest on either side of the scored line (marked here with a white dot). The side of the glass you scored should be facing upward. Your index fingers should securely grip the un-scored underside of the glass on either side of the line.



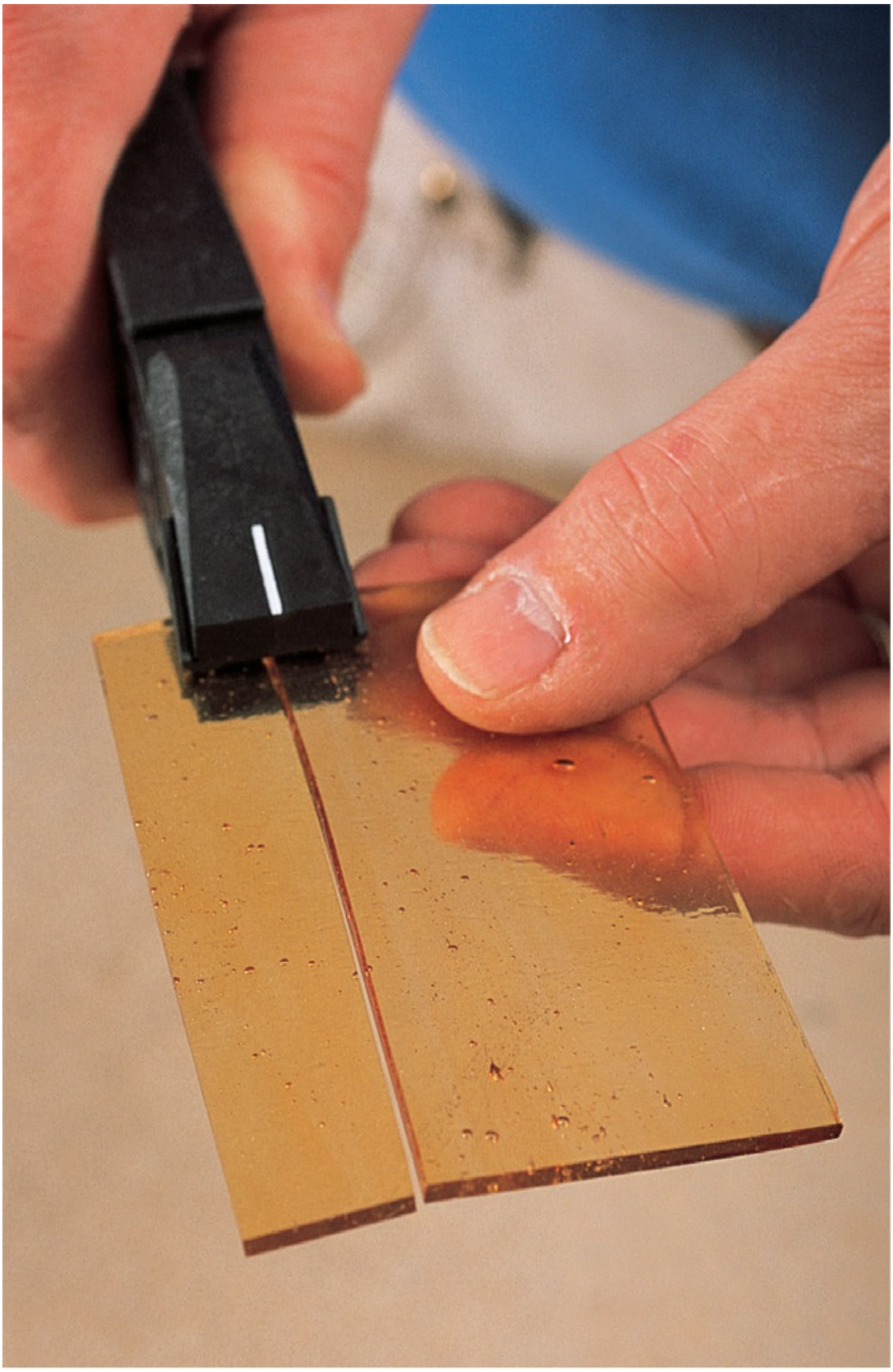
Hold the piece firmly and, with a quick snapping wrist motion, rotate both hands out and away from each other. The glass should break cleanly along the scored line.

Never break glass using an inward motion, which puts pressure on the stronger, unscored underside of the glass; it could shatter instantly.



Use running pliers if you don’t have enough glass on either side of the score line to get a firm grip with your fingers. Place the top jaw of the pliers on the scored surface of the glass. Position it so that the center of the jaw (marked here with a white line) is directly on top of the scored line.

Squeeze the pliers together to break the glass along the score.



Grozing and Grinding

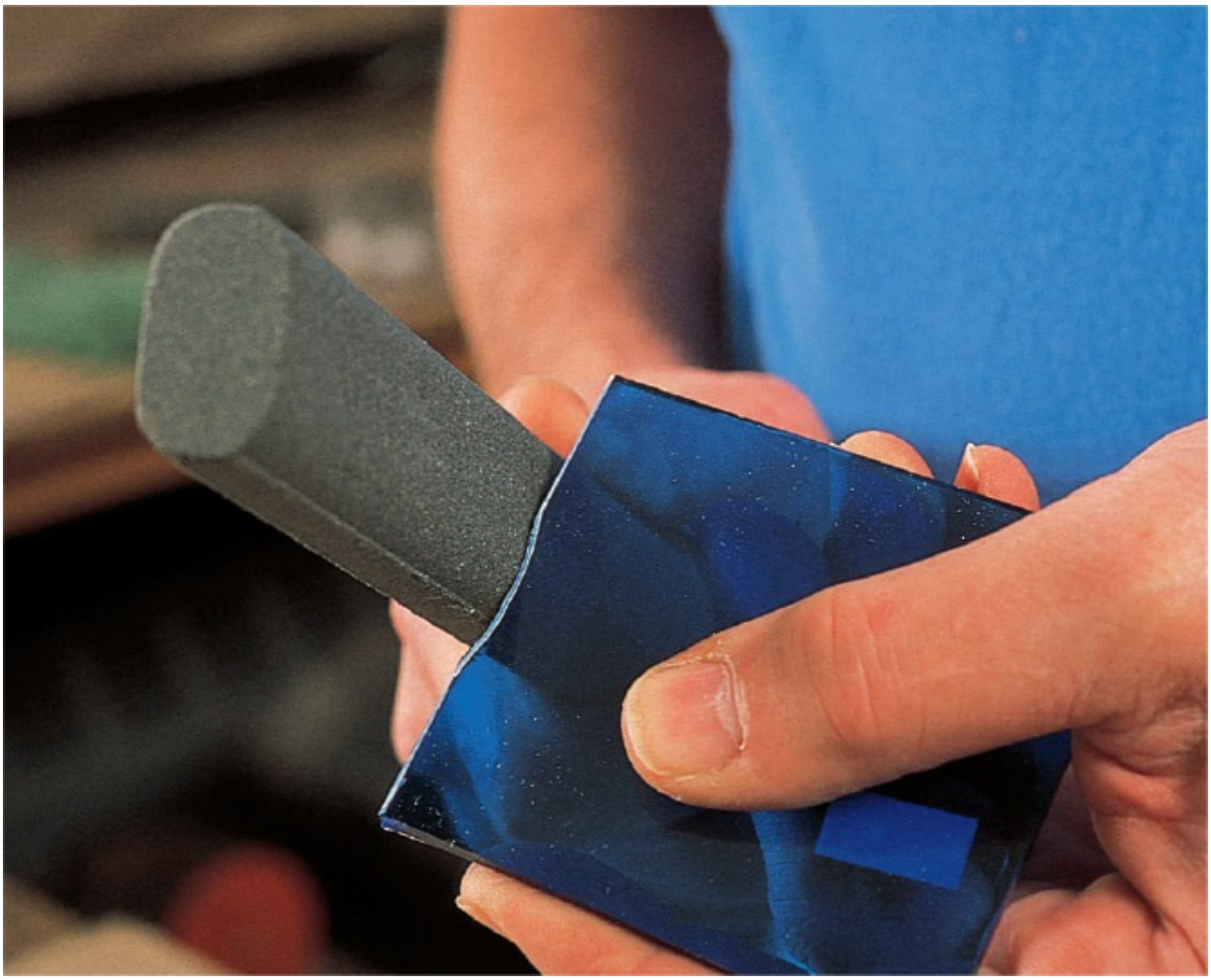
If your scored and broken glass has a jagged edge, use grozing pliers to remove the excess “burrs.” Position the pliers so that a corner of the jaws is pressed on the first $^{1}/_{16}$ inch of the edge you want to work on. The curved jaw should be on top, and the jaws should be at a 45-degree angle to the glass.

Squeeze the pliers. The jaws will bite into the glass, making a gritty, crunching sound. Hold the glass steady and bring the pliers away from the glass in a short, snapping motion.

Continue grozing to remove all the burrs—it's almost as though you are nibbling the glass with small, precise breaks.

To further smooth the edge of cut and grozed glass, use a Carborundum stone moistened with water.

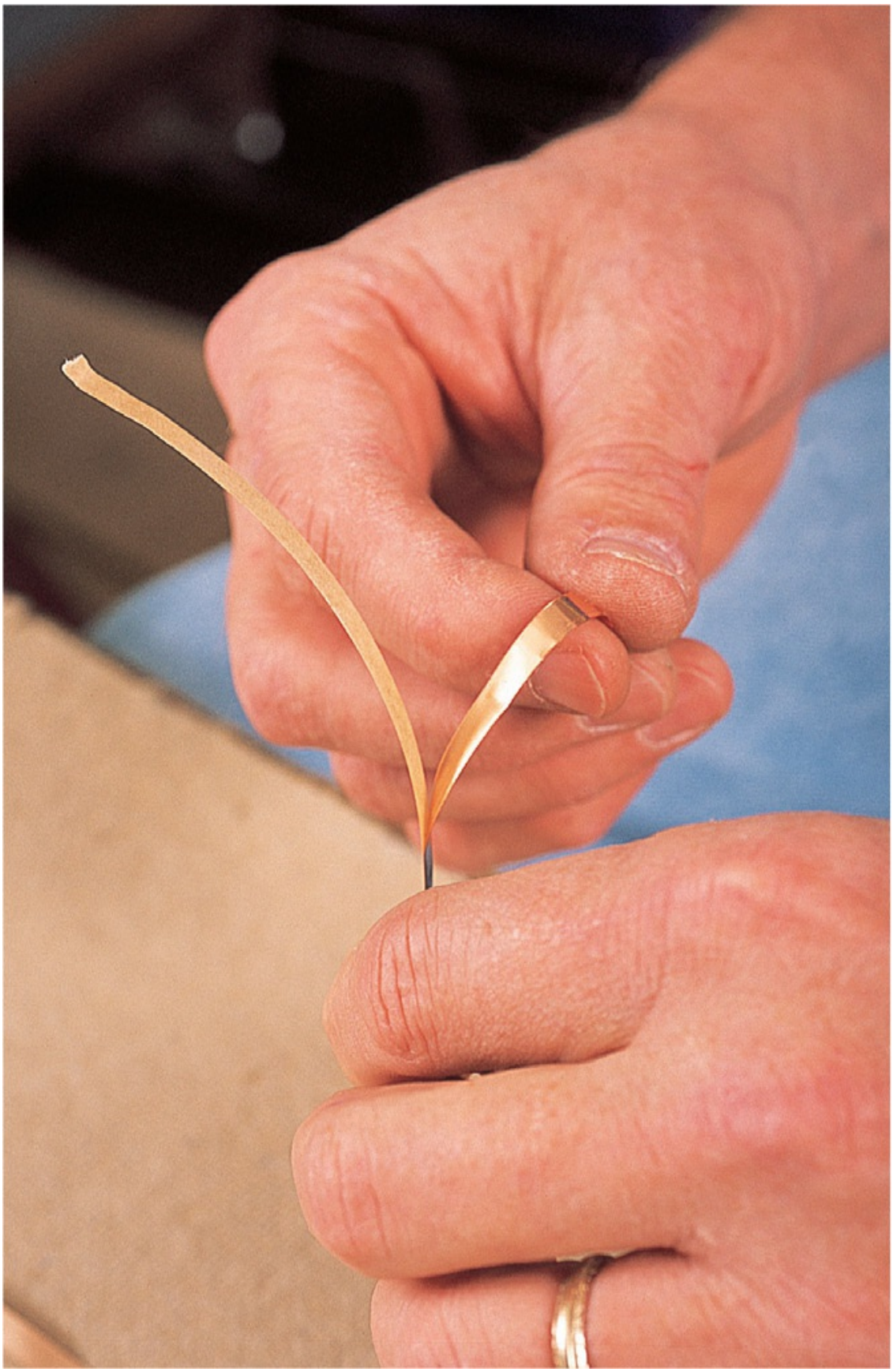
Press the stone securely against the rough edge and scrape along the glass in a fluid motion away from you, much like sanding a piece of wood. You will probably need to make just a few passes to remove all the rough spots.



A motorized grinding wheel can also be used to smooth rough edges. Read and follow the instructions before you use it. In general, you don’t have to press the glass very hard against the wheel to smooth effectively. A grinding wheel can take away glass quickly—work carefully so you don’t make the piece smaller than you intended.

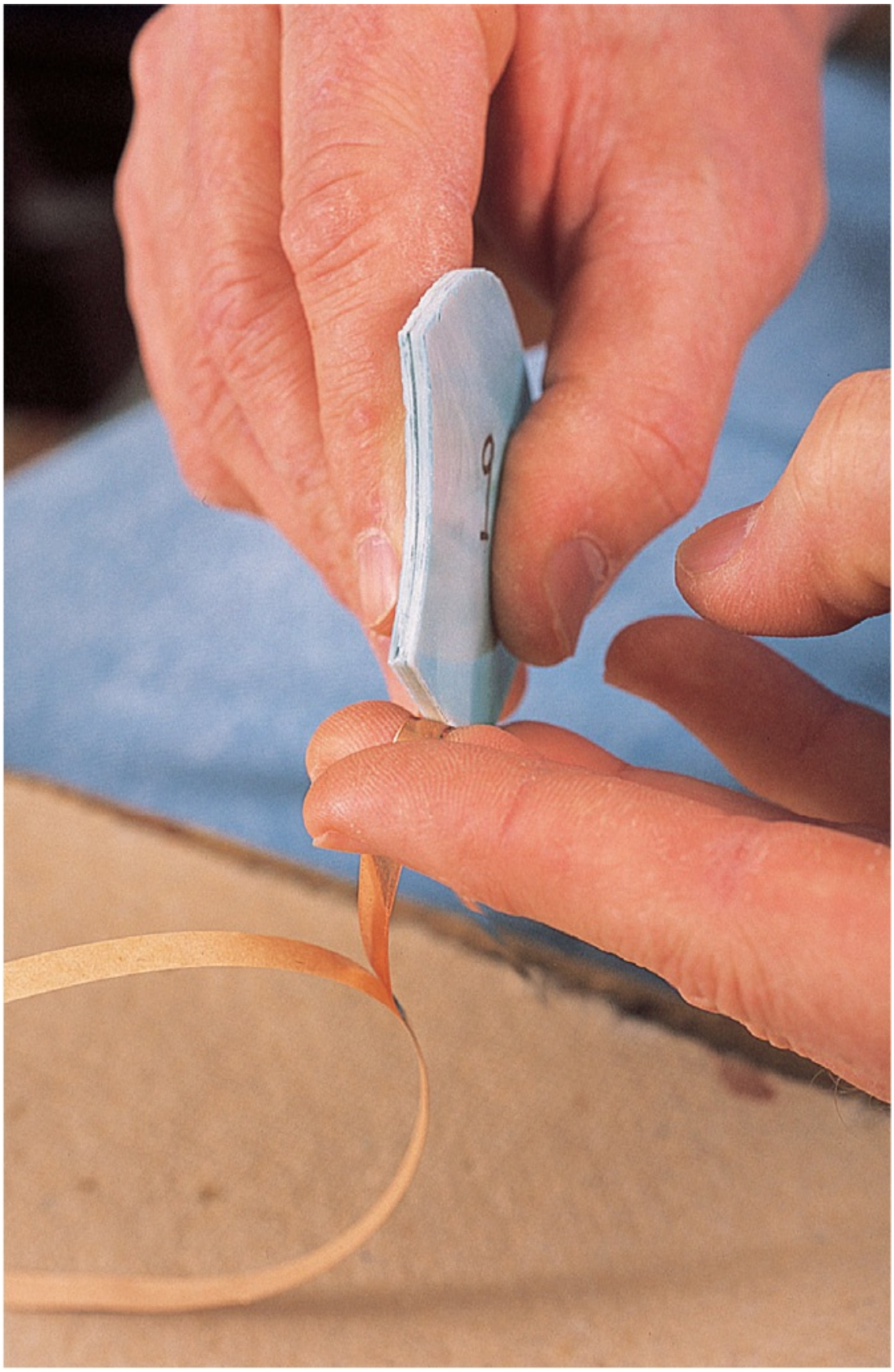
Applying Copper Foil by Hand

Begin by peeling the back away from the foil

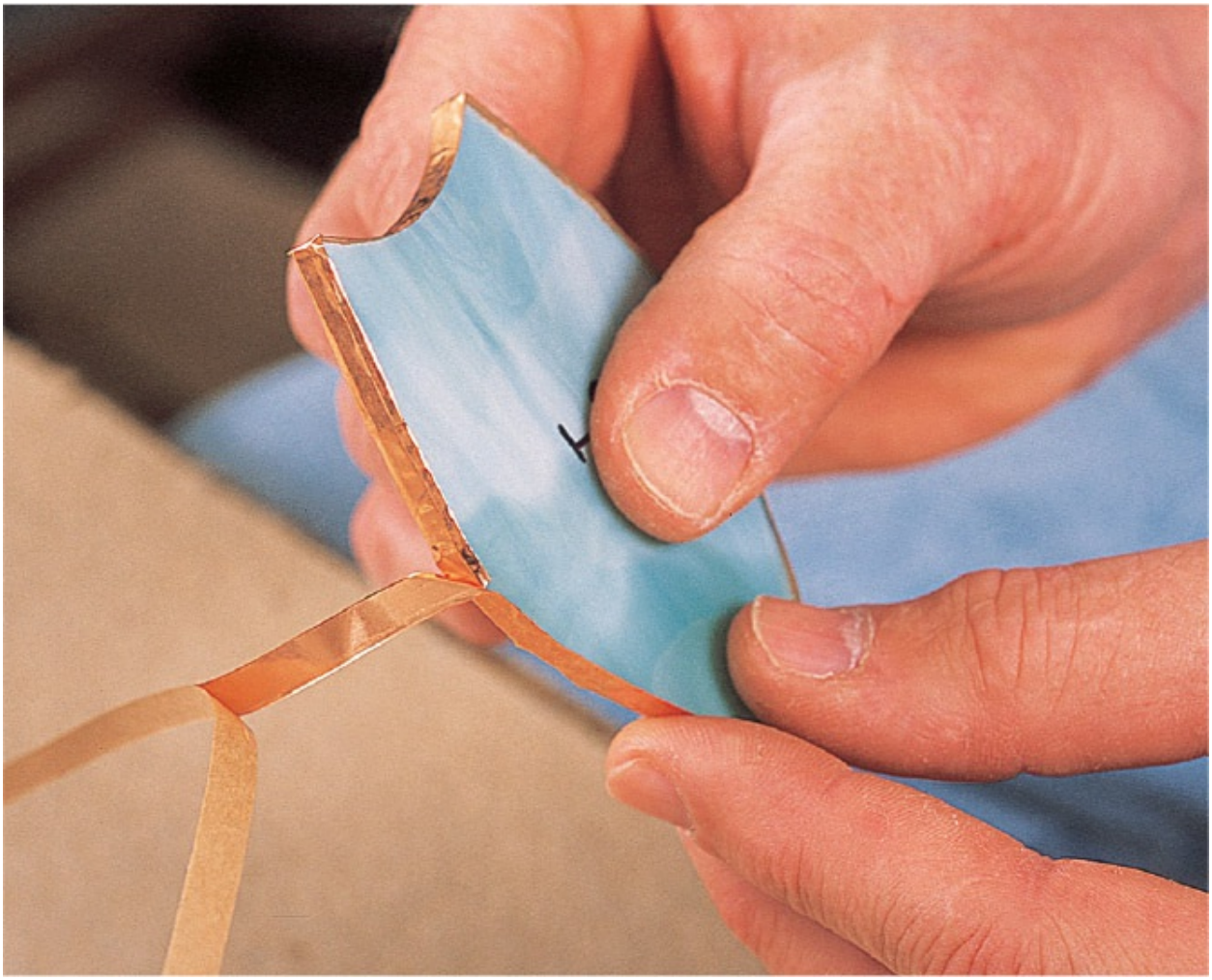


Apply the foil at the midpoint of one of the sides of the glass, not at a corner edge, where it might have difficulty sticking.

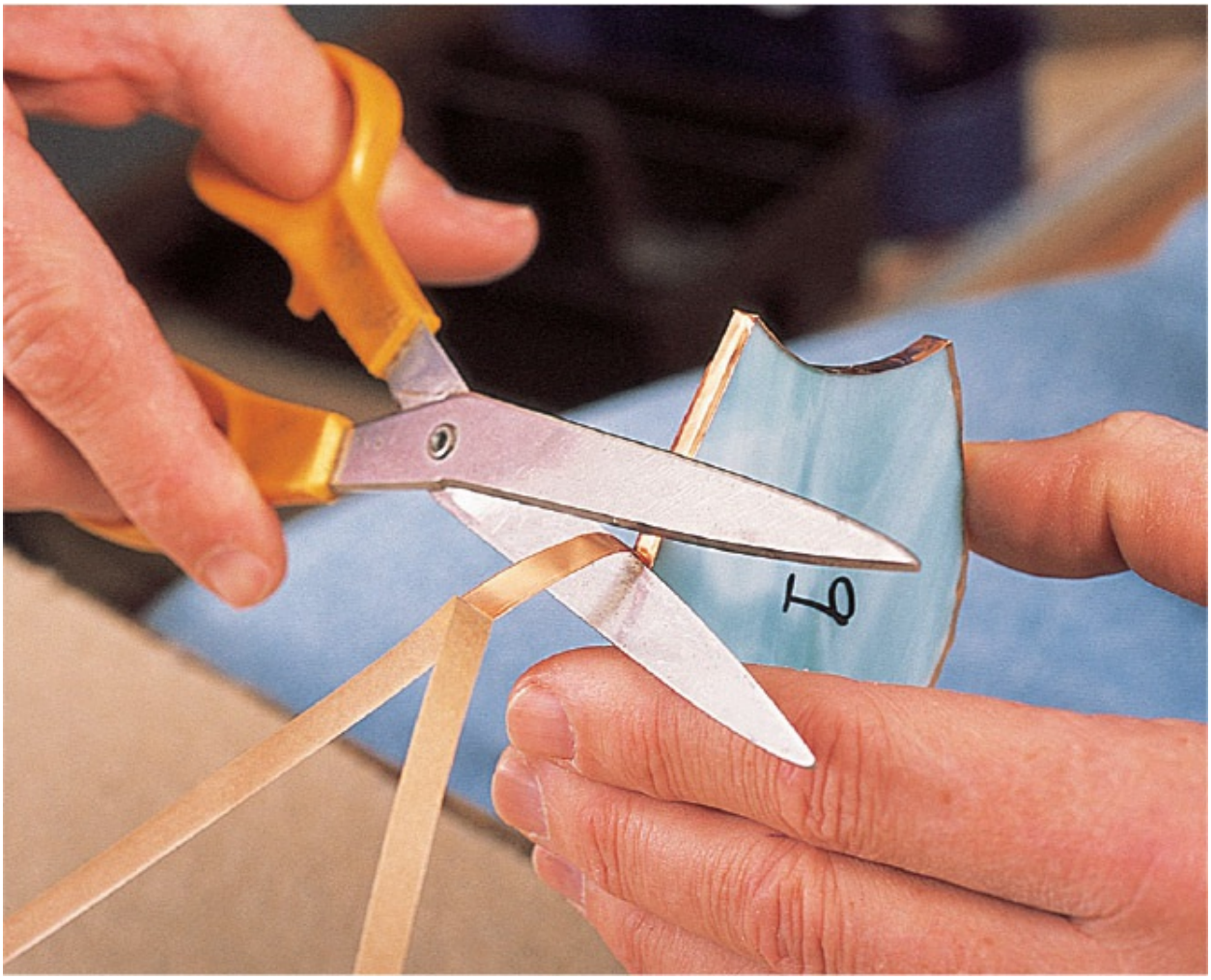
Keep the strand of foil under tension by pulling it gently as you press the adhesive against the edge of the glass, turning the glass as you work. Keep the foil centered on the edge, so an equal amount hangs over each side.



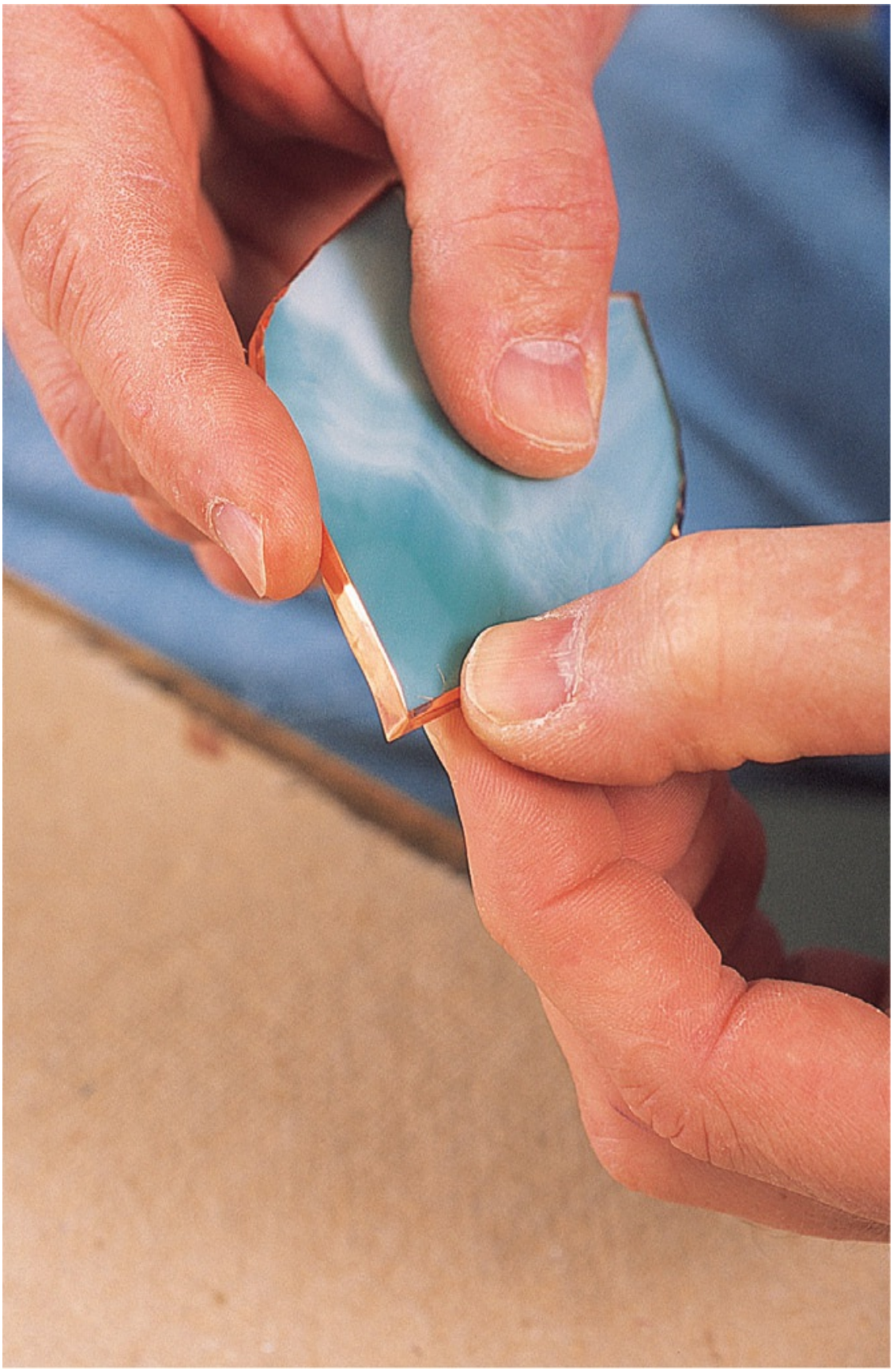
Continue foiling around the entire piece until you reach the starting point. Overlap the front and back ends of the foil slightly, about ⅛inch.



Then trim away the excess foil.

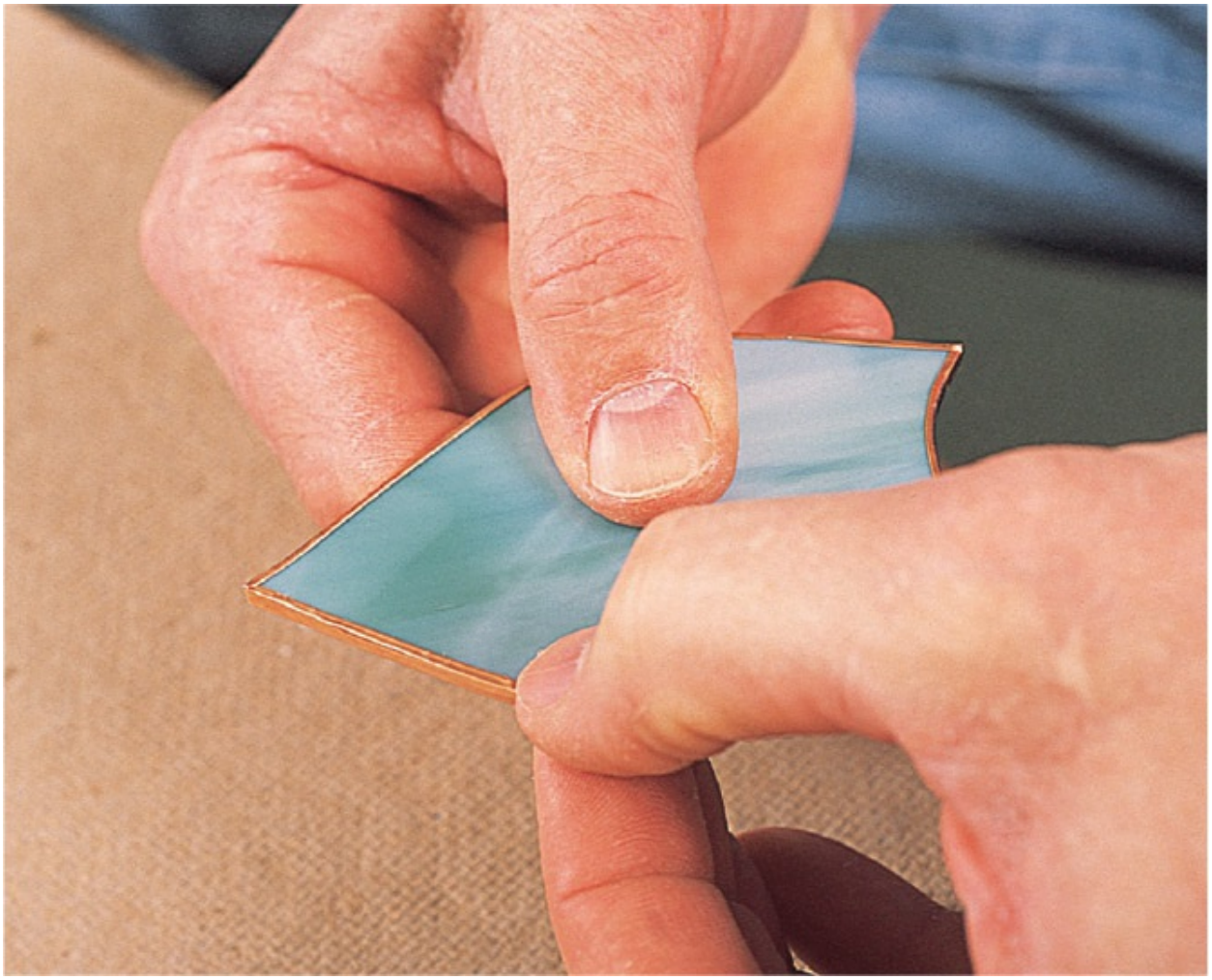


Use your thumb and forefinger to carefully fold down the edges of the foil so they stick to the glass.



At the corners, square off the edges where they meet—like “hospital corners” on a bed.

Press down these raised edges, and around the rest of the foiled edge.



Burnish the foiled piece using a fid. Press down firmly on the edges of the foil and slide the tool across it until it is smooth. Do both sides of the piece.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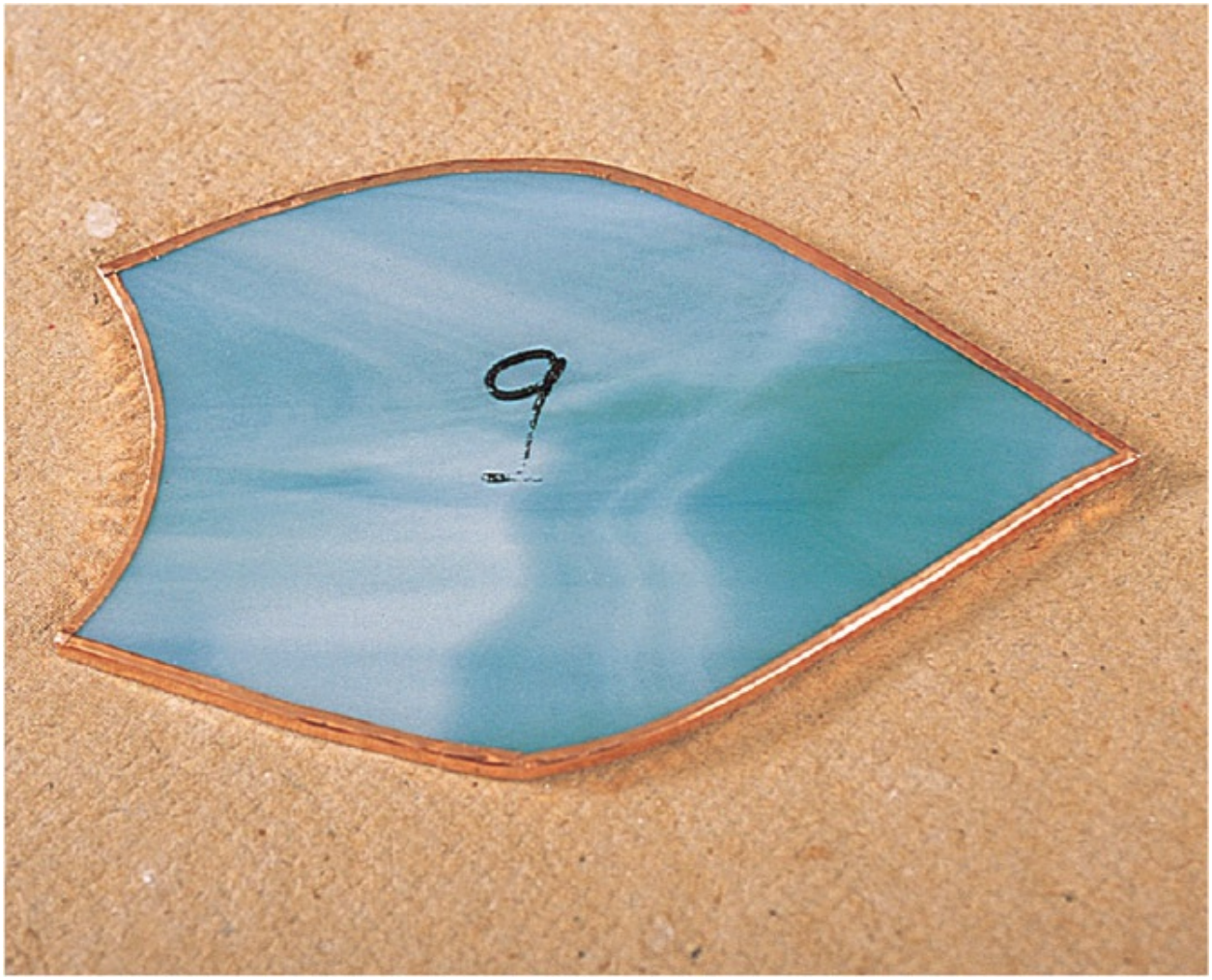
The finished piece should have completely smooth and flattened foil so solder will stick to it.



Using a Table Foiler

A table foiler makes foiling quick and easy. This foiler was screwed onto a block of scrap wood instead of a workbench so that it could be clamped to the edge of any sturdy work surface.


QUICK GRIP

Follow the directions for your particular foiler to get the foil strip in place. Most table foilers accommodate a range of foil thicknesses.

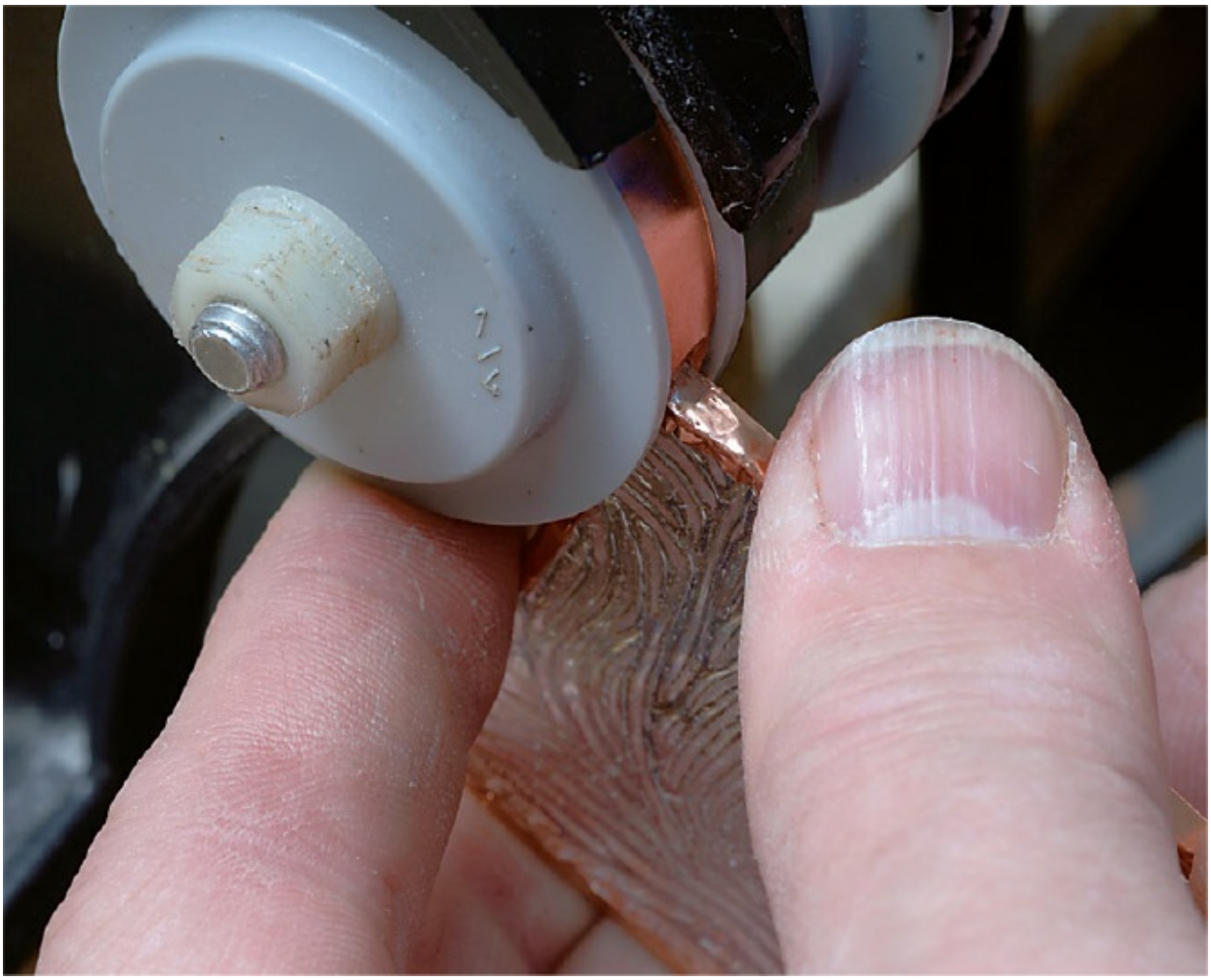

QUICK-GRIP

To use the foiler, place the edge of a sheet of glass against the foil on the small reel, as shown. The edge should be in the center of the foil strip so there is the same amount of foil on either side of the glass. Press the edge of the glass into the foil and push the glass downward, rolling the reel, so the foil is applied to the entire edge.

A common problem when foiling sharp corners is that the foil tears.

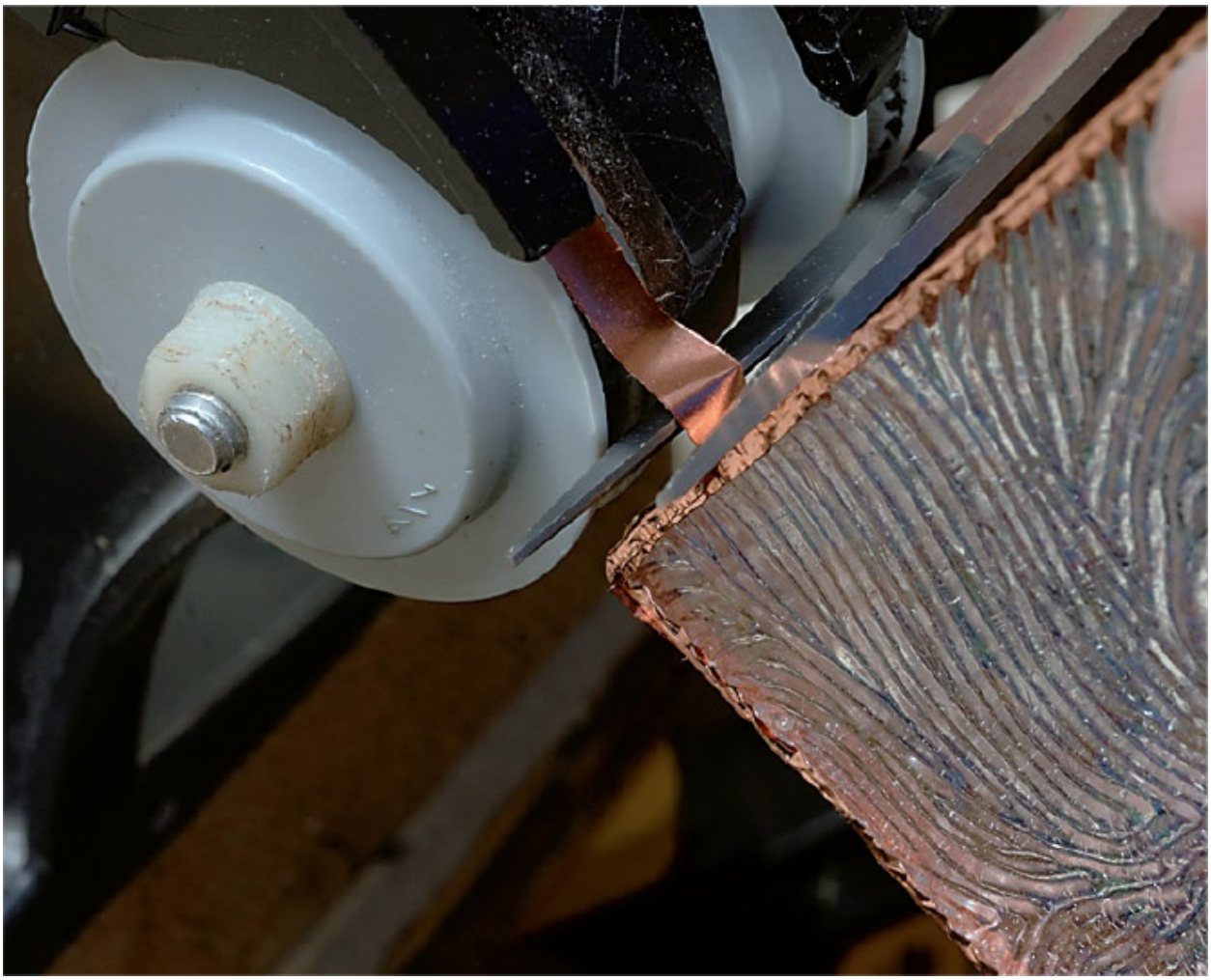
If it does, you can patch it. Press the edge of the glass against the reel just below the tear.

Push it downward, rolling the reel.



Tilt the glass up to cover the corner.

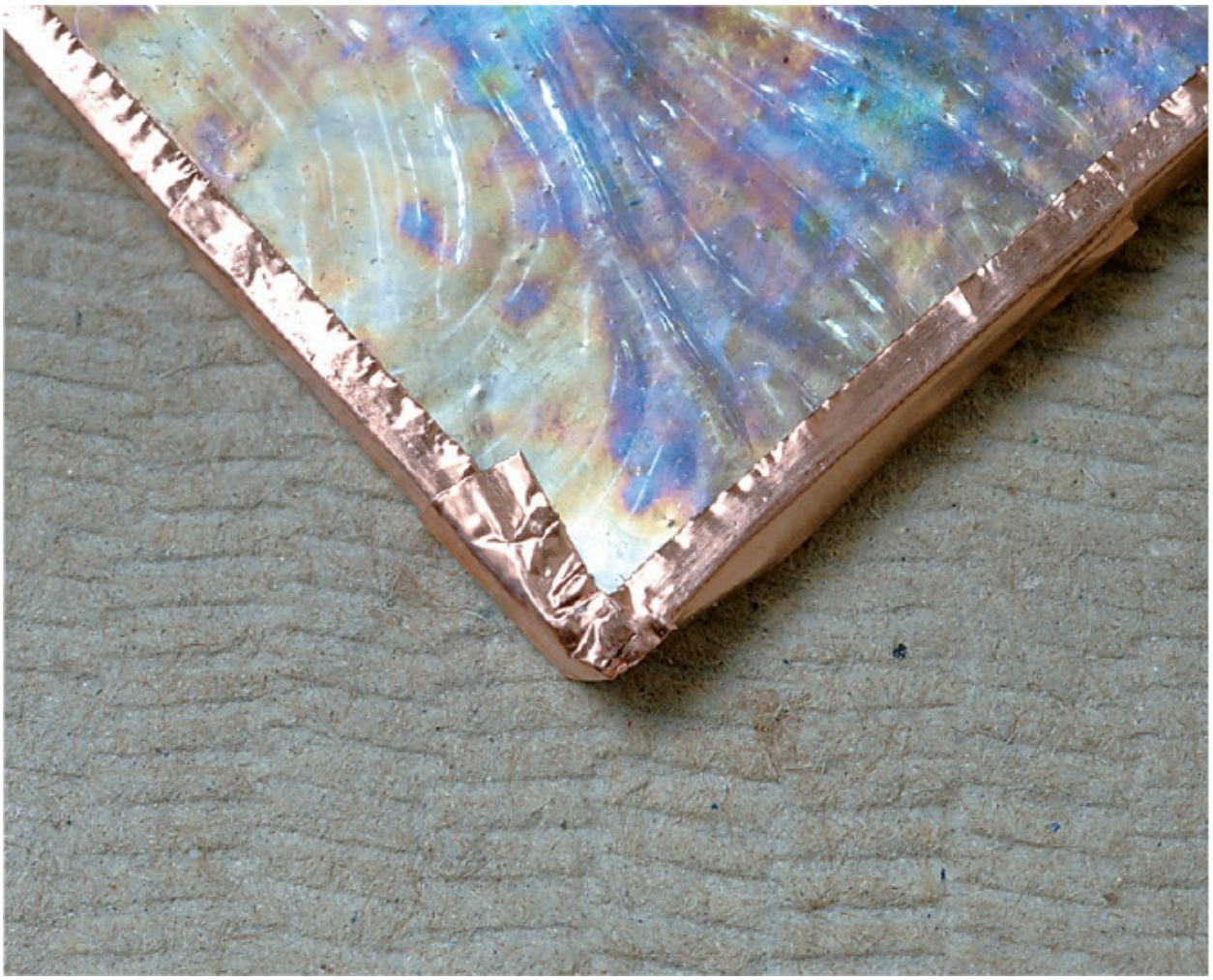
Foil above the tear and trim.



Use a rolling burnisher to smooth the foil after it’s applied. Push the glass between the tool’s two rollers, which are springy.

Roll the burnisher all around the edge of the glass to flatten the overlapped edges.

The tool will smooth the foil to prepare it for soldering.



Sometimes the foil won’t overlap evenly, as shown here. Look for this problem after you use the burnisher. If it occurs, it’s easy to fix.

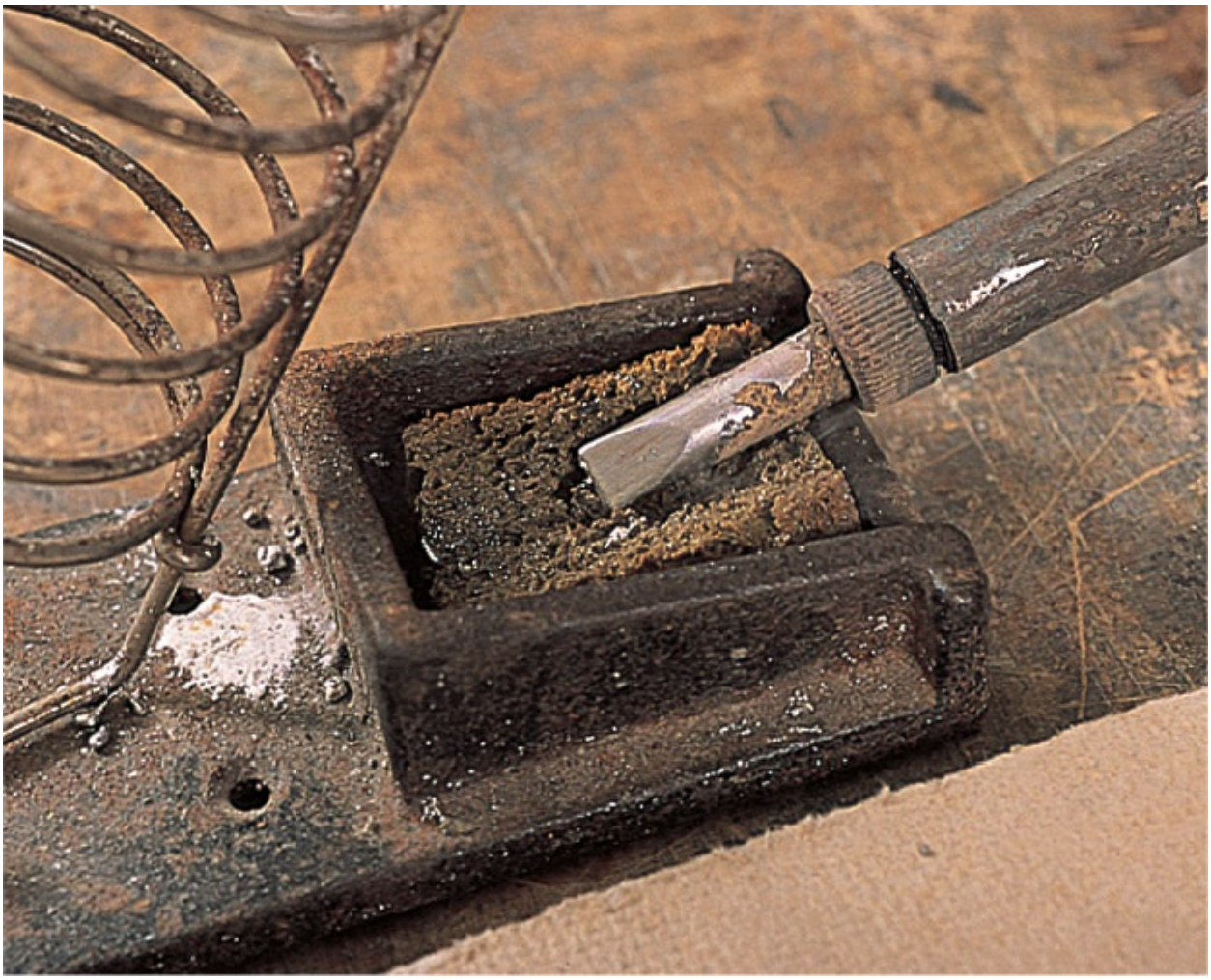
Use an X-Acto knife to trim away the overlap and create a straight foil edge.

After the repair, the spot might need to be burnished again.

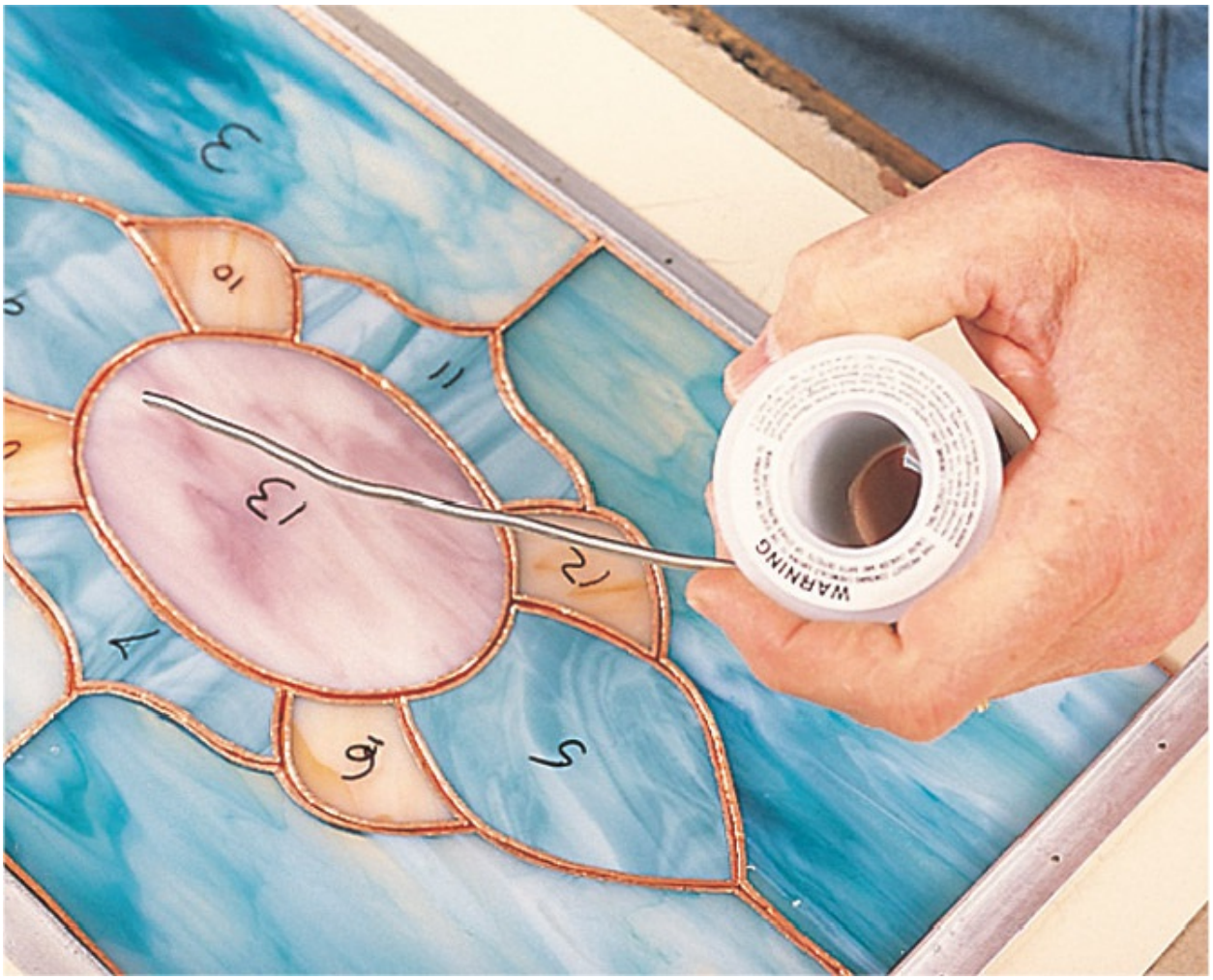
Soldering

You must apply flux to all metal surfaces before soldering. Apply the flux liberally to the foil, using a painting motion.

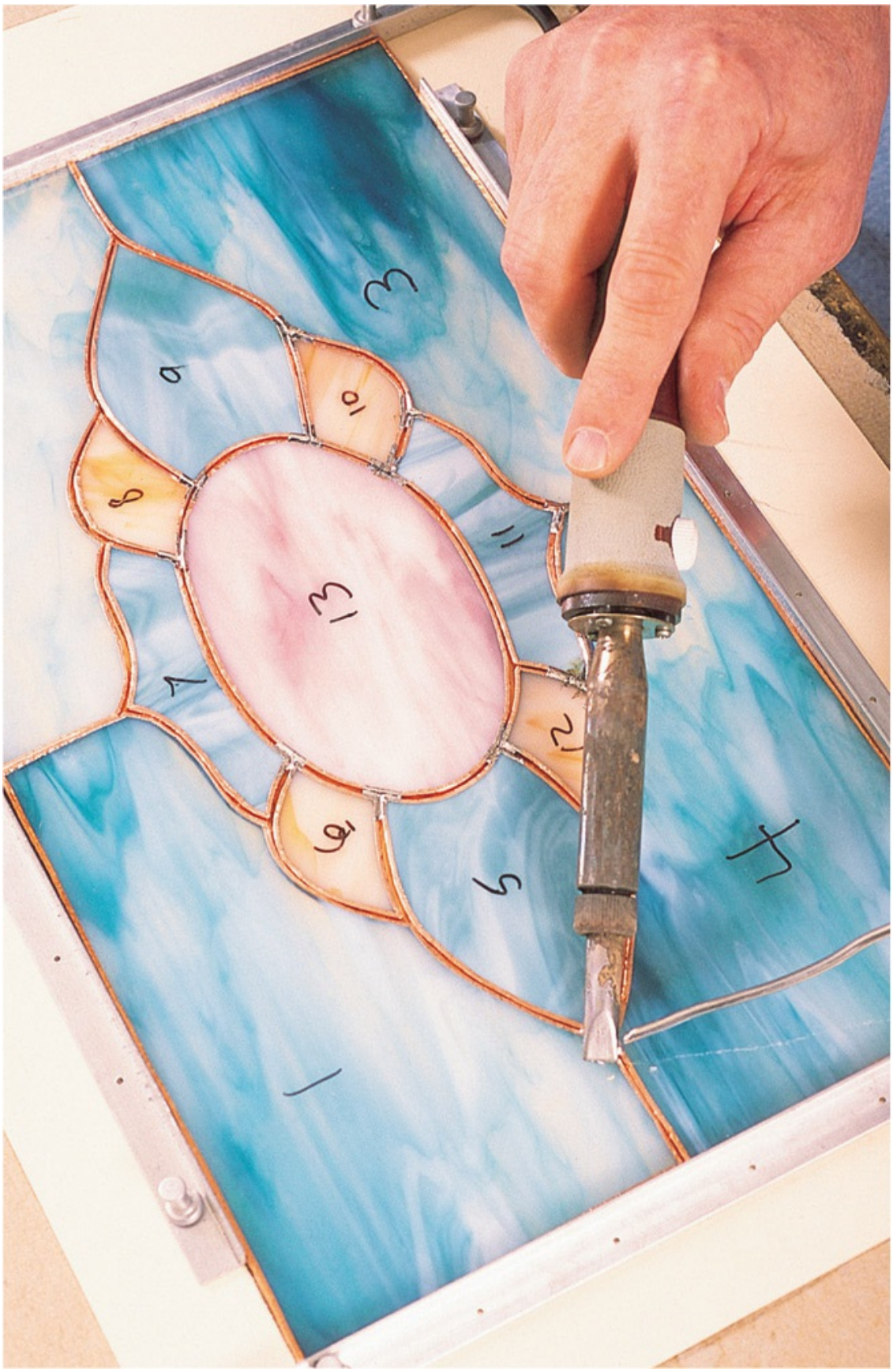
Clean the tip of the iron if it is not brand new. Use a moistened sponge to remove debris or rub the heated tip across a block of sal ammoniac to remove buildup.



Unspool a strand of solder.



To tack solder, place the tip of the solder wire against the copper foil where you intend to solder it and then touch the hot iron to the solder to melt about ⅛ inch of it. Lift the solder and then lift the iron, allowing the molten solder to flow onto the foiled pieces. It will cool and harden almost immediately.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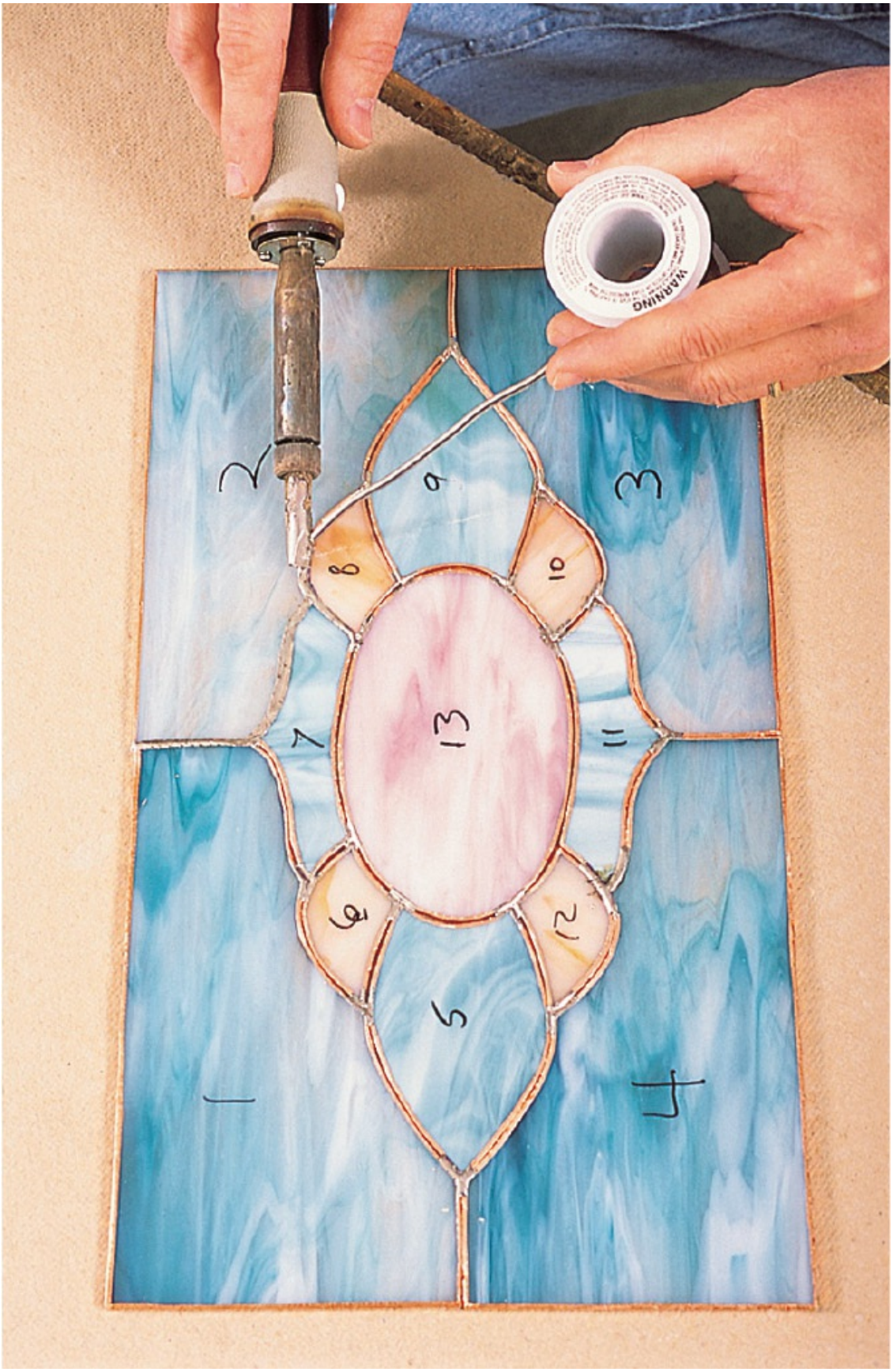
To solder along seams, position the end of the solder and the tip of the iron over the end of the desired foiled seam. The iron should be at a 45-degree angle to the foil and should rest on the copper.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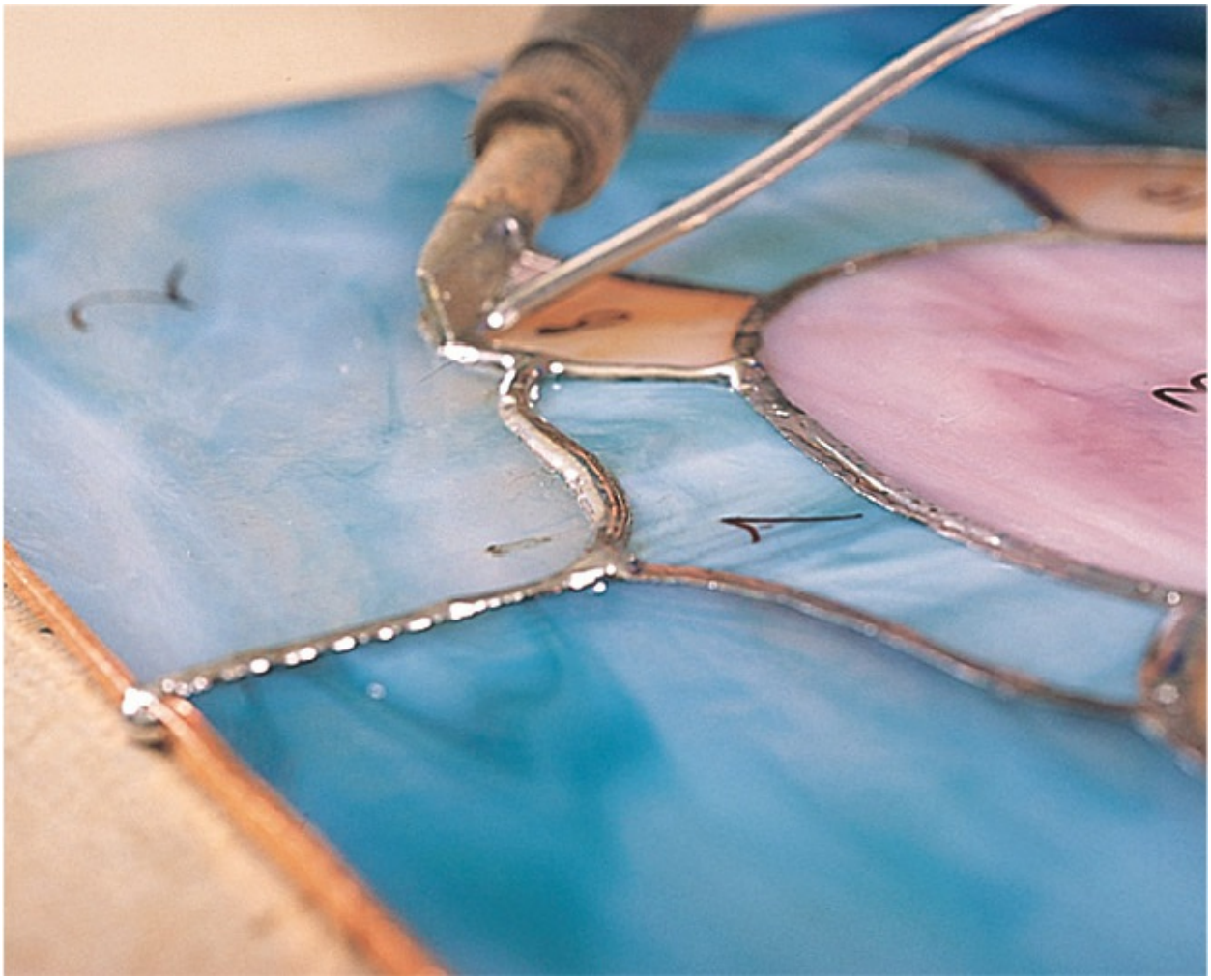
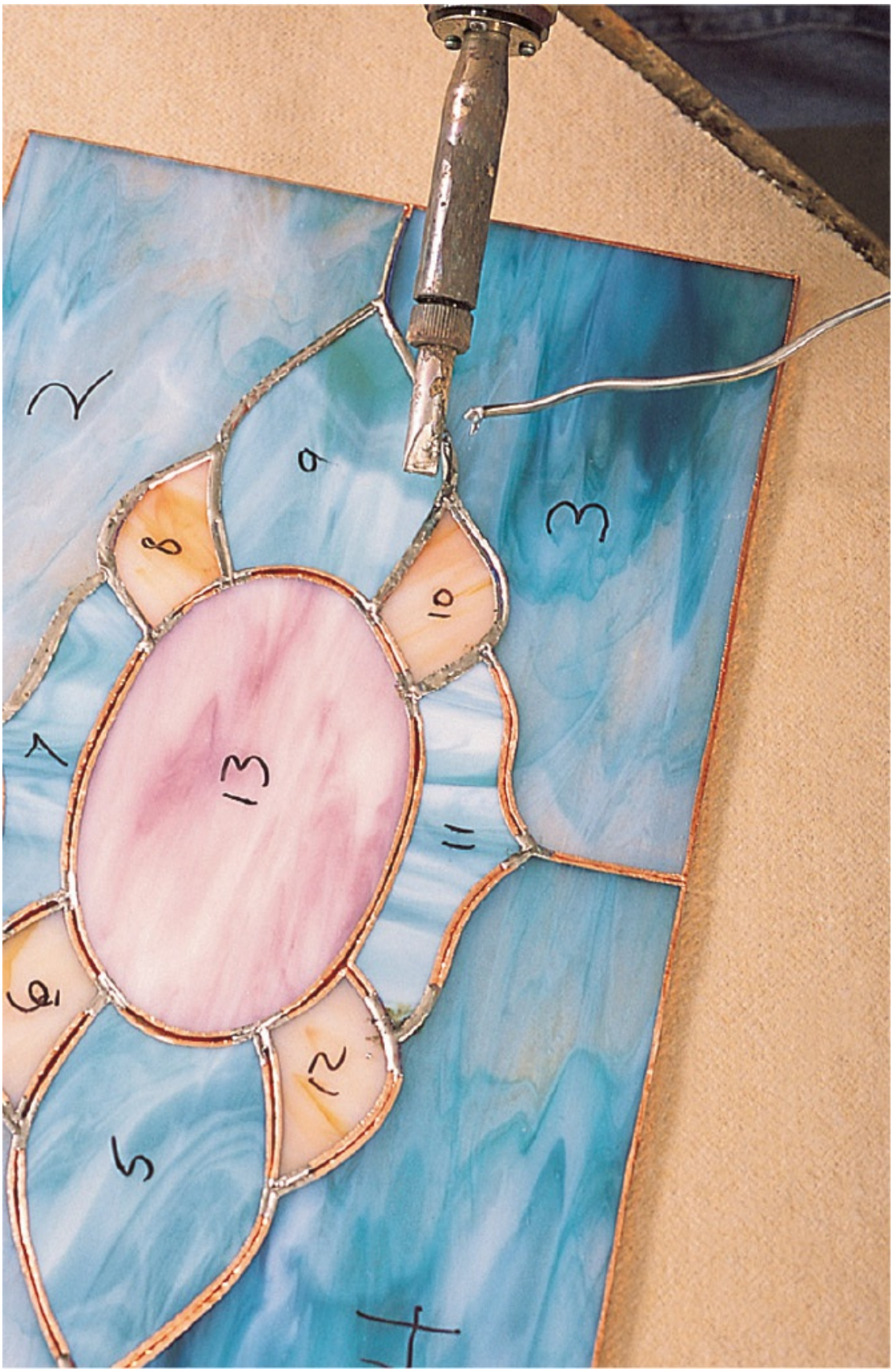
Gently touch the tip of the iron against the solder for an instant. Let the solder flow onto the foil, pulling the iron toward you at a speed that allows the solder to adequately cover the foil. Then lift the iron straight up from the solder.



Reposition the tip of the iron and the tip of the solder wire over the next section of exposed foil. Allow the solder to flow and remove the iron by pulling it straight up. As you work, make sure you don’t hold the iron in one spot for more than a second. When you encounter cooled areas of solder you applied earlier, make the new and old solder flow together seamlessly by touching the end of the cooled solder with the iron, then immediately apply the new solder to the foil and allow it to flow smoothly.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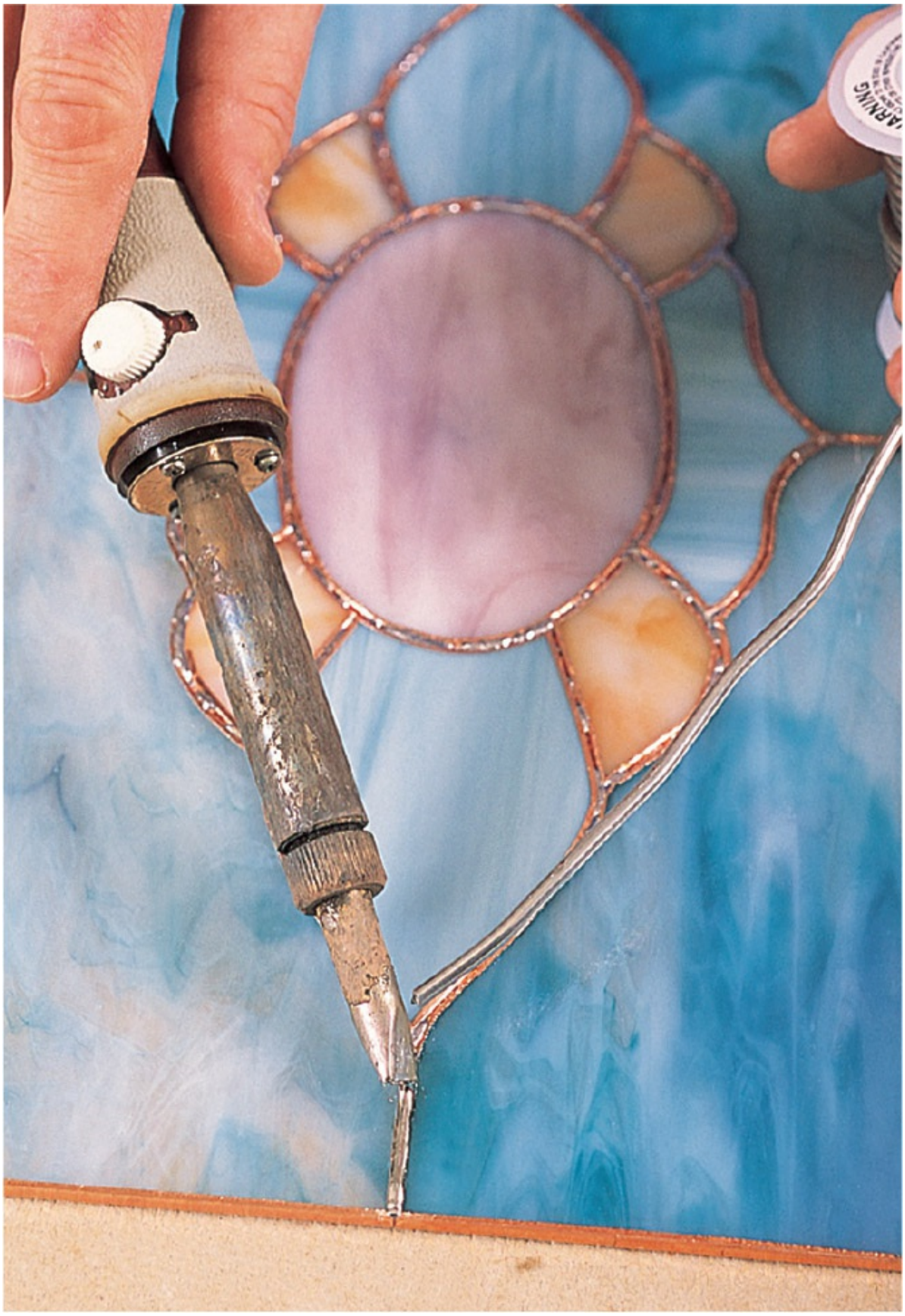
Don’t forget to solder the seams on both sides of a piece. Turn the panel over so the reverse side faces up.

Apply flux to all copper foil seams.

Solder as you did the other side.

Make sure you don’t hold the soldering iron in one spot for more than about a second because it might overheat the foil and cause the solder on the underside of the panel to remelt. This will cause the solder on the top side of the panel to become indented.



Tips for Soldering

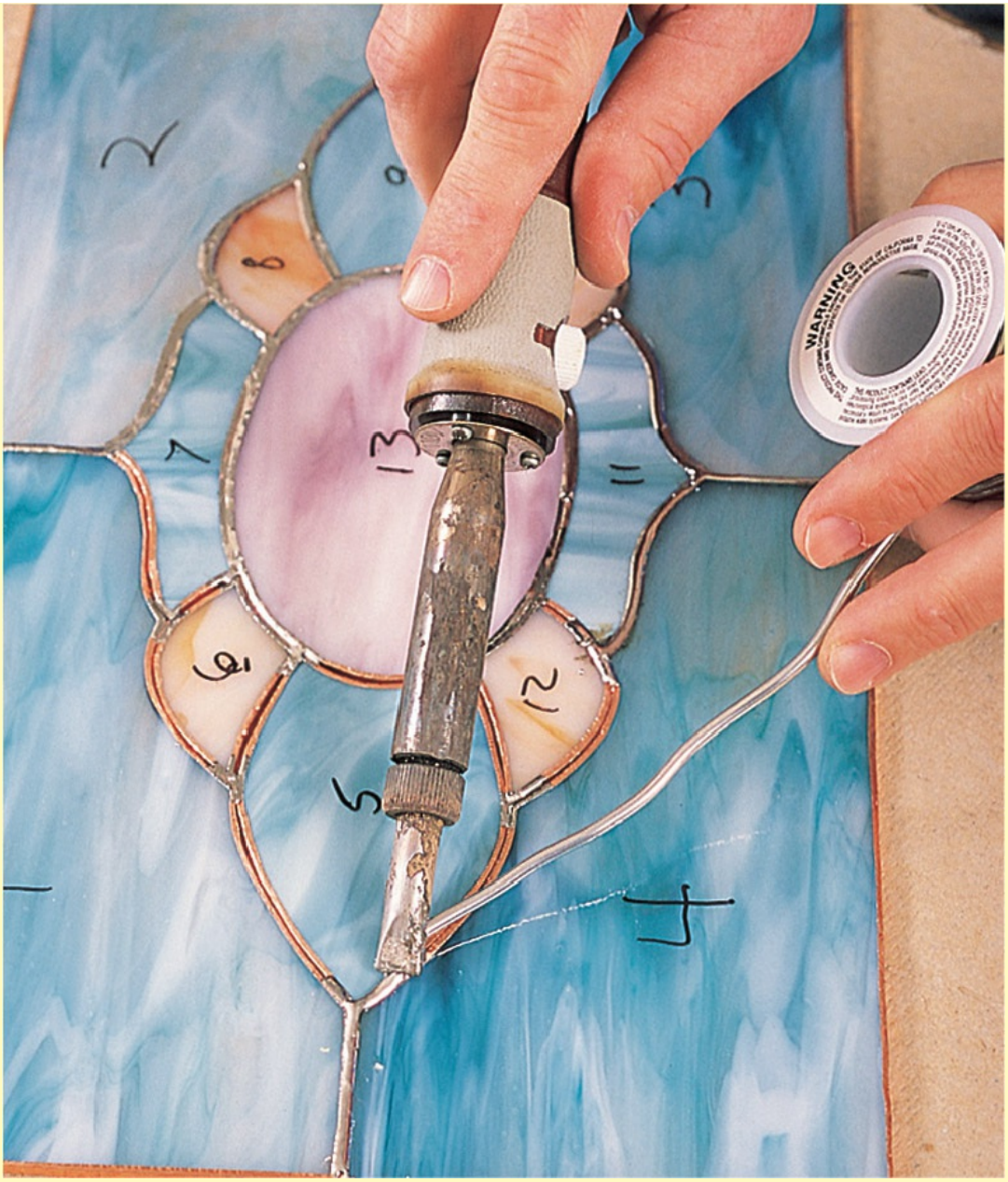
- You must apply flux to all metal surfaces before soldering. If the solder refuses to melt and flow properly and instead forms heaps or mounds on your project, you probably forgot the flux. Just apply some and continue soldering.

- Frequently drag the tip of the soldering iron across a damp sponge or cloth to remove built-up solder and flux residue. Especially keep this in mind after you finish soldering a long seam or a number of smaller spots.

- Try not to lean directly over the spot where the solder meets the hot iron. The fumes emitted contain toxins.

- Gauging the proper temperature for a soldering iron is tricky. An effective and simple test: Touch the hot iron to a cool bead of solder; if it turns to liquid instantly and stays attached to the iron, the temperature is good.

- An iron that is not hot enough will cause the solder to blob up and refuse to flow properly.

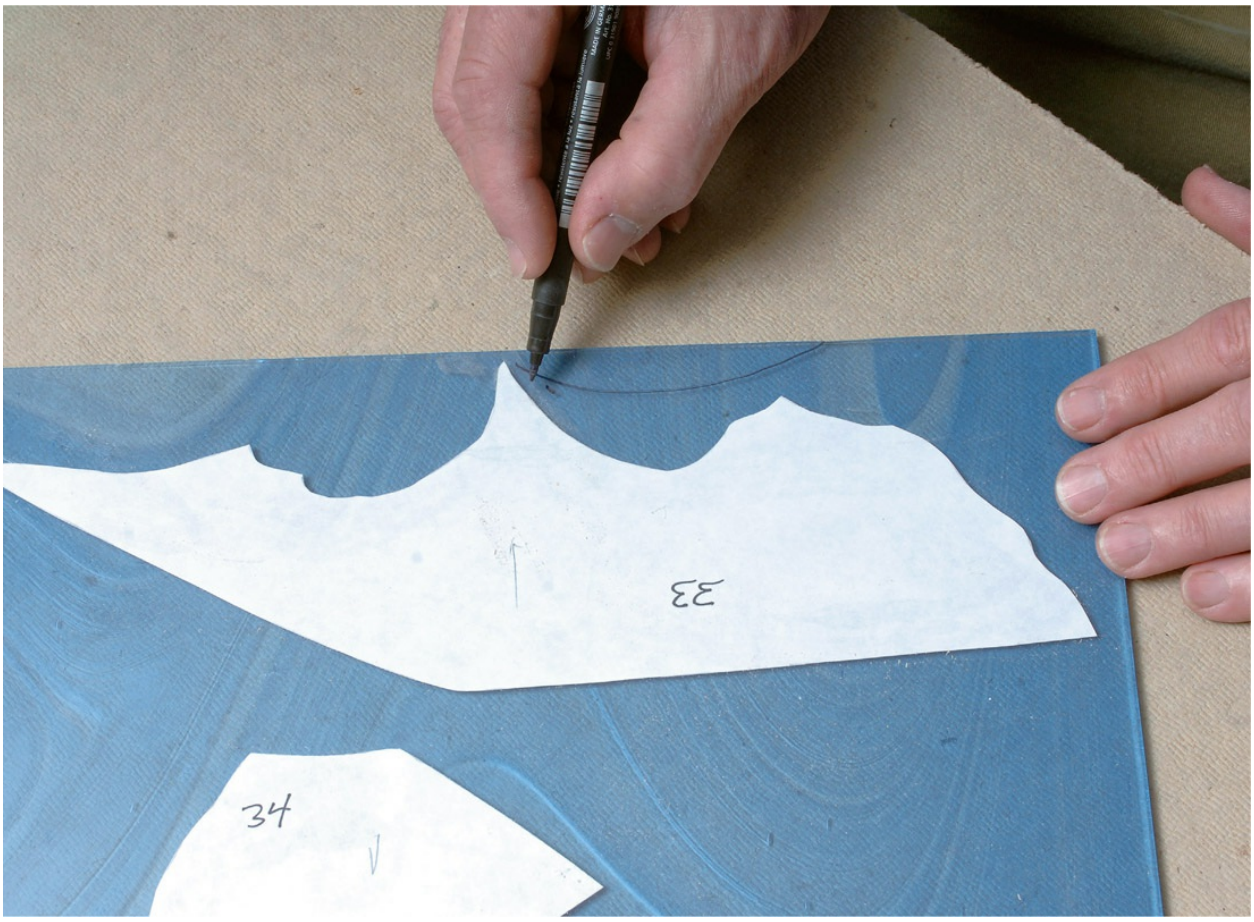


- An iron that is too hot will cause the solder to flow too quickly, and it may transfer too much heat through the copper foil, causing the glass to crack.

- If you use an overly hot iron around lead, it will turn it to slag in an instant.

4

Advanced Cutting Techniques

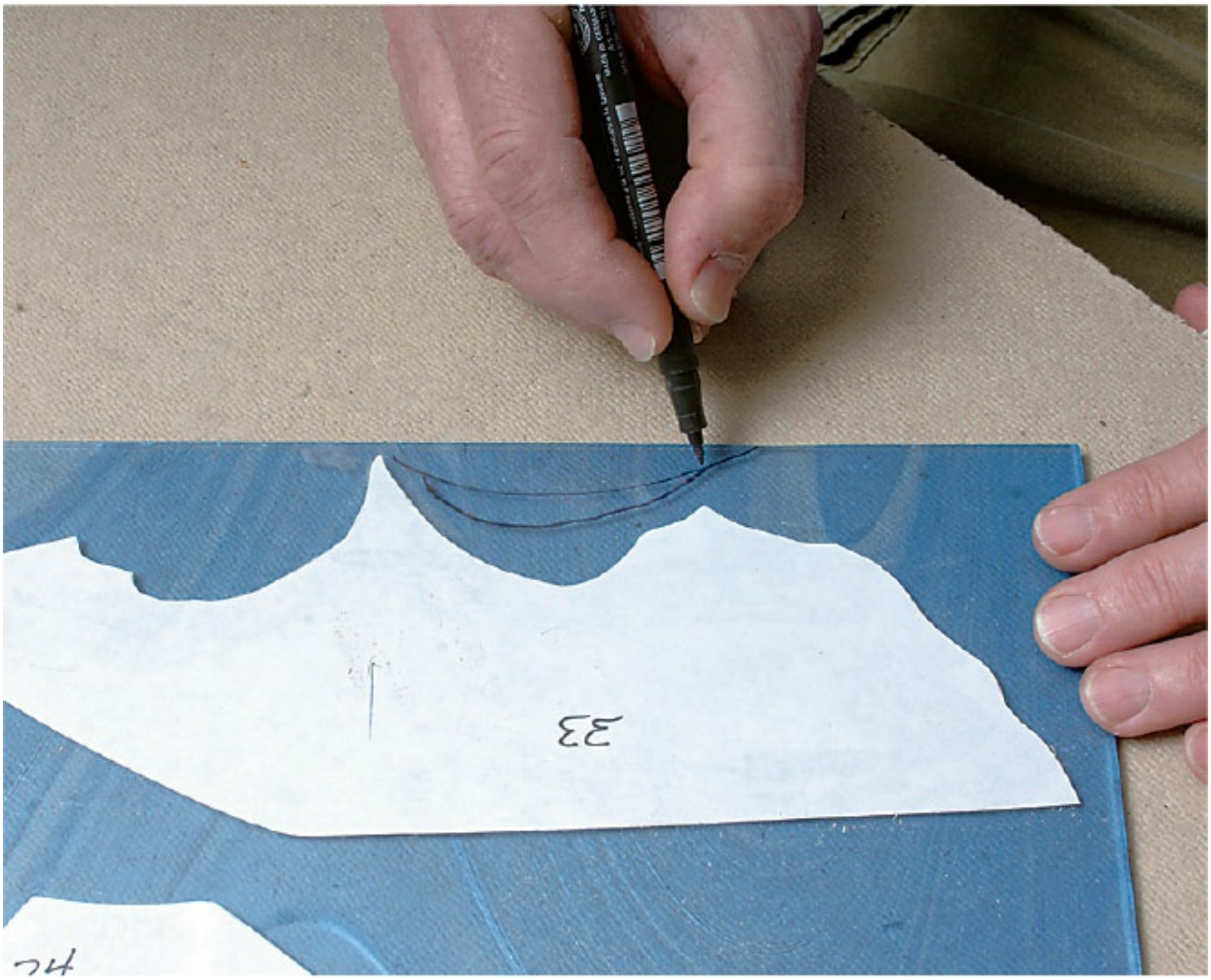


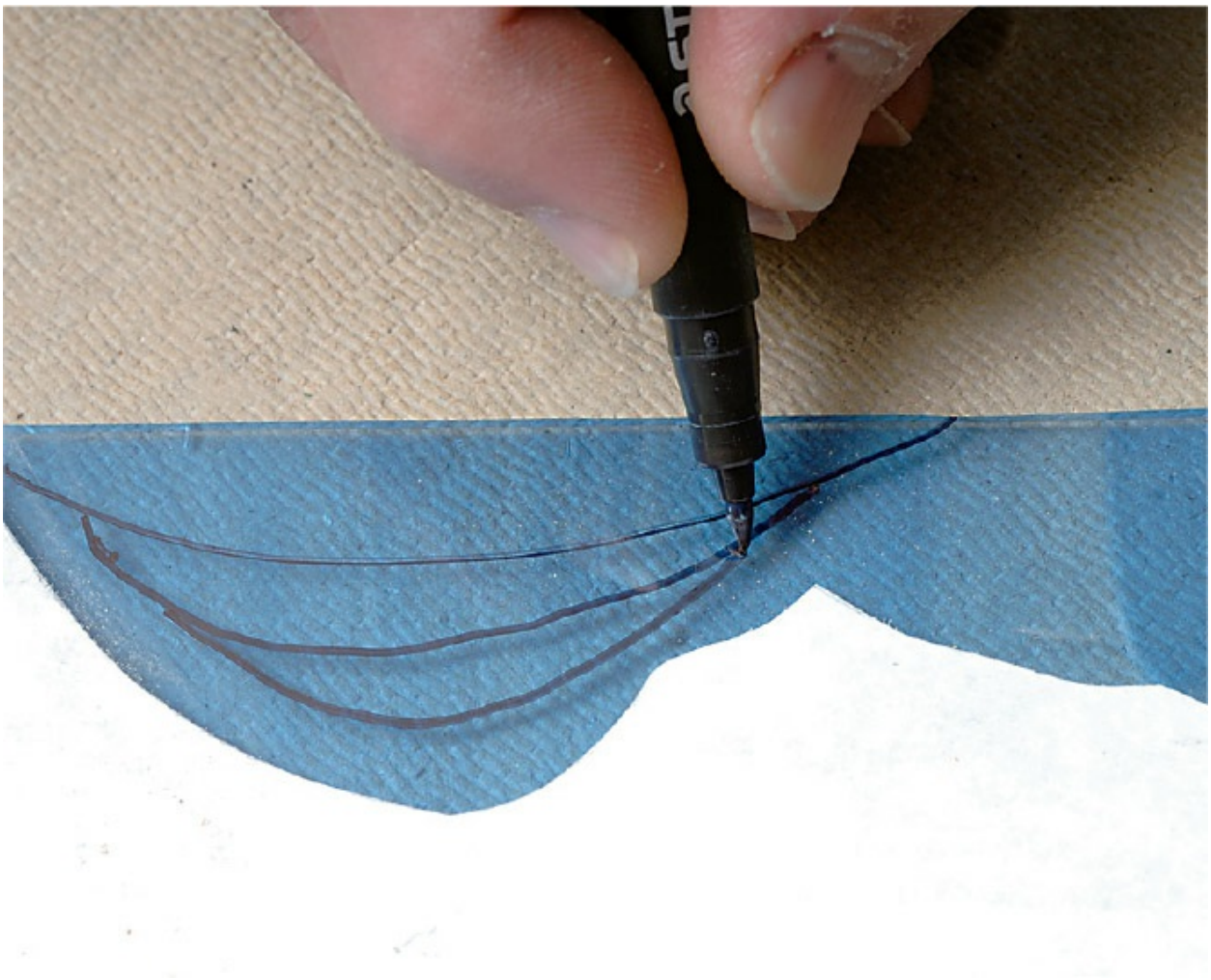
Mastering the techniques of making complicated cuts will help you to create pieces of glass of almost any shape, and allow you to develop and create almost any stained glass design. Many complicated cuts can be made by hand, often with the help of a jig system, or by using a tabletop saw.

Cutting Deep Curves

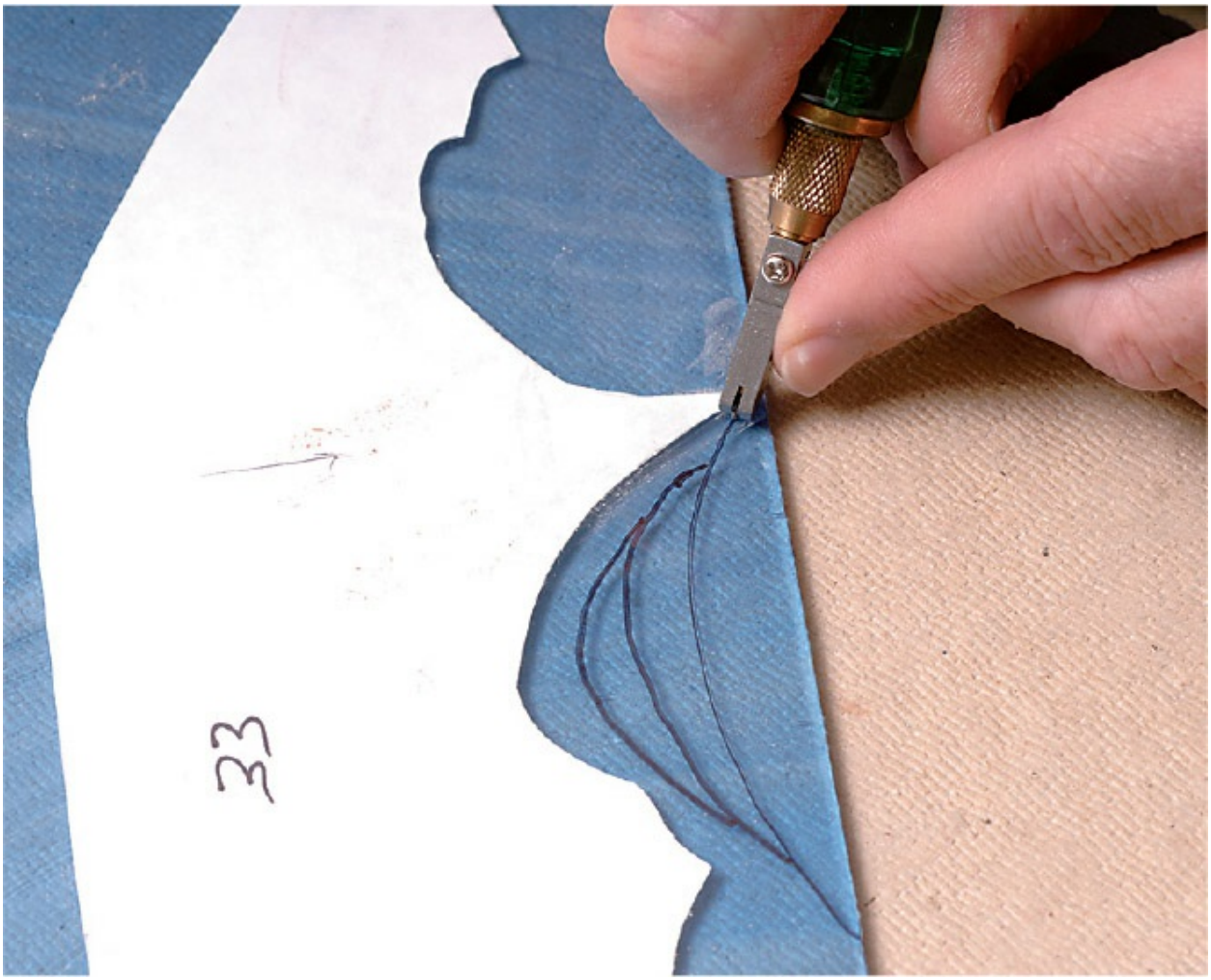
These pattern pieces feature deep curves, which can be cut with a handheld glass cutter or a table saw. The paper pieces are attached to the glass with rubber cement.

Before you cut the pieces, draw the lines to be cut on the glass with a marker. To cut a deep curve, make a series of smaller, shallow cuts that remove the glass little by little until you reach the marked line. Three separate lines here indicate the three smaller cuts made to reach the final curve.



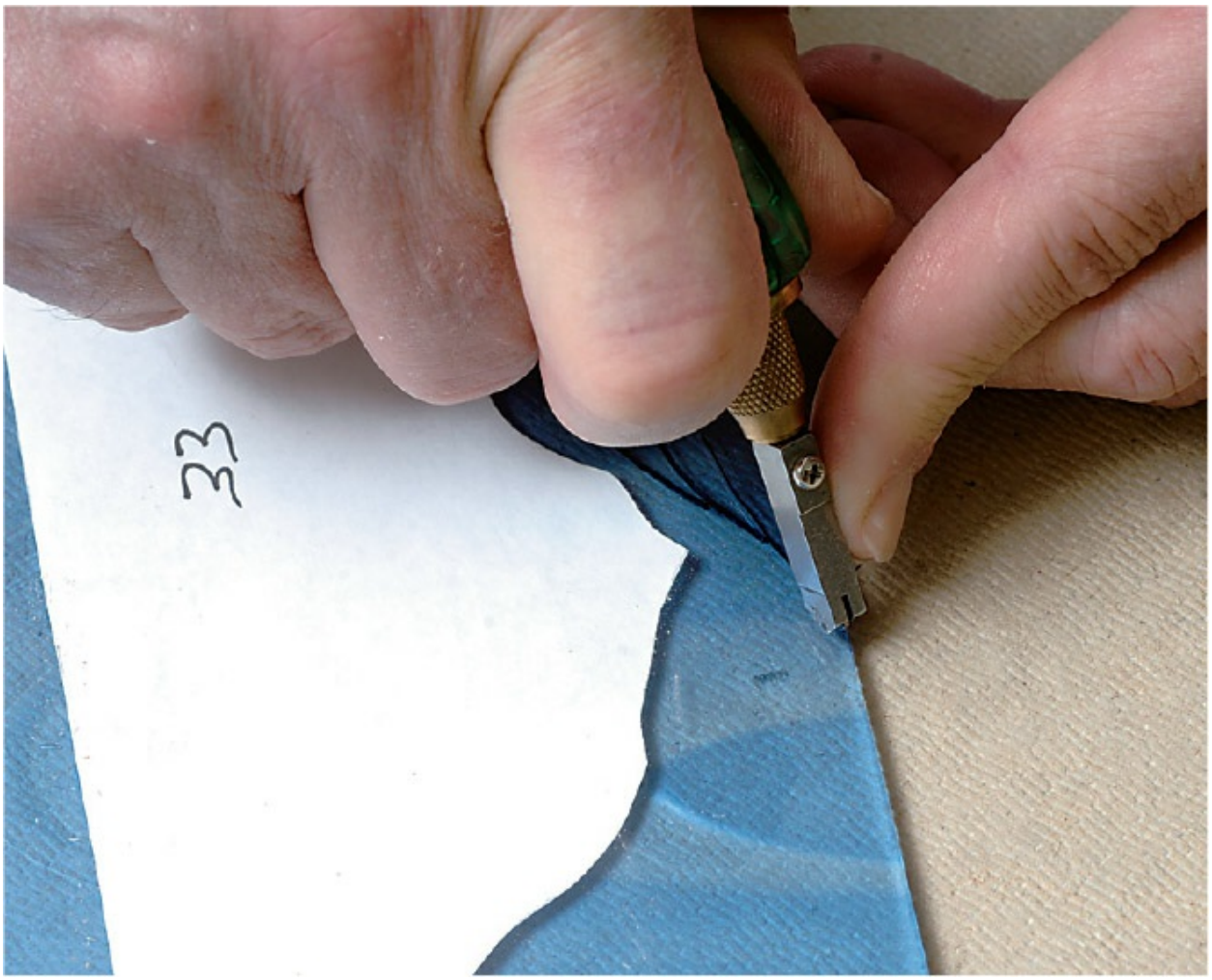


Place your handheld cutter on the outermost line about 1/16 inch away from the edge of the glass.



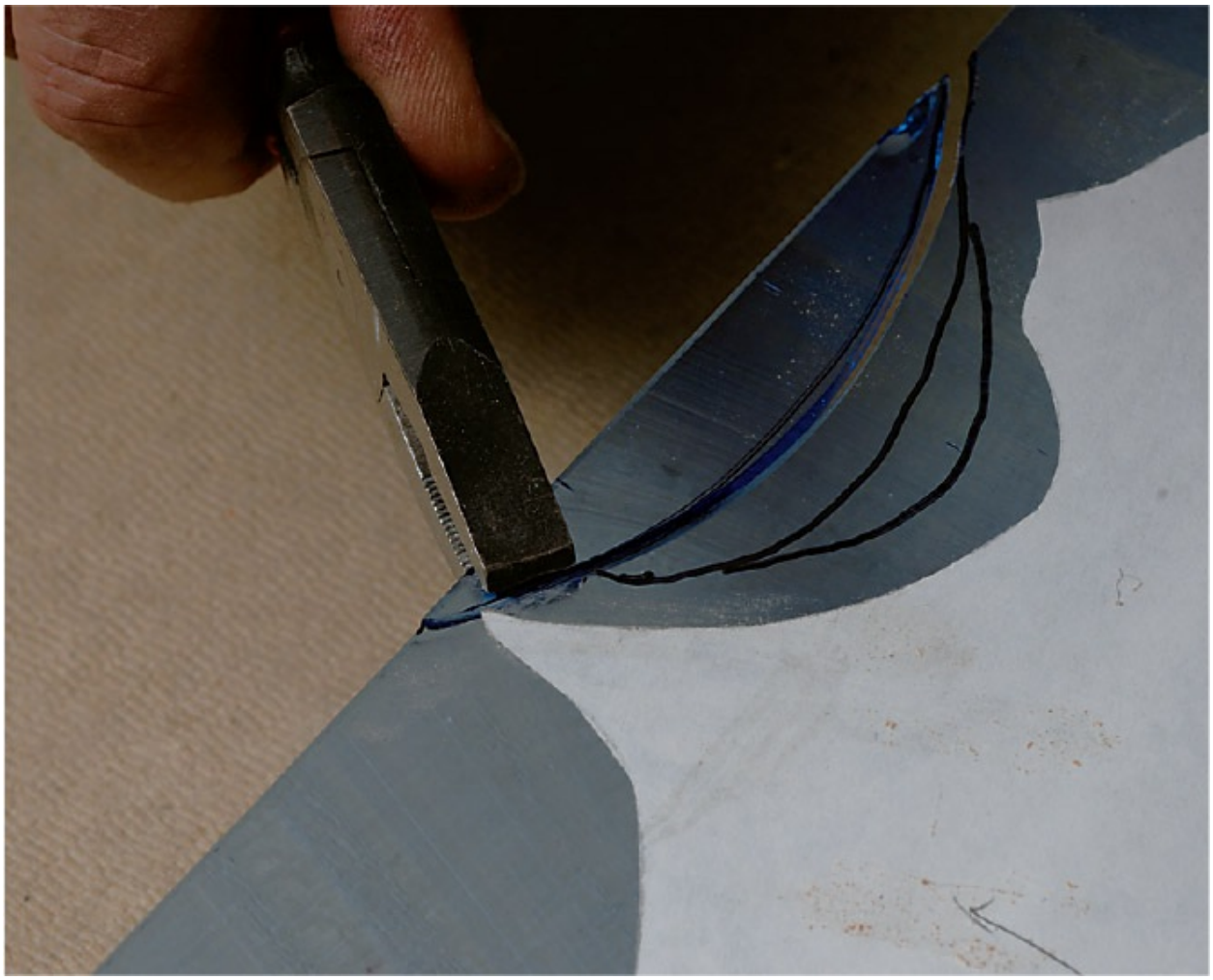
Score the glass along this line, moving at a slow, steady pace.

Stop the cut about $^{1}/_{16}$inch away from the edge of the glass.



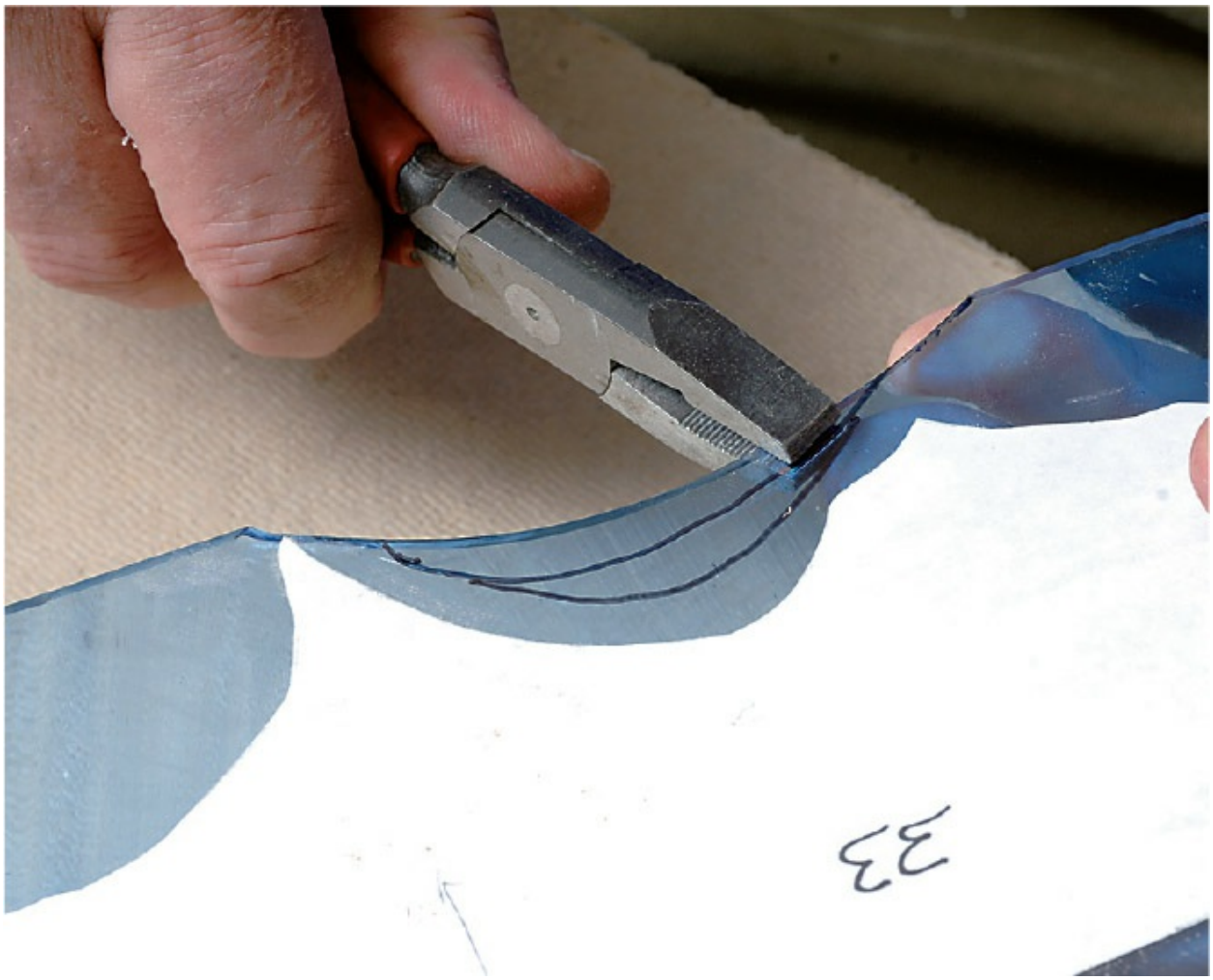
Squeeze one end of the scored curve with breaking pliers and pull the pliers back and down until you hear a click. This snaps the unscored portion, as shown.

Repeat the process on the other end.

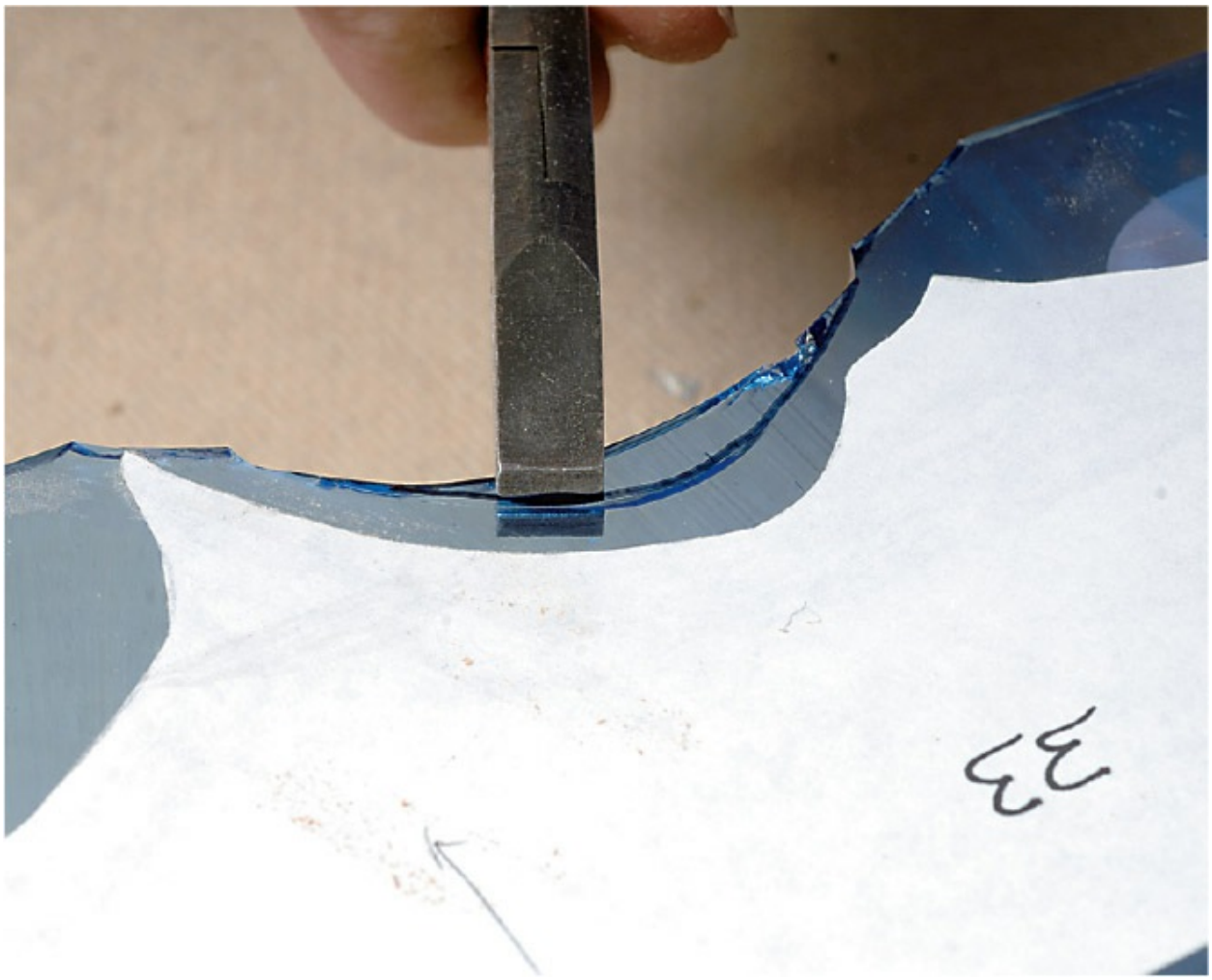


Score the second marked line the same way.

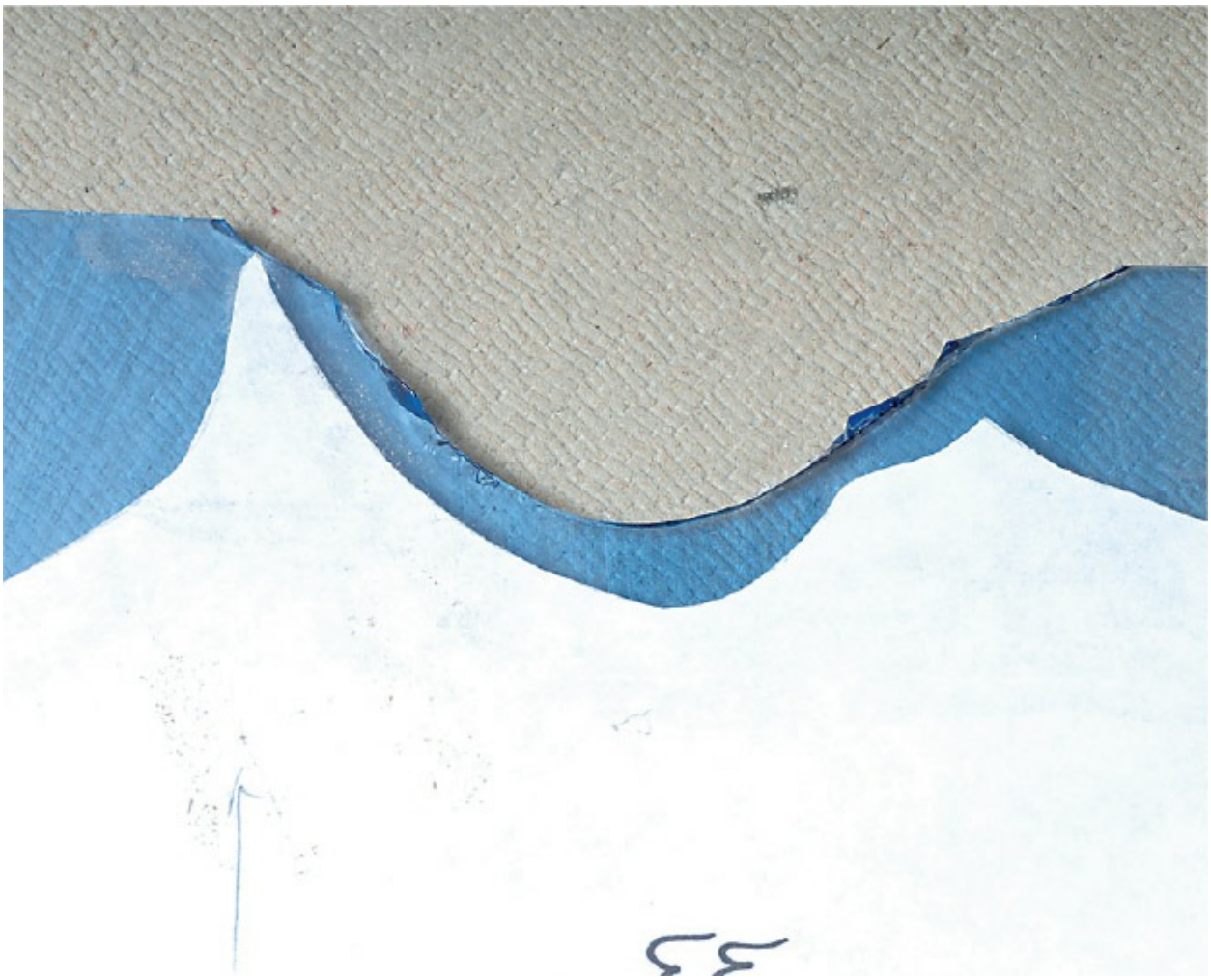
Remove the second curve of glass.



Score and remove the third curve . . .



. . . until you’re left with the last curve.



Don’t try to score and break this final curve all in one piece. Score a series of even smaller curves to remove the final curve bit by bit. Continue to nibble away the glass until you’ve removed the entire final curve.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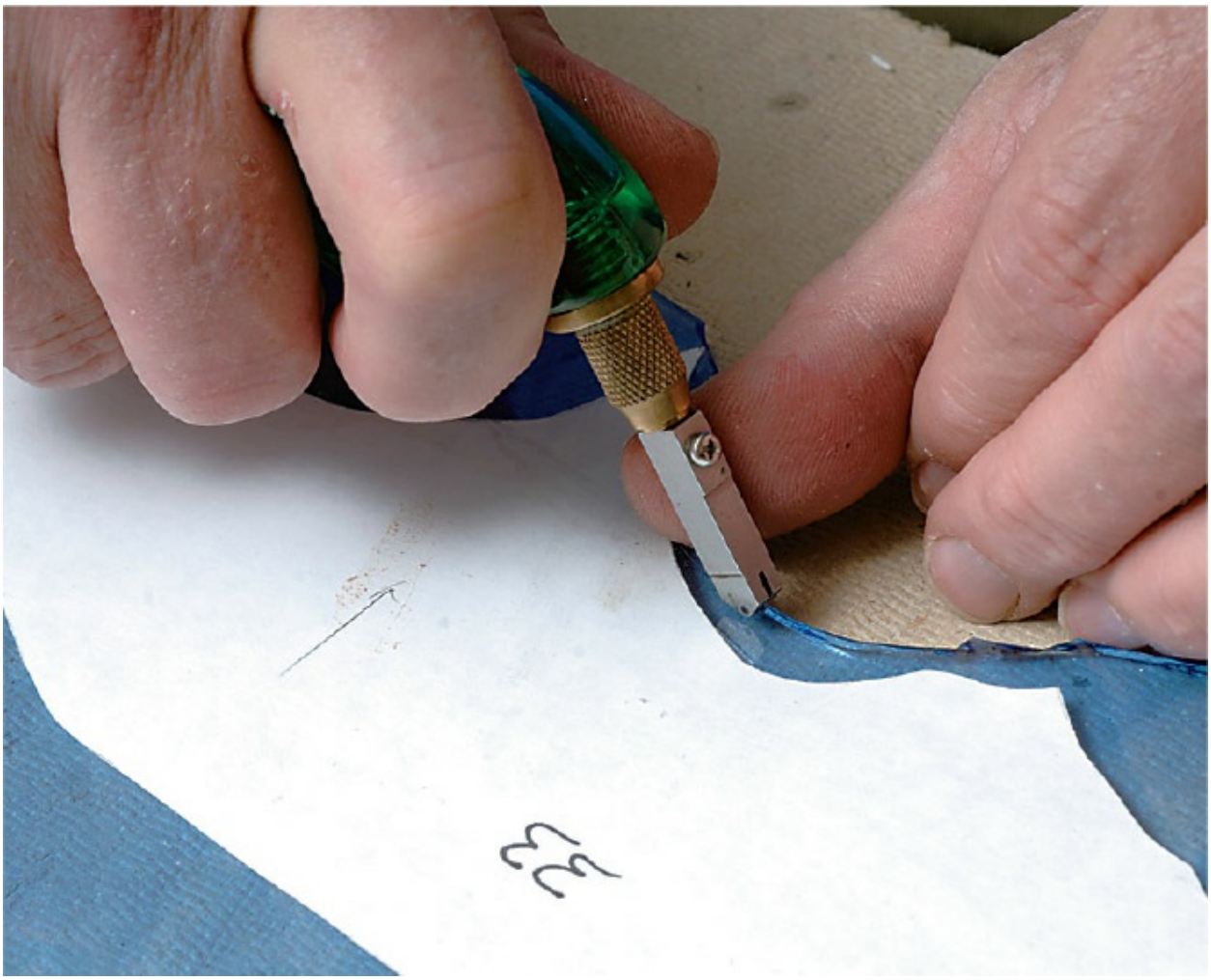
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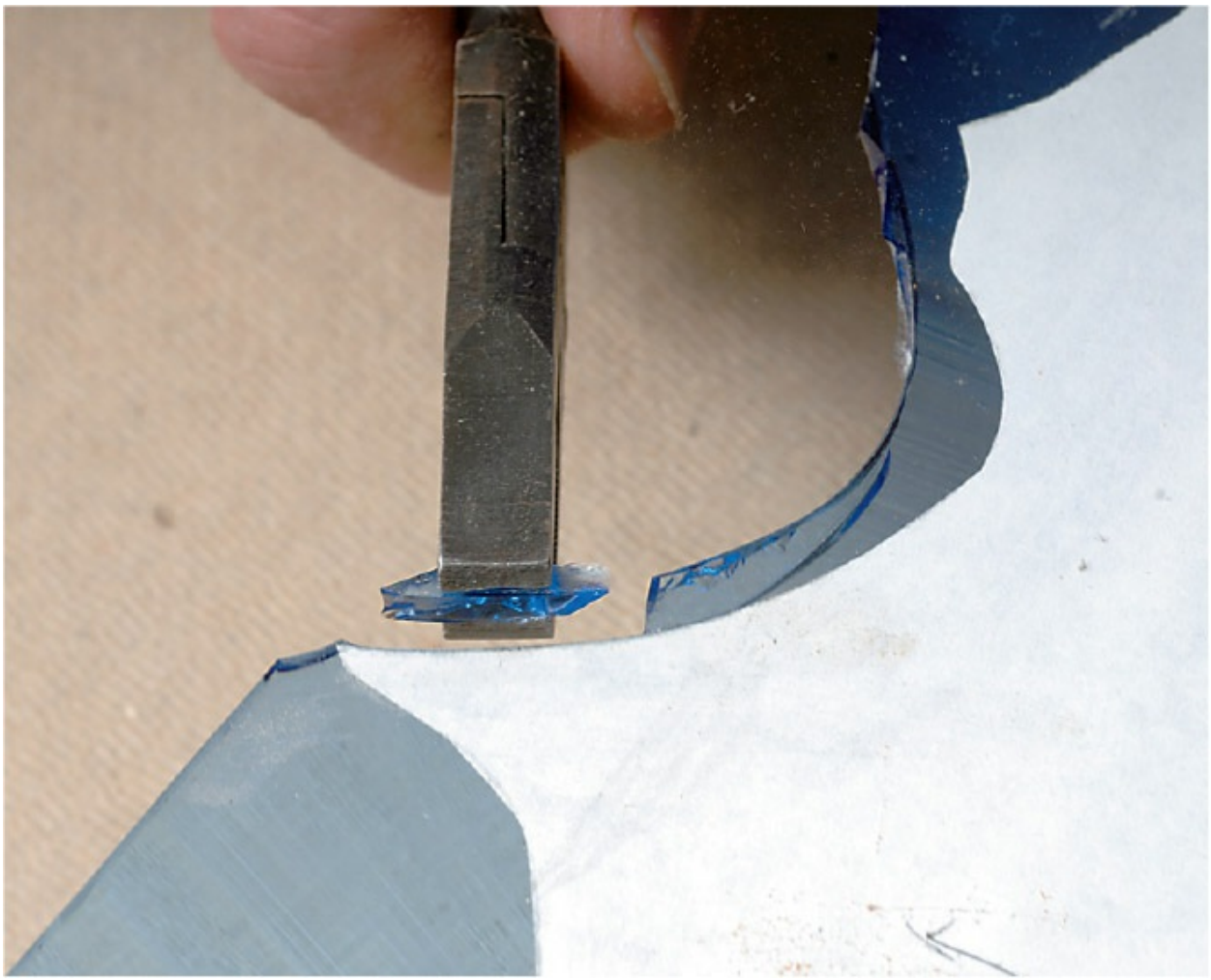
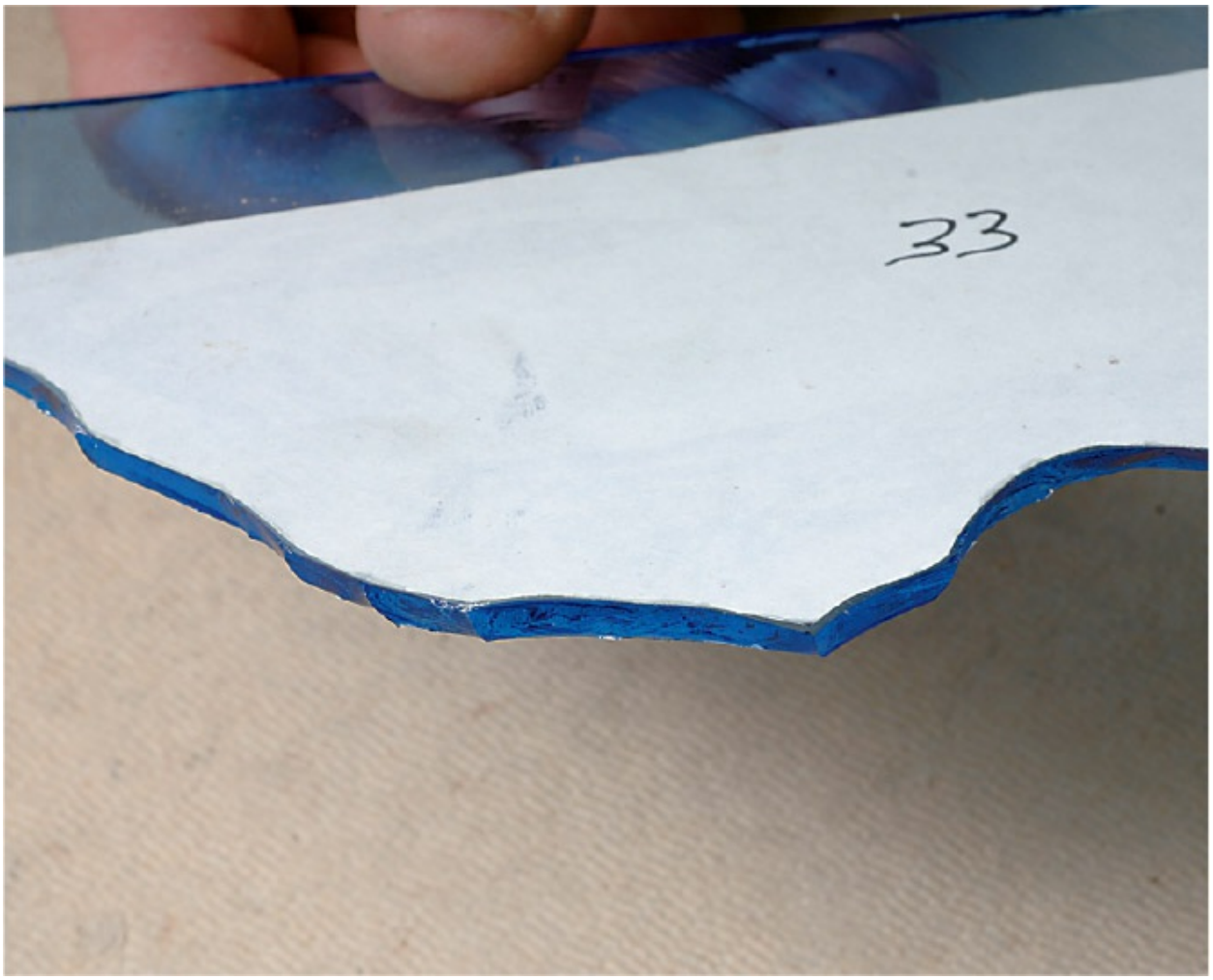
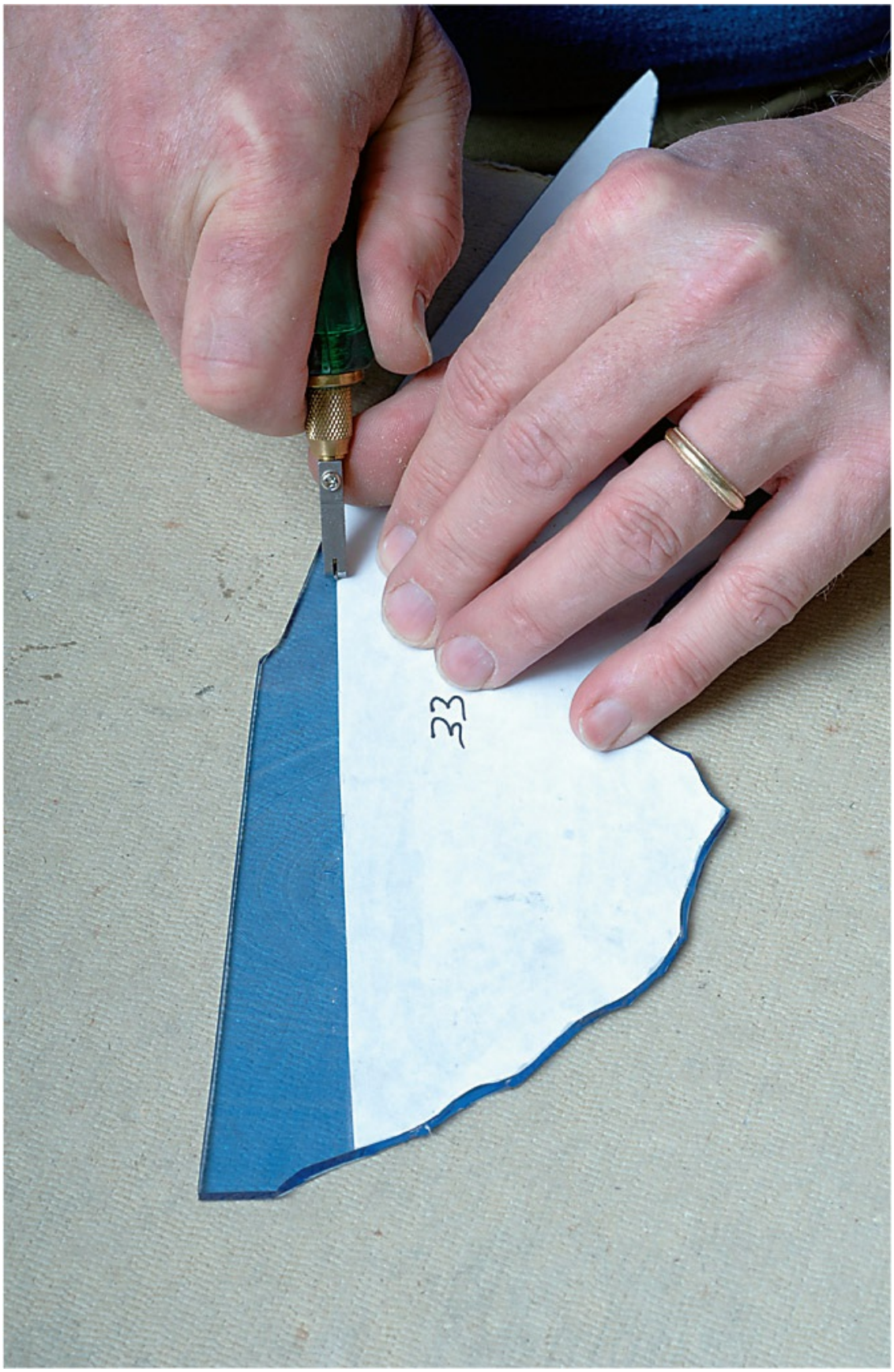


You can use handheld cutters to make deep curves and elaborate cuts if you work slowly and carefully. Remember that any glass cut in this method will need to be smoothed further with a grinder.



Of course, straight portions of a pattern can be scored with one long stroke and then broken off.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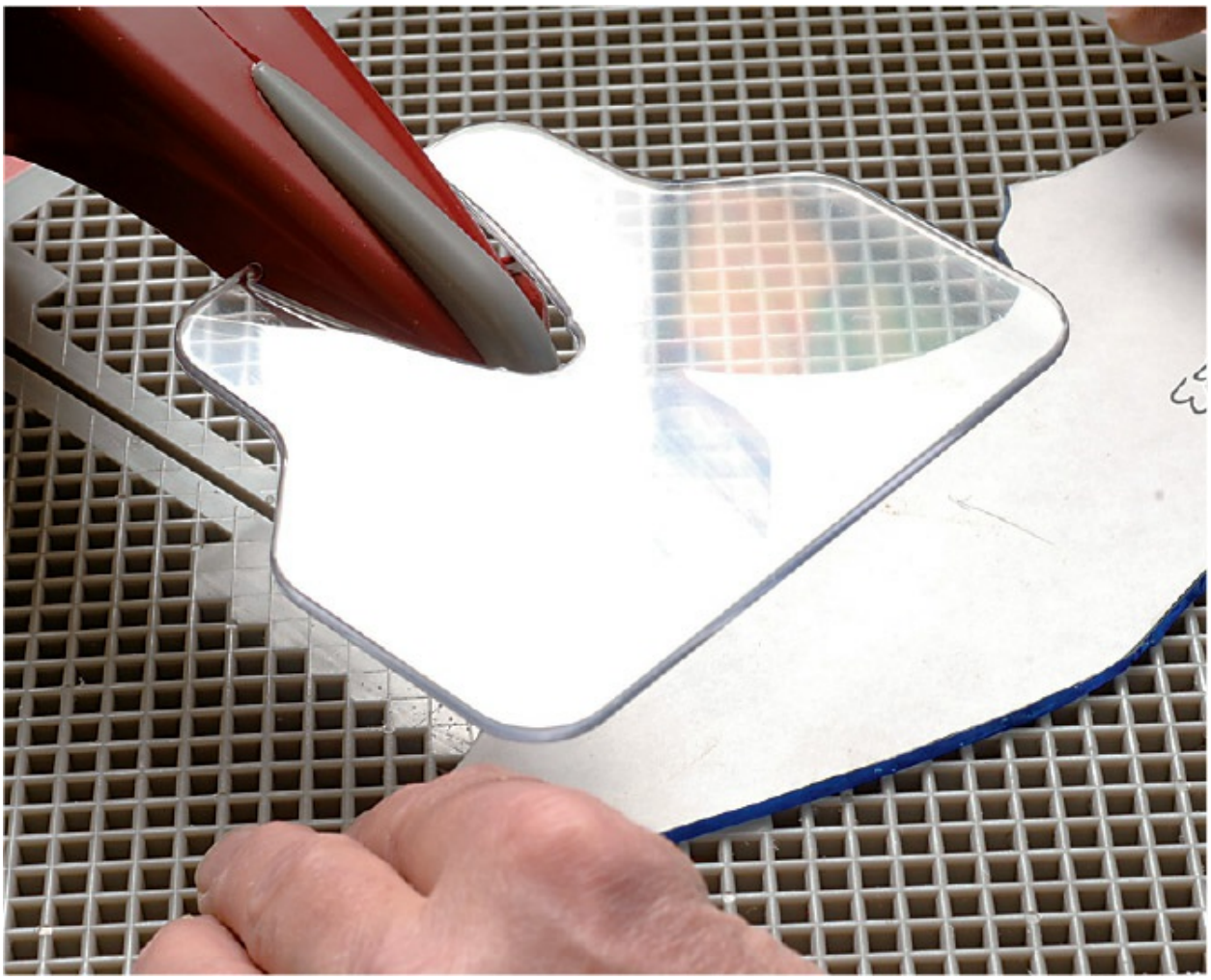
Using a Ring Saw

A ring saw can cut glass more easily than a handheld cutter can. It can also cut complicated curves and complex patterns. Most ring saws include an eye guard; most also have a refillable reservoir that holds water—this lubricates the blade during cutting.

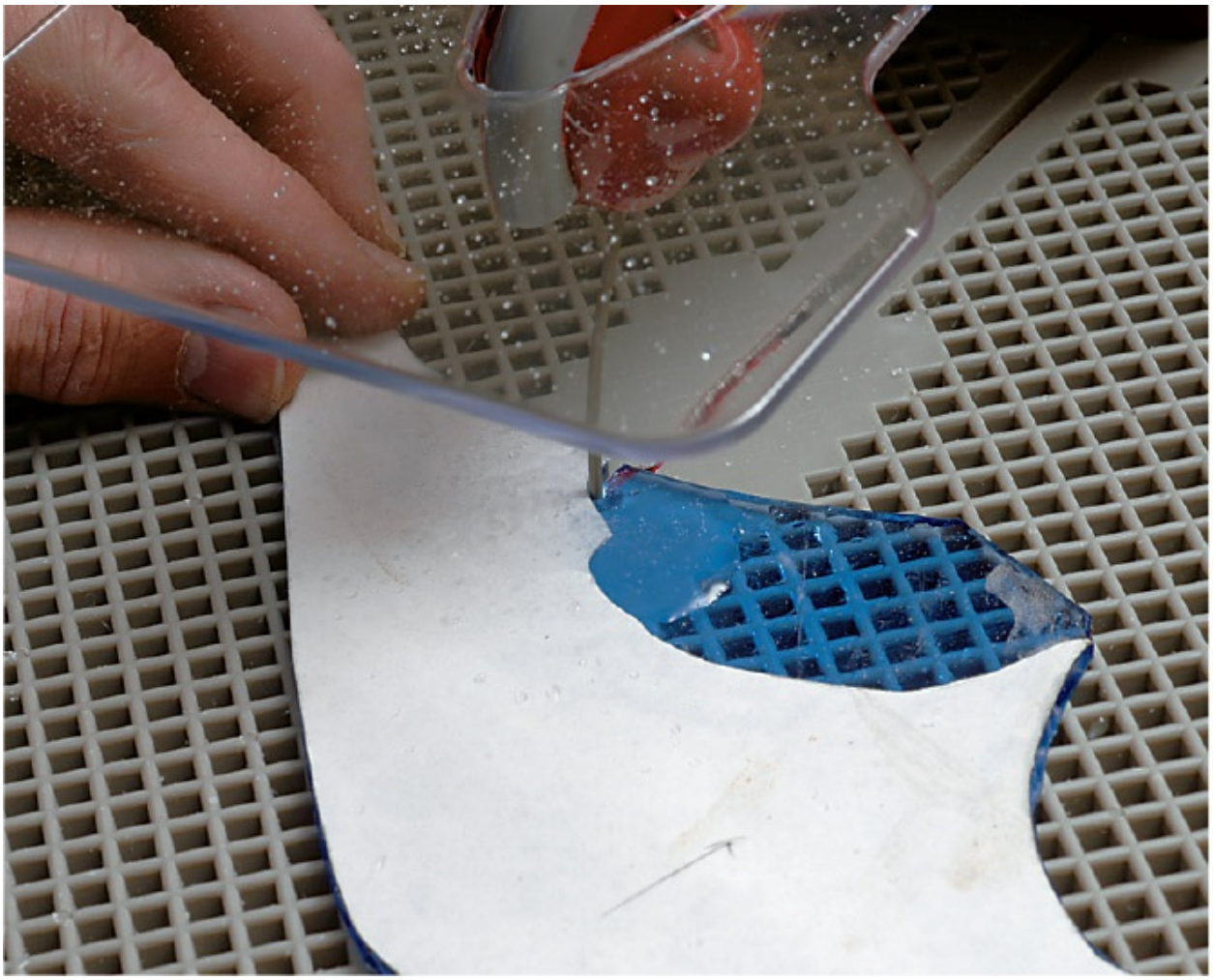
The first step is to fill the saw's tank with water, as directed.

Don’t overfill the tank.

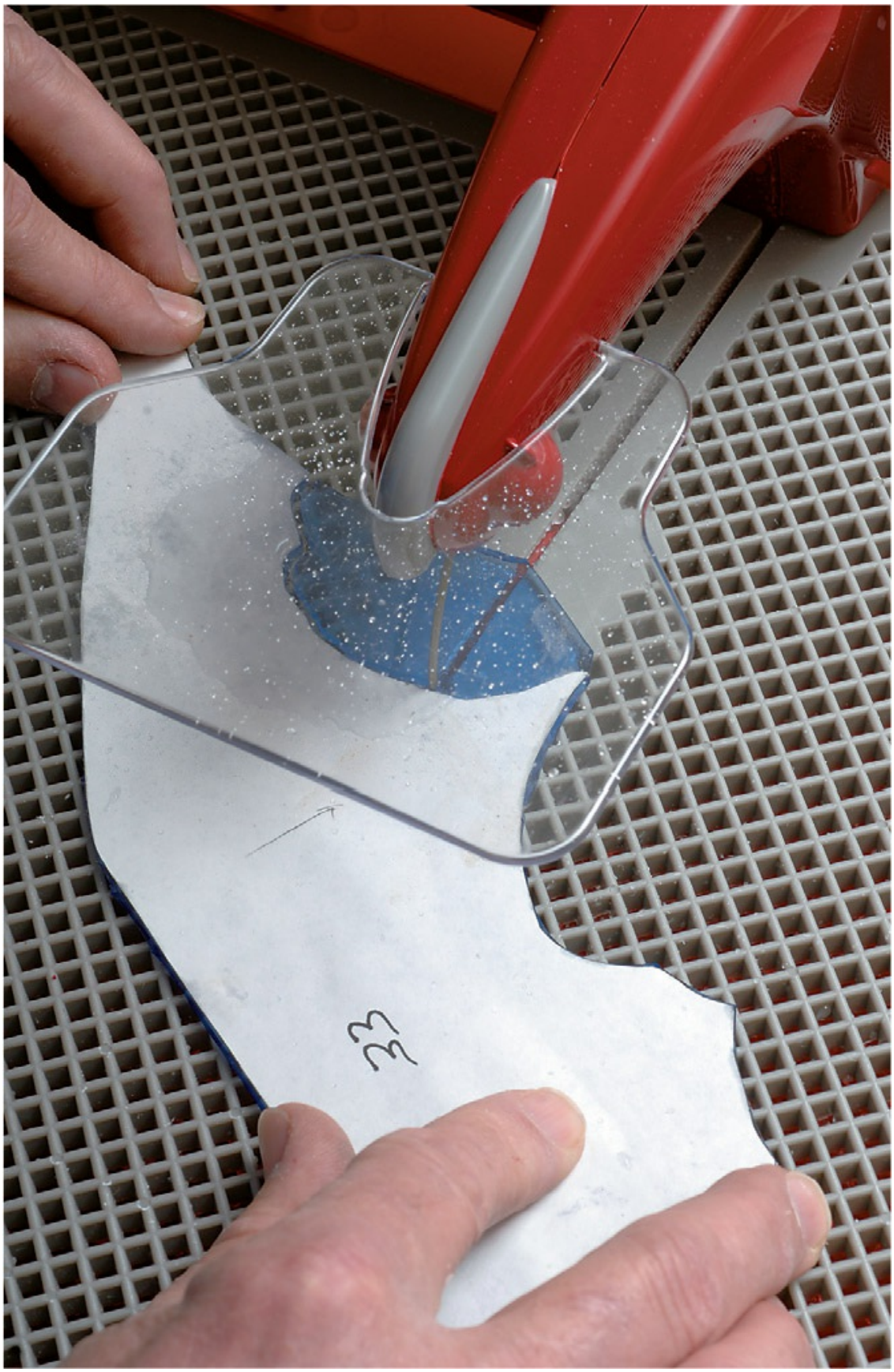
The saw's eye guard keeps spray and grit from hitting you in the face as you cut. Make sure the guard is in place before you do any cutting. You should also wear safety goggles.



Start the machine and then push the glass into contact with the blade. Never hold the glass against the blade before you turn the saw on. Because the ring saw blade is rounded and cuts on all sides, you can move the glass in any direction to get a smooth cut.



Move the glass slowly and steadily, keeping it flat on the work surface. With practice, you'll be able to follow just about any pattern line.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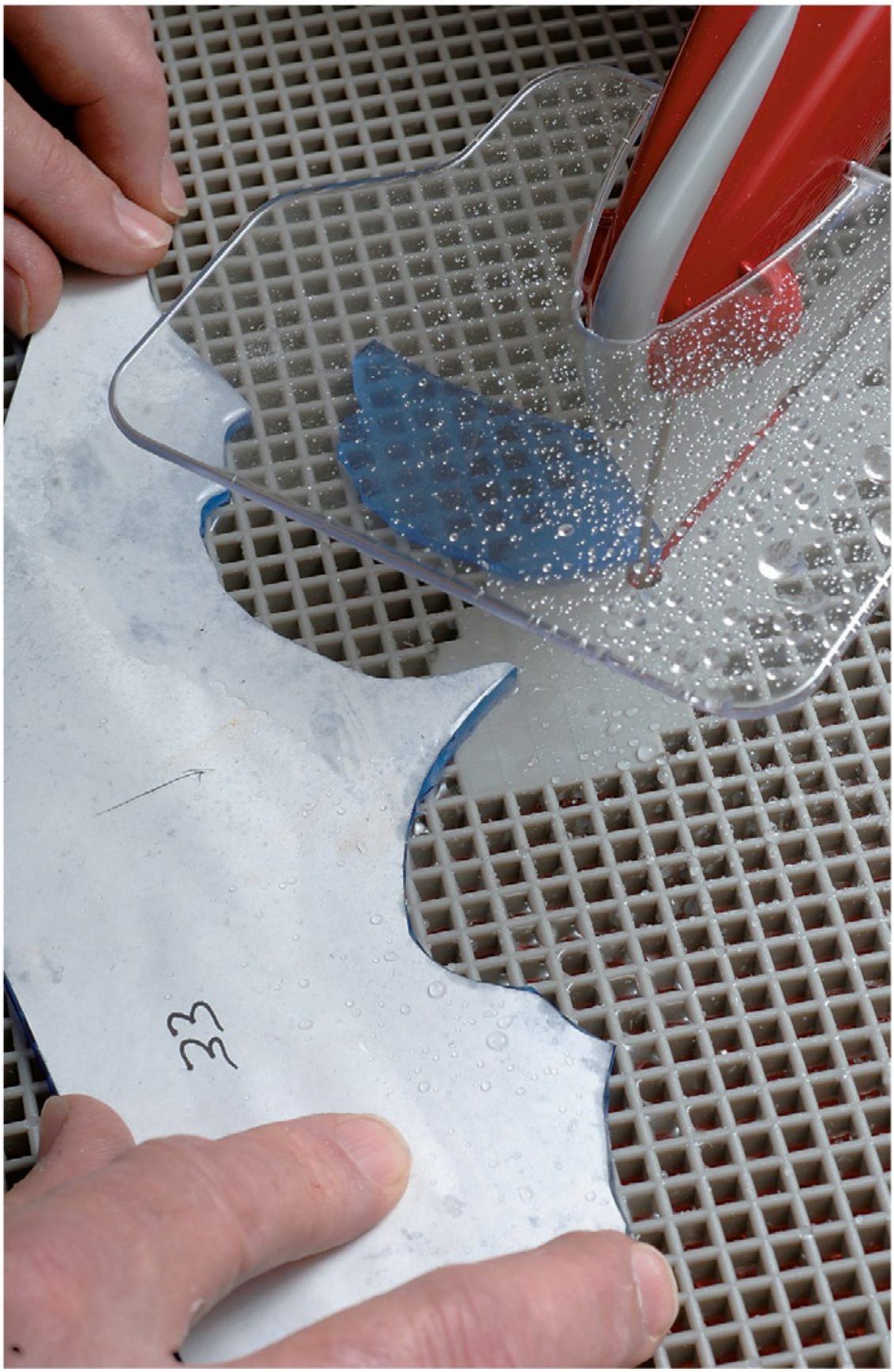
If the blade is sharp, the cut should be smooth and free from bumps and ridges. For best results, change your blade frequently, following the saw's instructions.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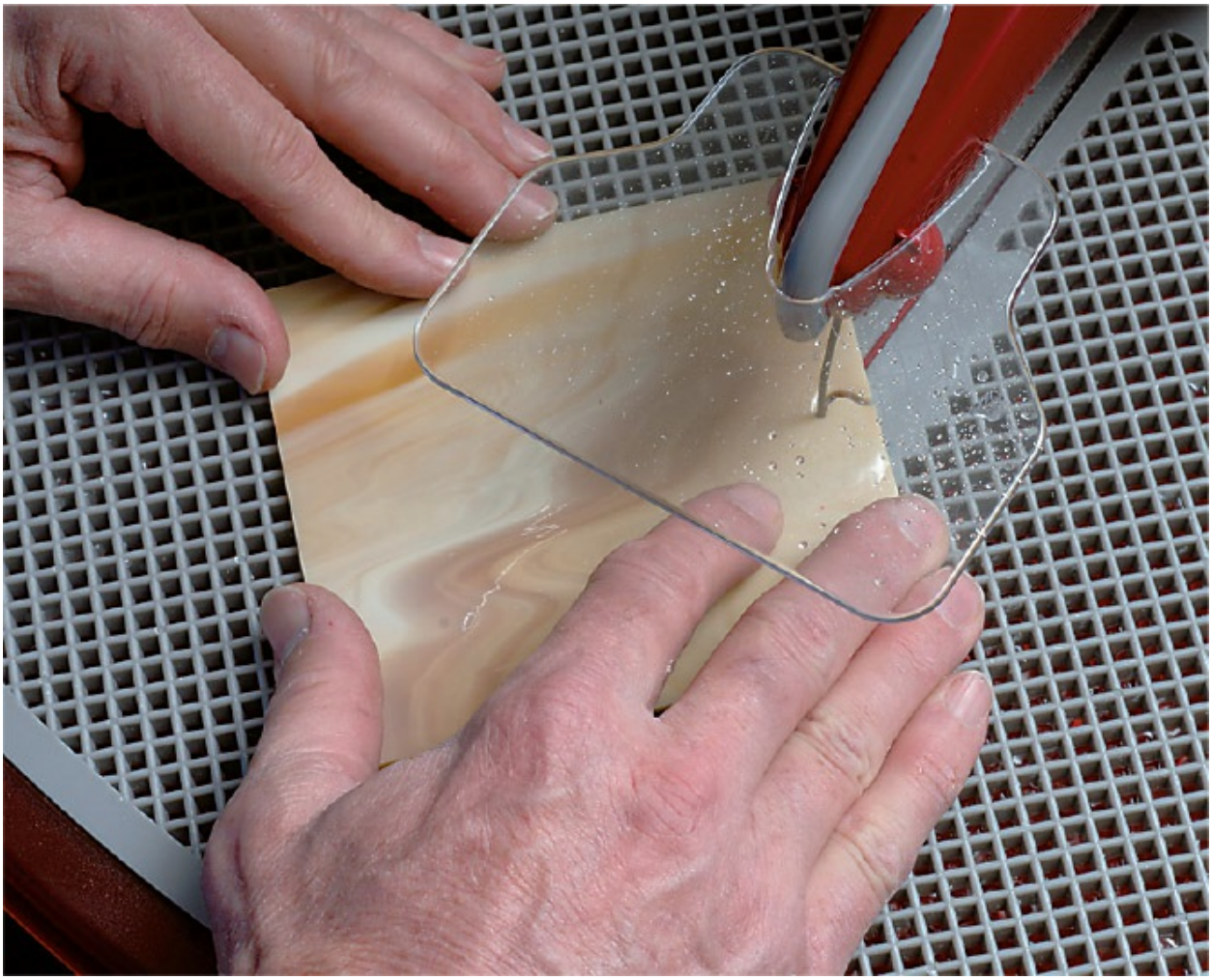
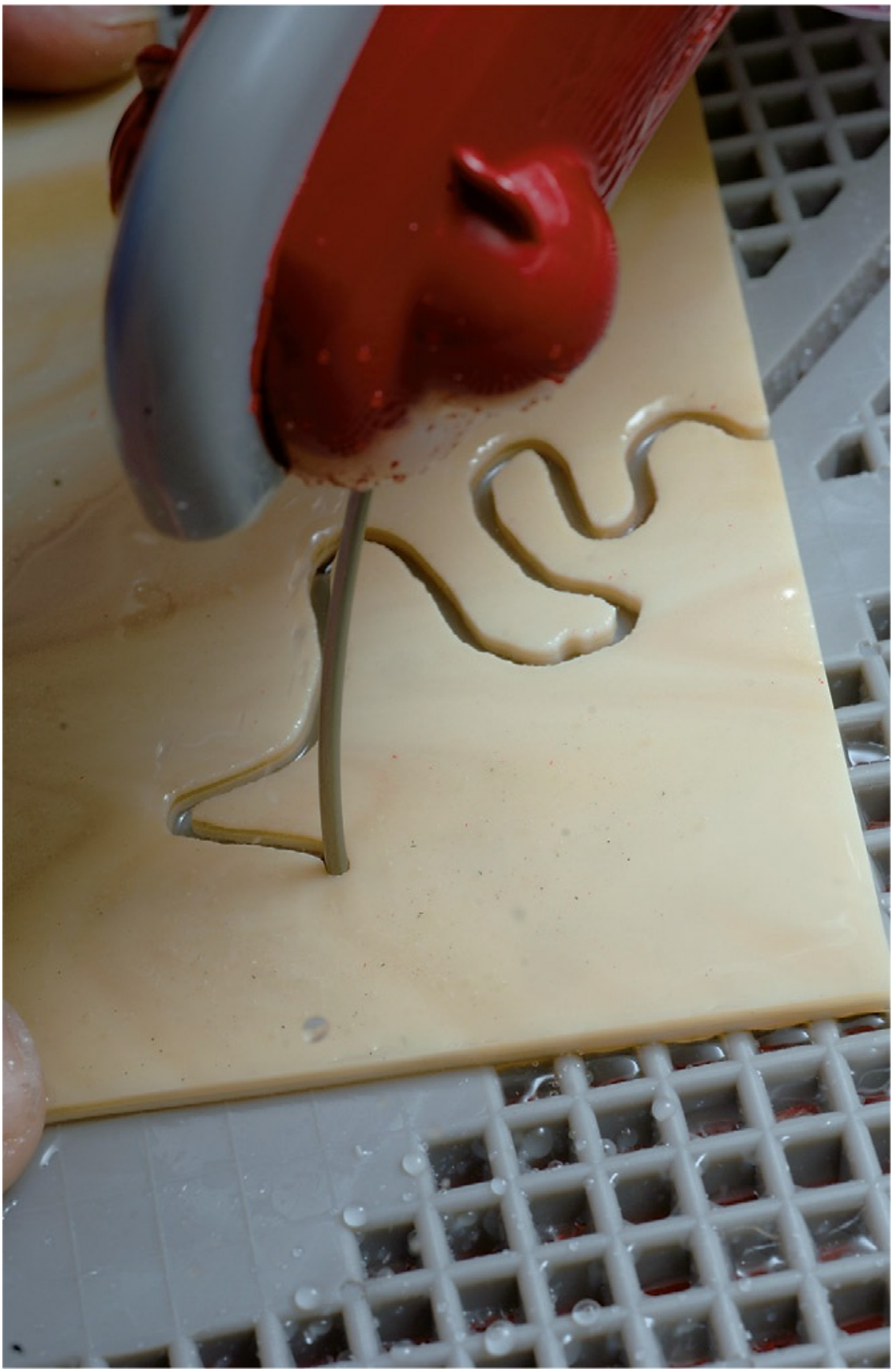
Practice on scraps of glass to get a good feel for how the saw works.



You don’t need to push or pull the glass hard against the blade.

A light touch works best.



A cut like this would take a long time to make using a handheld cutter.

As you work, the water level in the tank will drop. When it gets low, turn off the saw and refill the tank.

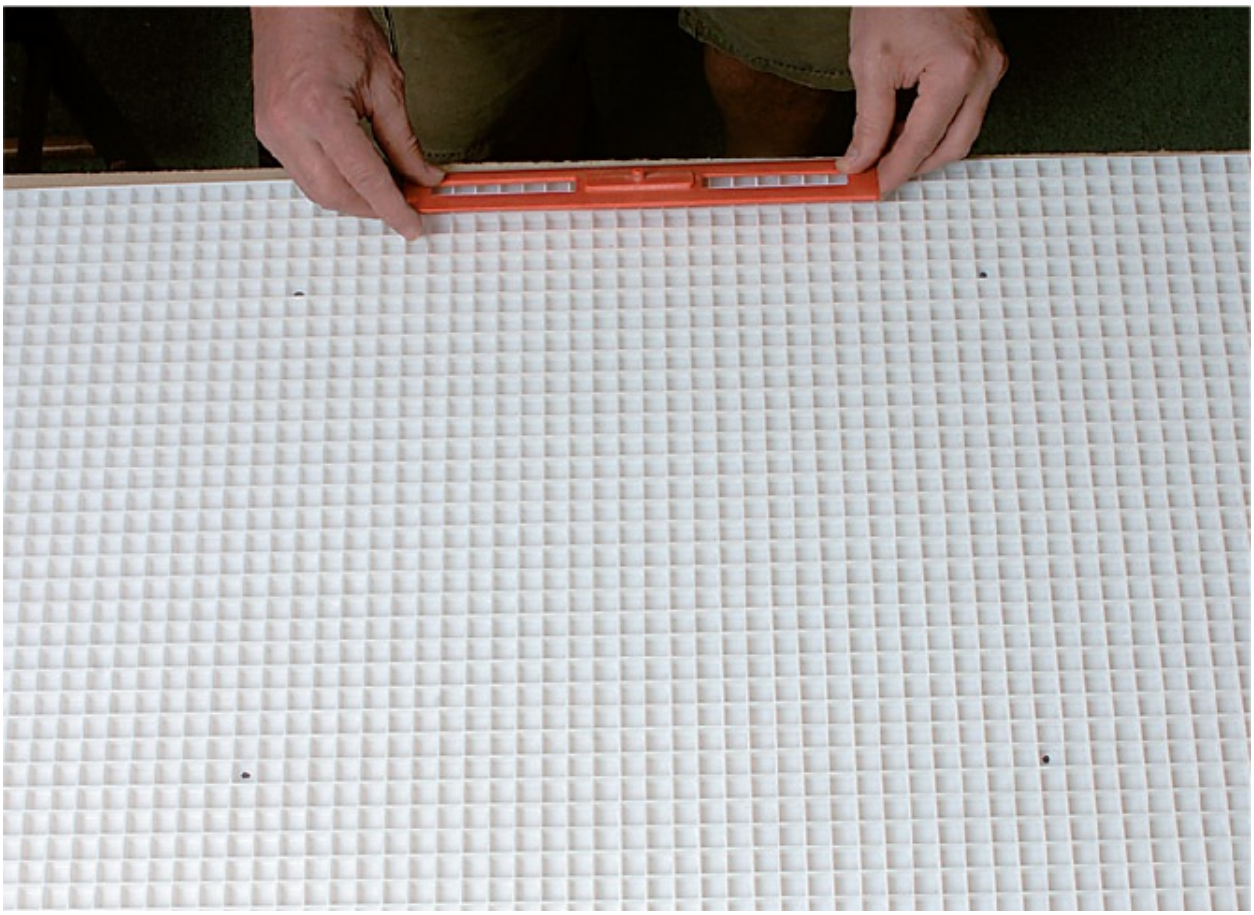
When you're finished cutting, empty the waste water into a container—don't dump it down the drain. The water contains grit—tiny bits of glass—that can harm plumbing and cause clogs.

Dump the water outside. Use it to water your plants.

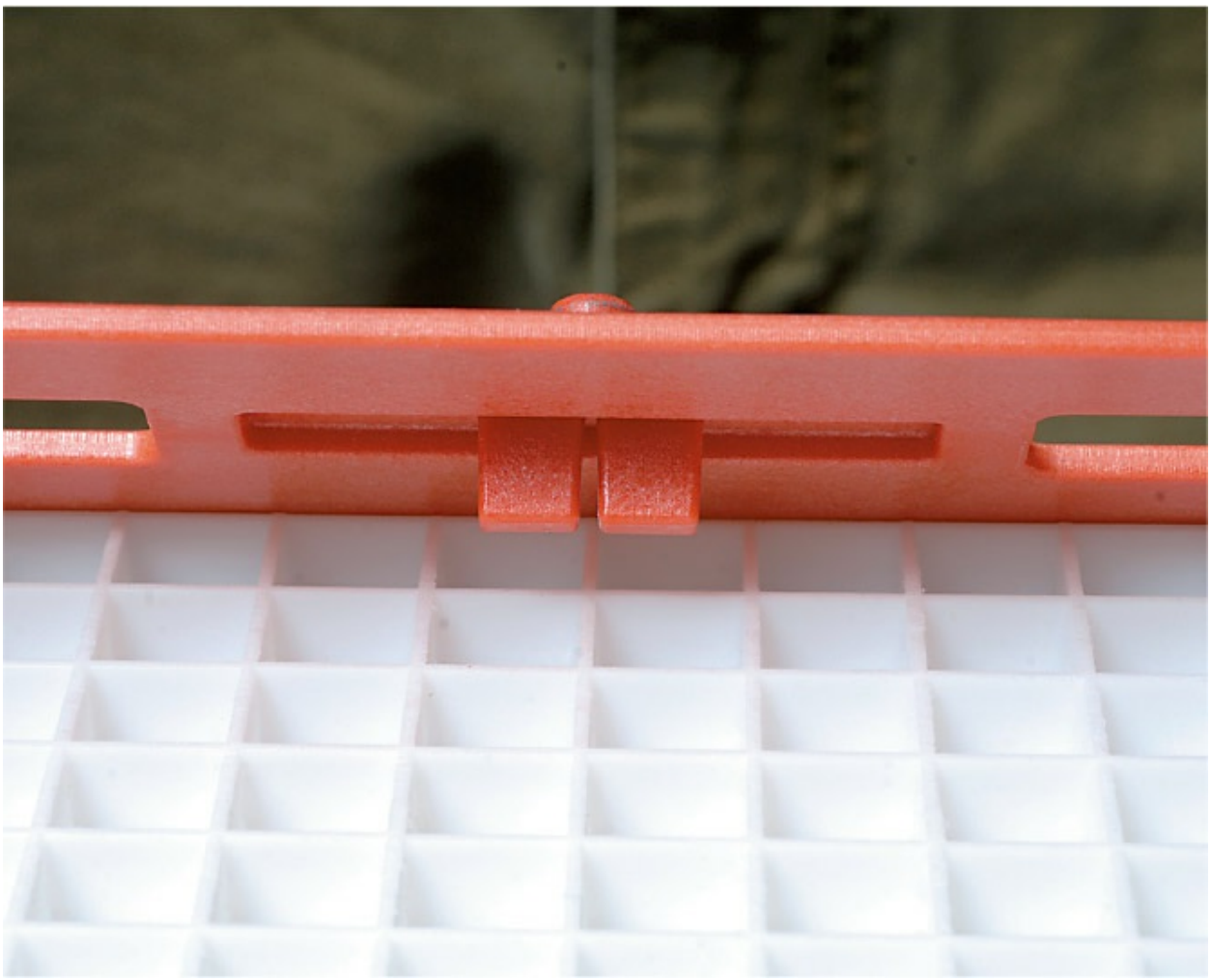
Using a Jig System to Cut Glass

A jig system makes cutting numerous straight or angled lines by hand accurate and easy. The system shown here is the Portable Glass Shop manufactured by Morton Glass Works. It includes a base made of numerous cells (helpful to catch and hold bits of glass) as well as a cutting bar and ounting pieces, adjustable glass stops, and a copy angle.

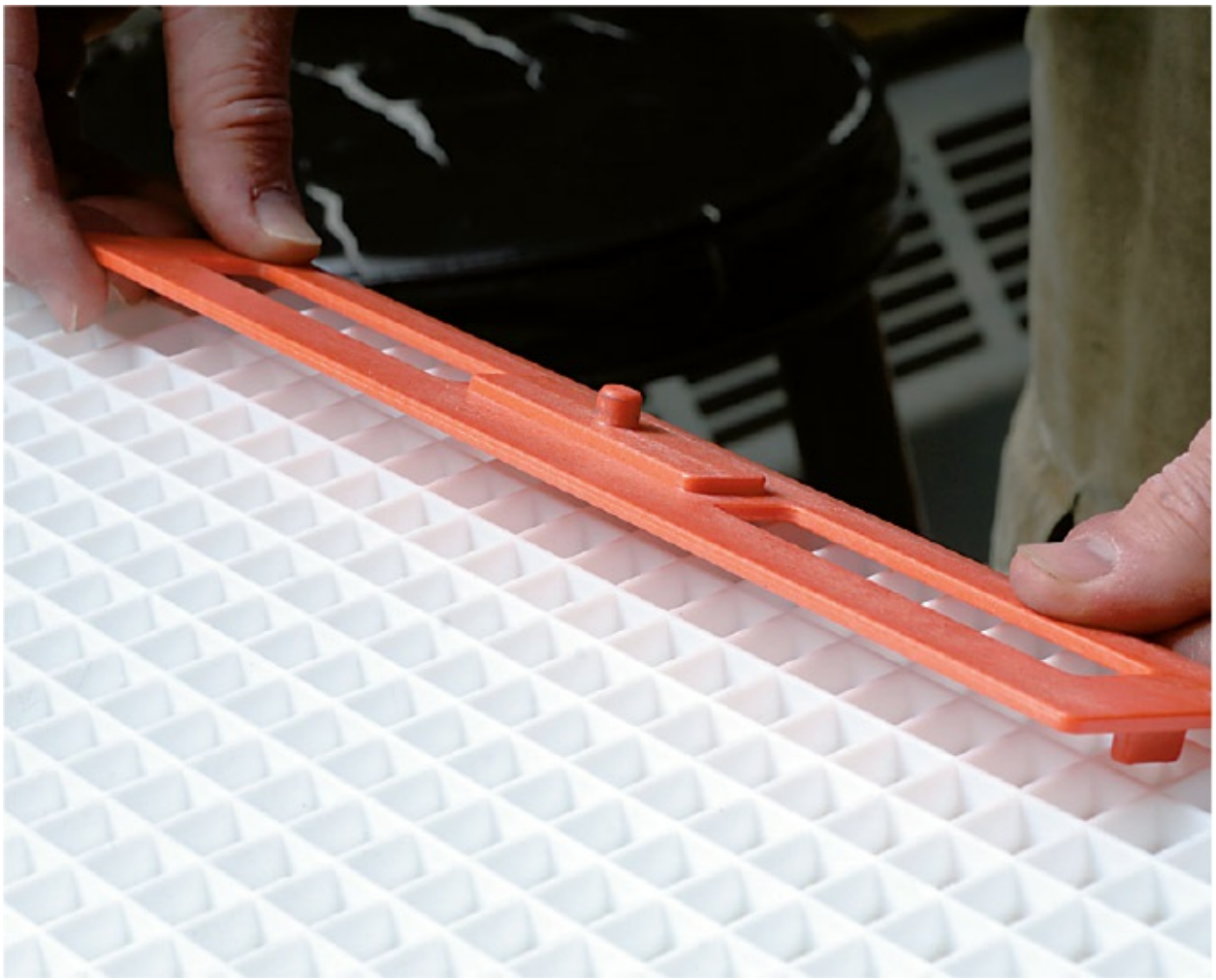
To set up the system, place the squaring fence on the board in the row nearest you, as shown.



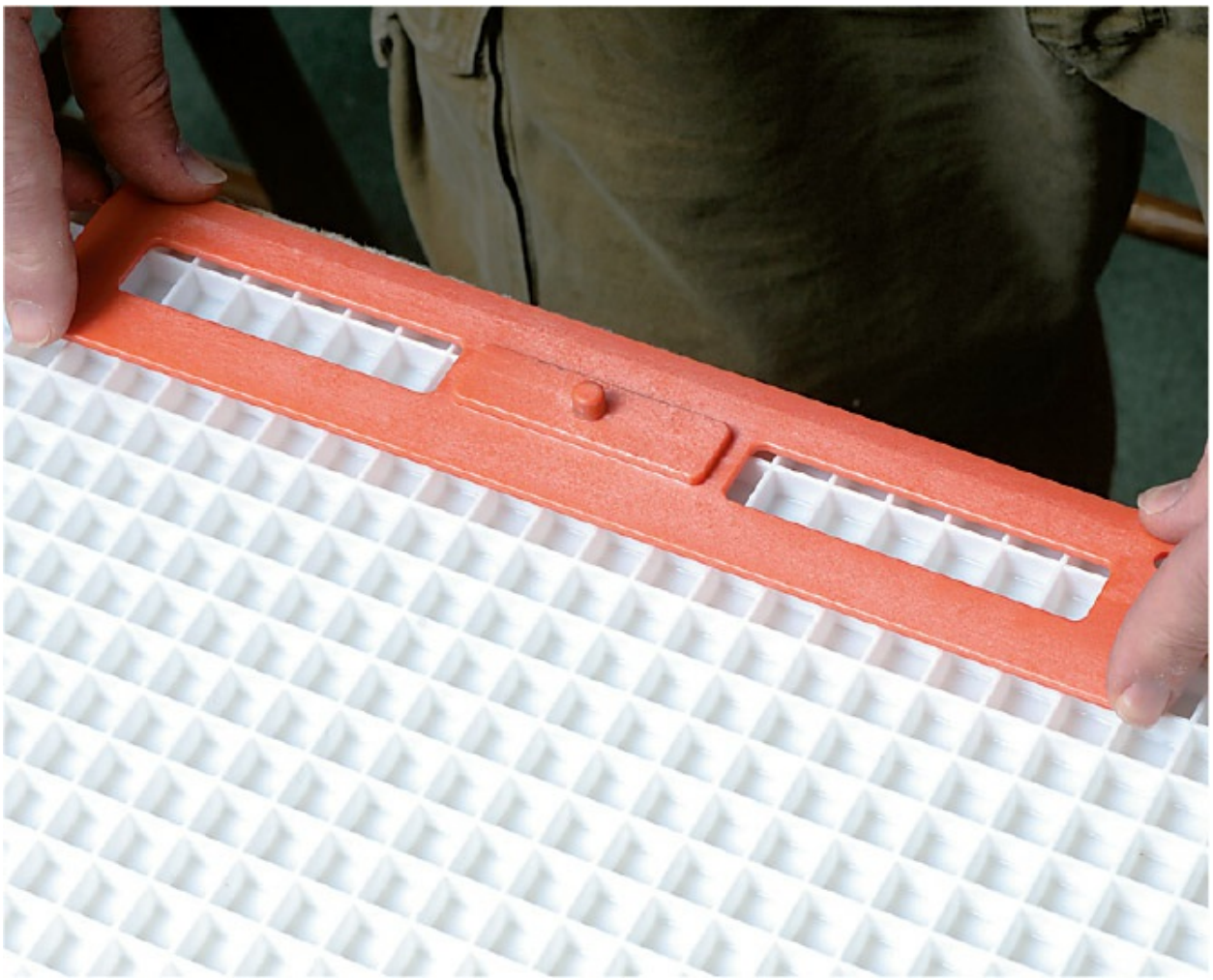
In the center of the squaring fence is a grooved tab that fits over the sides of one of the board’s cells.



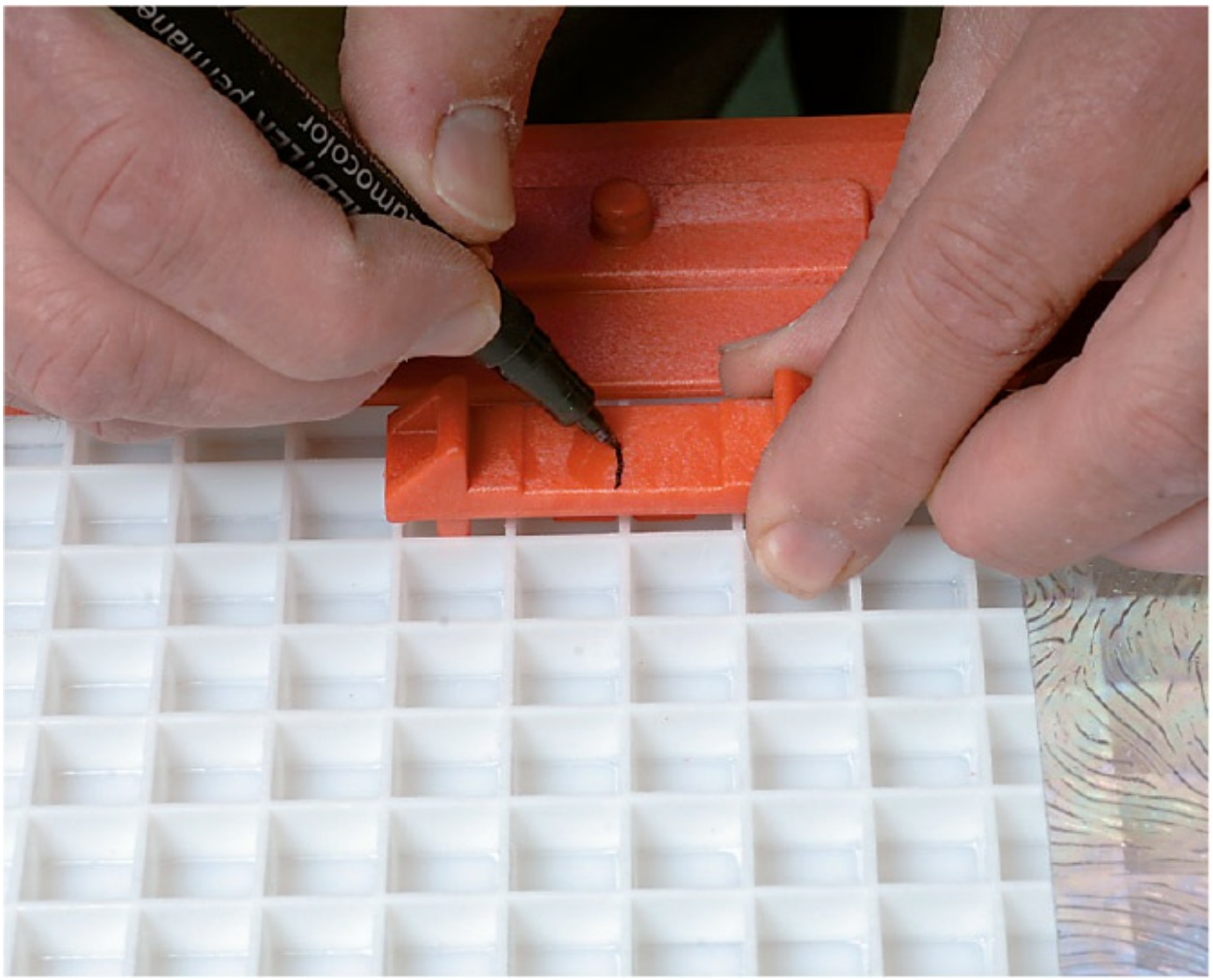
The tabs at each end of the squaring fence fit into a cell.



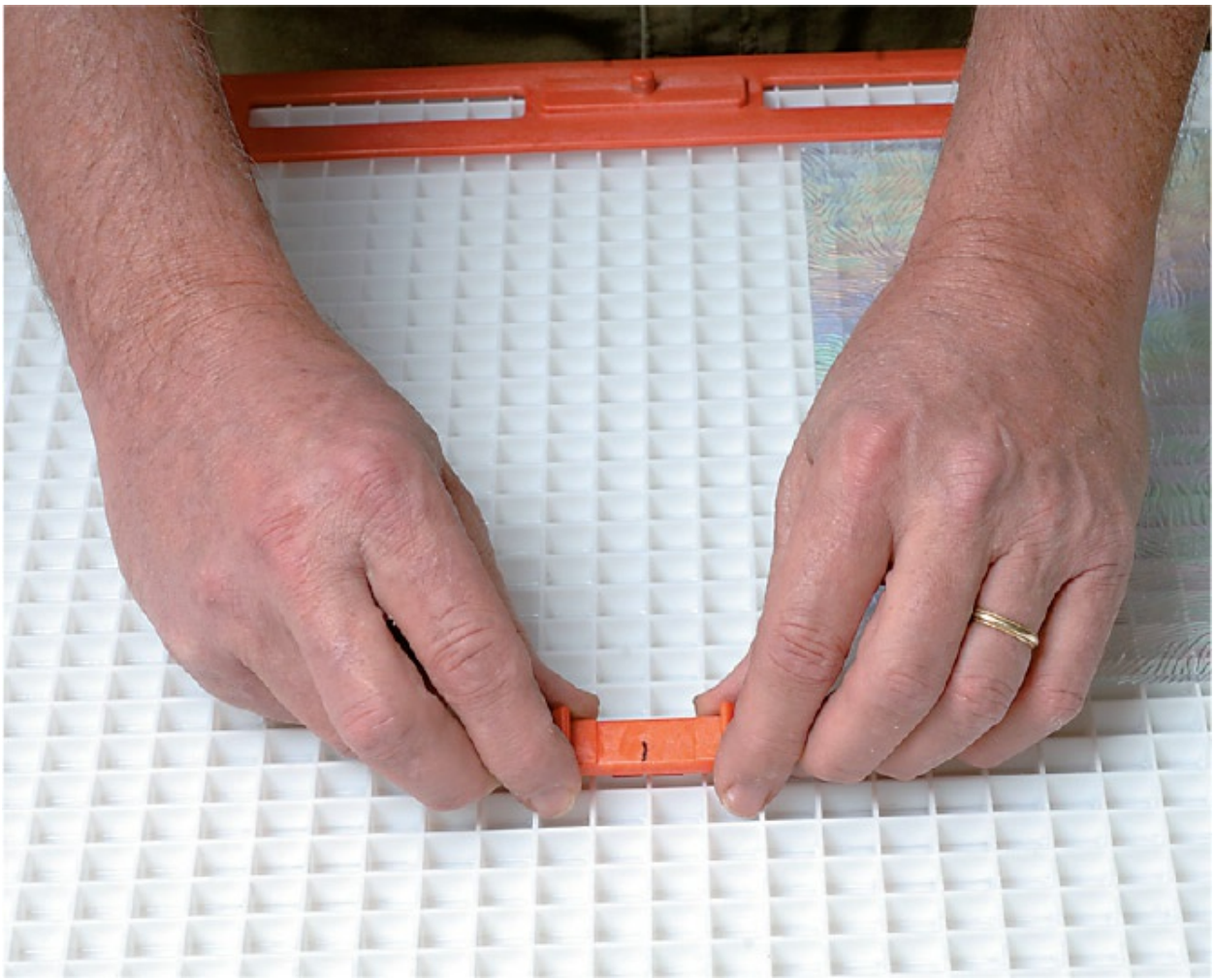
When it’s positioned correctly, press the squaring fence into the board so it snaps into place.



Place the squaring block alongside the squaring fence so it is centered on the fence's button. It's helpful to make a mark on the squaring block that lines up with the row of cell sides that hits its middle.

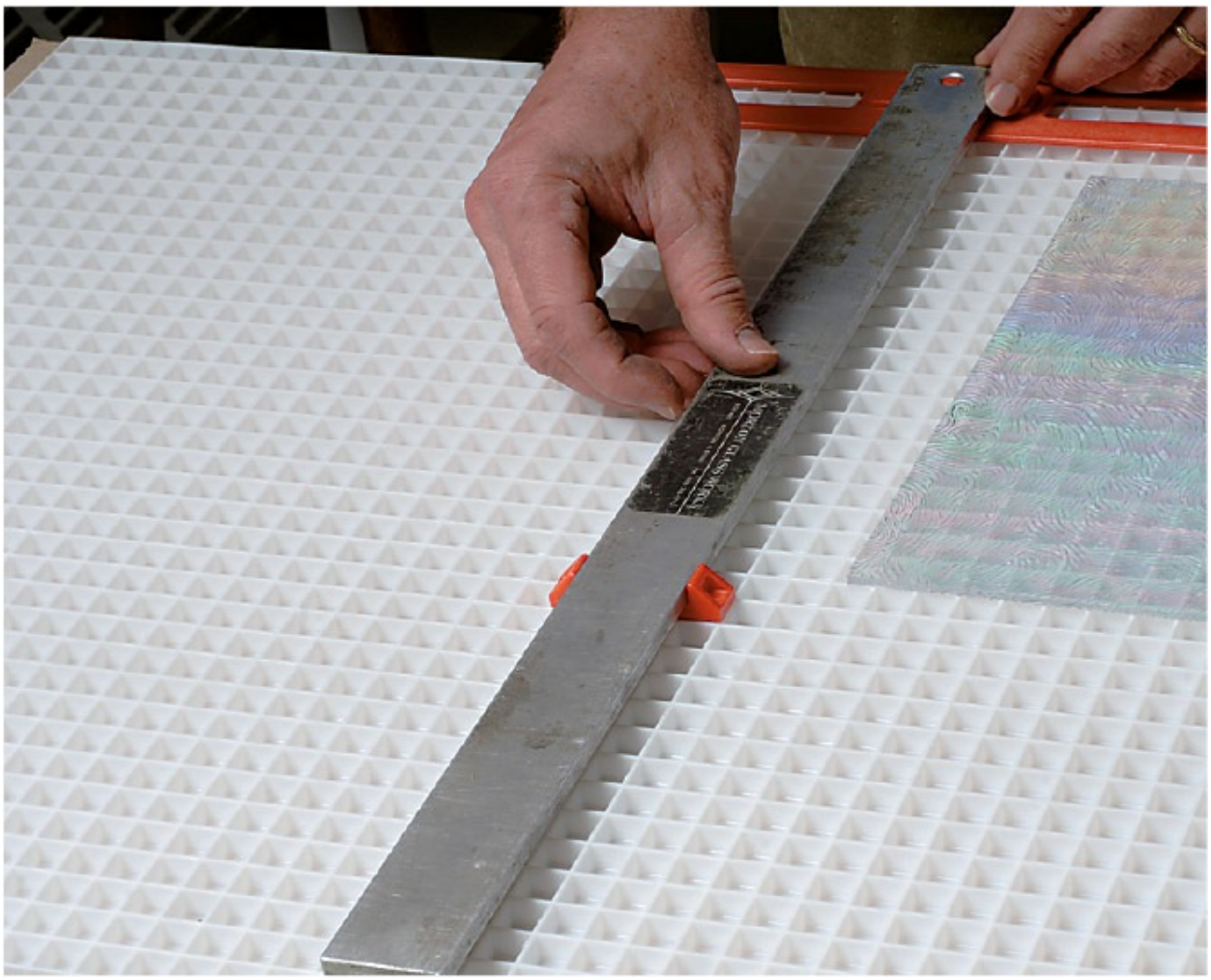


Pick up and reposition the squaring block away from the fence, keeping the mark in line with the cell-side line, and snap it into place. The distance away from the fence should be a little less than the length of the cutting bar.

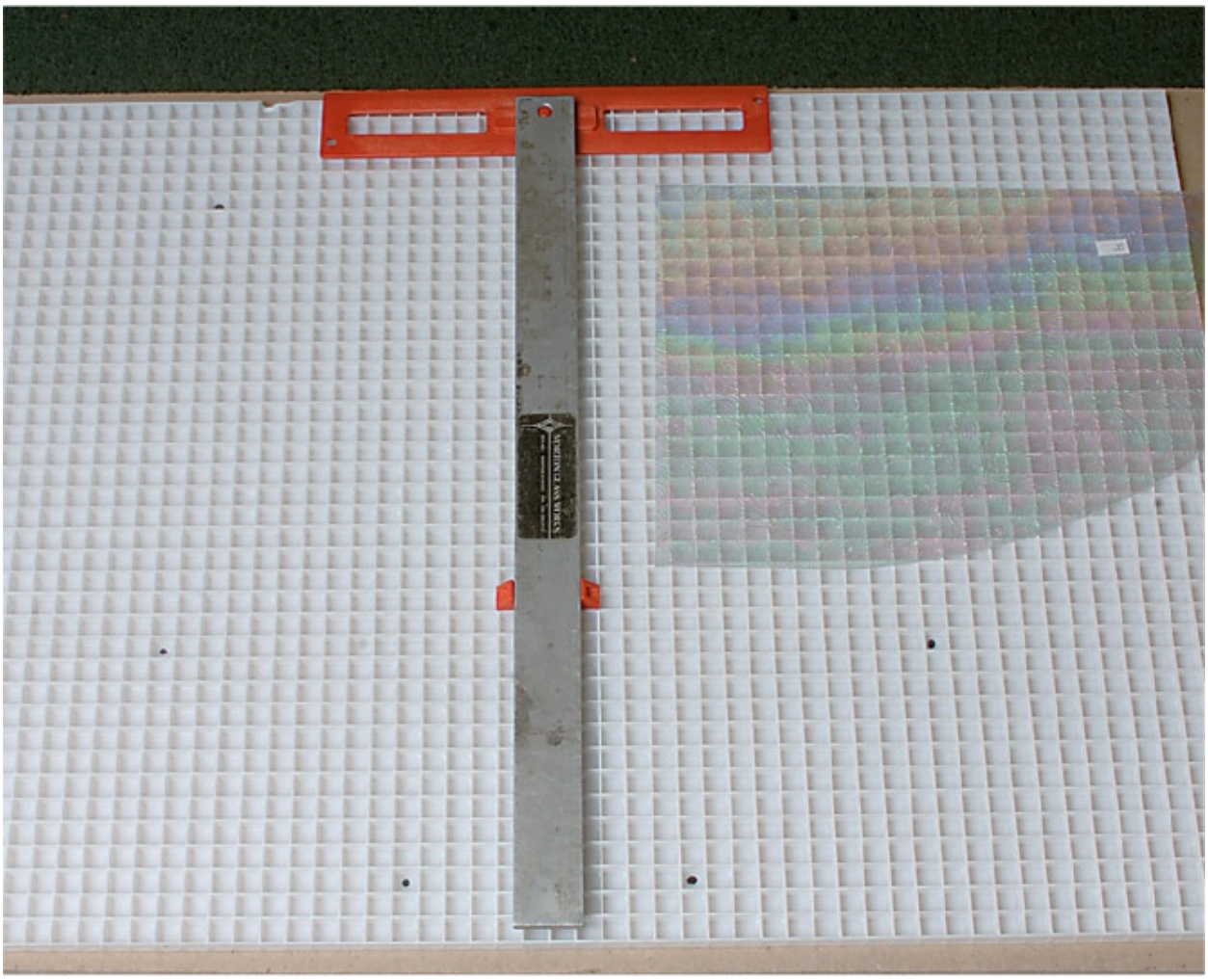


Fit the hole on the cutting bar onto the fence’s button, as shown.

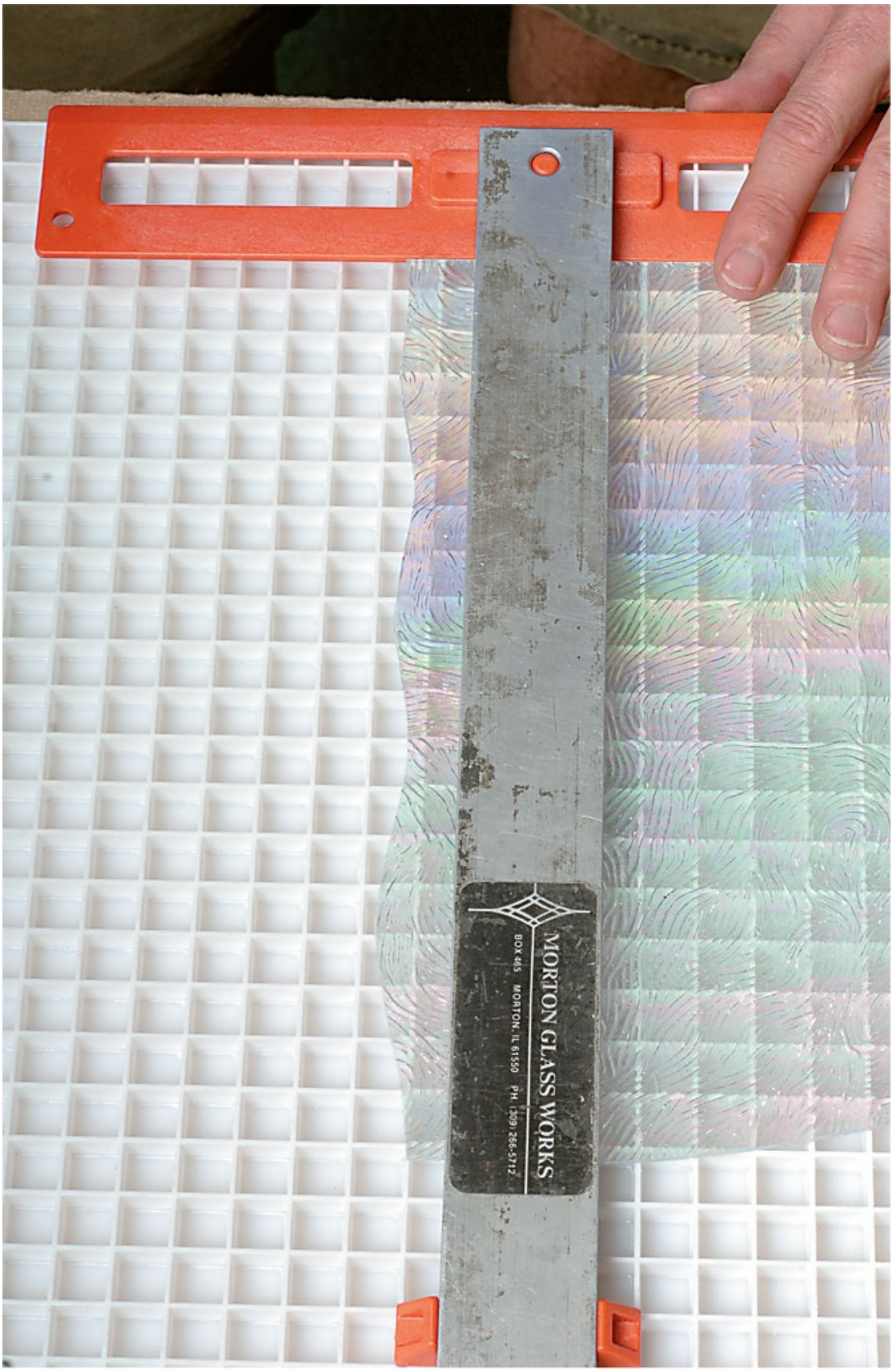
Lay the bar flat so it fits into the squaring block.



The correctly positioned system will allow you to make perfectly straight cuts perpendicular to the straight edge of a piece of glass.



Uncut glass sheets usually have straight edges; however, you might have to use the jig to put straight edges on the glass so the system works properly. To do so, slip the glass underneath the cutting bar so the edge you want to cut is to the right side of the bar. (If you are left-handed, you will want to do your cutting on the left side of the bar.)


MORTON GLASS WORKS
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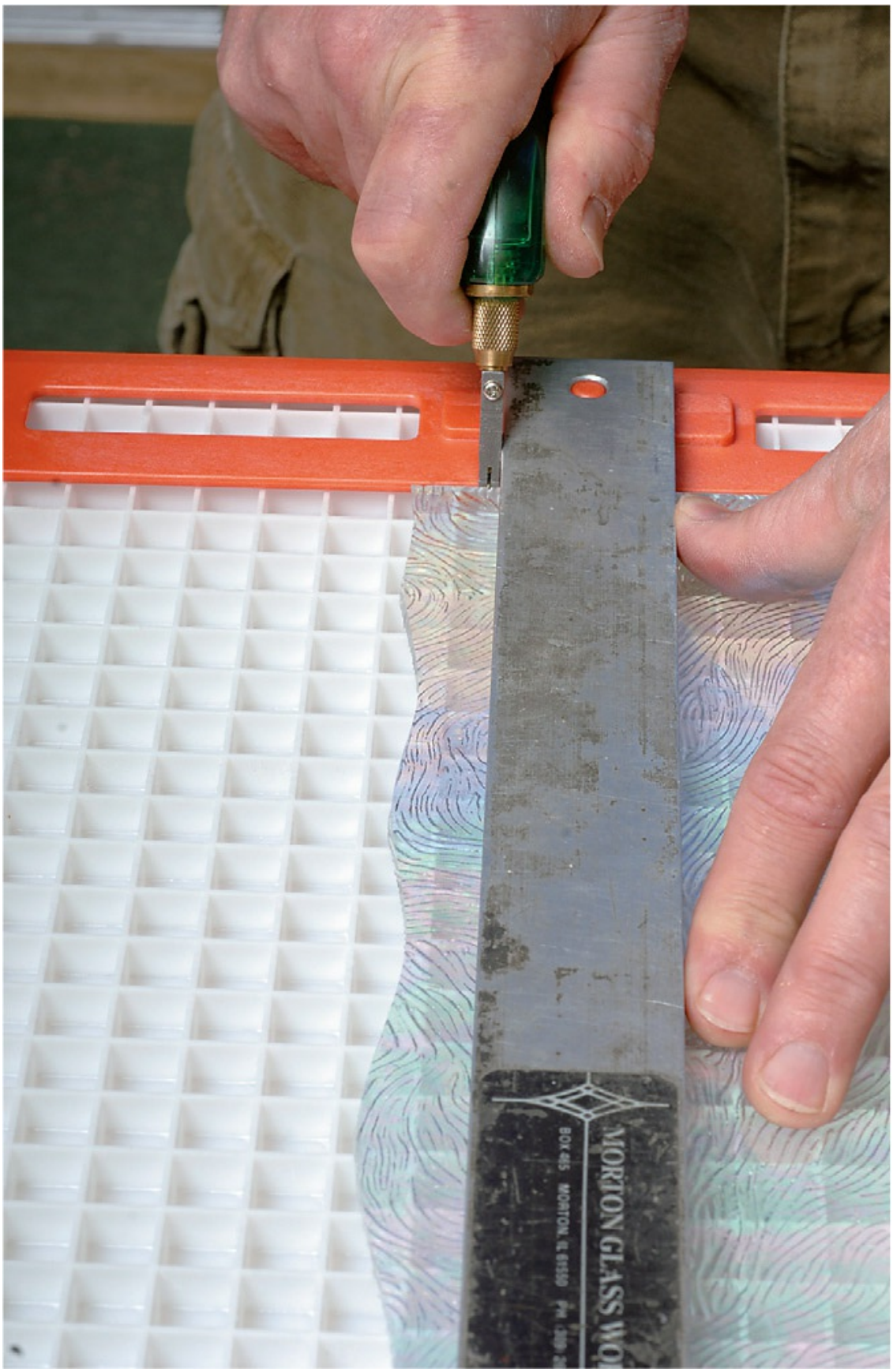
Hold the glass in place with one hand and run the glass cutter along the cutting bar with the other. Make sure you keep the cutter upright and pressed against the edge of the bar.

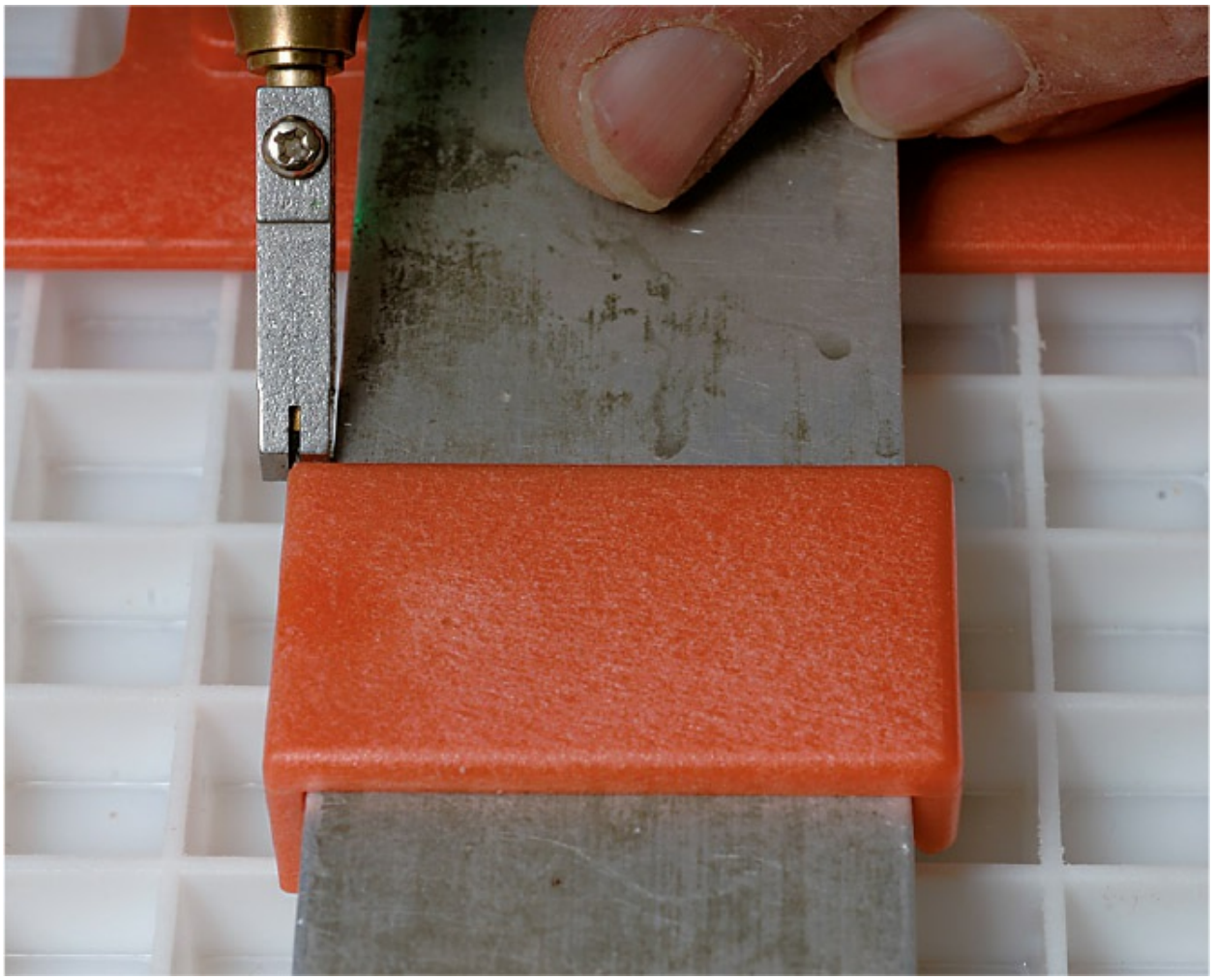

MORTON GLASS WO

Remove the glass and snap it with breaking pliers. Score and snap one of the edges perpendicular to the edge you just cut so that you have at least one perfectly squared corner on the glass sheet.

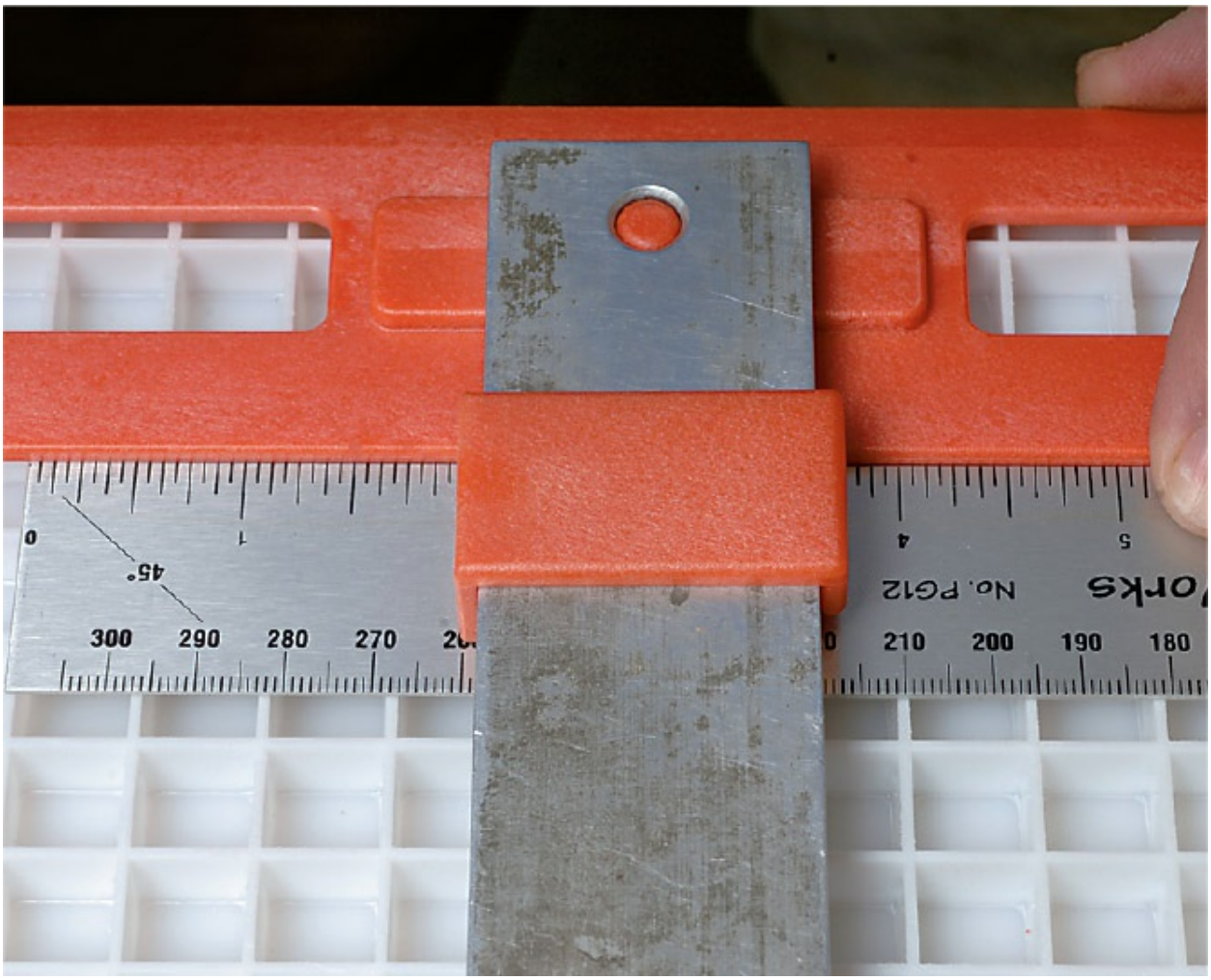
Place the cutter gauge on top of the cutting bar, alongside the squaring fence. Note that the gauge has two legs—one long and one short.

The longer leg should go along the cutting edge of the bar.

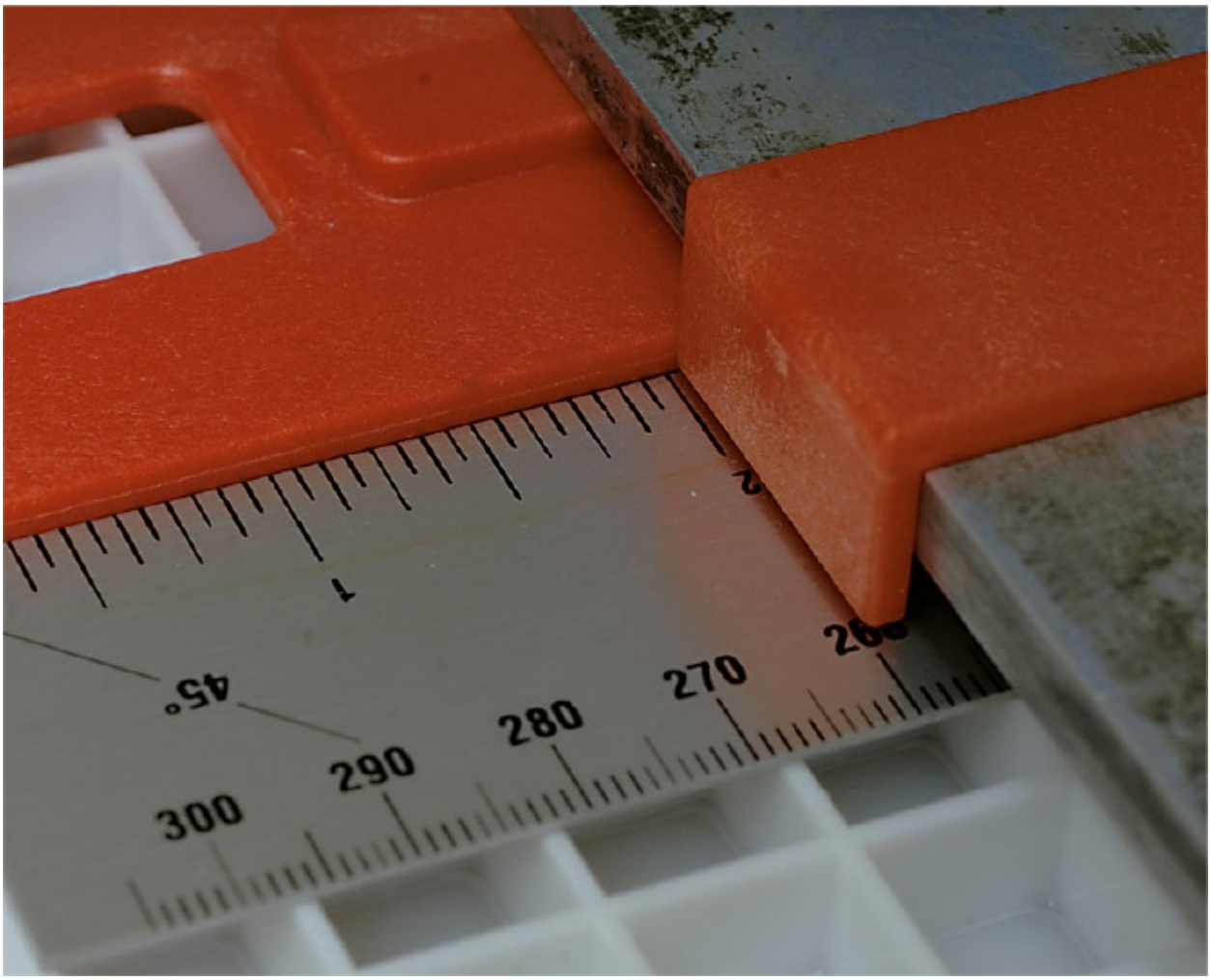
The gauge compensates for the gap between the rolling blade of the cutter and the edge of the cutting bar.



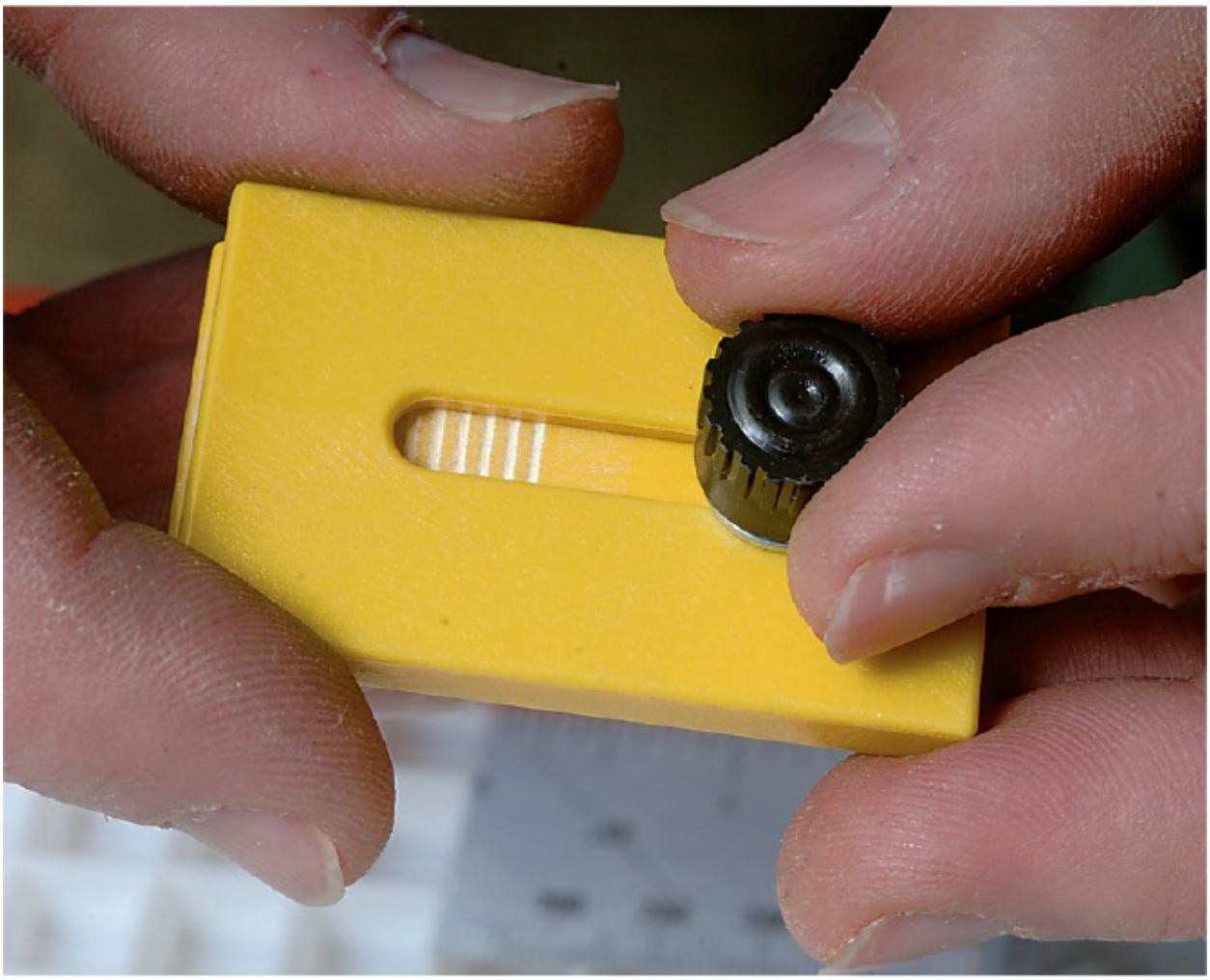
For the lampshade project in chapter 5, you will need to cut a number of strips that are all 2 inches wide.



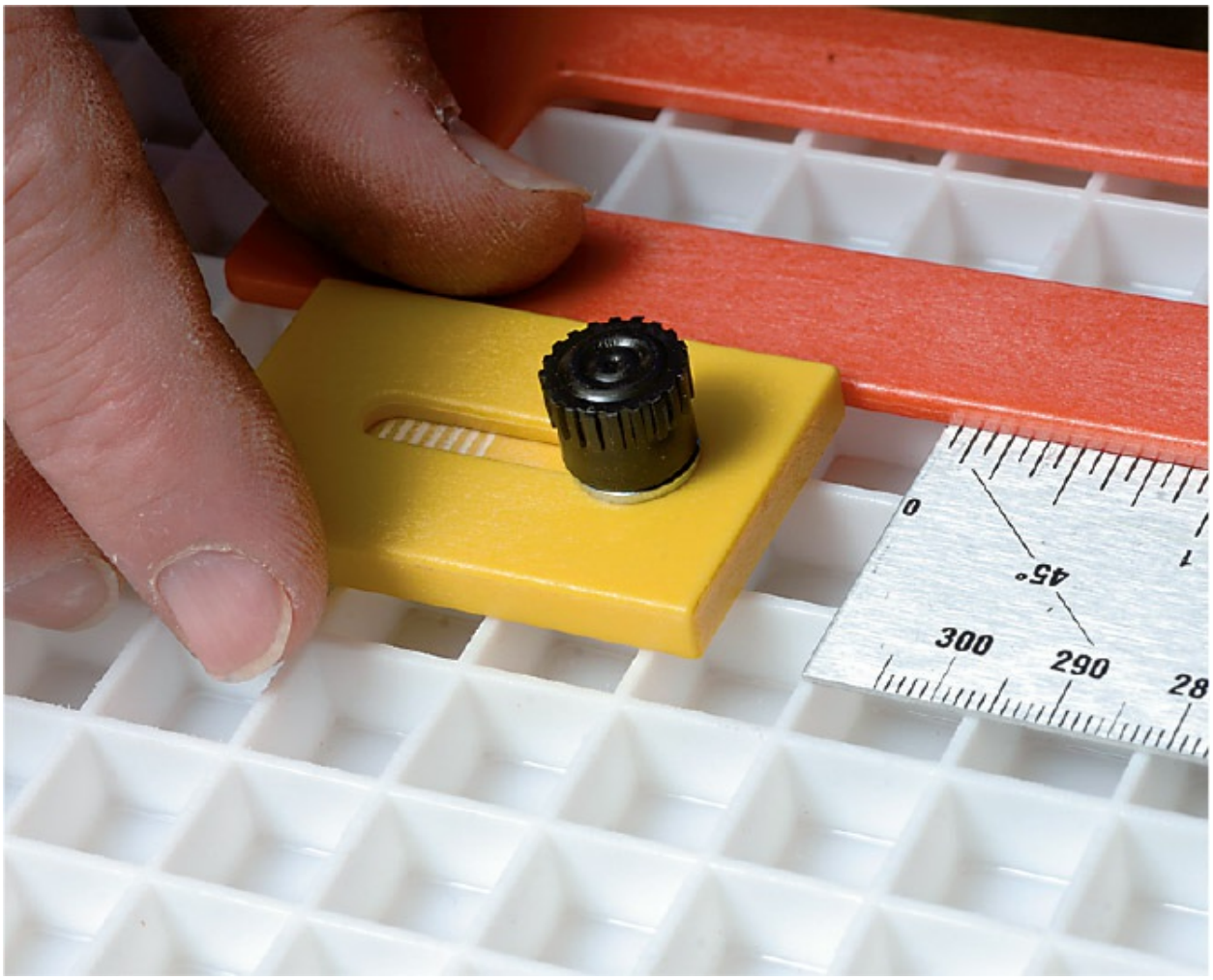
To set the system to do this, slide a ruler underneath the cutting bar and alongside the squaring fence until the end of the second ruler is exactly 2 inches from the side of the cutter gauge.



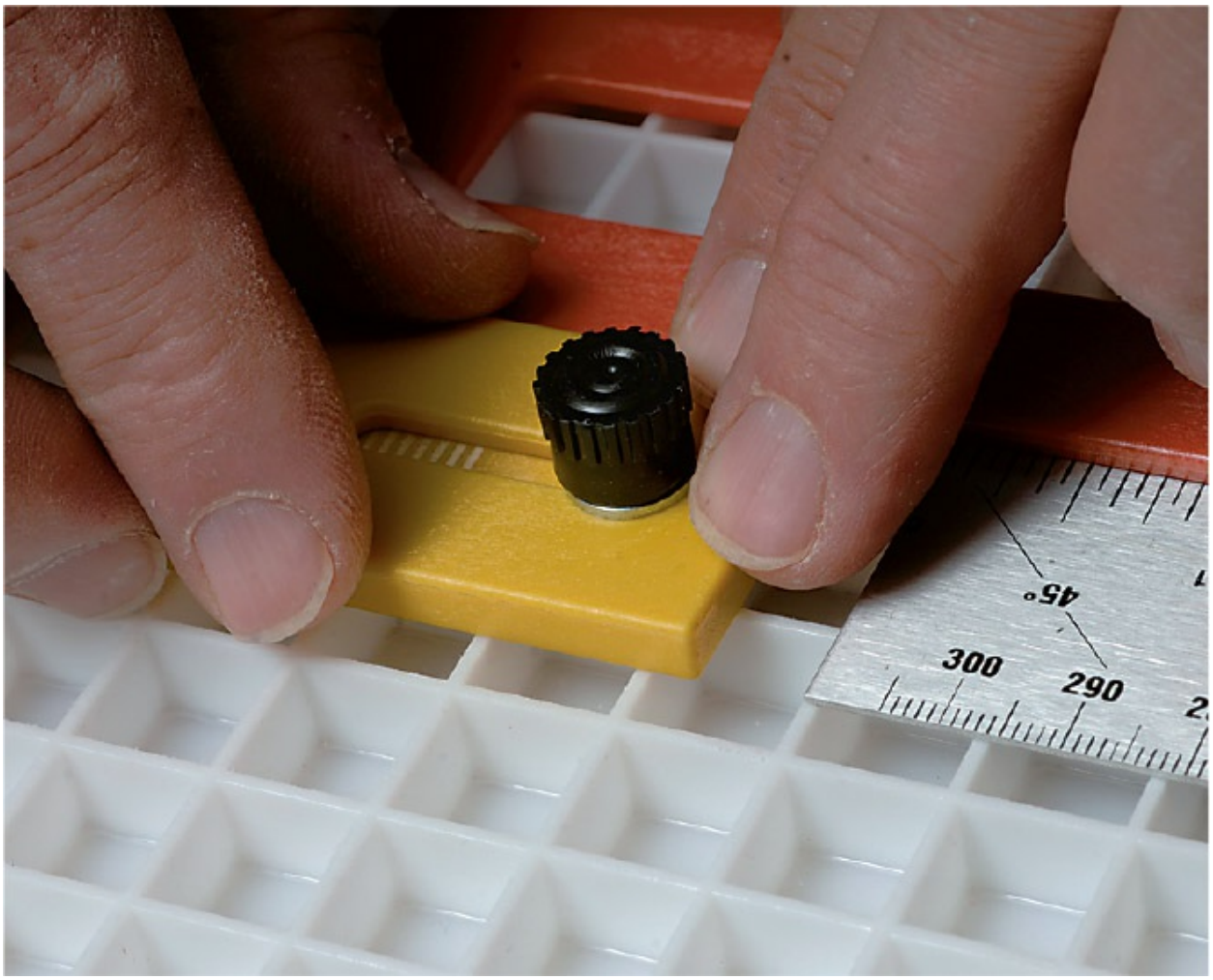
Loosen the screw on one of the adjustable glass stops.



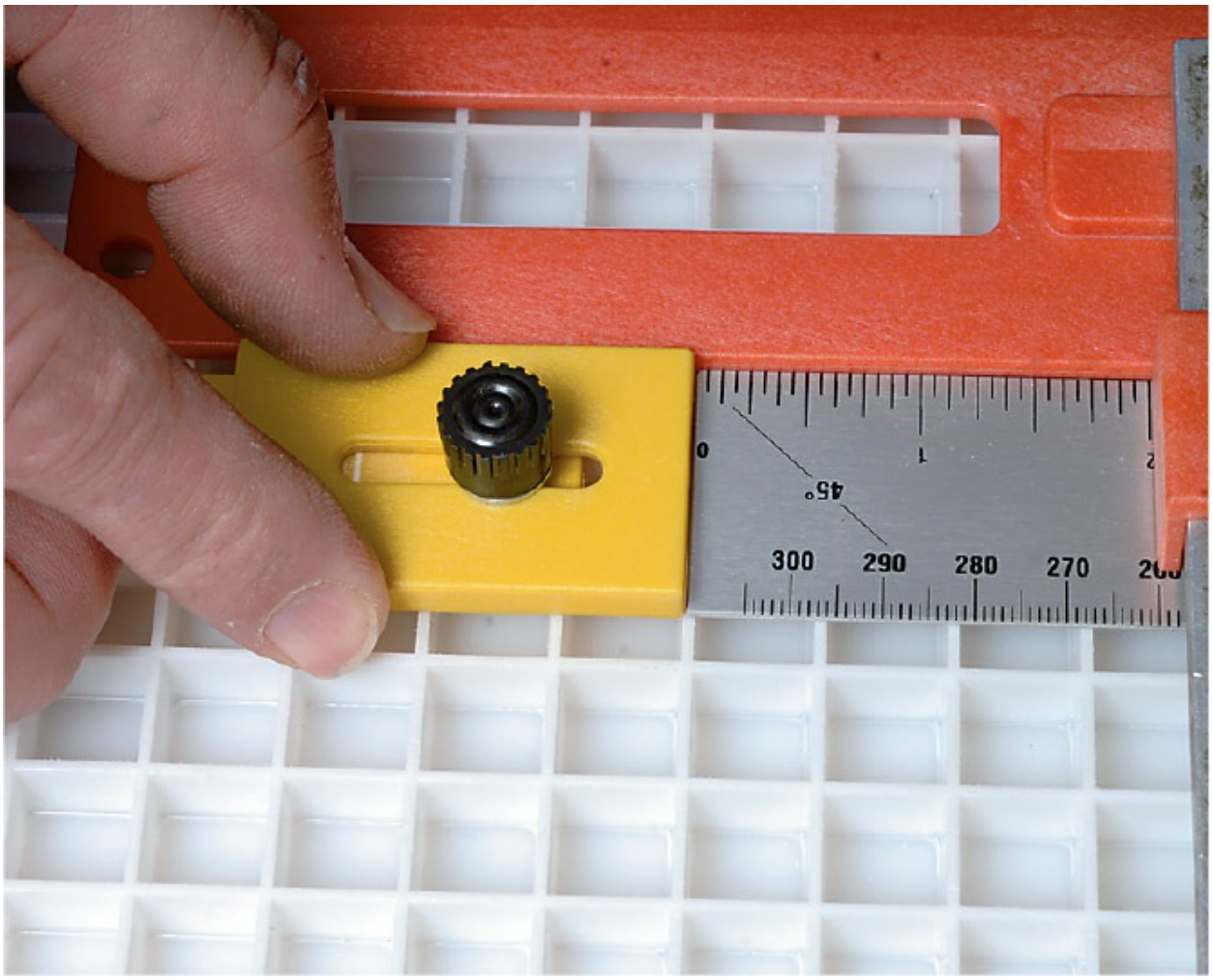
Place the stop onto the board next to the bar, as shown.



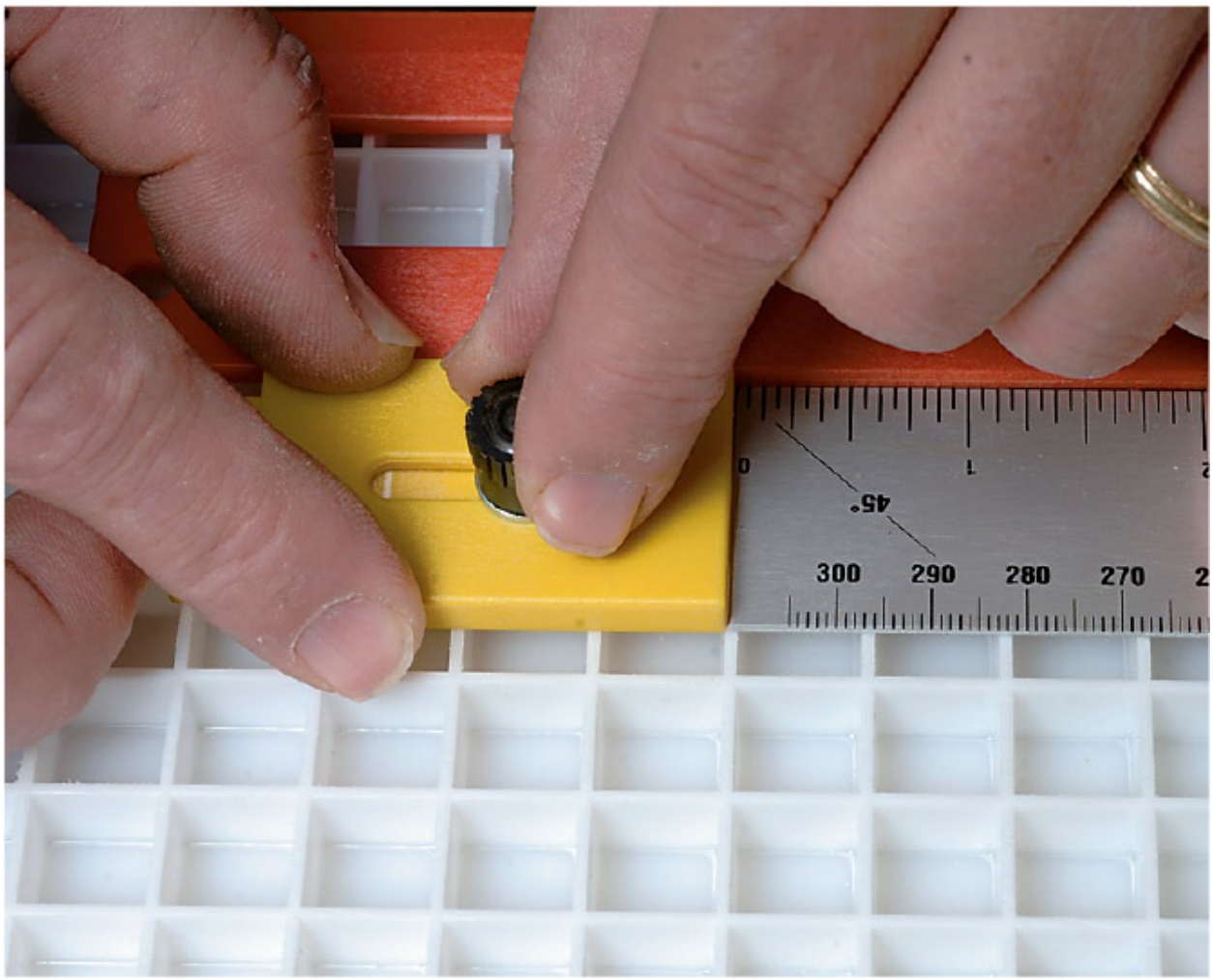
Press it into place.



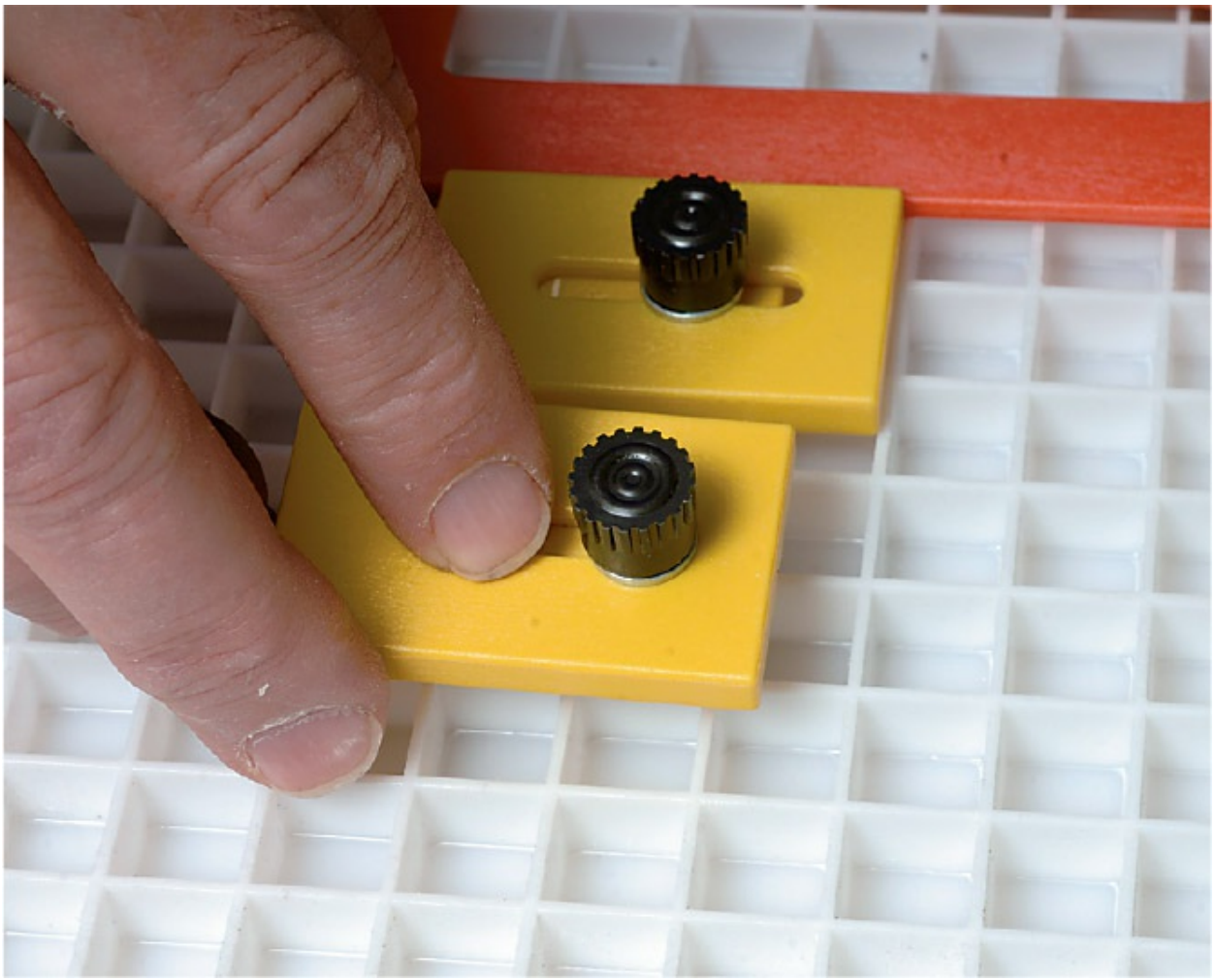
Hold the ruler down with one hand and gently slide the stop until its edge rests along the end of the cutting bar.



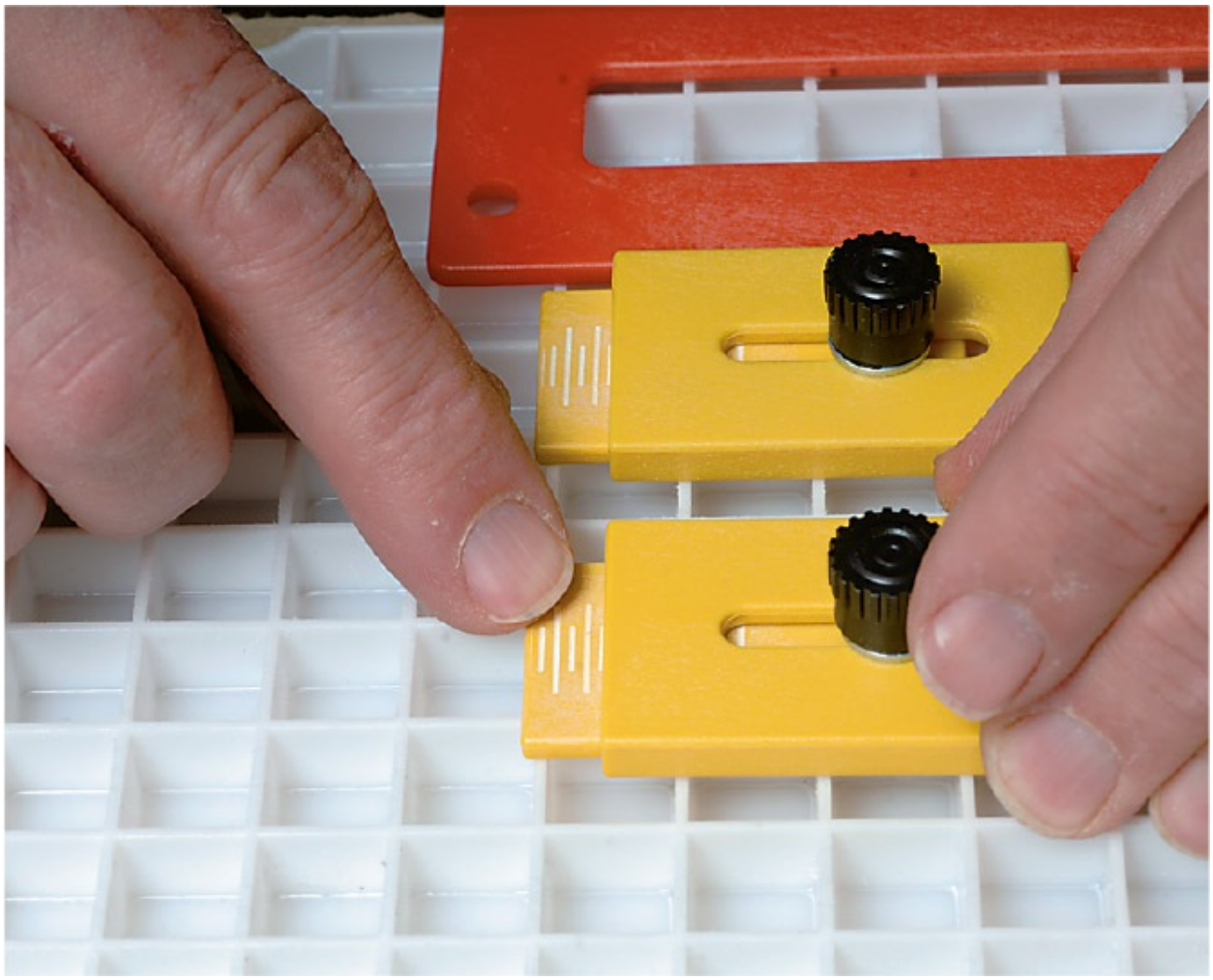
Tighten the stop’s screw to hold the setting. The distance between the edge of the stop and the side of the cutter gauge should be exactly 2 inches.



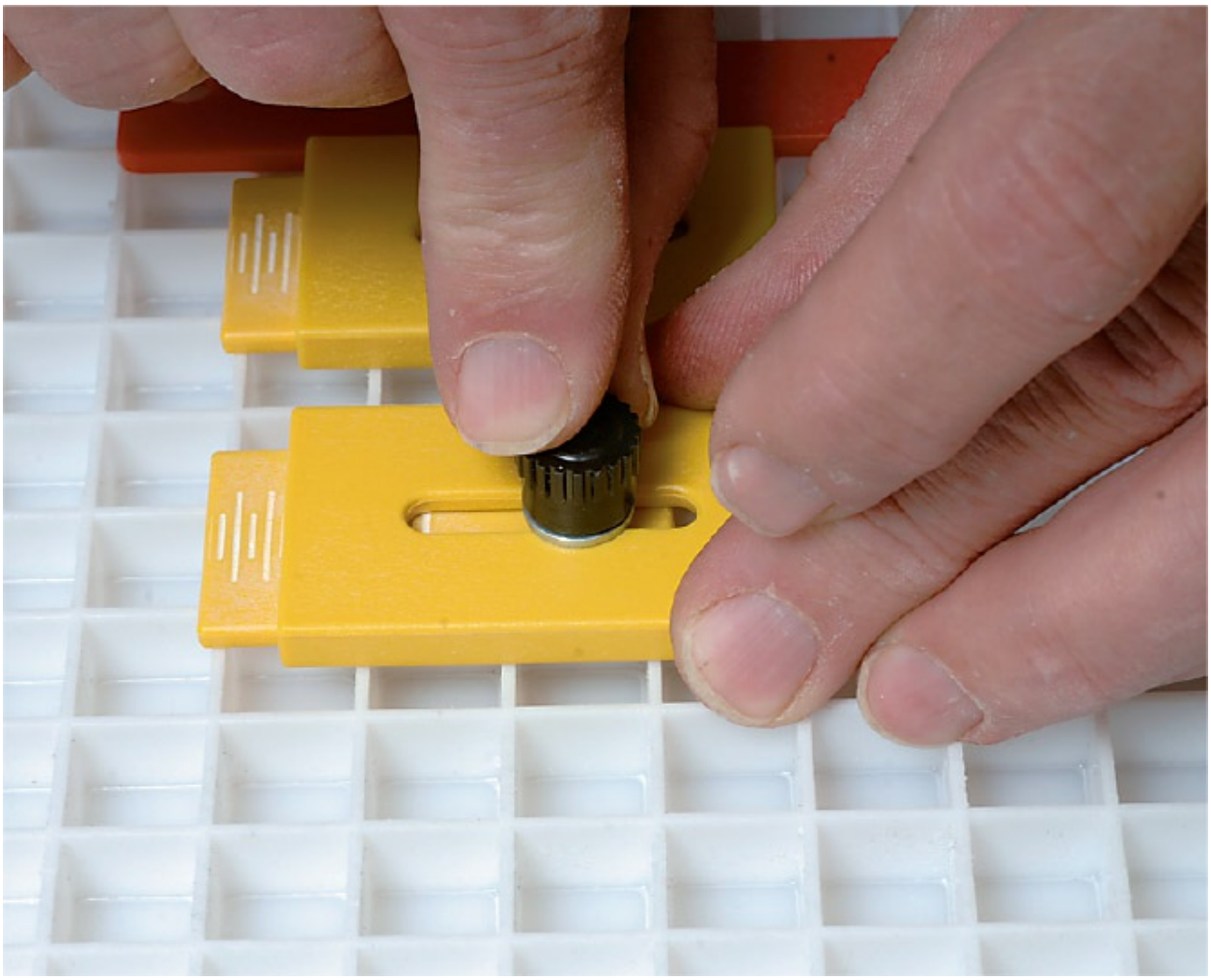
Place a second adjustable glass stop alongside the first one.



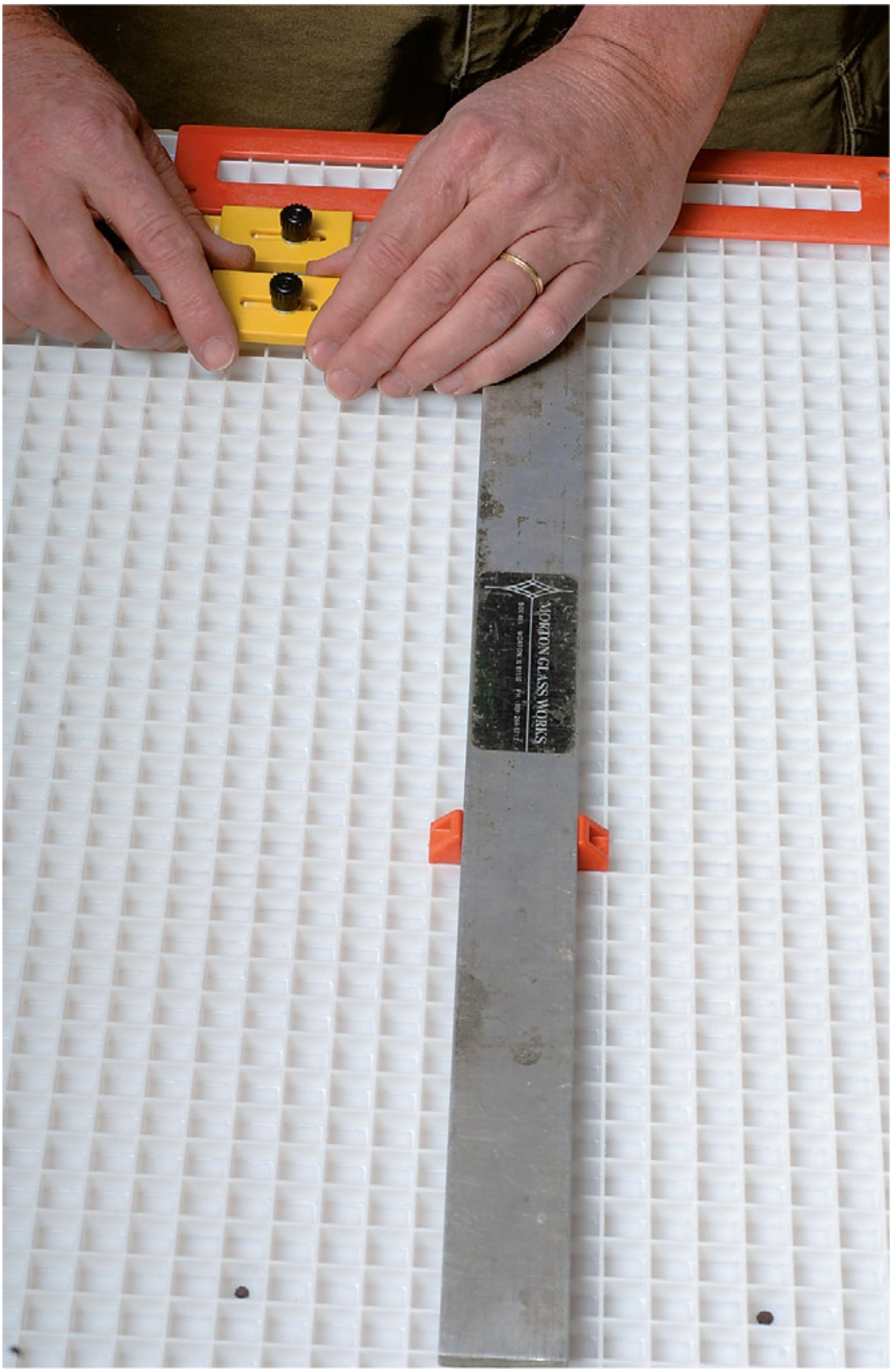
Adjust it so that it lines up perfectly with the first.



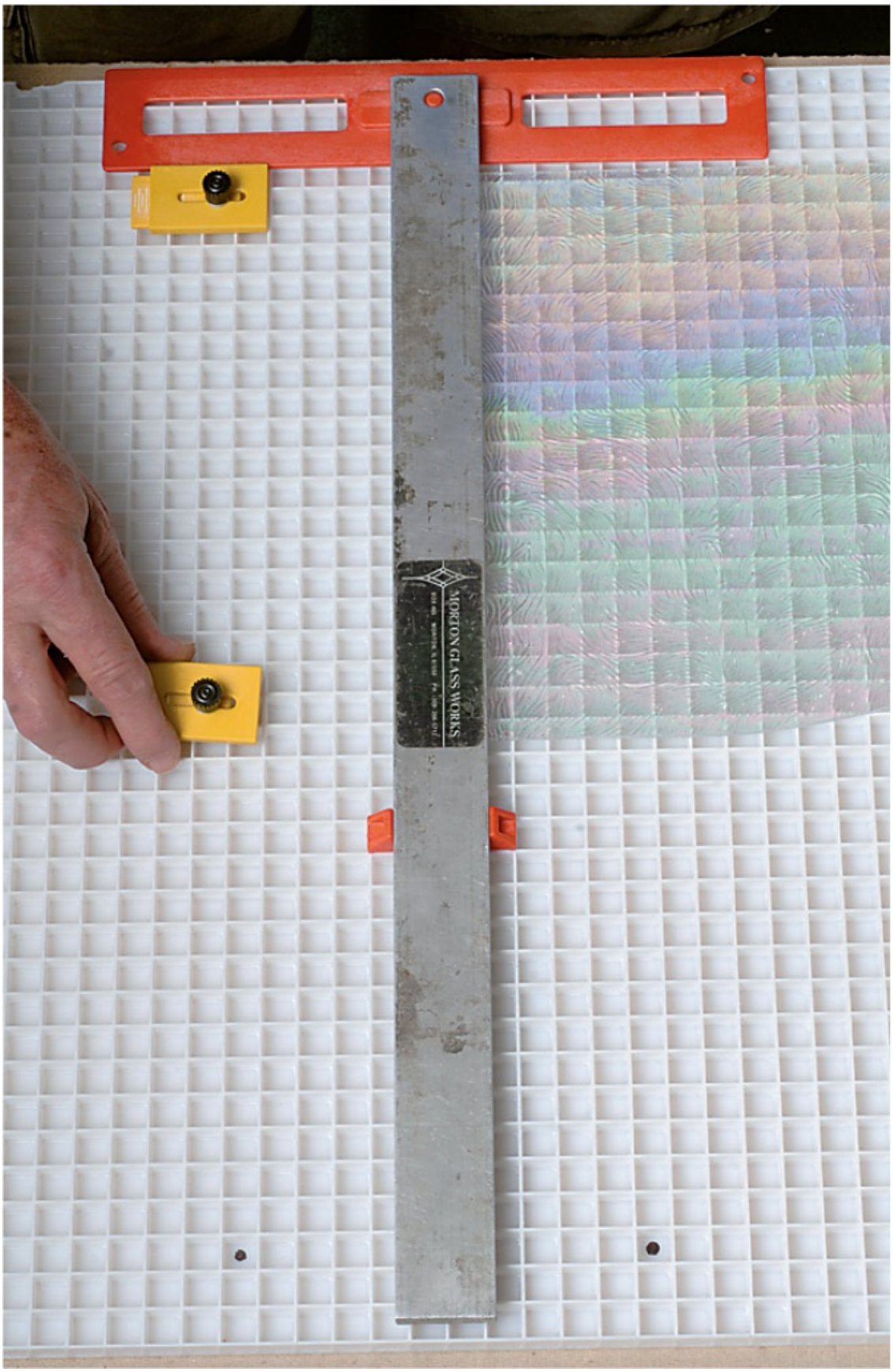
Tighten the screw to hold the setting.



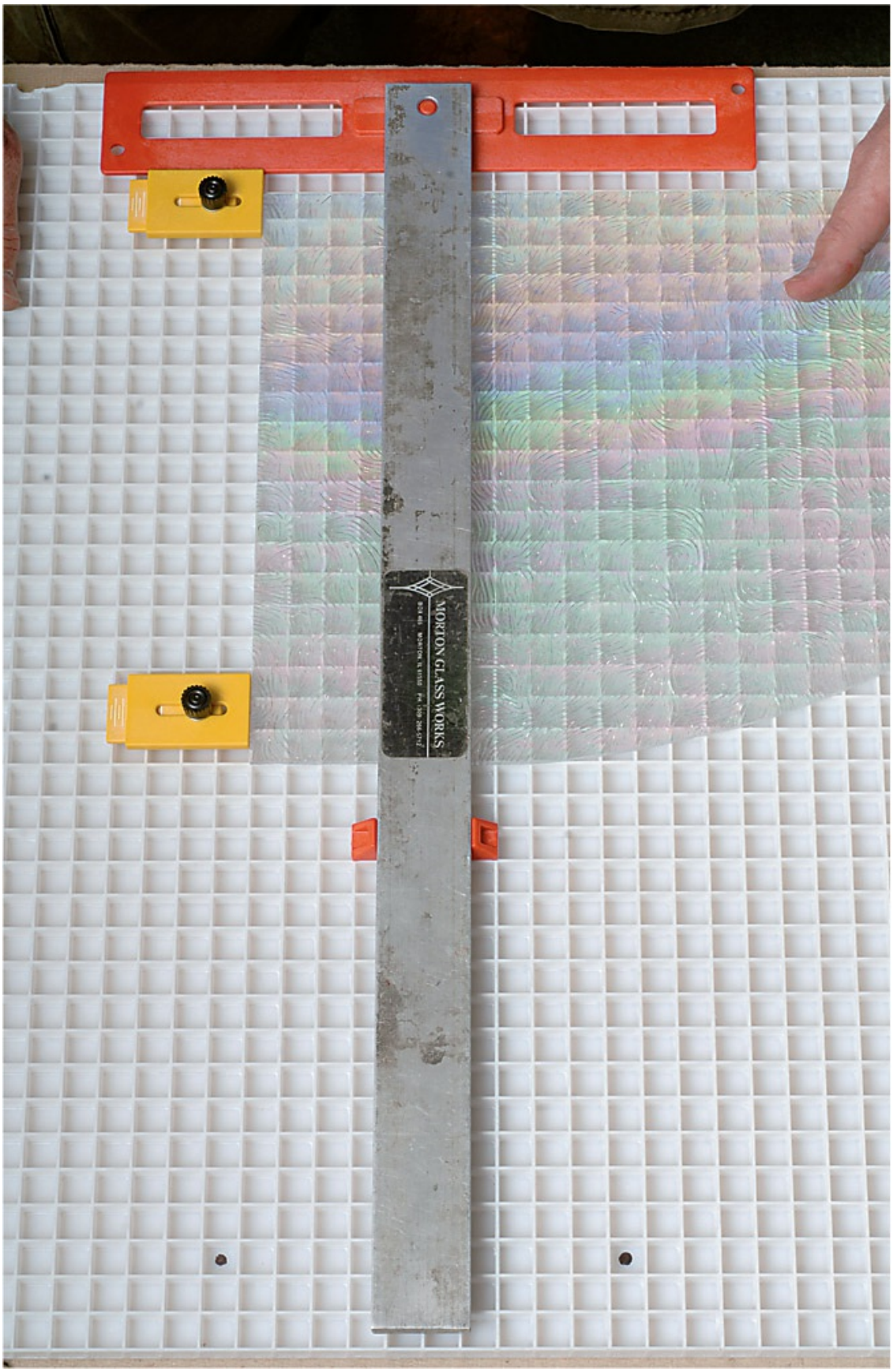
Lift the second stop out of the board.


MORTON GLASS WORKS

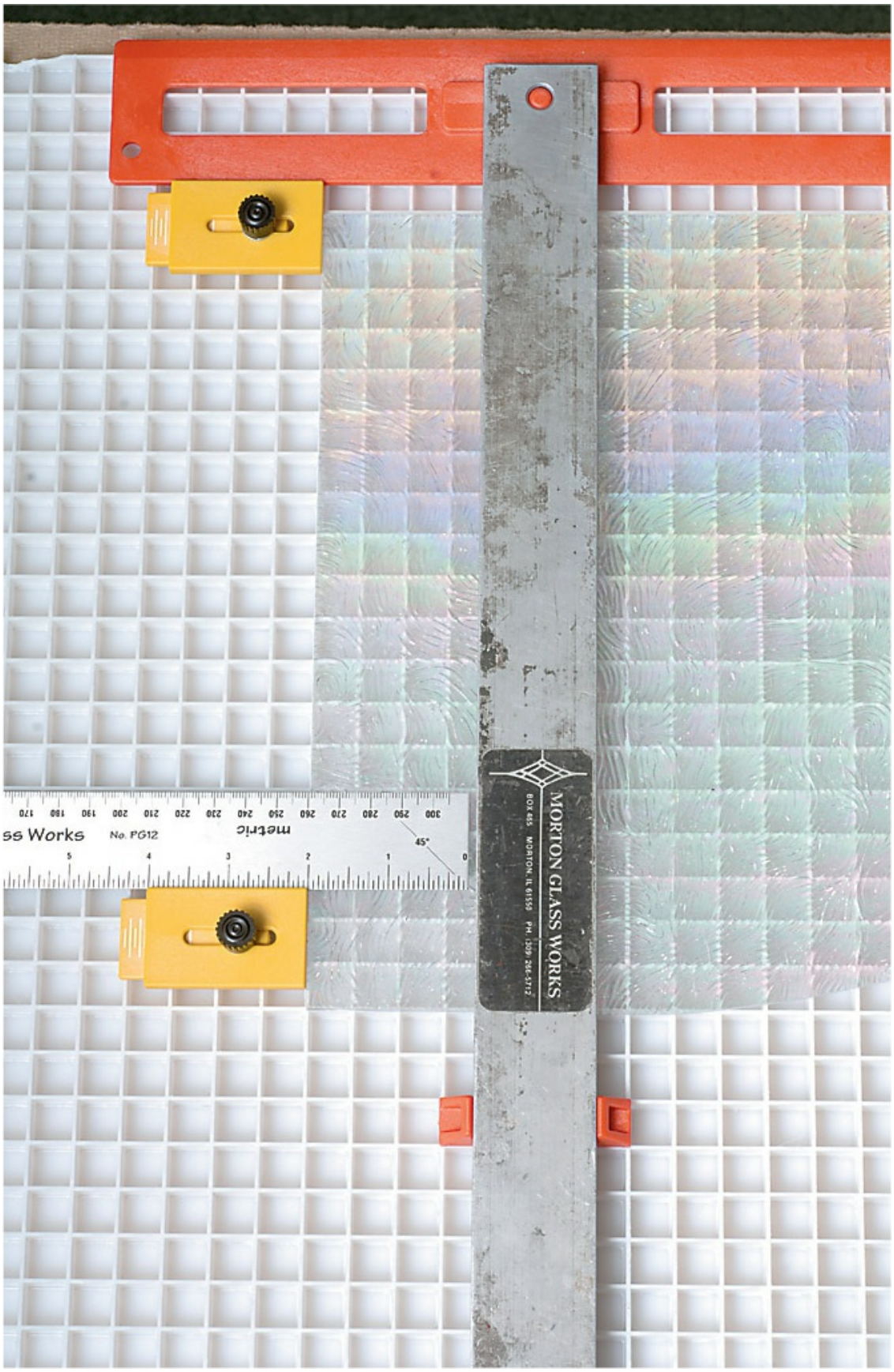
Place it in the same row as the first brace further up the board to a distance just shy of the width of the sheet of glass to be cut.


MORTON GLASS WORKS

Slide the glass underneath the cutting bar and against both glass stops.


MORTON GLASS WORKS

Check to see that both stops are set for the same width.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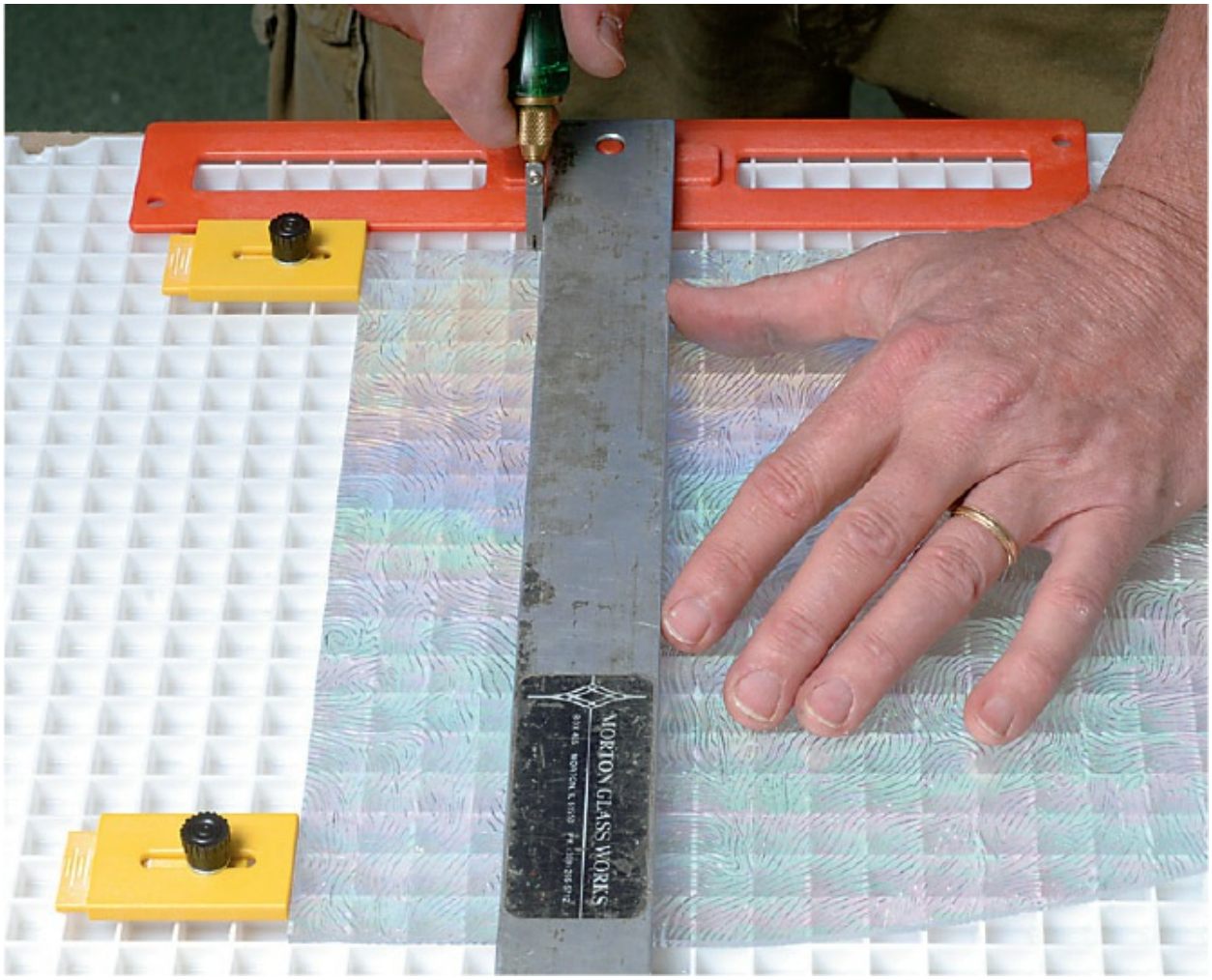
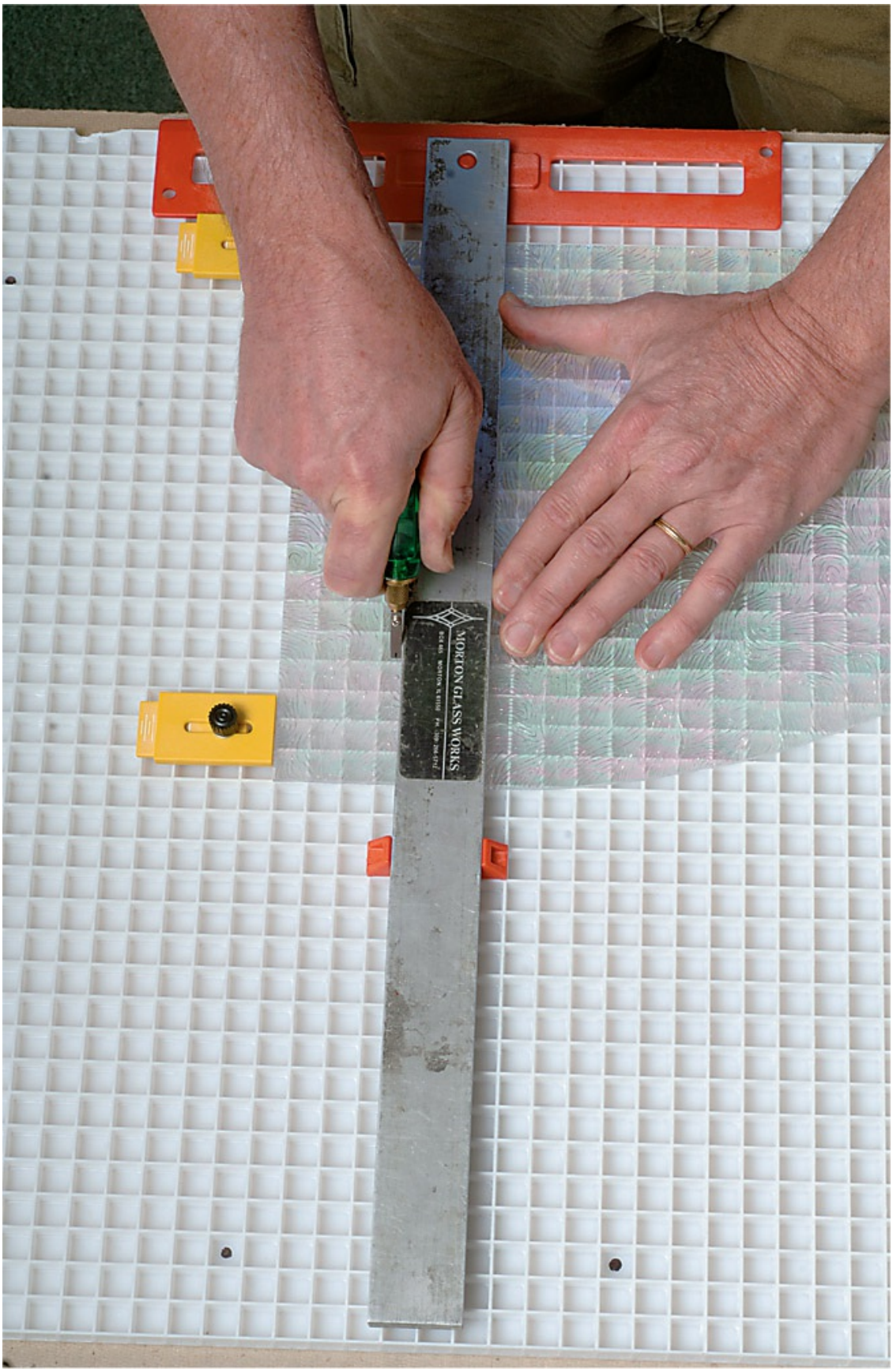
ss Works
No. PG12
metric
45°

When the settings are correct, remove the cutter gauge before you cut. Hold the glass down on the board and against the stops. Score the glass with the handheld cutter (remember to start the cut $^{1}/_{16}$ inchfrom the edge). Run the cutter alongside the cutting bar.



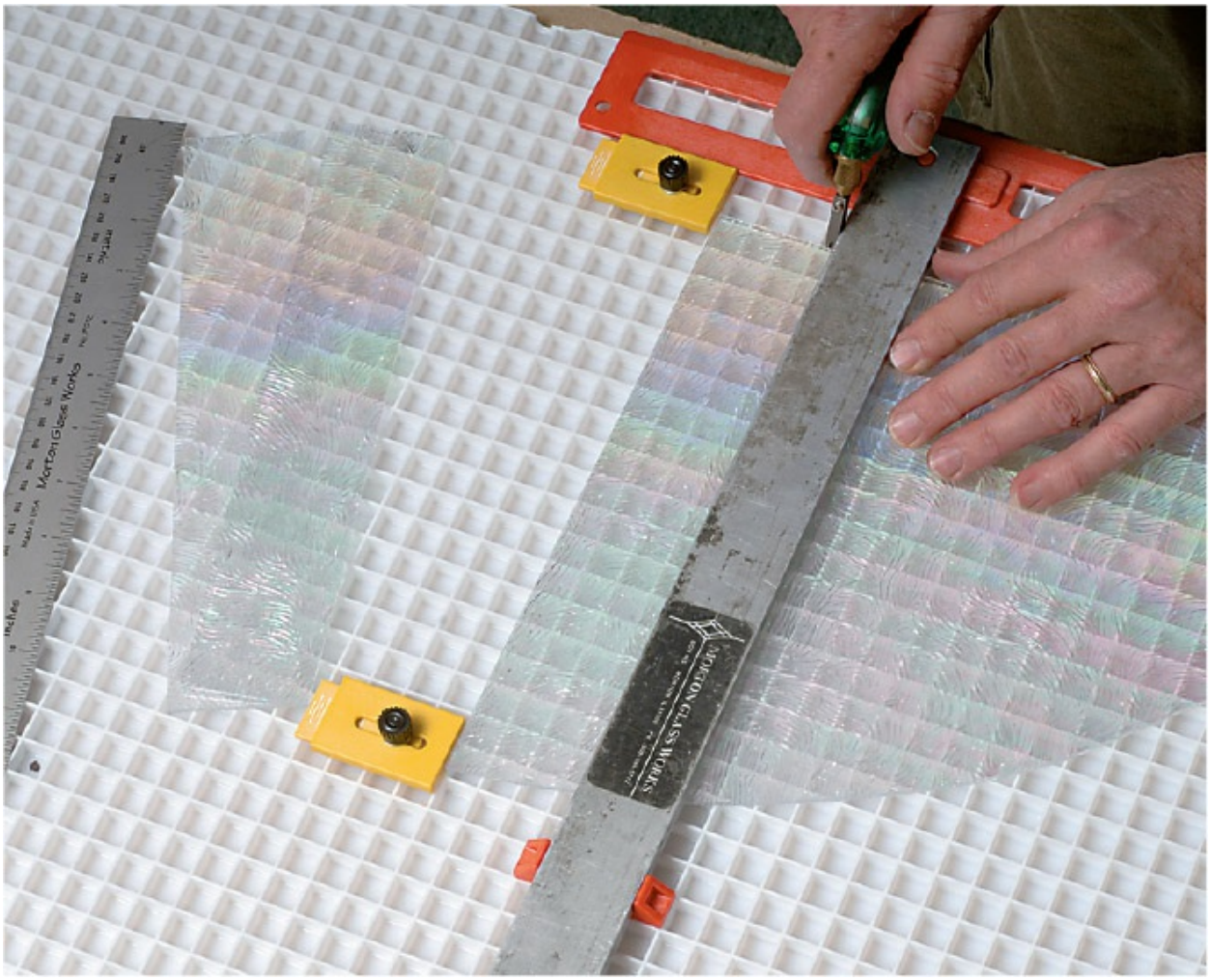
Stop the cut about $^{1}/_{16}$ inch from the edge of the glass.

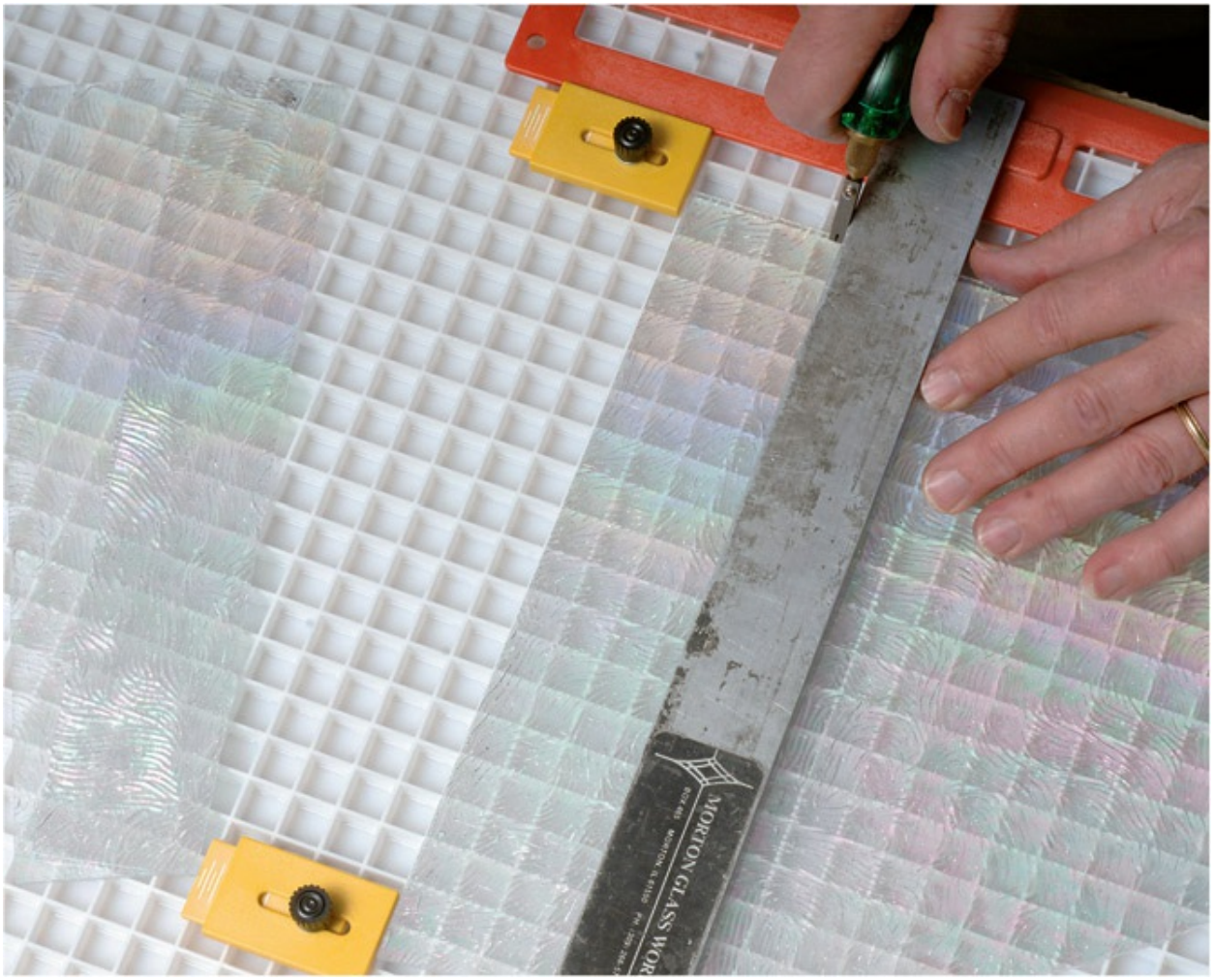

MORTON GLASS WORKS

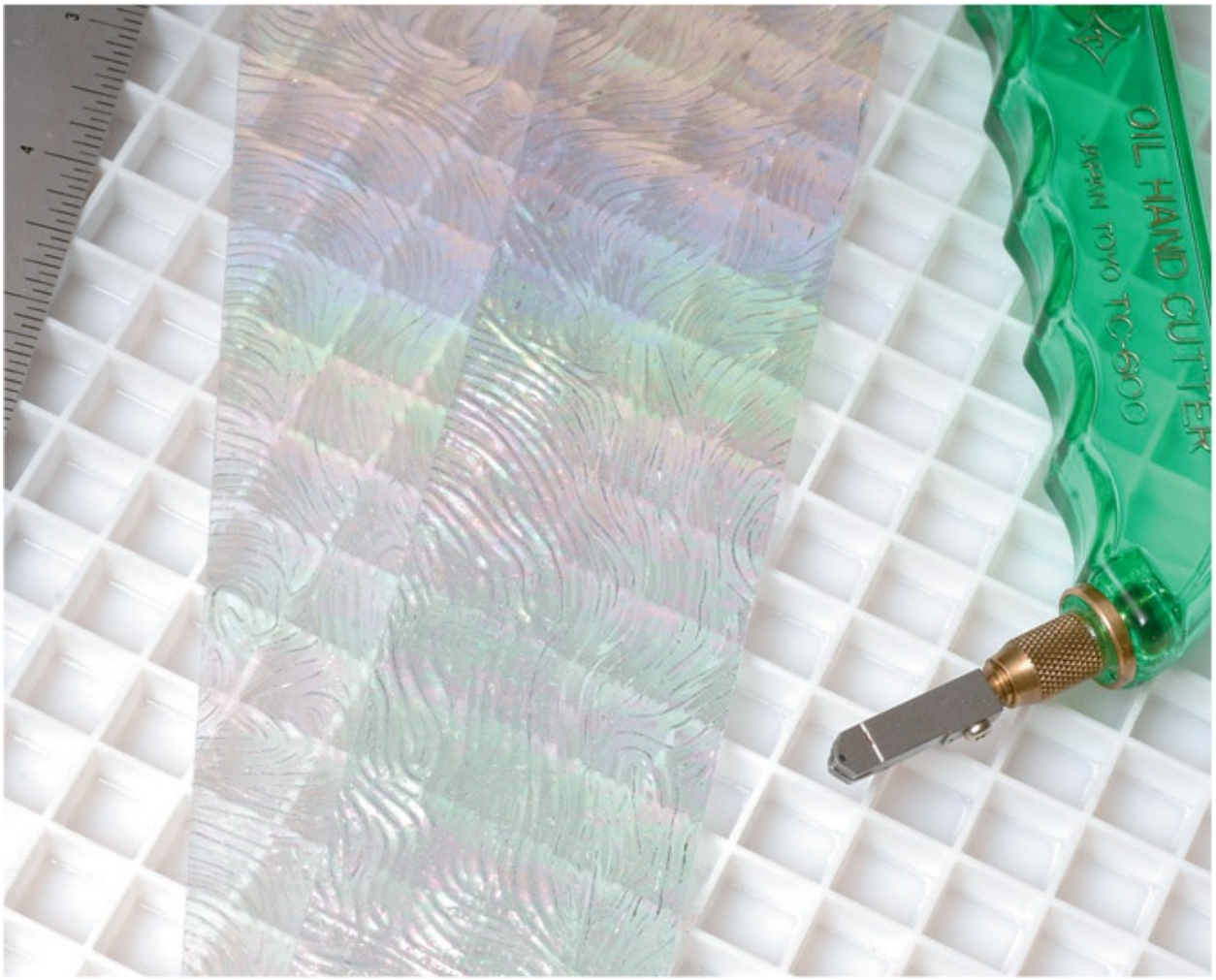
Use running pliers to snap the glass along the scored line.


MORTON GLASS

Repeat the process to cut as many strips as you need. The system will allow you to quickly create strips that are exactly the same width.




MORTON GLASS WOR

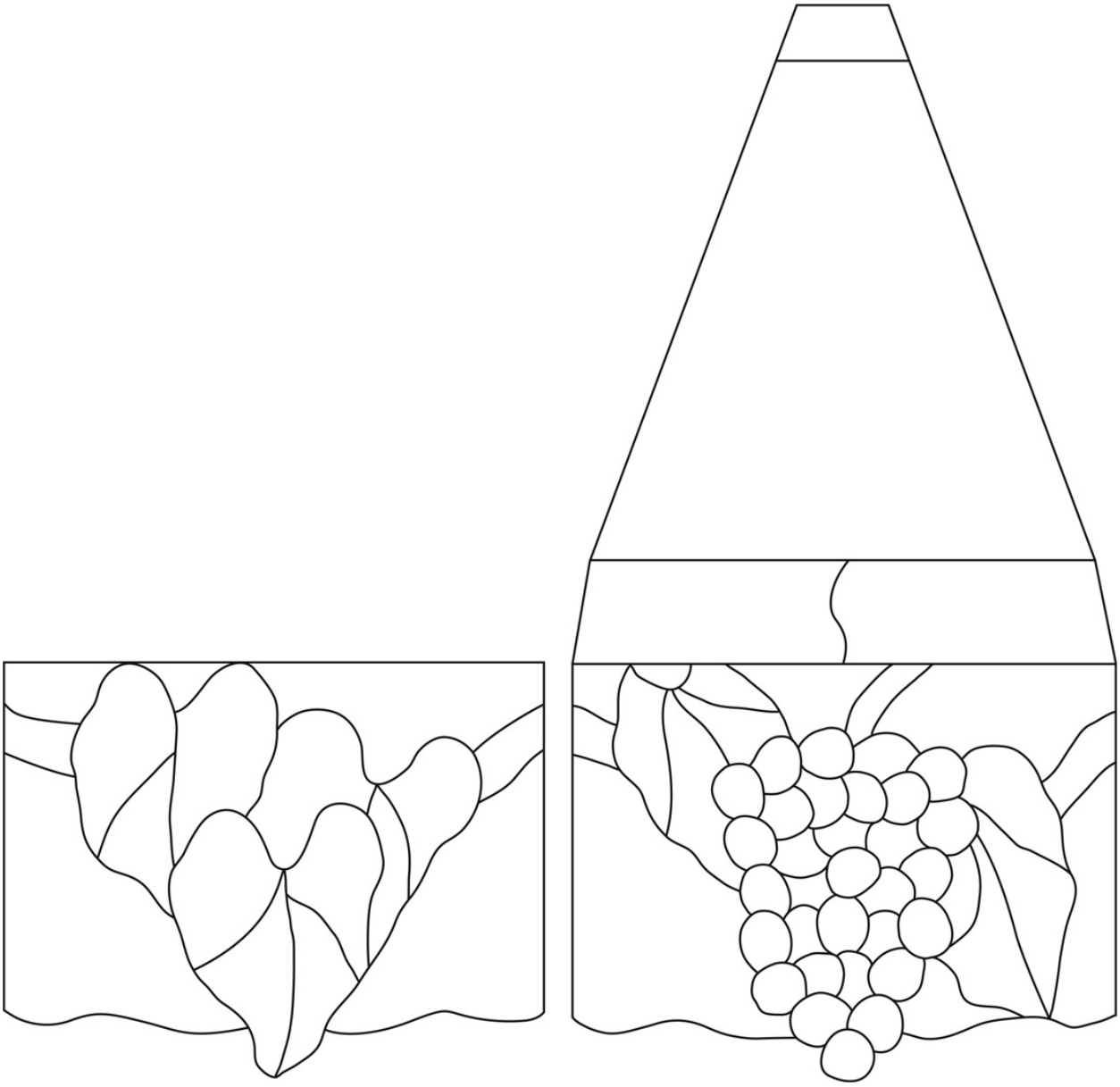

OIL HAND CUTTER
JAPAN TOYO TC-600

5

Ornate Hanging Lampshade

This handsome hanging lampshade is sure to be the focal point in any room it graces. The grapes-and-leaves design—consisting of hand-cut glass and colorful glass nuggets—makes the piece perfect for a kitchen, dining room, or bar area. A lamp-holding jig simplifies the assembly of this

heavy piece. The addition of reinforcing wire on inside seams and around the lamp's edge make the piece sturdy. A store-bought lamp fixture was installed to the finished shade's tinned top.



Enlarge 155%

Materials and Equipment

LAMP JIG

An adjustable jig holds lampshades in a variety of positions to make soldering them easier. The jig is usually clamped to the edge of a work table. Approximate cost: $20–$30.

NUGGET FOILER

A simple wooden block with a rubber channel that holds a strip of foil and allows you to easily foil the rounded edges of glass nuggets and jewels. Approximate cost: $5.

WEDGIES

Nonflammable, nonslip Wedgies made by Glass Rainbow are specially made to support stained glass projects in a variety of positions. Never use regular foam to support stained glass projects—foam is highly flammable. Approximate cost: $20–$25 for a pair.

LAMP WEDGIE

This foam and metal support is made by Glass Rainbow to support taller stained glass projects. Approximate cost: $20–$25.

BRASS LAMP CAP

A lamp cap such as this is tinned and soldered to cover the shade's top opening and hold the light fixture.

LIGHT FIXTURE

A three-bulb light fixture such as this can be found at lighting suppliers or home improvement centers.

FINIAL

The fixture is attached to the lamp cap with a threaded finial.

CHAIN

A chain with substantial links is necessary to hold the heavy stained glass lampshade. The end link of the chain must have a break so the link can be opened and closed with pliers.

LEAD VISE

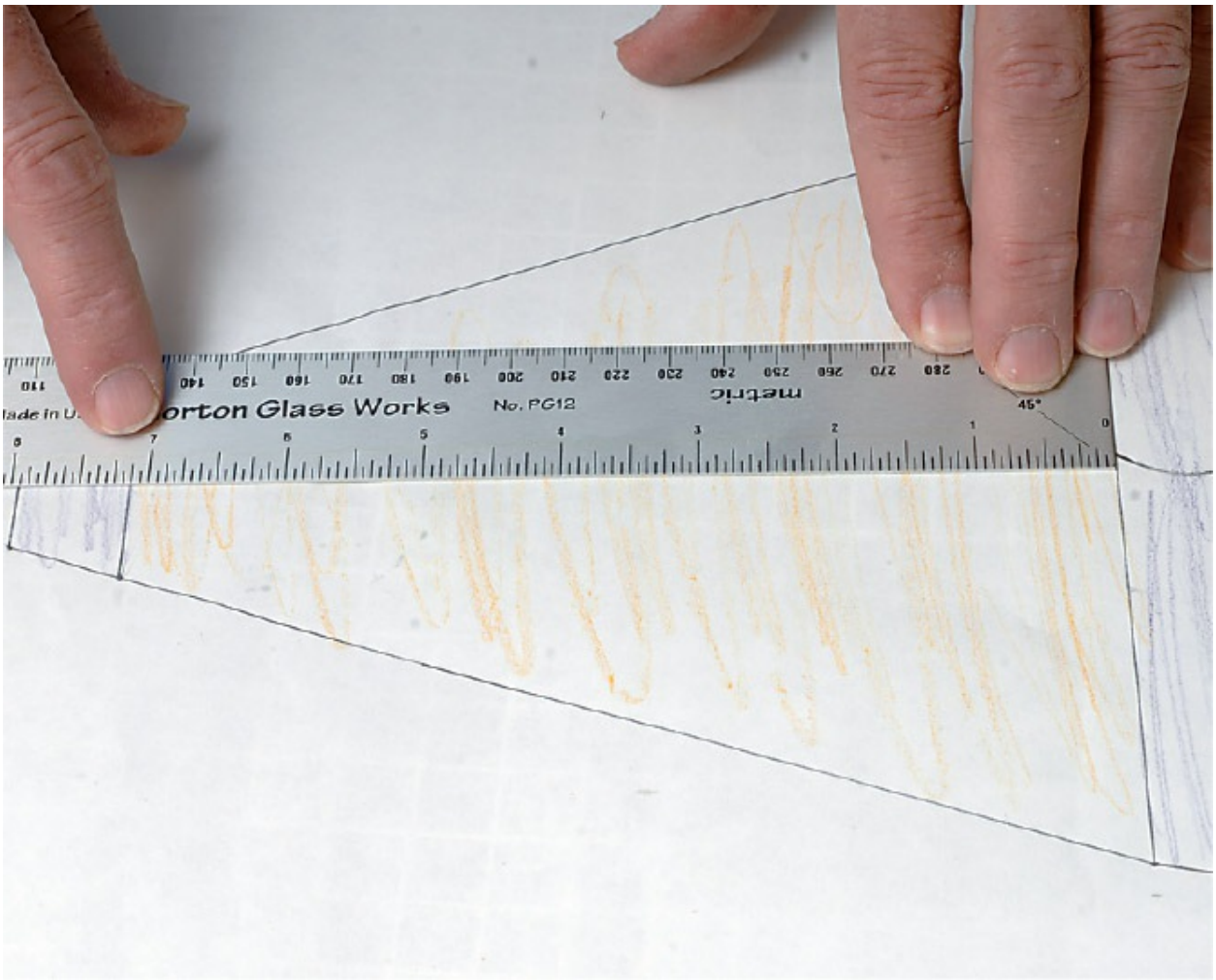
A simple vise helps you pull the kinks out of copper wire.

A small bottle with a cap, plastic electrical tape, scissors, colored marker, clamp, old toothbrush, hand towel, pliers, and steel wool are also needed for this project.

Ornate Hanging Lampshade

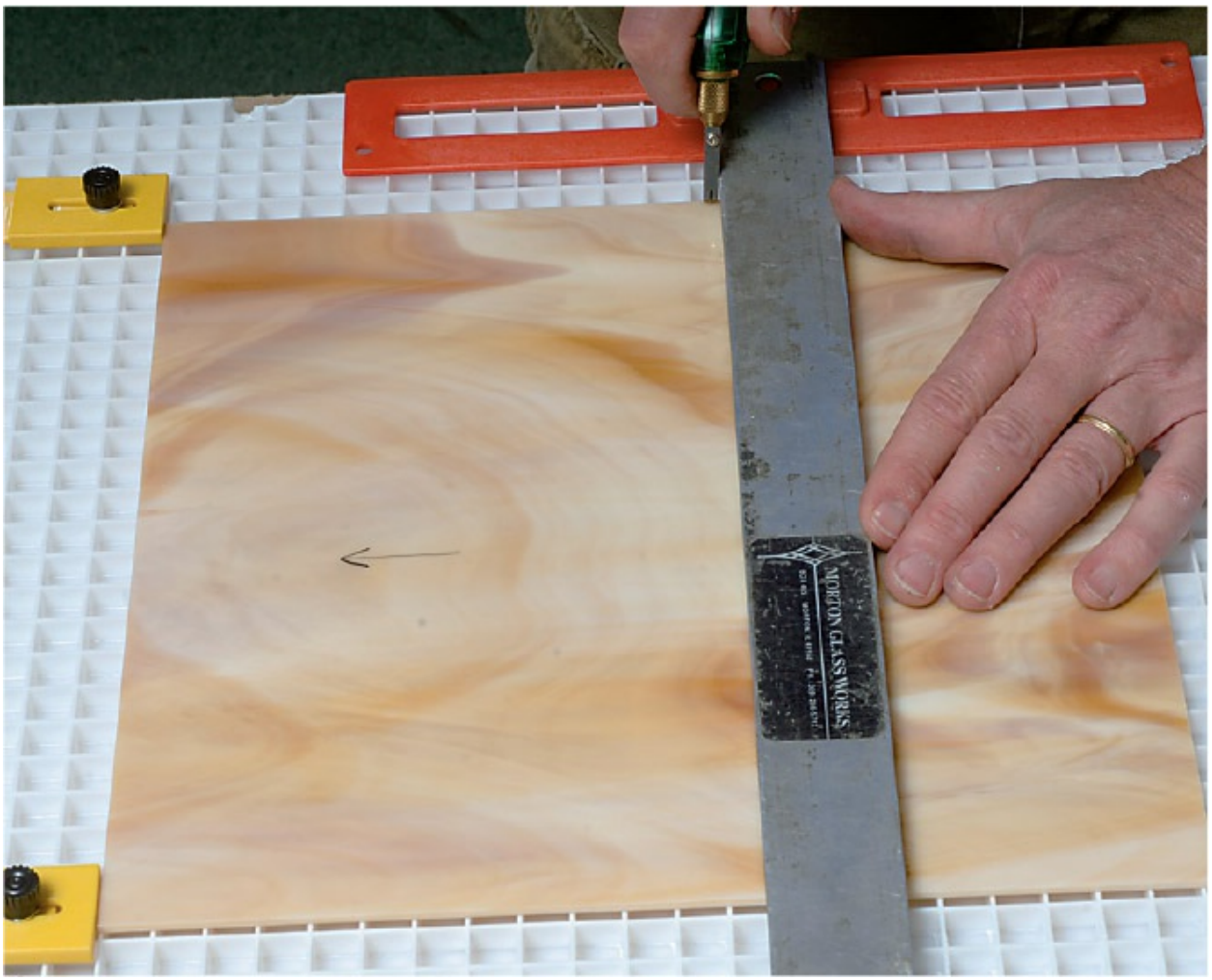
The trapezoidal pieces that form the cone of the lampshade have two parallel sides and two angled sides. All the cuts can be made using the jig cutting system, or by using a straight-edge and a hand cutter.

1. Measure the height of the large trapezoid, which should be 7⅛ inches.

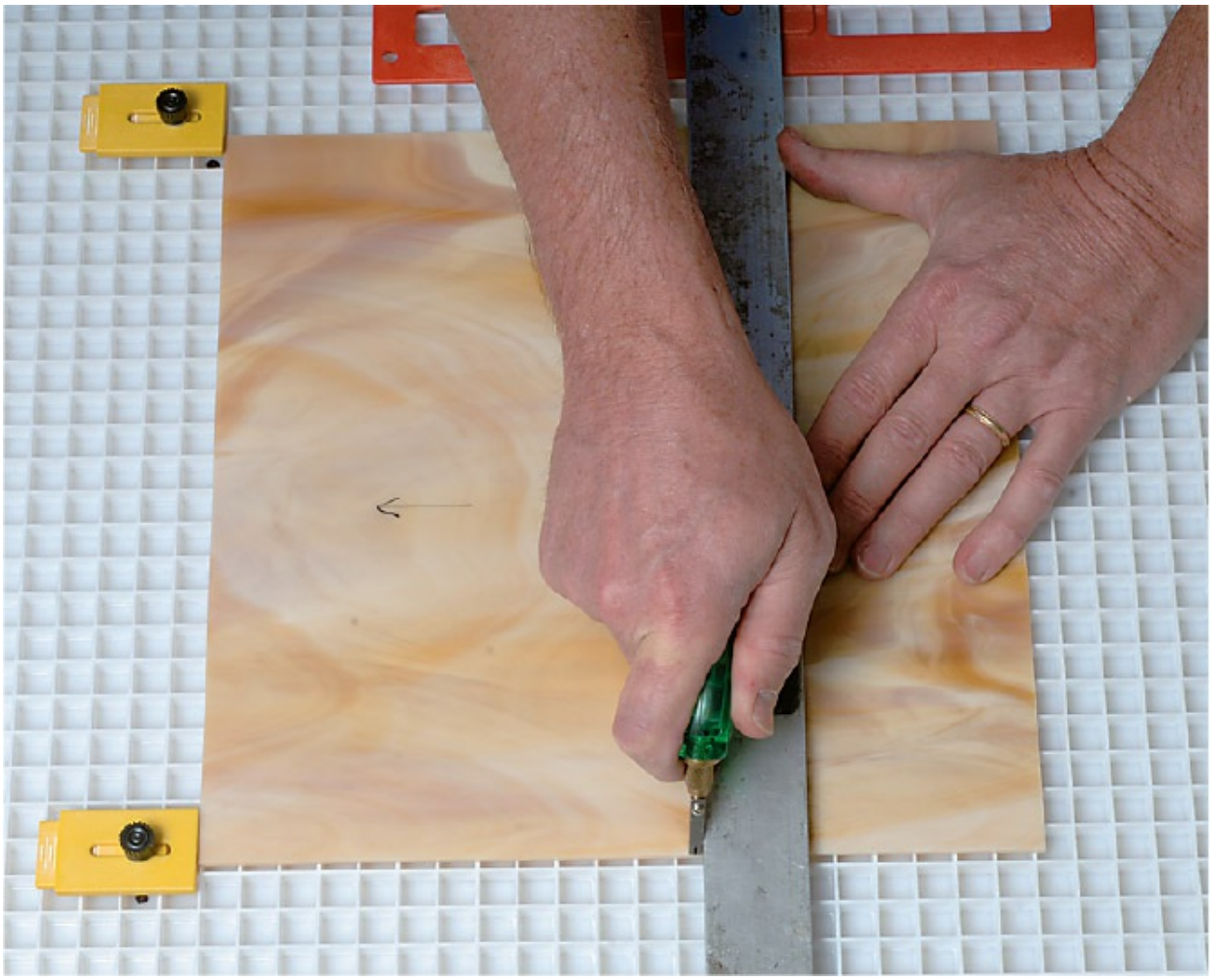


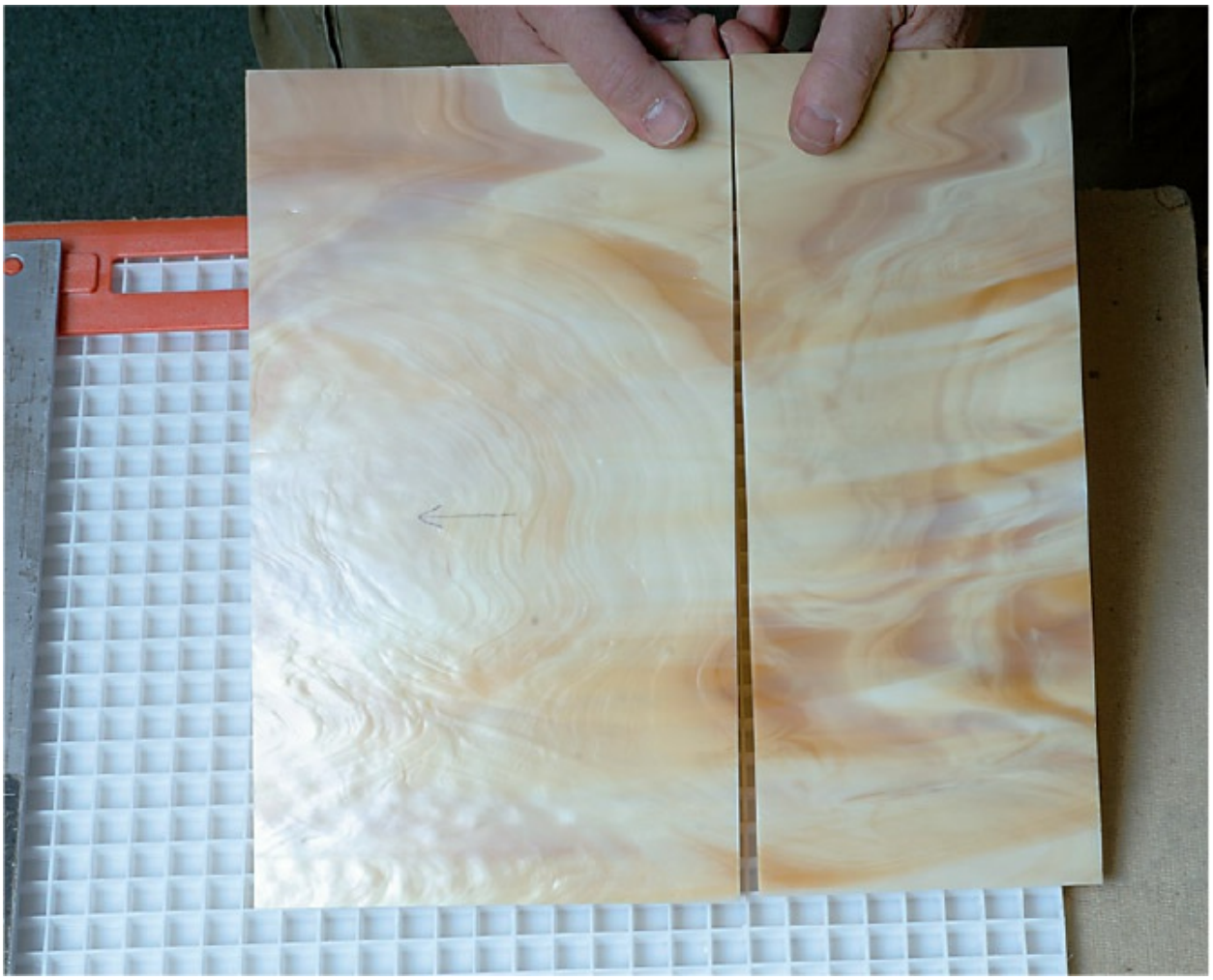
2. Mark an arrow on the glass indicating what you want to be the top of the piece, based on the pattern of the swirls.

3. Set the system to cut a 7⅛ -inch-wide piece.

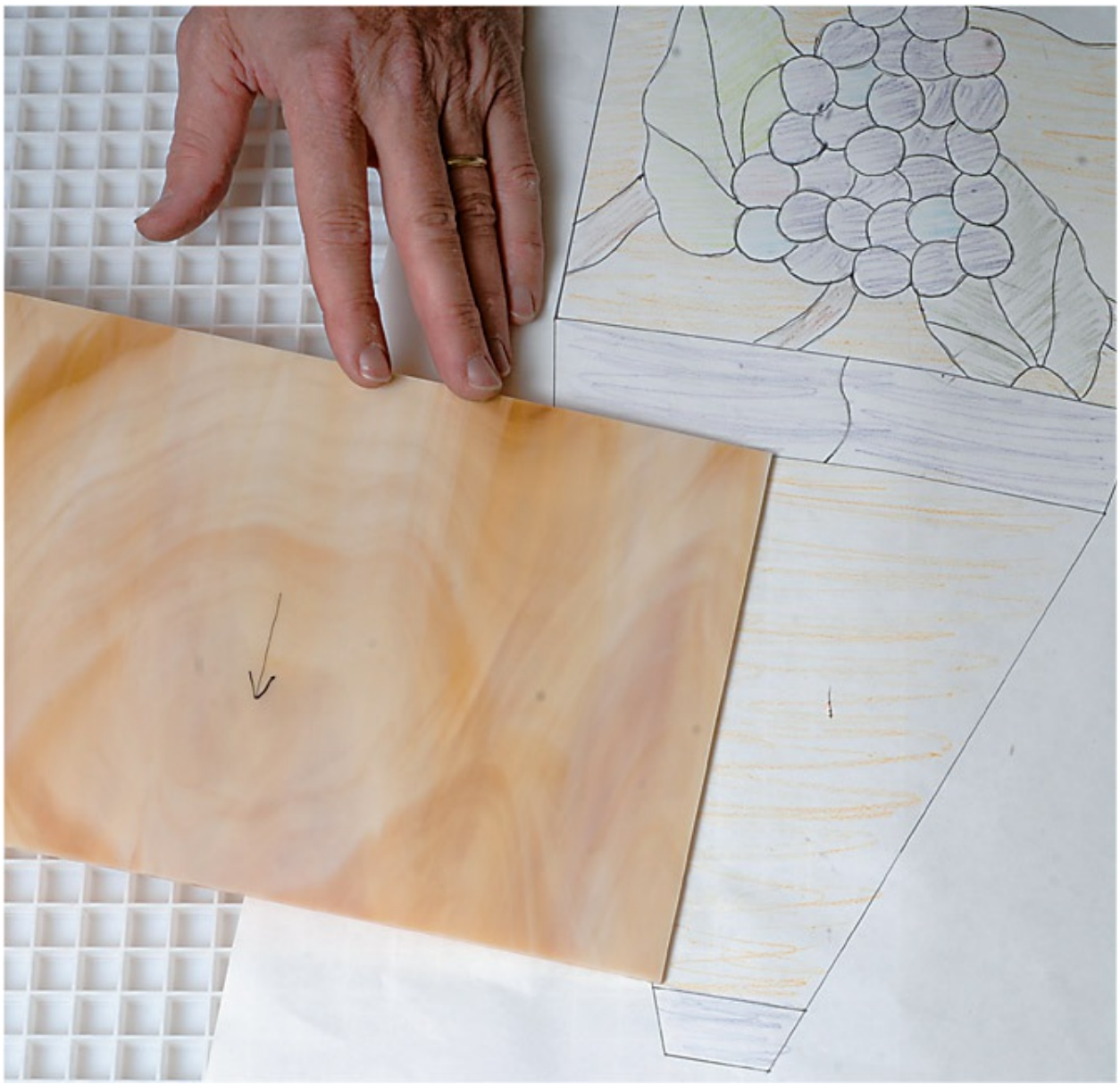


4. Score and snap the piece of glass.

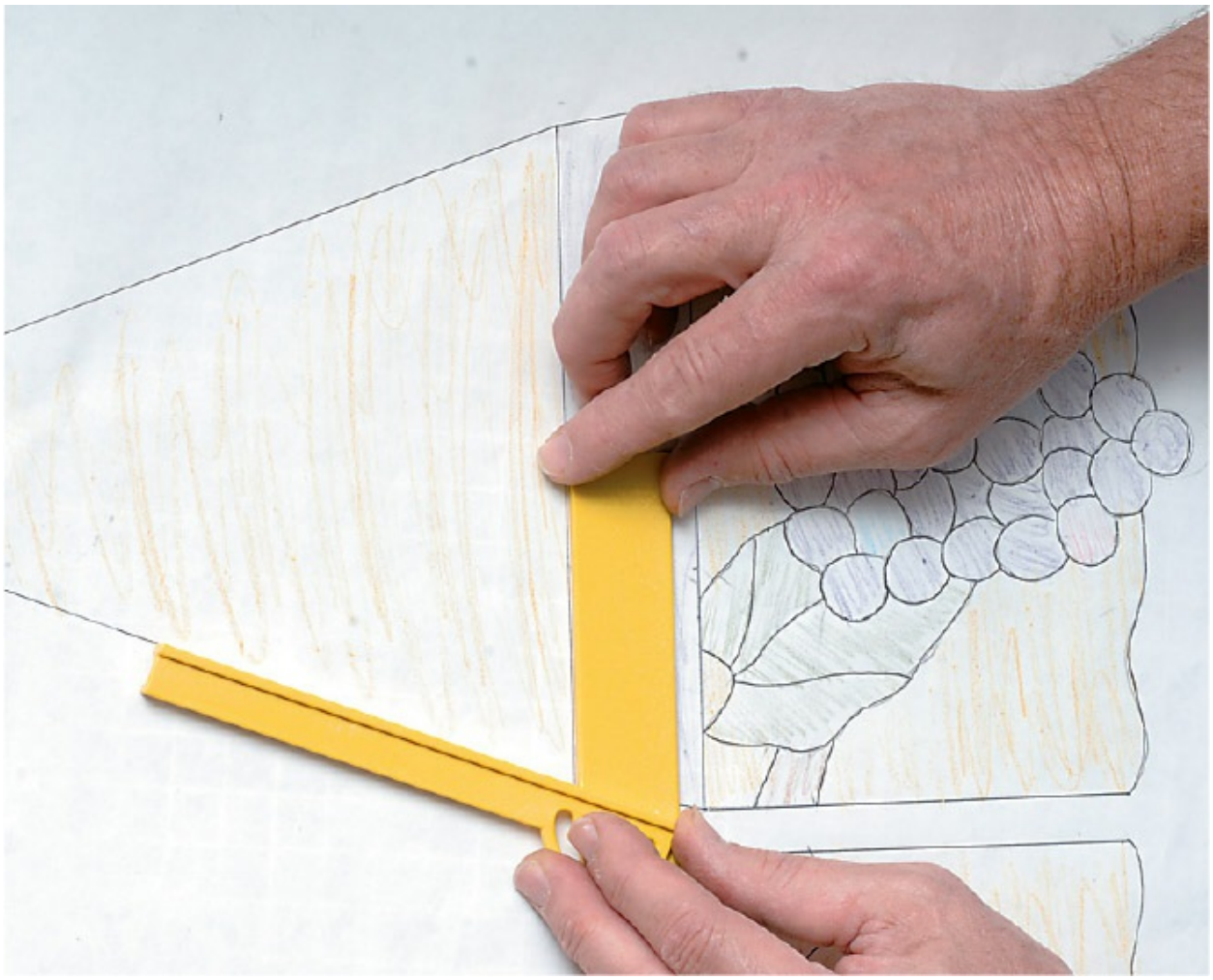




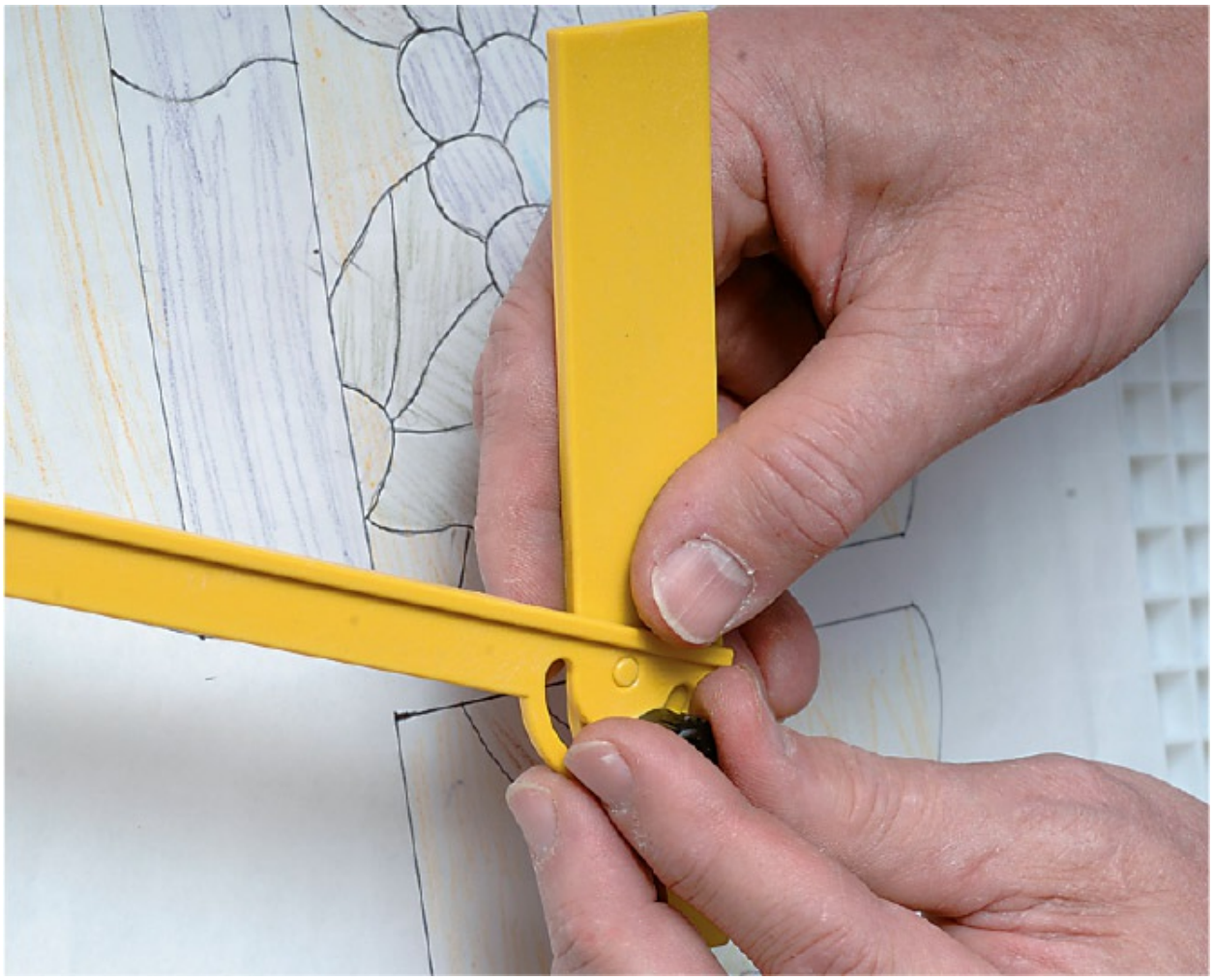
5. Double check that the cut piece is the width it should be.



6. To make the angled cuts, you need to reset the system. Lay the copy angle on the pattern and adjust it so that the edges of the inside of the angle match the pattern lines exactly.



7. Tighten the copy angle screw to hold the setting.



8. Slide the thick side of the angle under the cutting bar and hold it against the squaring fence.


NORTON GLASS WORKS

9. Swing the bar so it aligns with the angle, as shown.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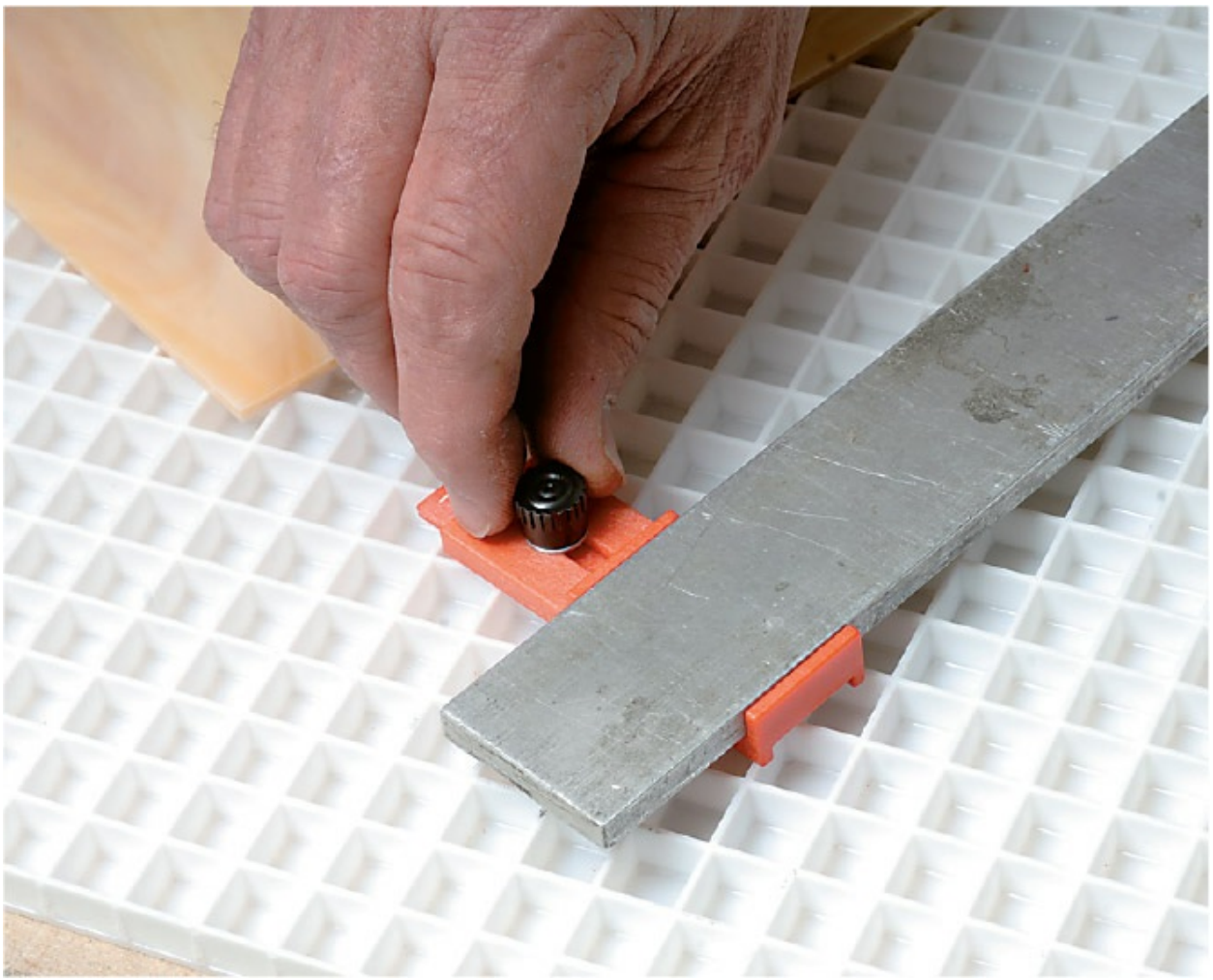
BOX 45
MORTON, IL 61550
PH (309) 26

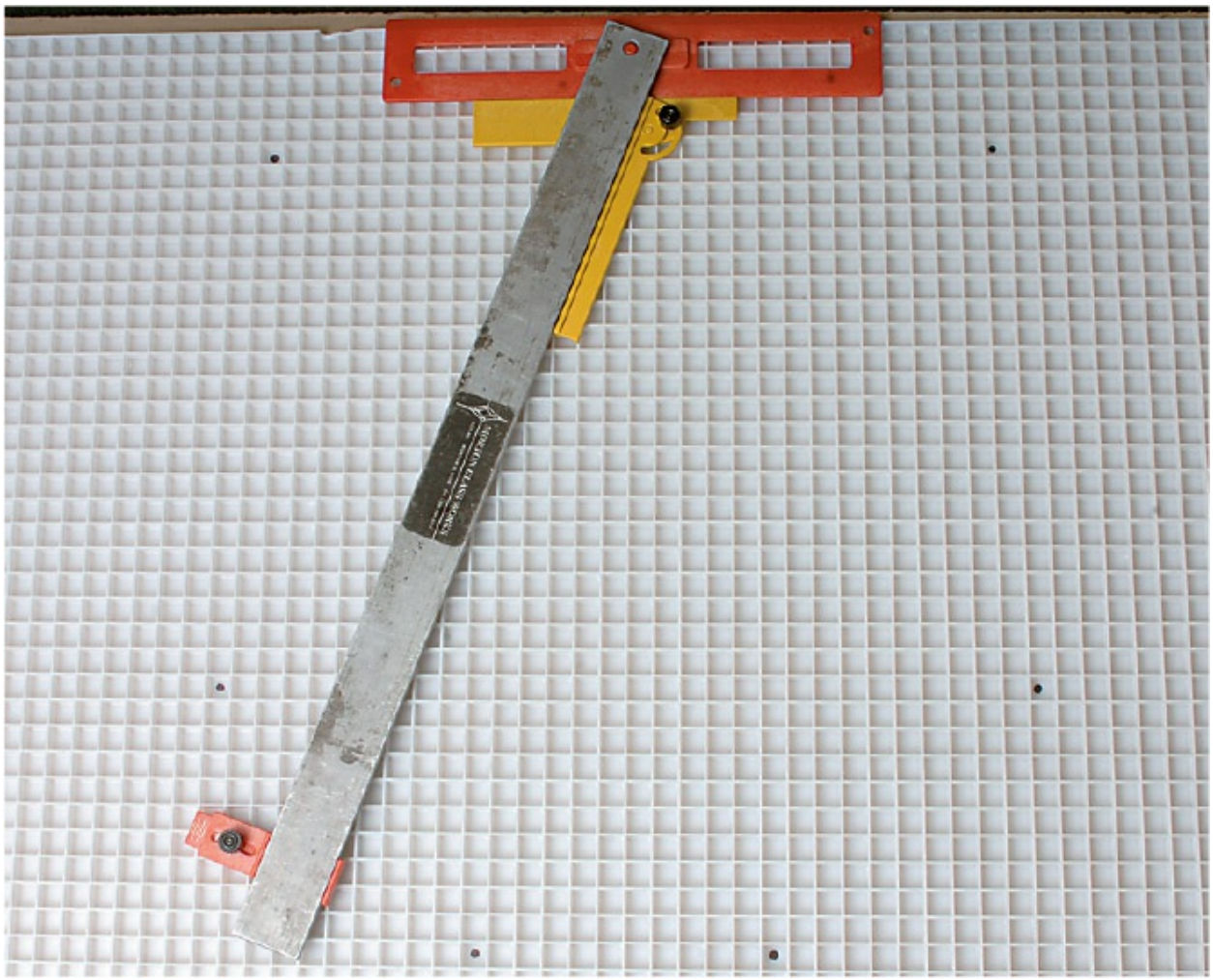
The adjustable squaring block will keep the bar in place when you cut.

10. Set the squaring block in the board near where the end of the angled ruler will fall. Place the ruler on the block and adjust the block's setting so that the ruler is held at the proper angle.

11. Tighten the block’s screw to hold the setting.

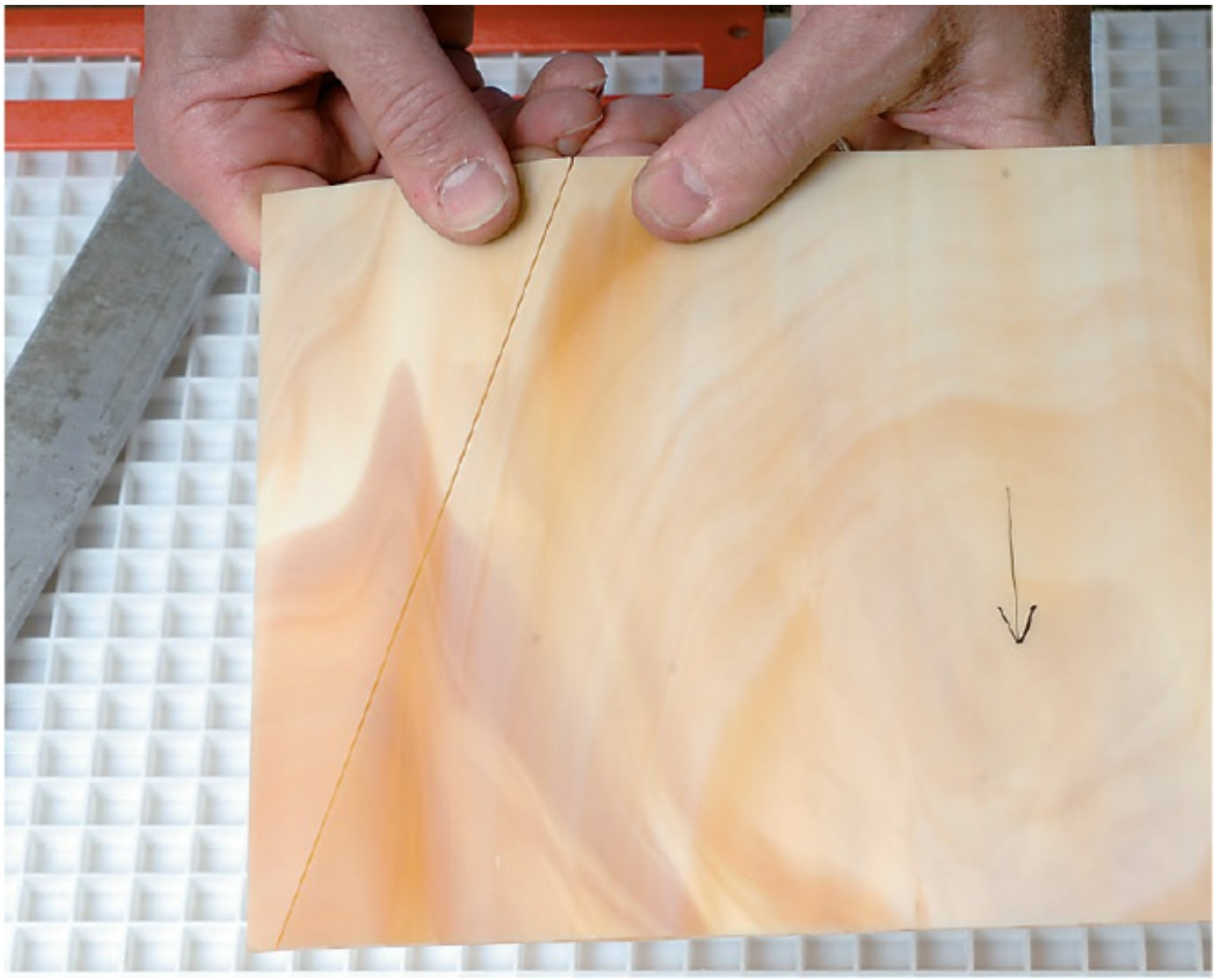


When set properly, the system will allow you to cut both of the angled sides of the lampshade’s cone pieces.

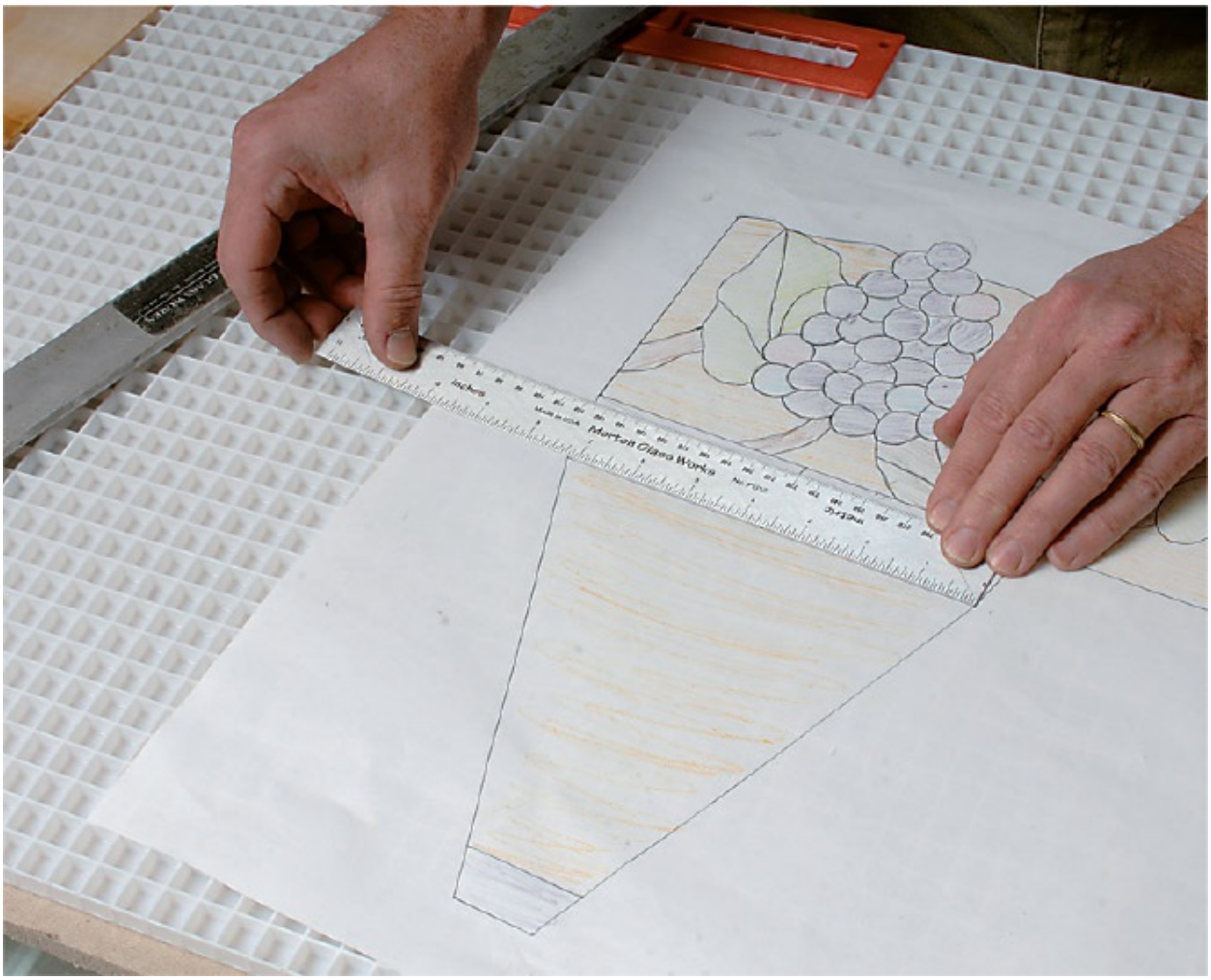


12. Cut one angled side of the piece (the slim part you cut off will be scrap).

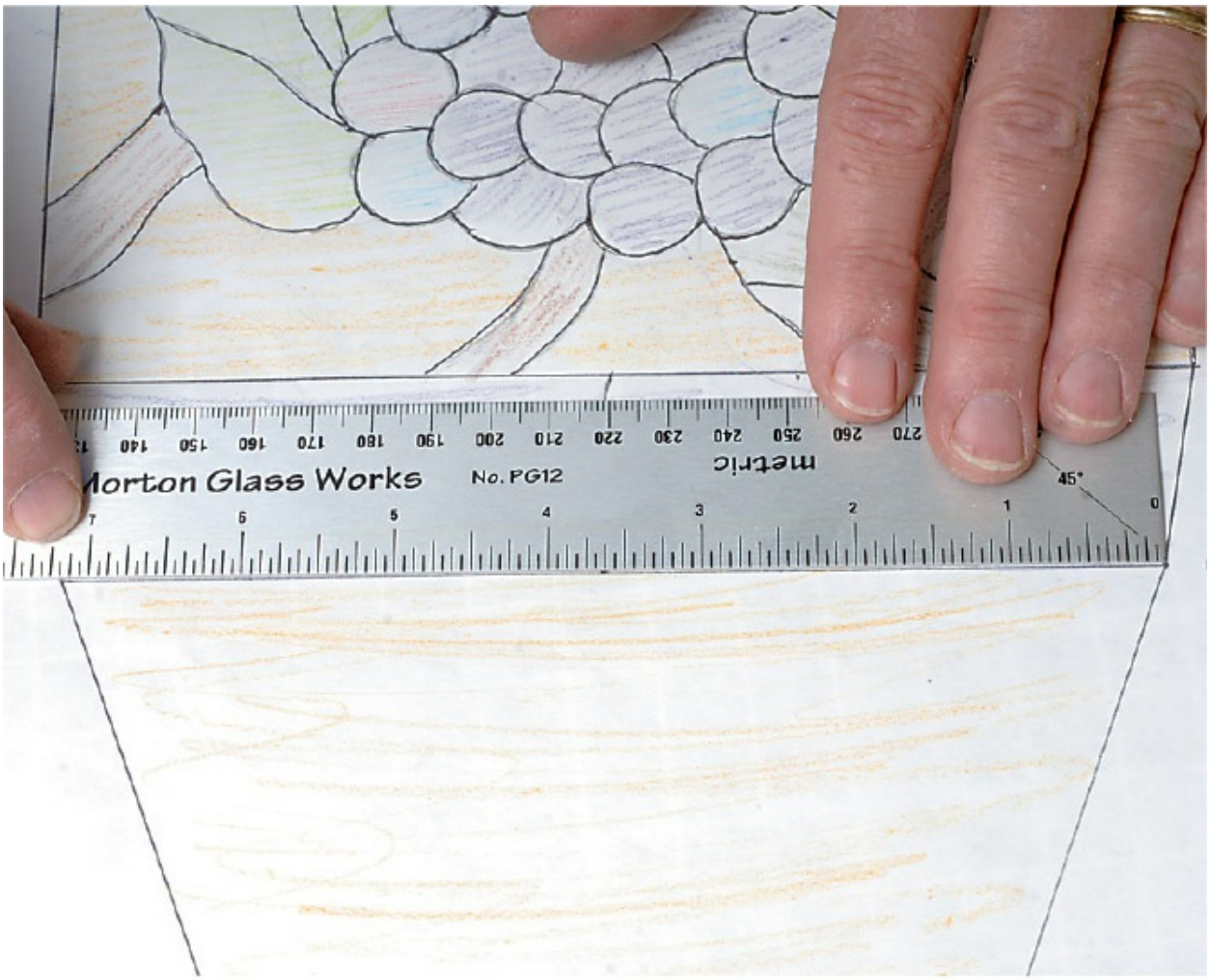
13. Break the glass along the score.



14. Measure the base of the trapezoid.

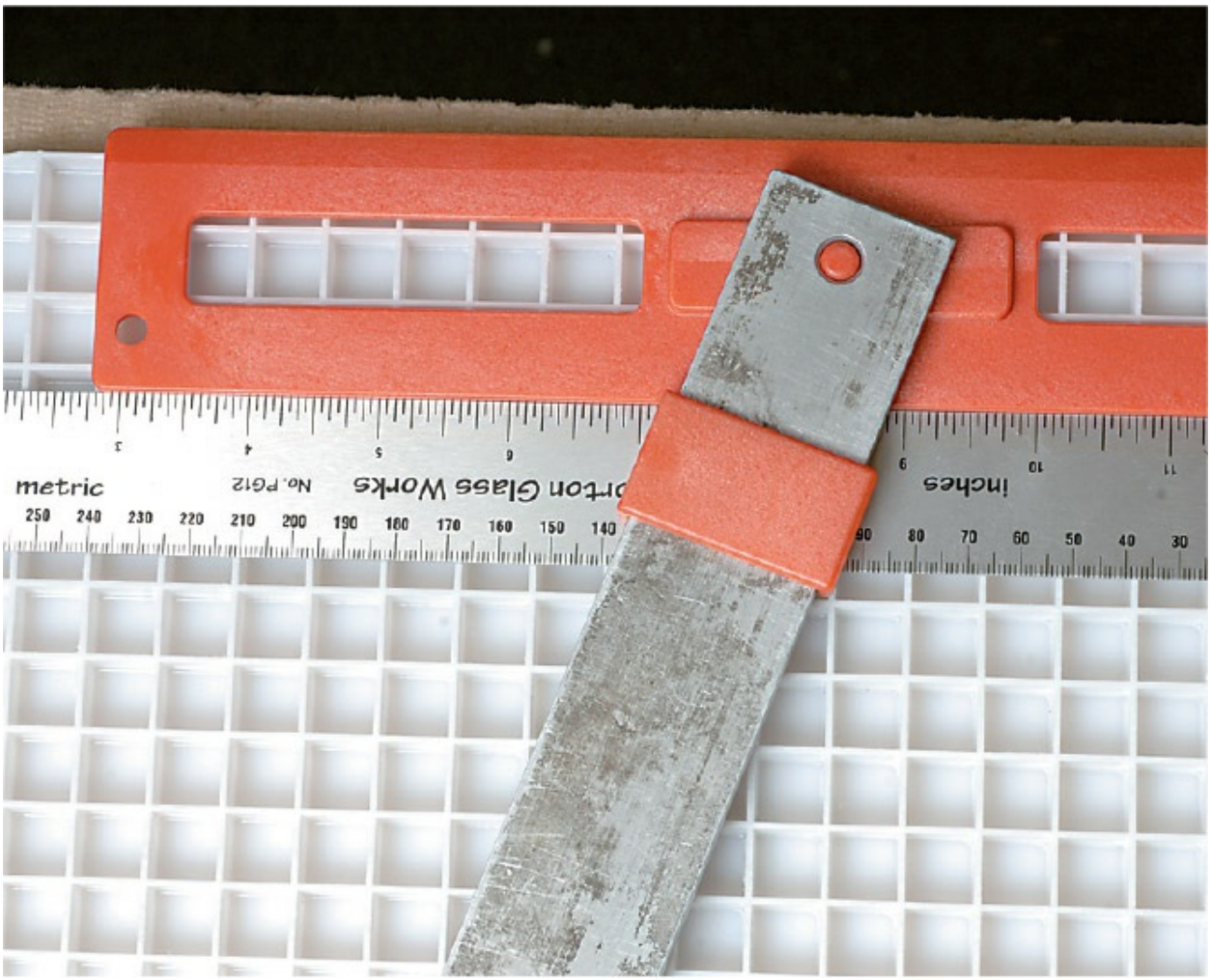


15. It should be $7^{3}/_{16}$ inches.

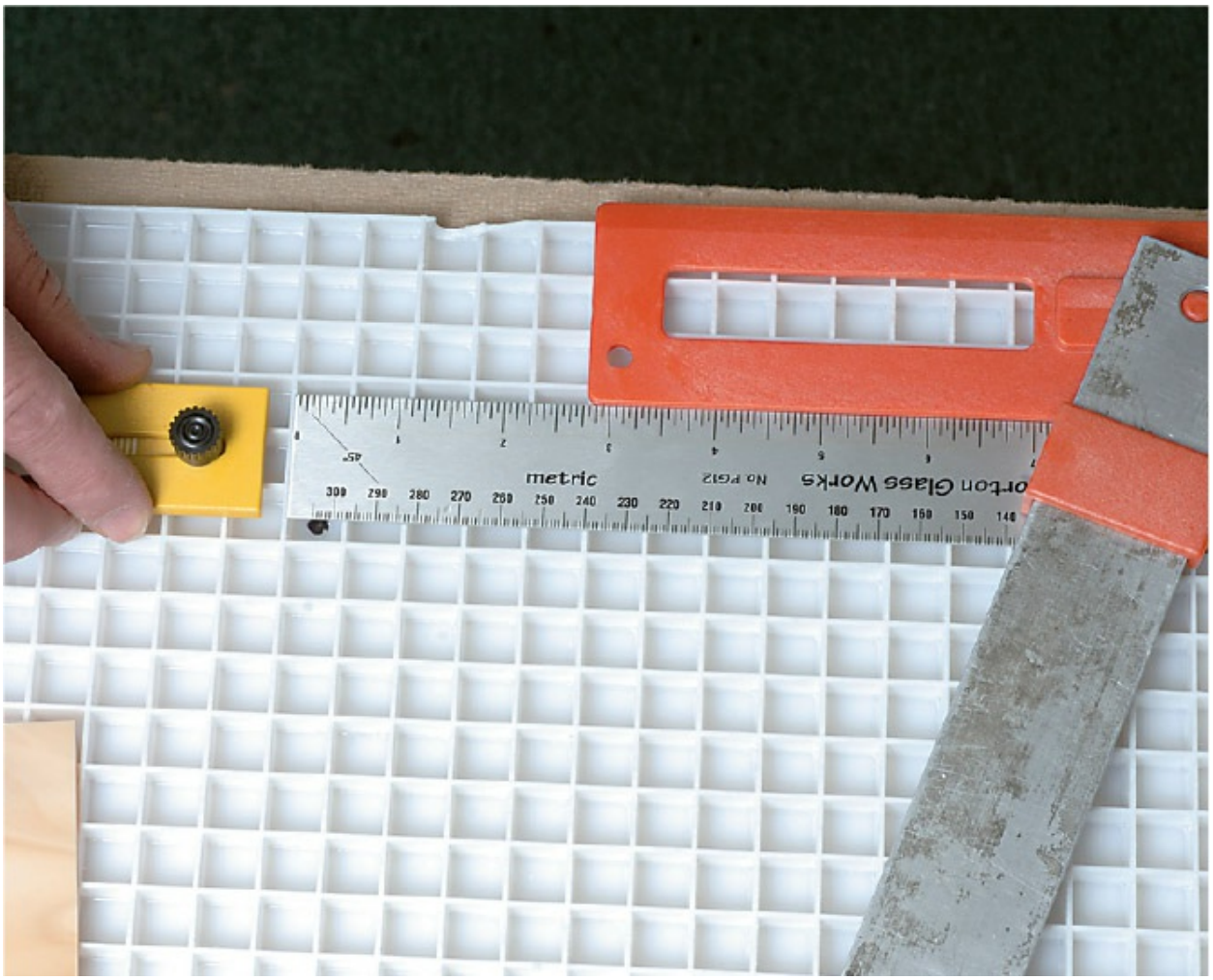


16. Slide the cutter gauge onto the base of the cutting bar.

17. Slide a ruler under the bar.



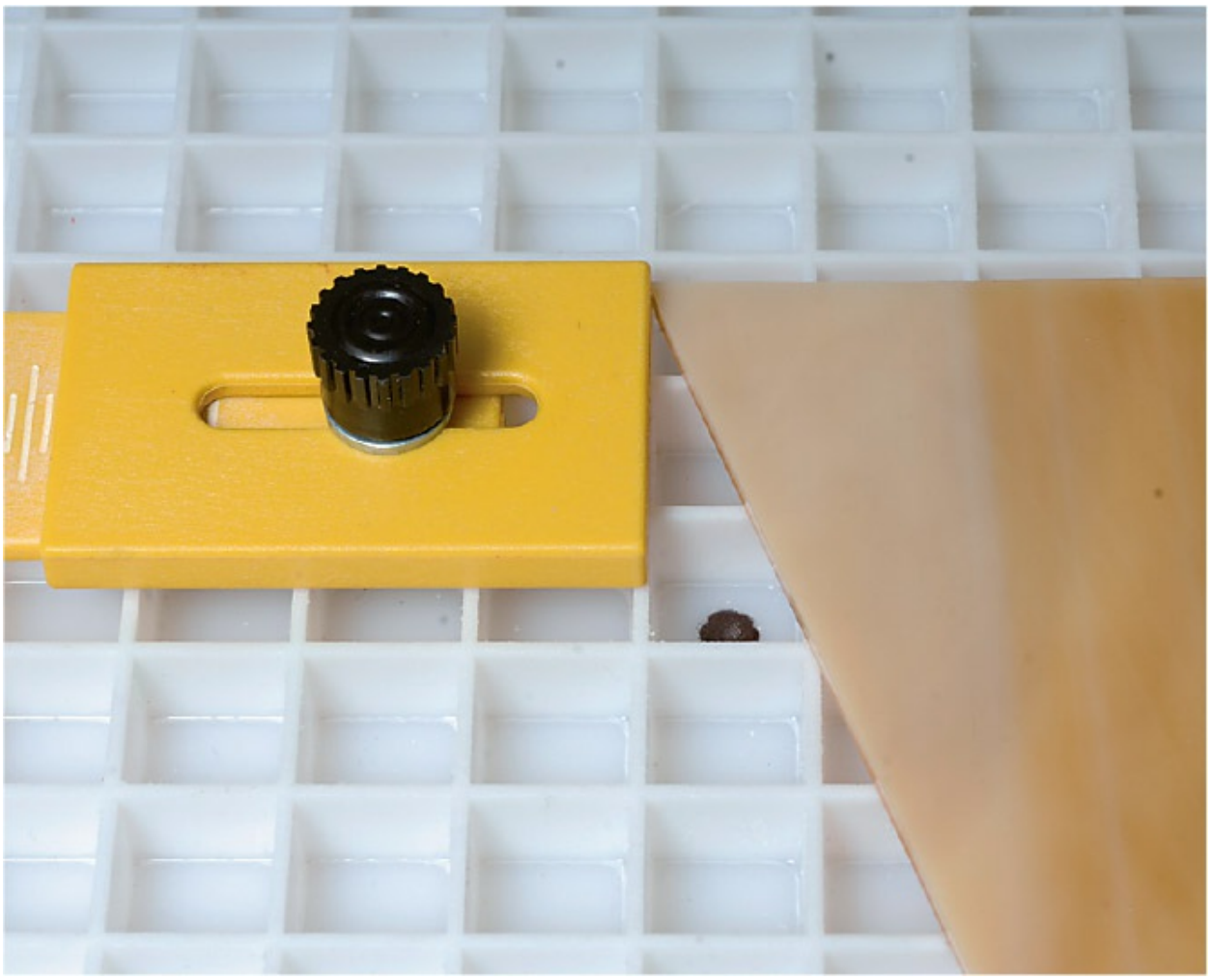
18. Set a glass stop exactly $7^{3}/_{16}$ inches away from the side of the gauge, then remove the gauge.



19. Flip the sheet of glass over.

20. Slide it under the cutting bar. . .

21. . . . until it hits the glass stop.

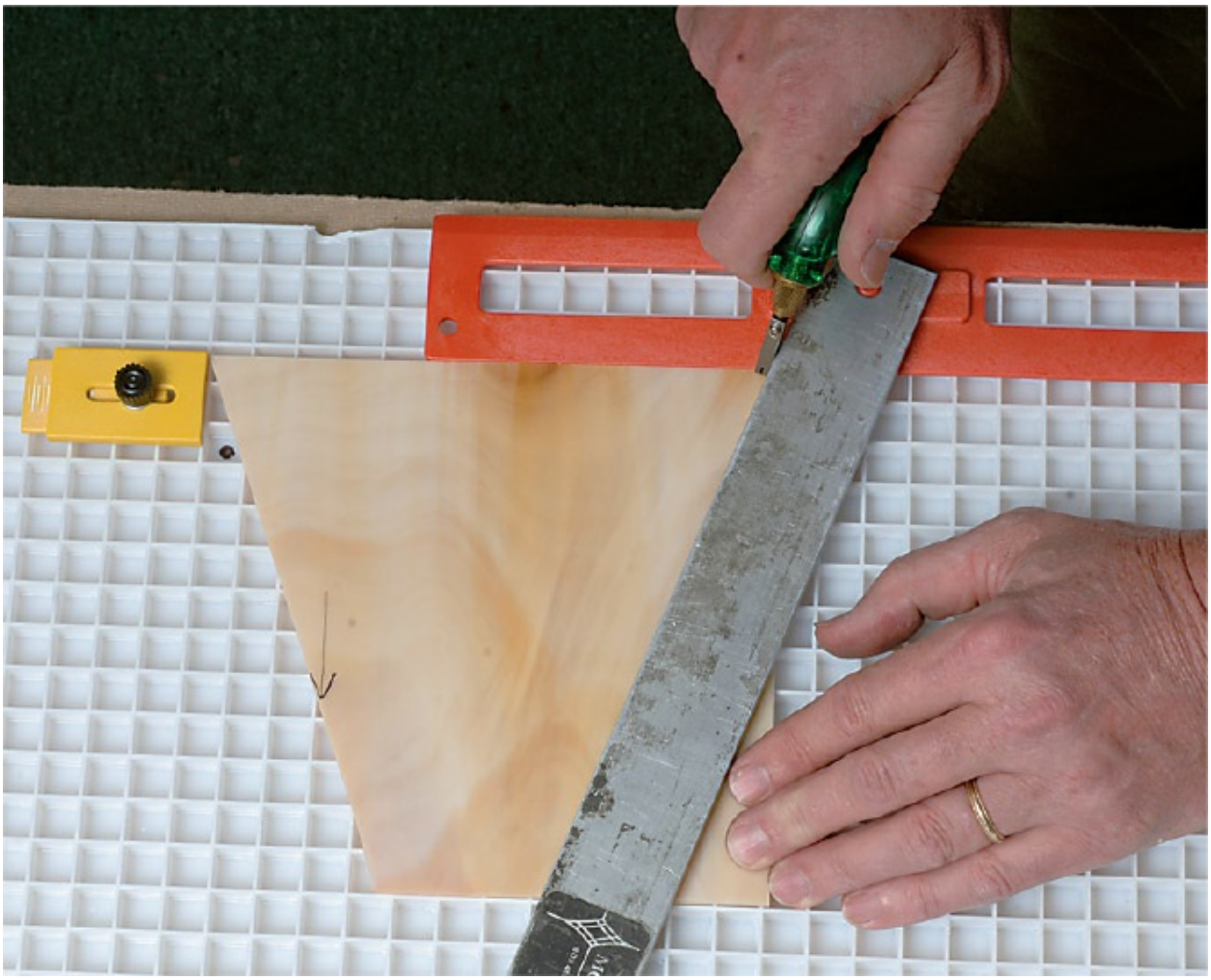


22. Cut the second angled side of the glass.

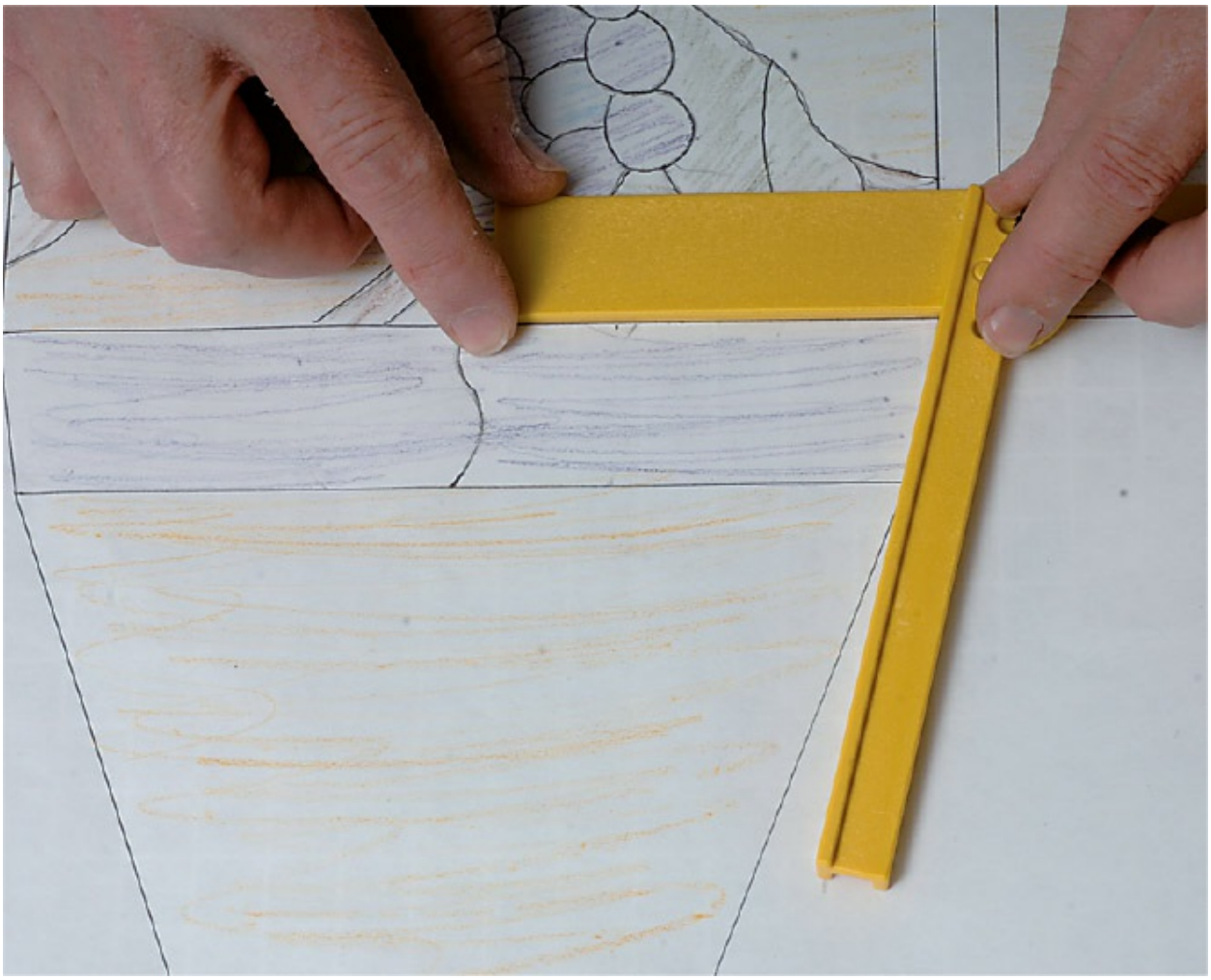
23. Break the piece.

24. The cut glass should fit the pattern perfectly.

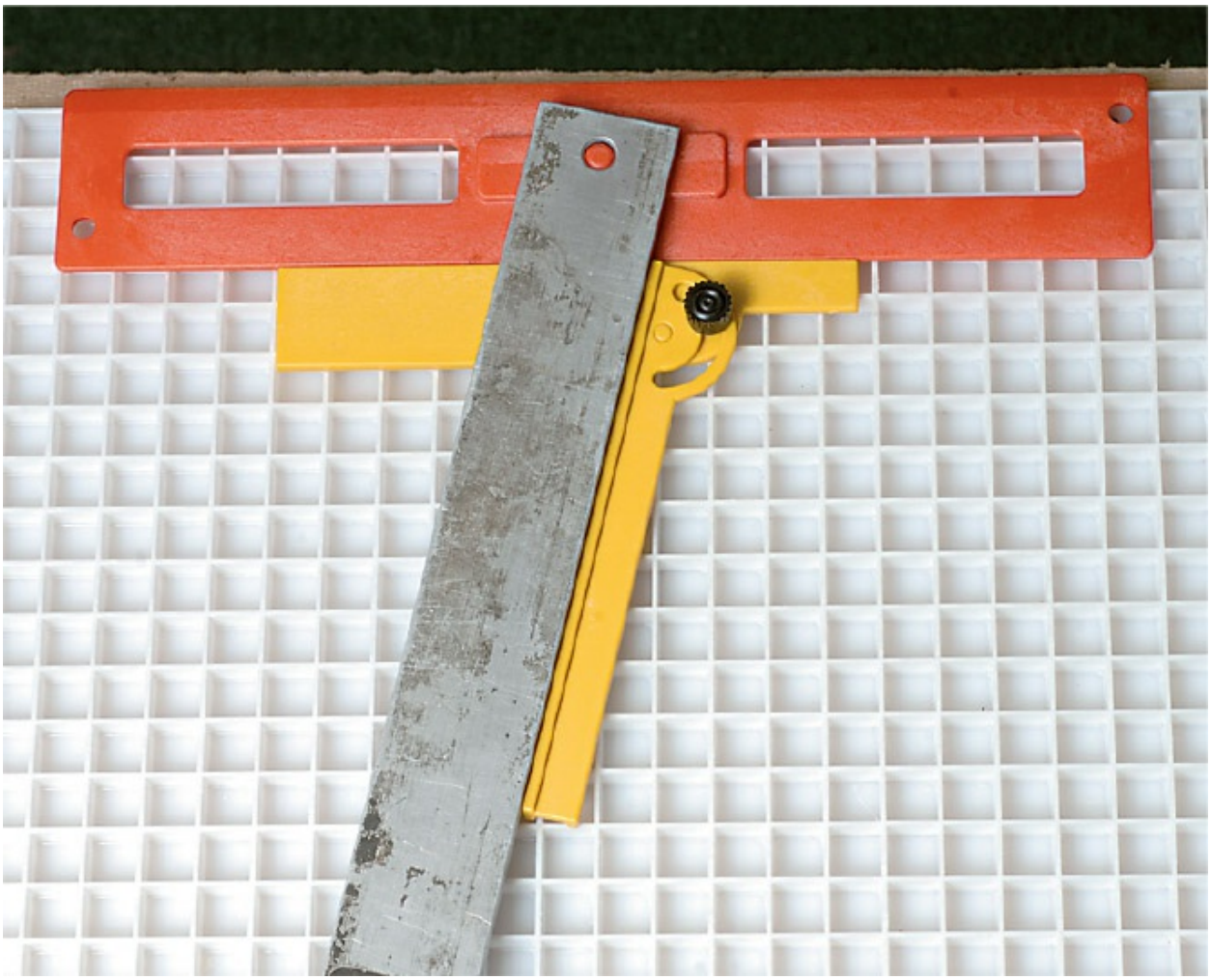
25. Cut seven more pieces the same way.



The contrasting bands at the base and the top of the cone piece are cut the same way as the trapezoid. The top band has the same angle as the trapezoid; cutting the sides of the lower will require you to reset the jig.

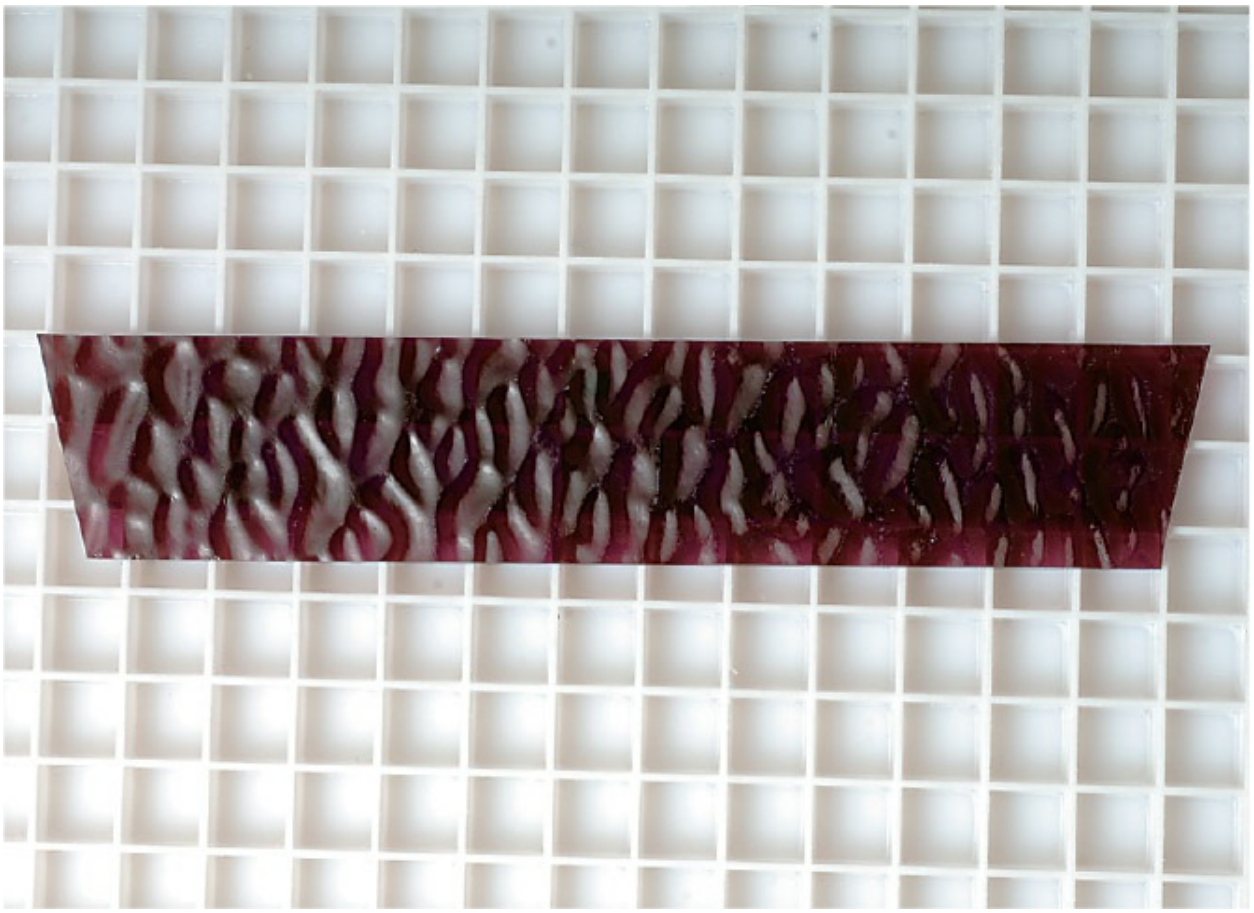


26. Adjust the copy angle and set the cutting bar.



27. Set the glass stop and make your cuts.

The finished piece.



28. Glass nuggets are used for the grapes on four of the lampshade's side panels. Before you work with them, wash the nuggets in soapy water and rinse them in clean water to remove surface grime and film that might prevent the foil from adhering.

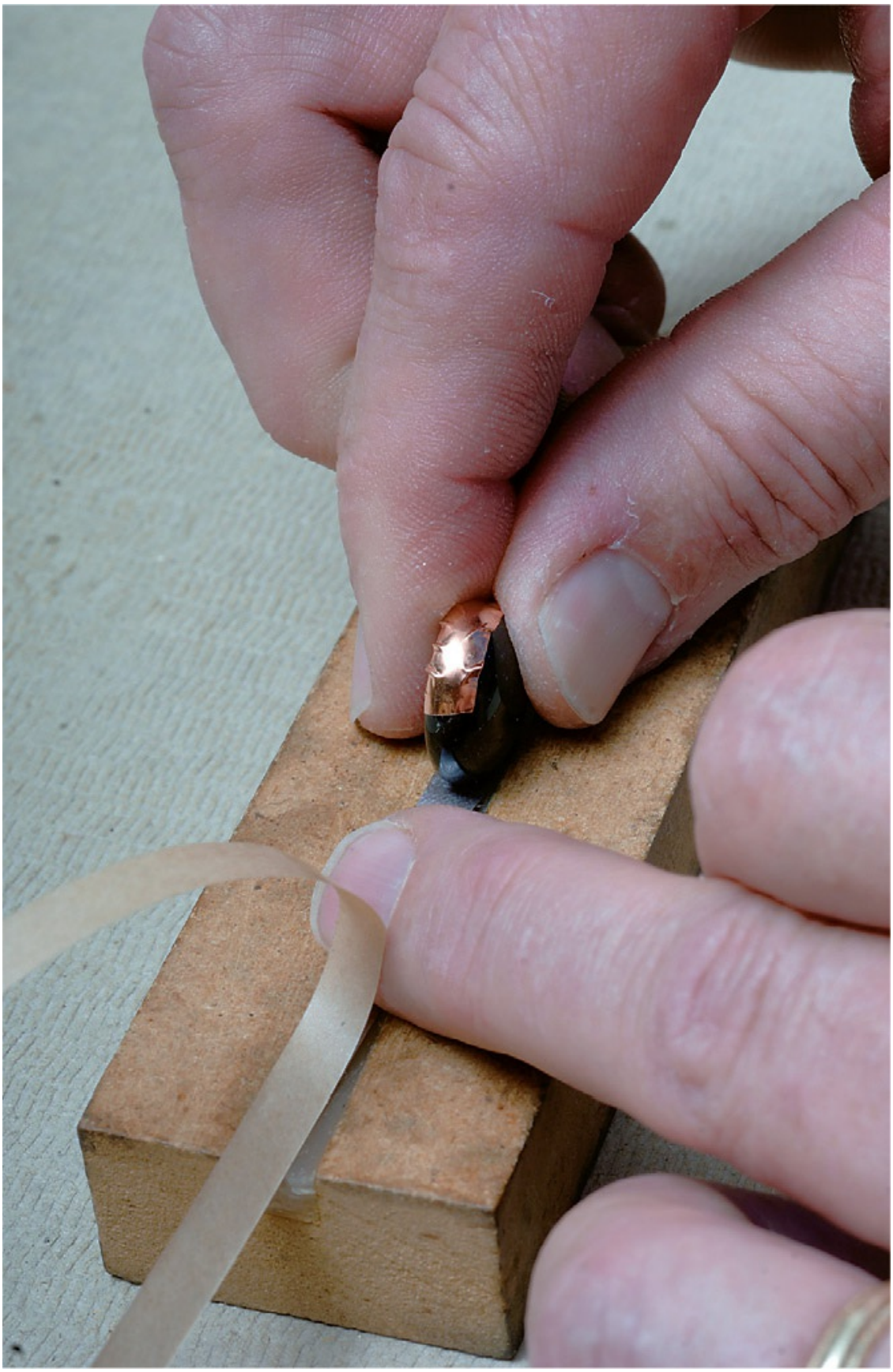
29. Dry them completely with a hand towel. Foil won’t adhere to wet glass either.

30. Remove the backing from 4 or 5 inches of foil and lay the stripped foil face down on the nugget foiler's rubber groove.


FOIL FINISHER

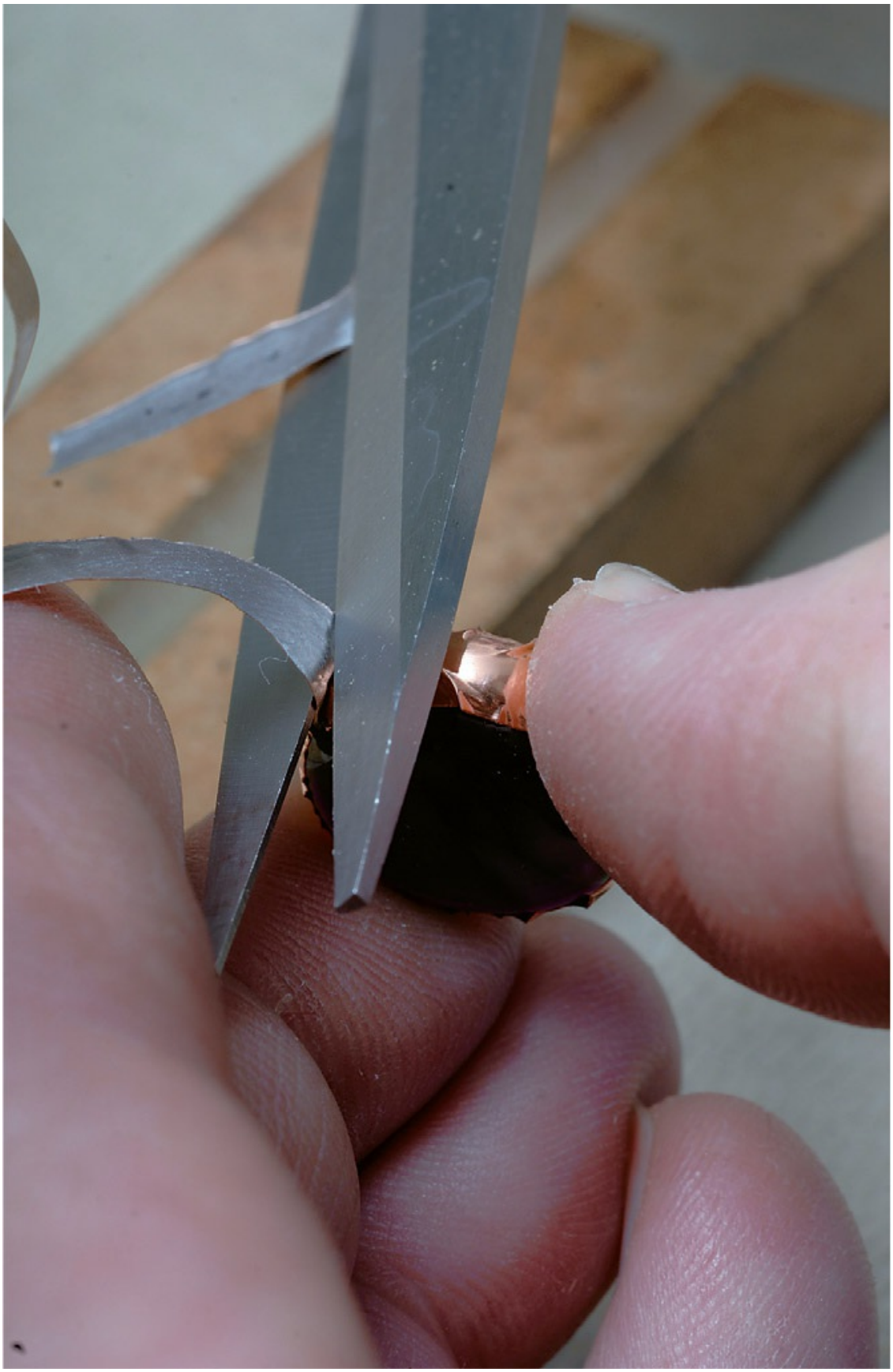
31. Place a nugget on the foil with its “edge” facing down.

32. To foil the nugget, roll it slowly along the groove, pressing it into the foil as you go. The rubber underneath will give a little, pushing the foil around the nugget's curves.



33. Keep rolling until you reach the starting point, then overlap the foil strip about⅛ inch.

34. Trim the foil.



The foil should be wrapped tightly around the nugget. Notice that there are still some gaps along the edges of the foil. These will be flattened by shaking the foiled nugget with others in a plastic bottle.

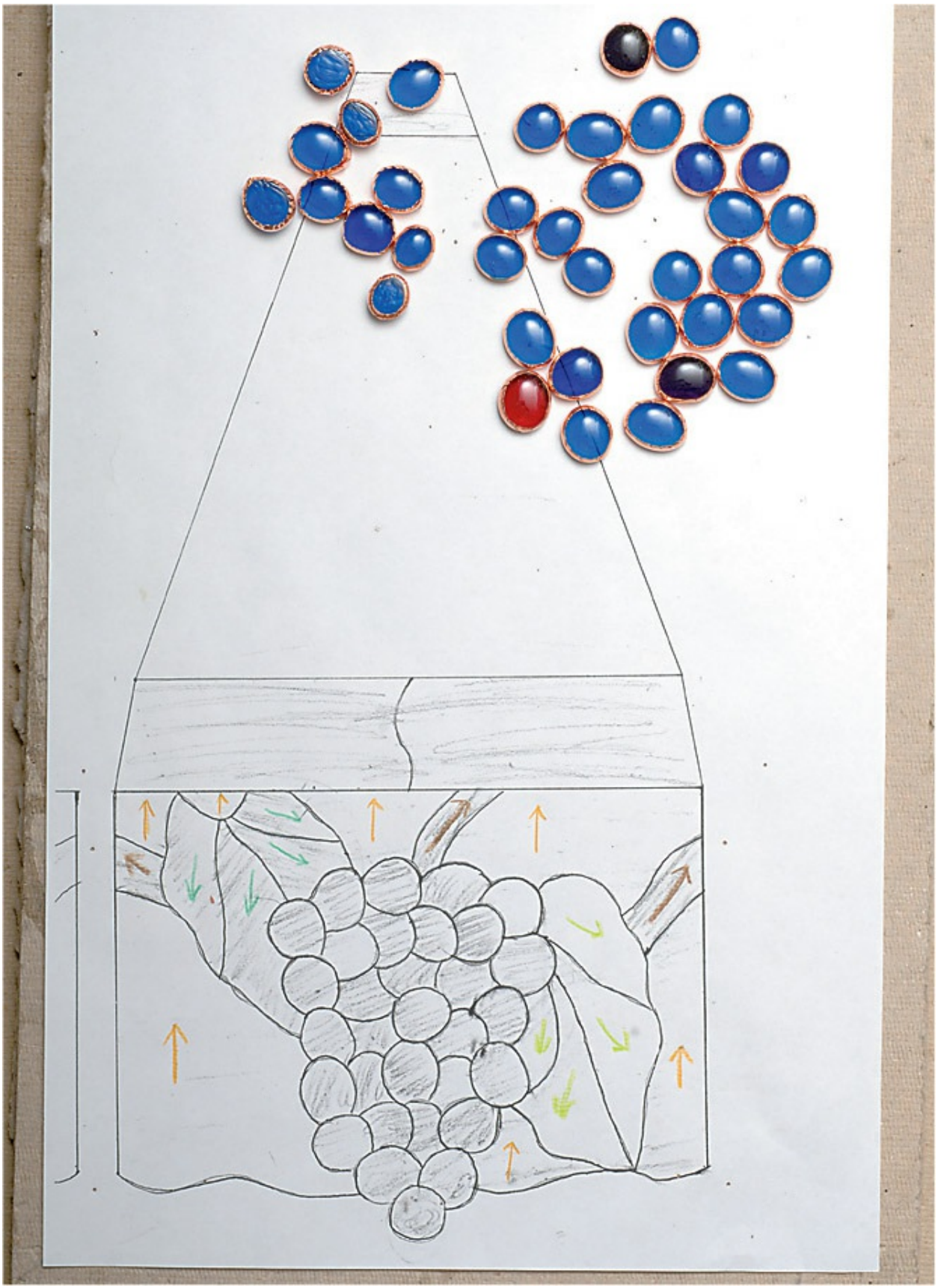
35. When you've foiled enough nuggets to fill the bottle about halfway, pour them in.

36. Put on the cap and shake the bottle firmly for about 30 seconds. You don’t have to shake it for a long time, just make sure the nuggets are all rattling around against each other.

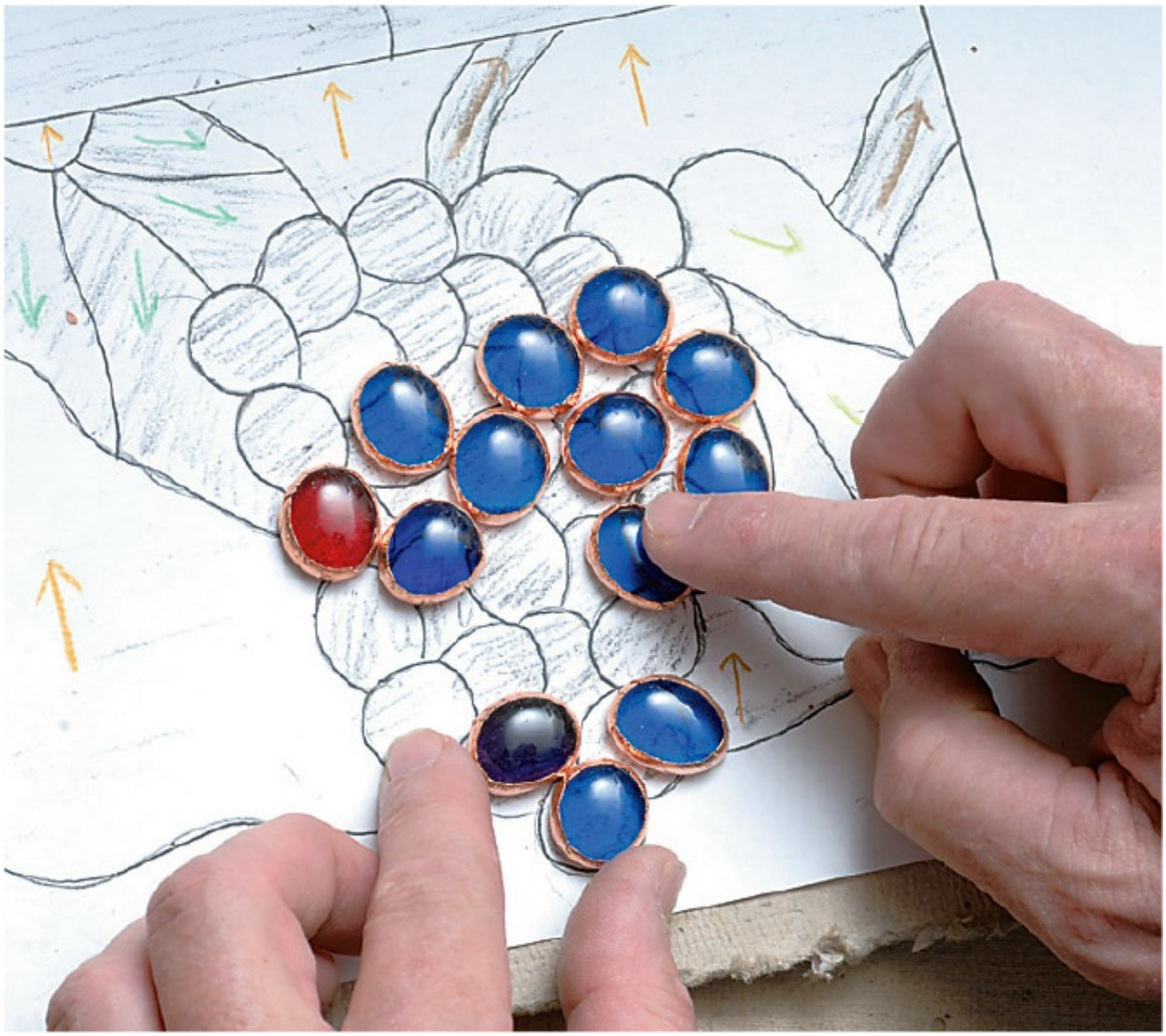
After shaking, the foil should be well flattened all around each nugget. For this project, 104 nuggets were foiled and tumbled. It’s a good idea to

foil a few extra nuggets so you have some choices when you try to match the pattern.

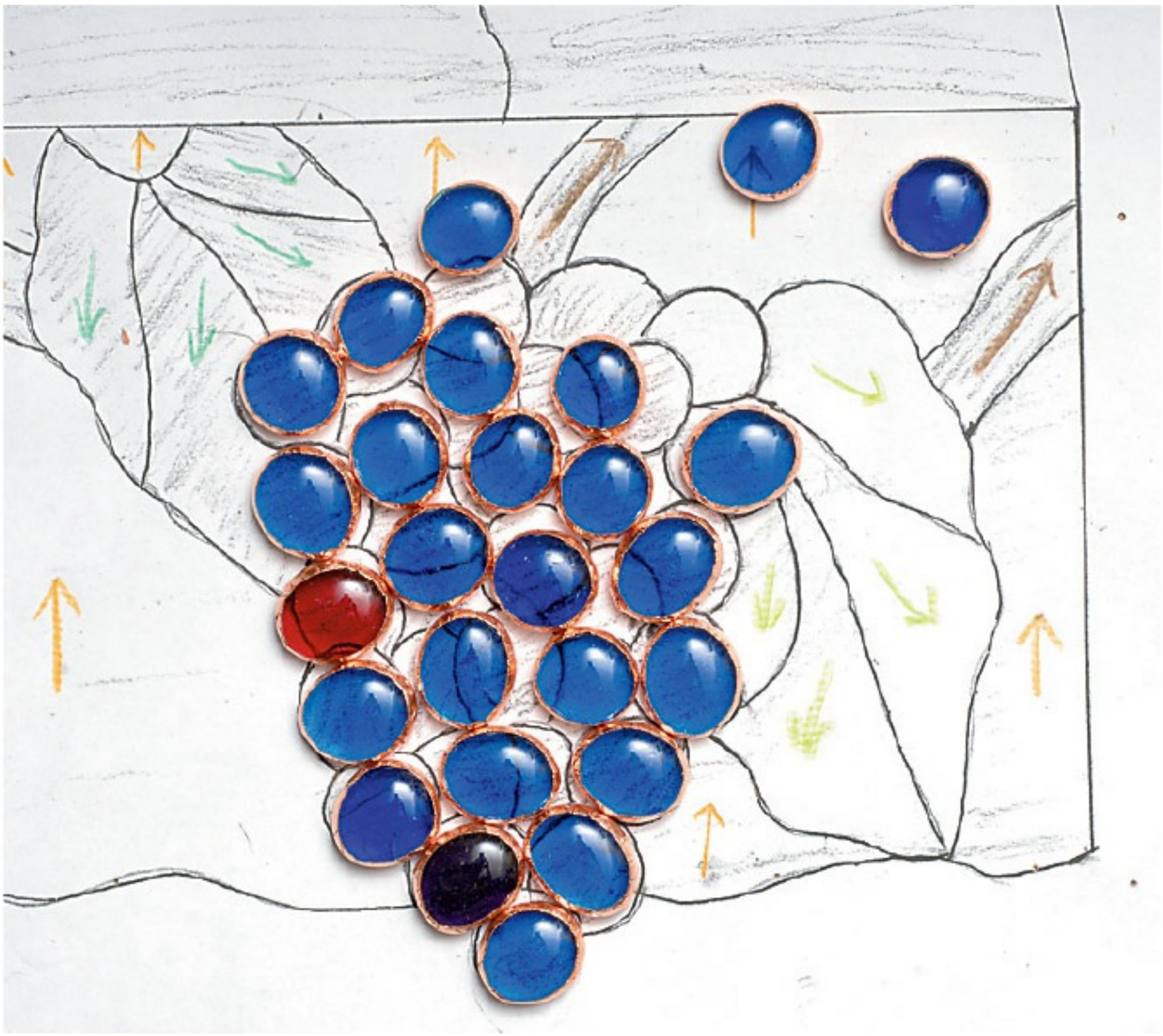
To create the grape cluster for the skirt of the lampshade you'll use 24 blue foiled nuggets plus a red one and a purple one for variety. On the finished shade, two grape clusters are blue (with a couple contrasting nuggets) and two are purple.



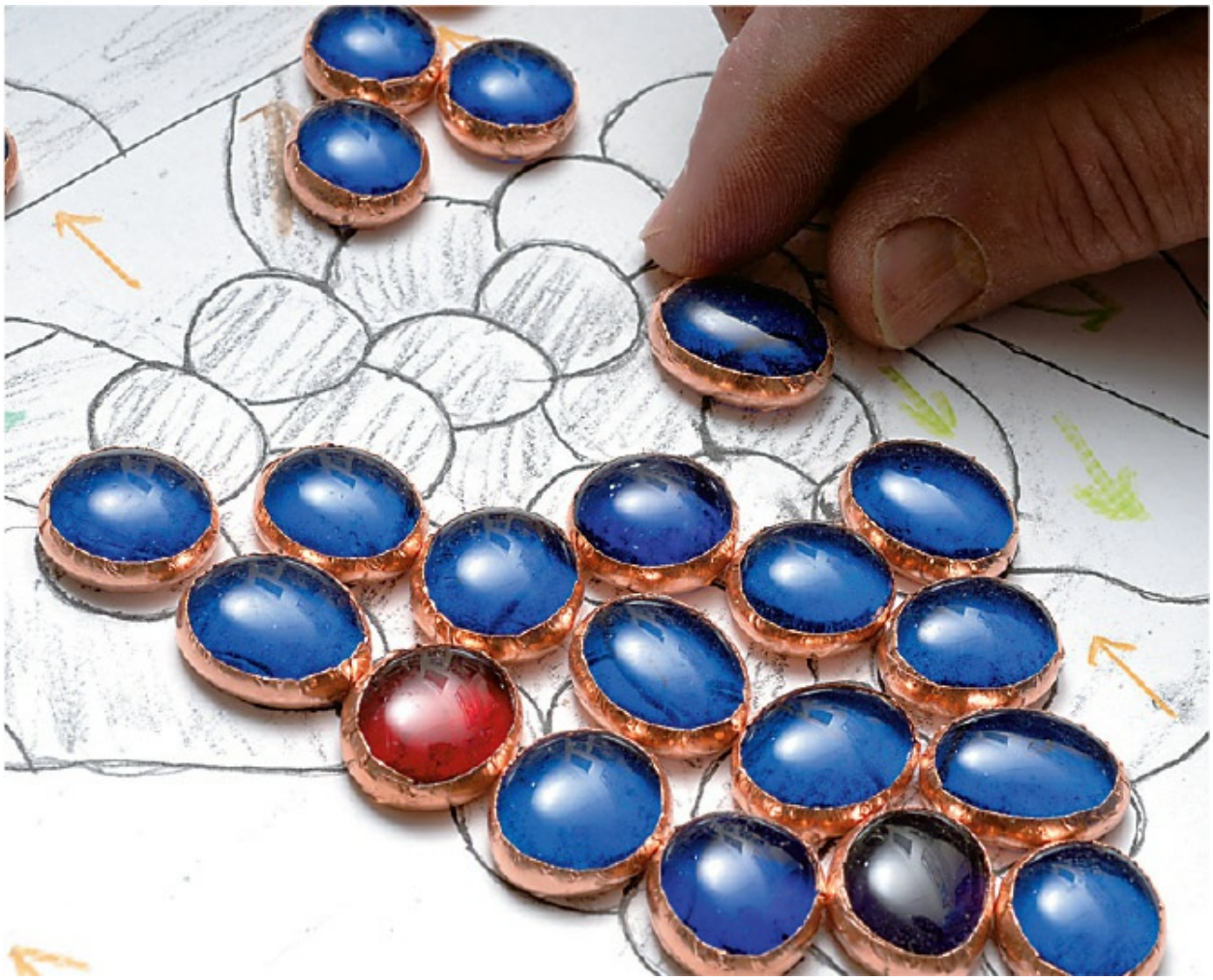
37. Arrange the nuggets on the pattern so they fit within the confines of the cluster's outline.



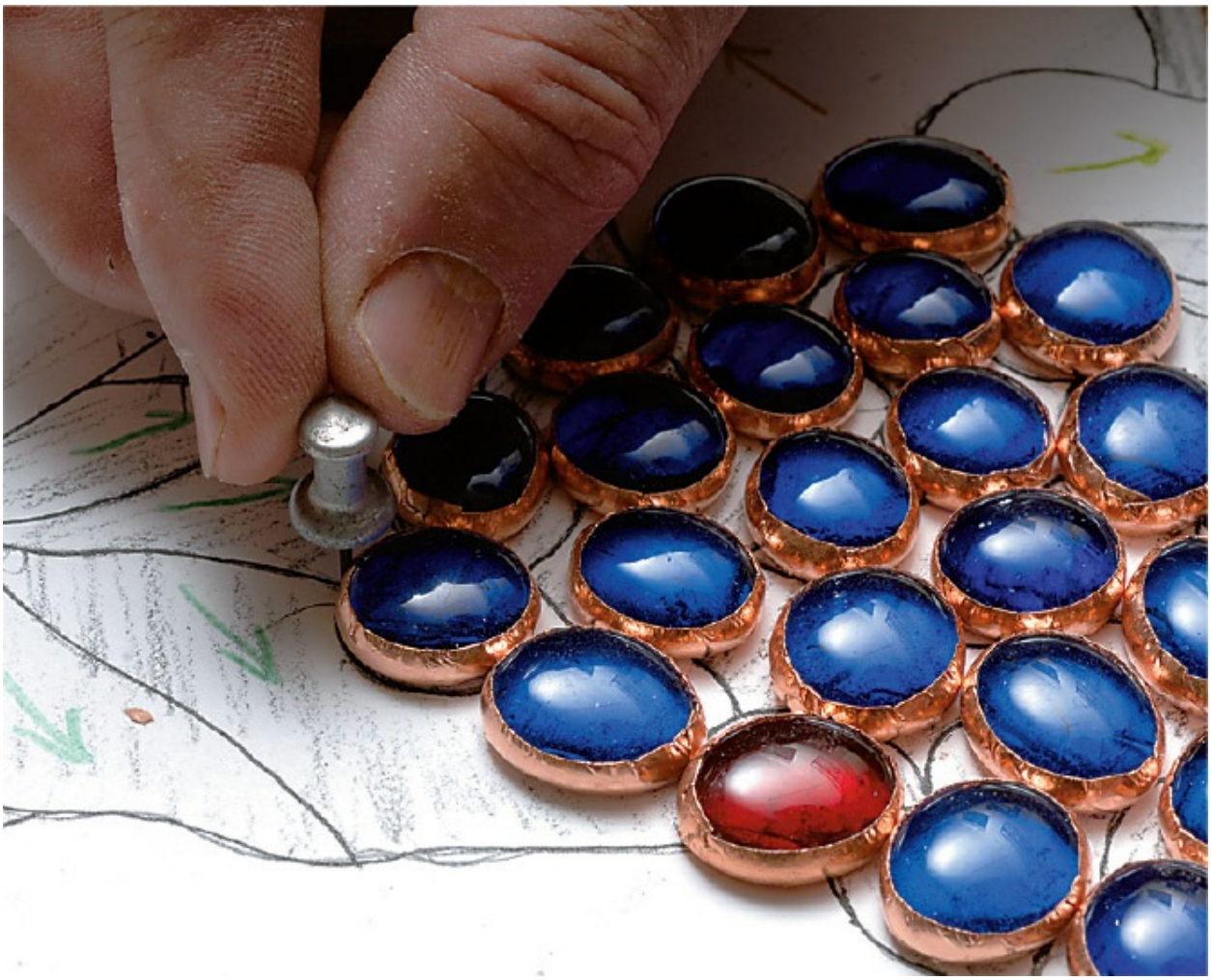
38. You won't be able to match the pattern exactly. Position the nuggets along the edge of the cluster's outline so that they match the contour as closely as possible.



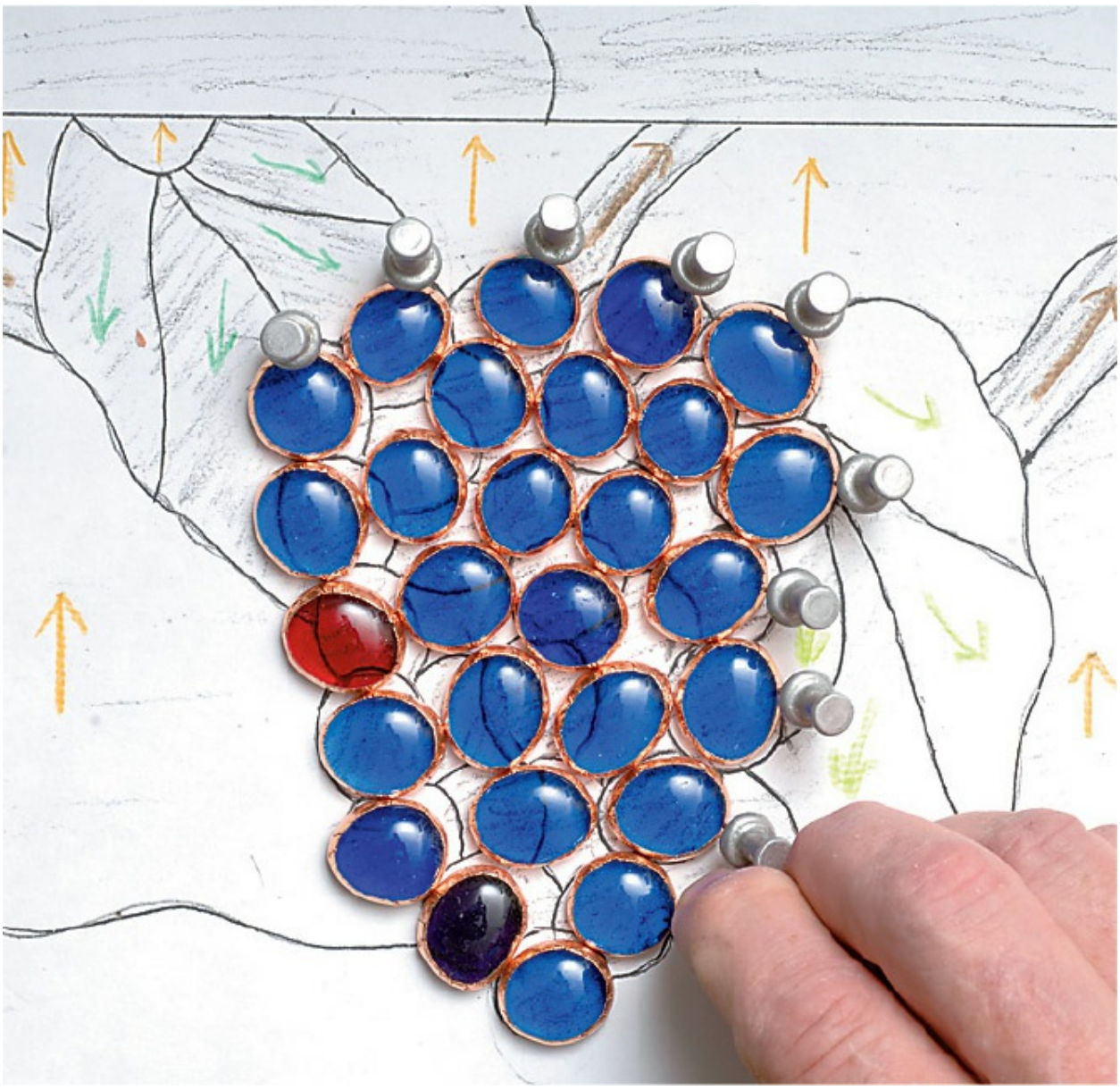
39. It might take a bit of fiddling and nugget-turning until you get the cluster in a shape you like. Try to keep the gaps between the nuggets small so you won't need to fill them with a large amount of solder.



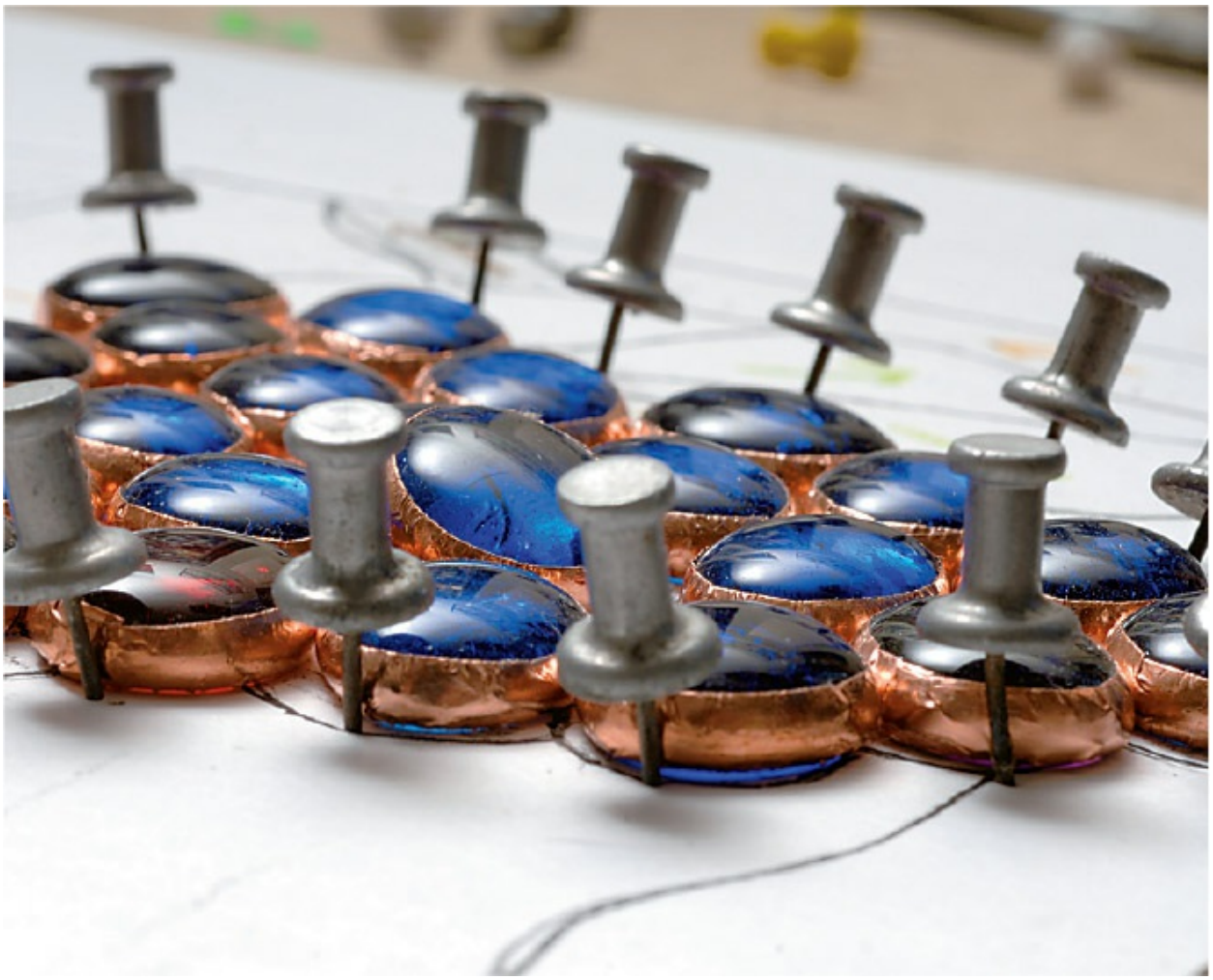
40. When you're satisfied with the arrangement, use pushpins around the perimeter of the cluster to hold all the nuggets in place.



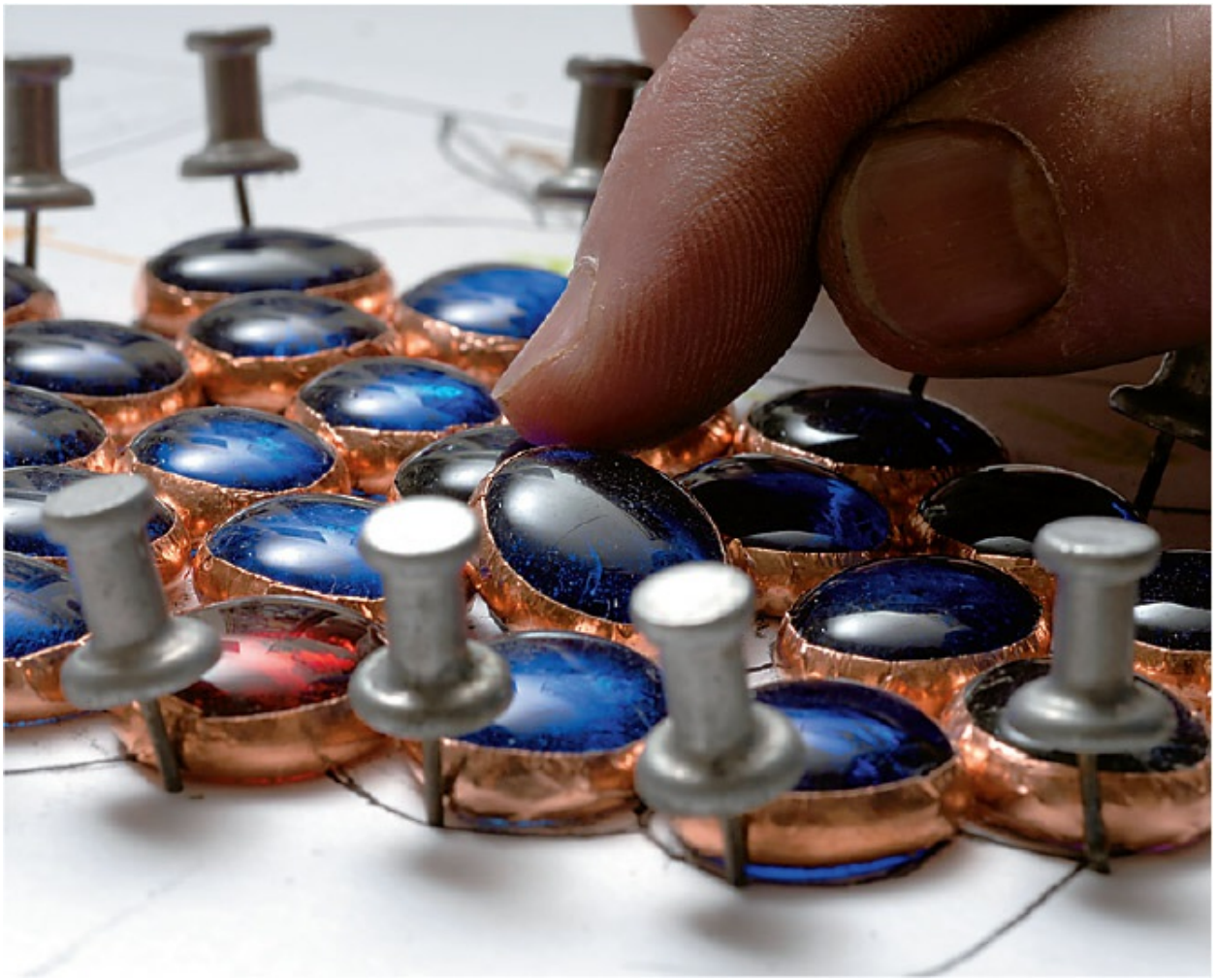
41. The pins should press the nuggets against each other fairly tightly.

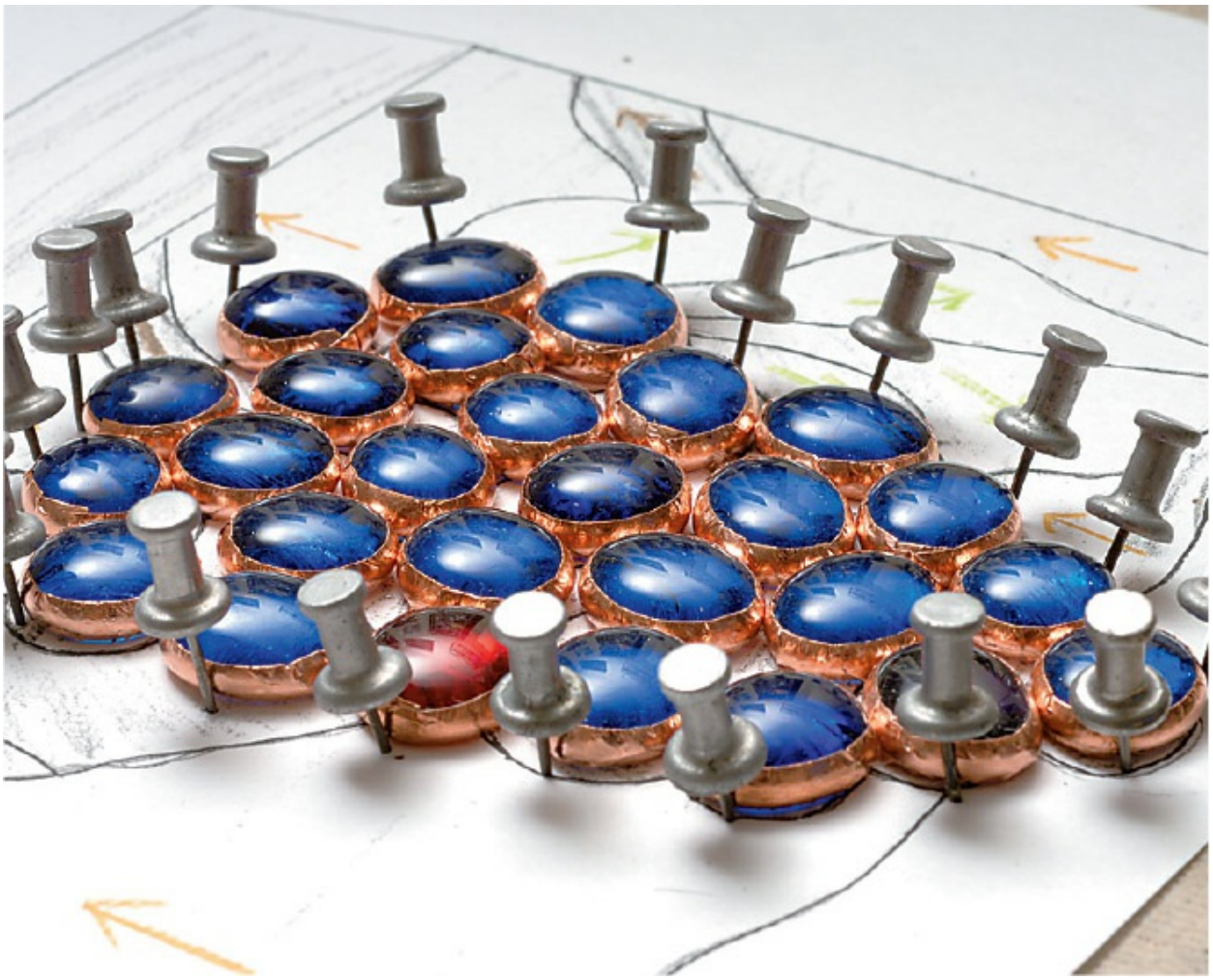


42. A nugget or two will probably pop up because of the pressure.

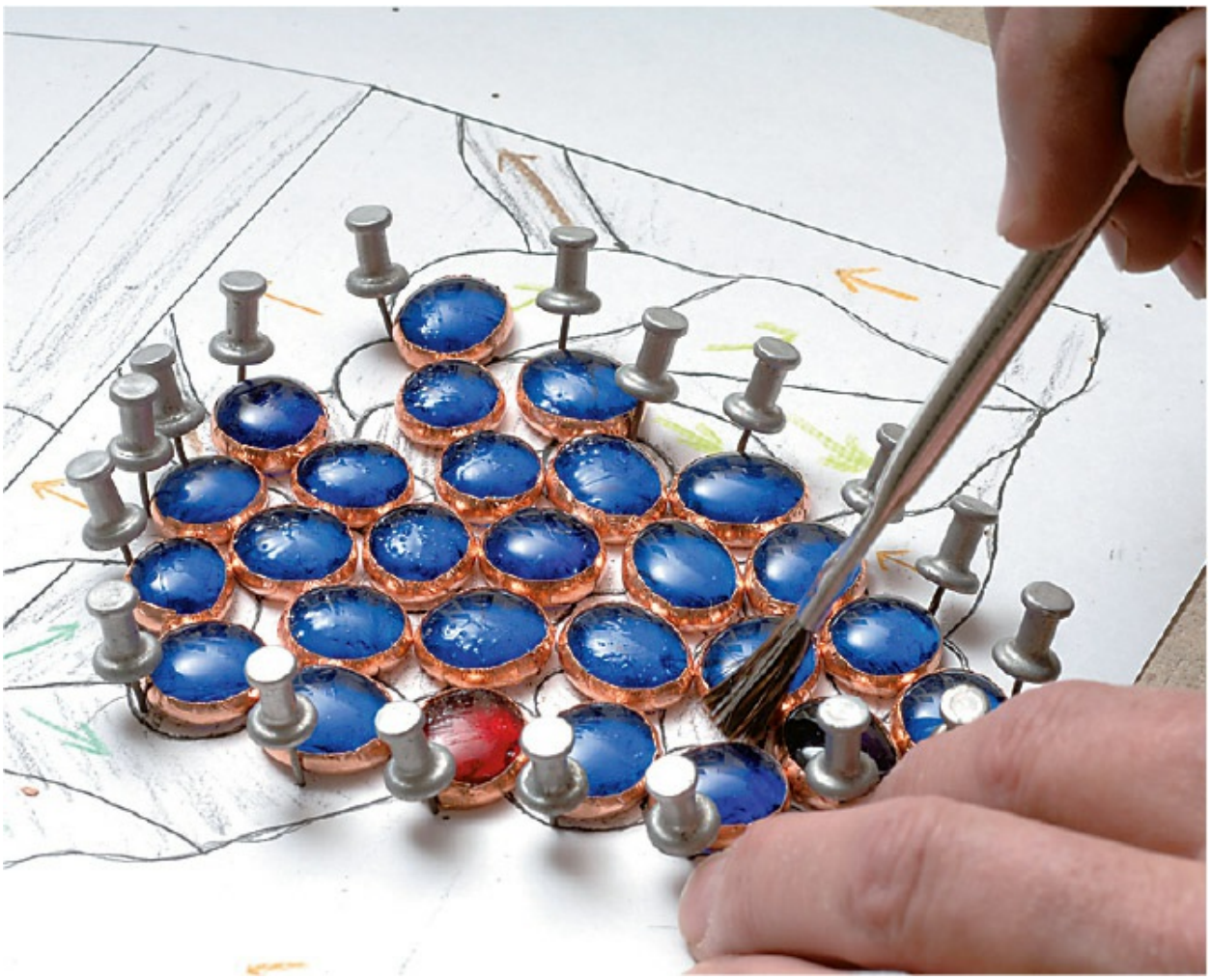


43. If one does, you might need to remove a pin or two and reposition some nuggets so they all lay flat when pinned.

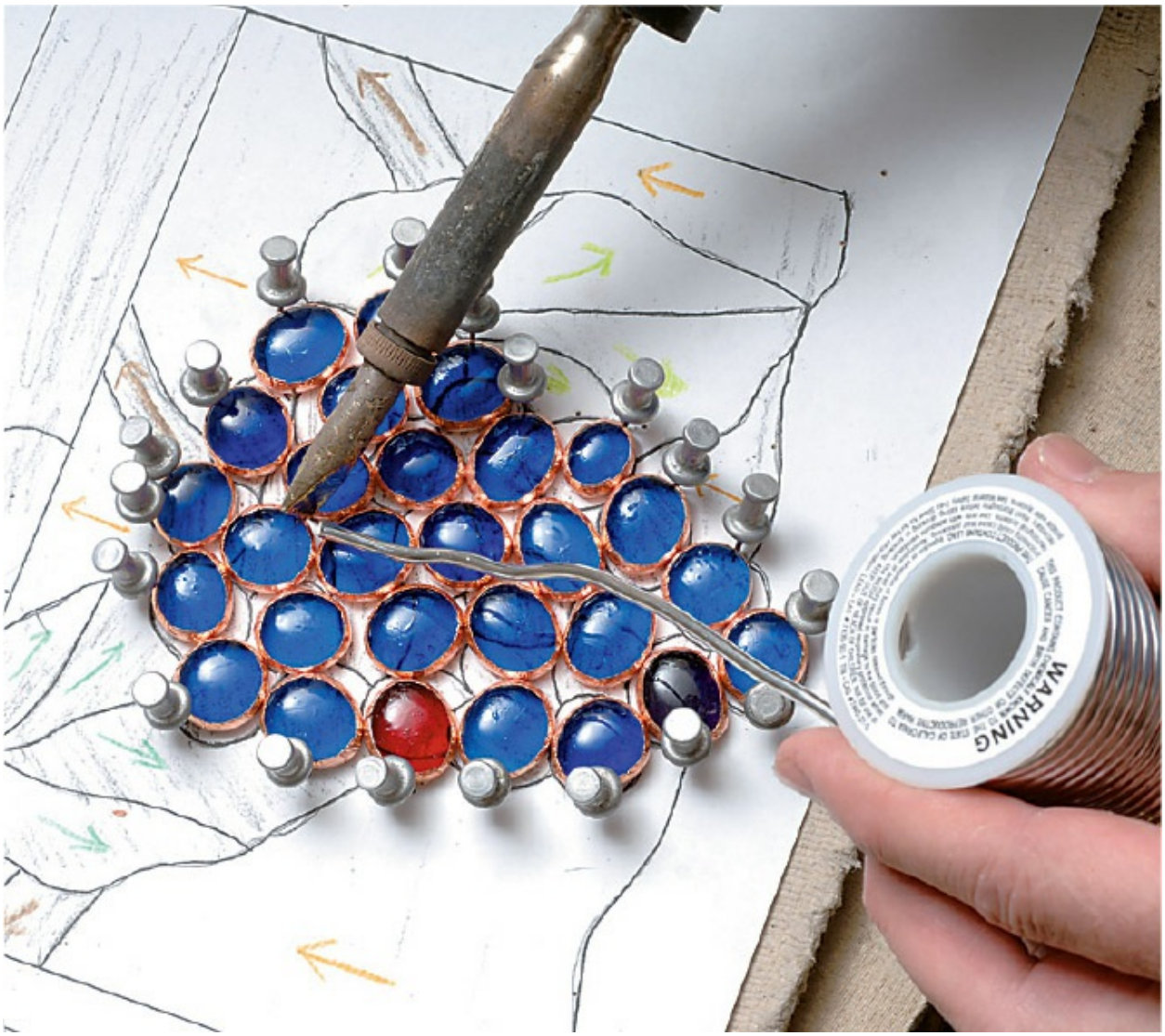


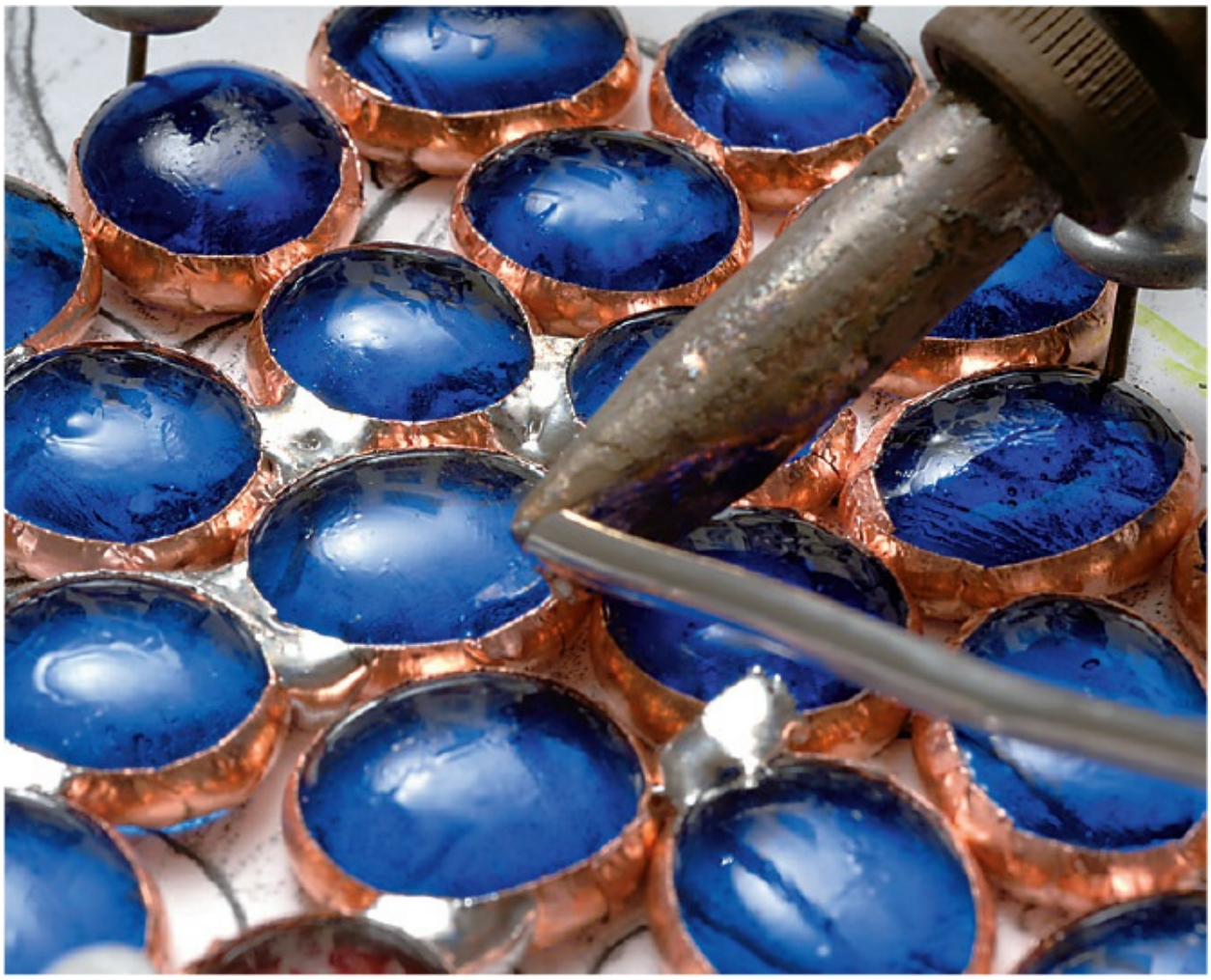


44. Flux the areas where the nuggets touch each other.



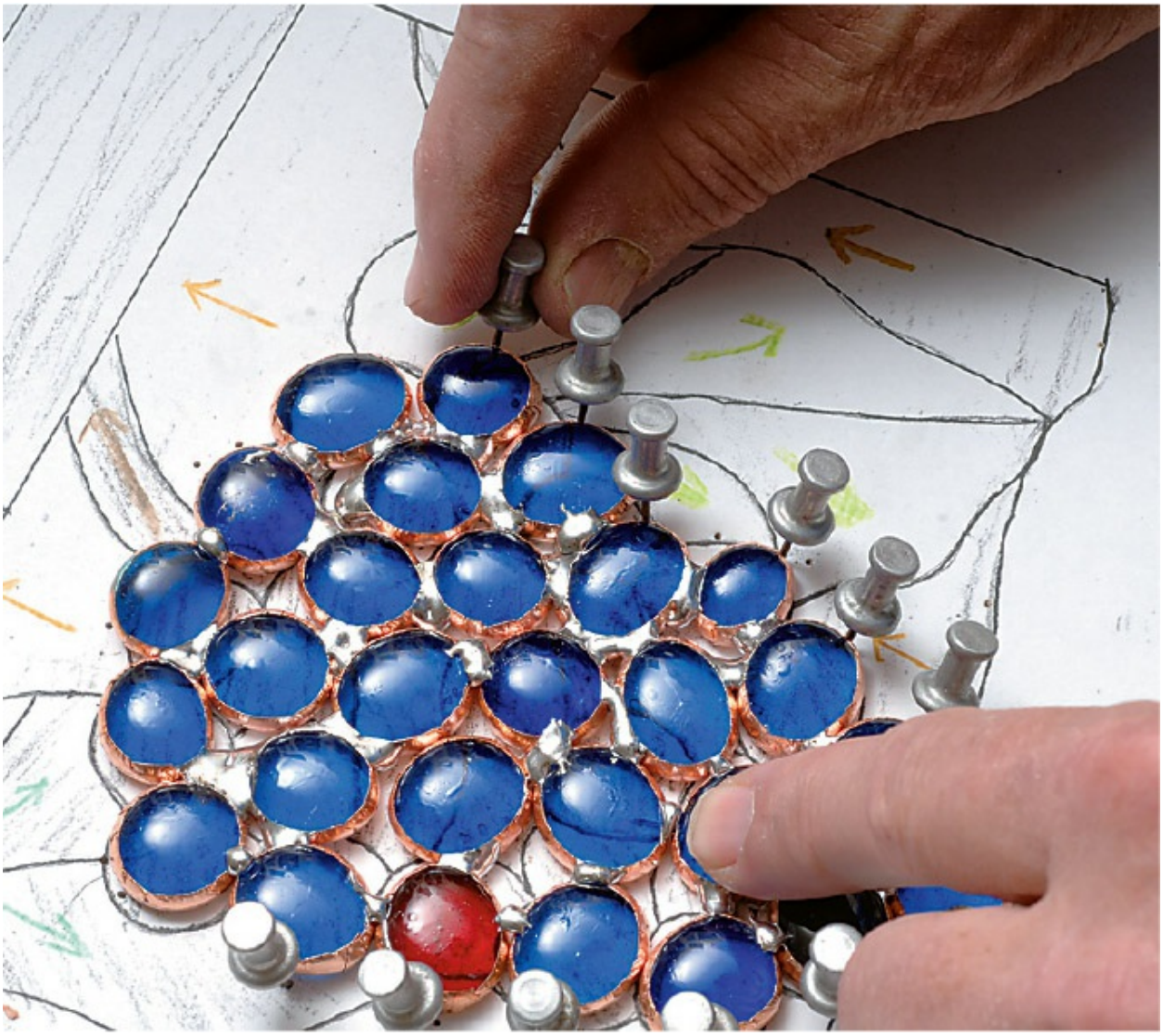
45. Solder each spot where the nuggets touch.


WARNING

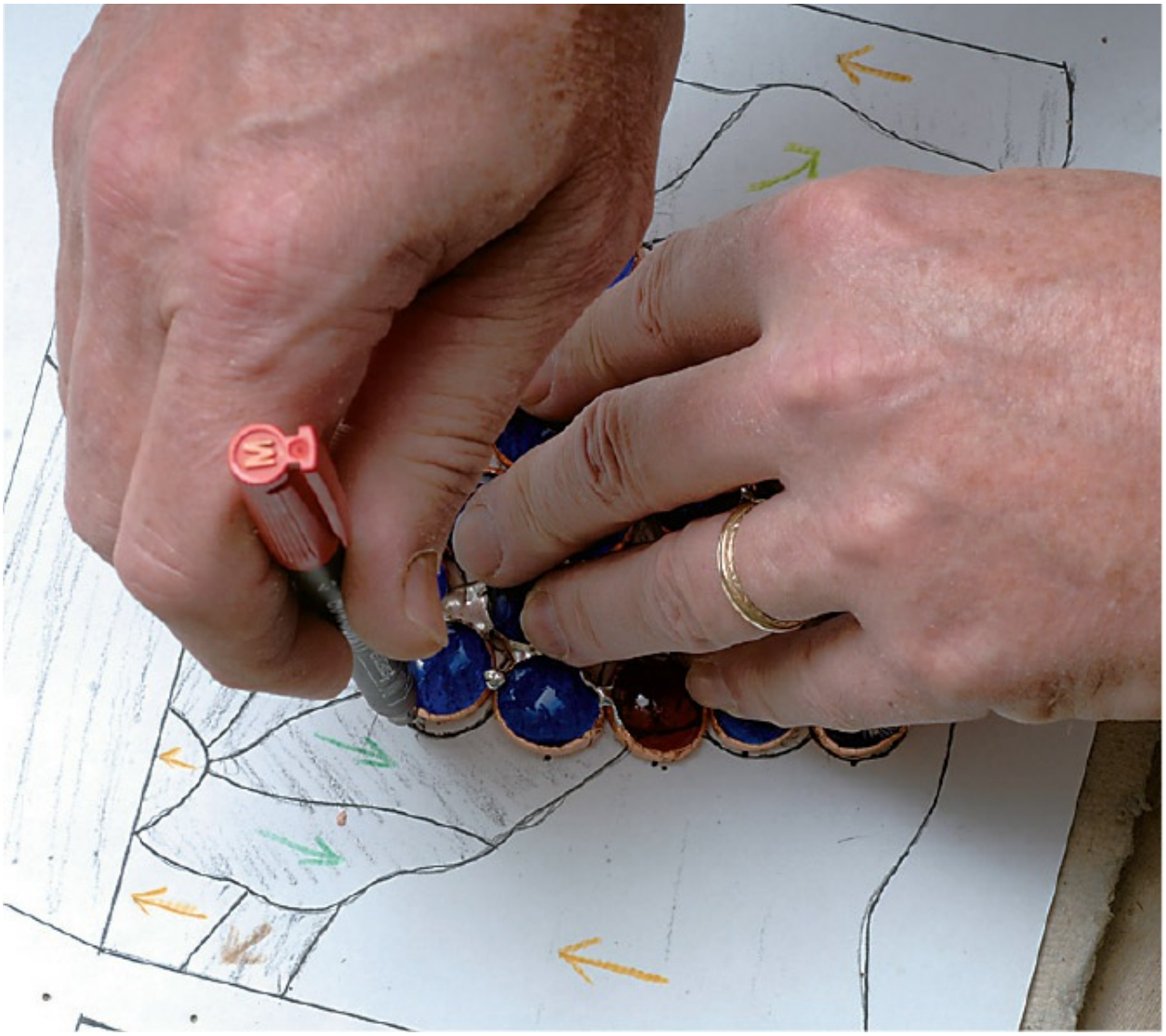


46. Work carefully, making certain that the molten solder isn’t just falling between the glass.

47. When you're done, you can remove the pushpins to make the final soldering easier, which will probably require you to turn the cluster as you work.

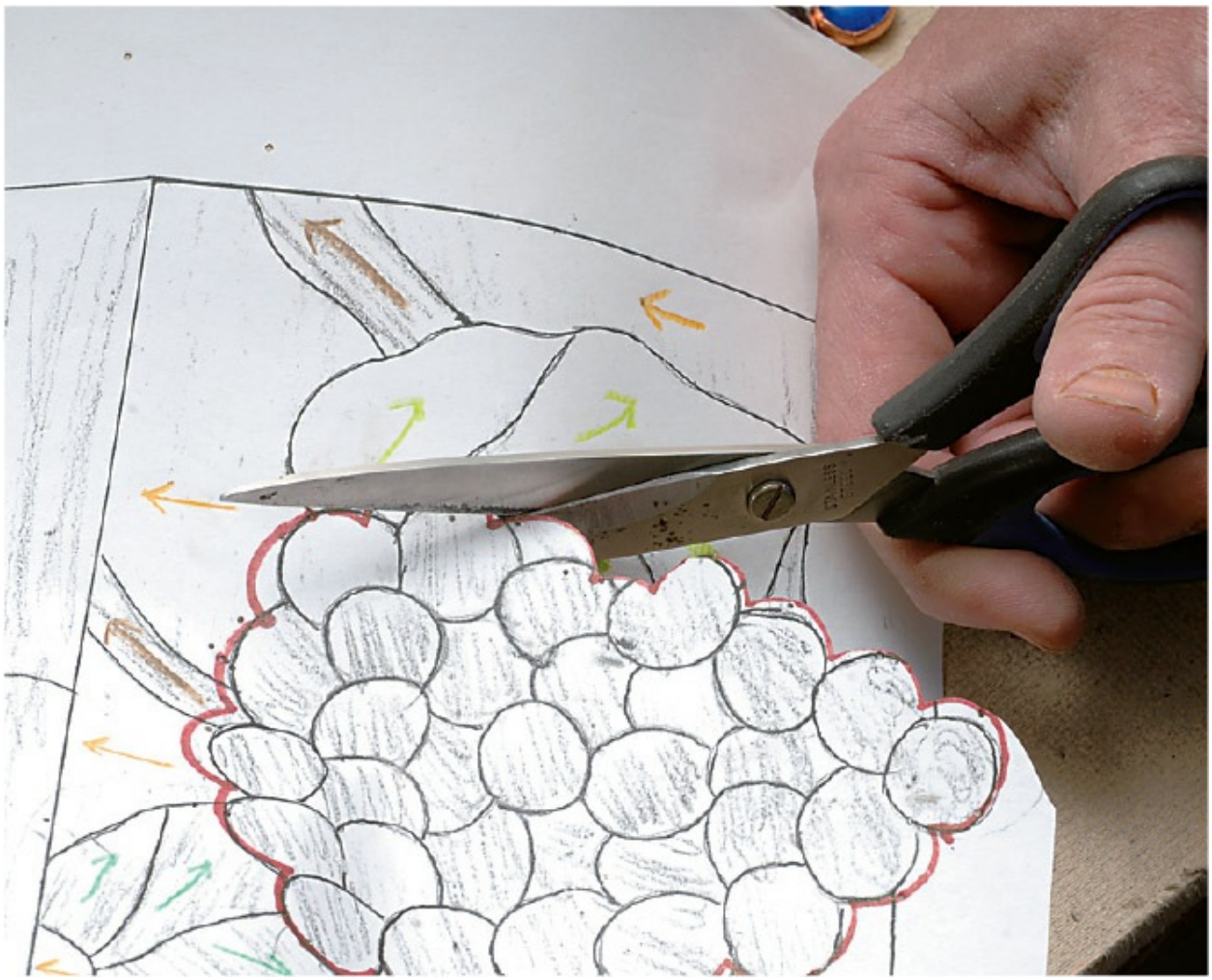


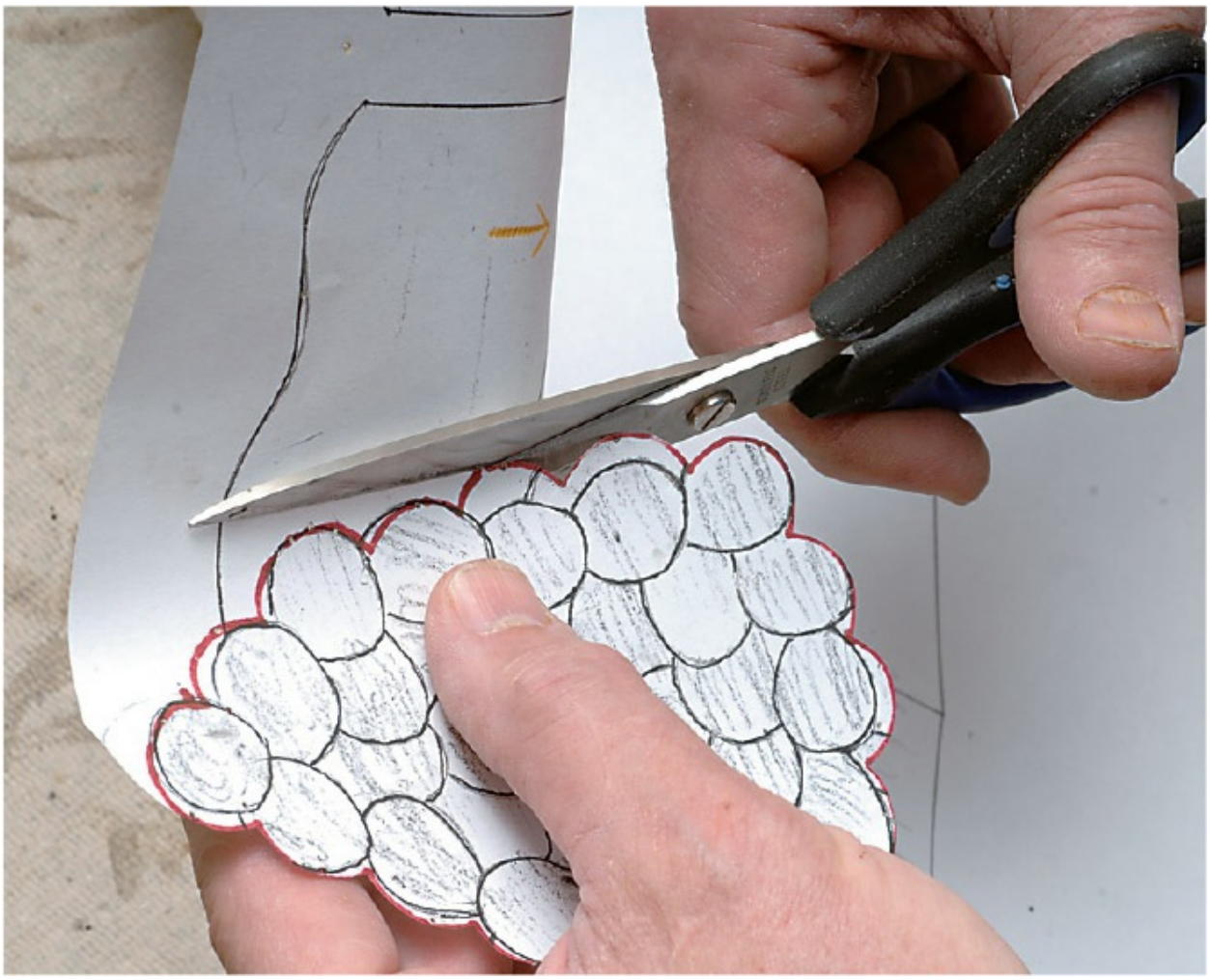
48. Before you flux and solder further, however, draw a new line around the cluster so the pattern will reflect the actual cluster outline. If you use a colored pen, the new outline will be more apparent.



49. The outline will most likely change somewhat, so you will need to adjust the outlines of the adjacent pieces to match the redrawn cluster outline.

50. Cut the cluster out of the pattern along the new outline. Use regular scissors and cut down the center of the line.





51. Flux the unsoldered foil in the inside of the cluster.

52. Work the brush into the grooves as best you can.

53. Fill in every gap with solder.

54. For the wider gaps, you might have to make two passes with the soldering iron.

On the finished cluster, all the gaps are smoothly filled.

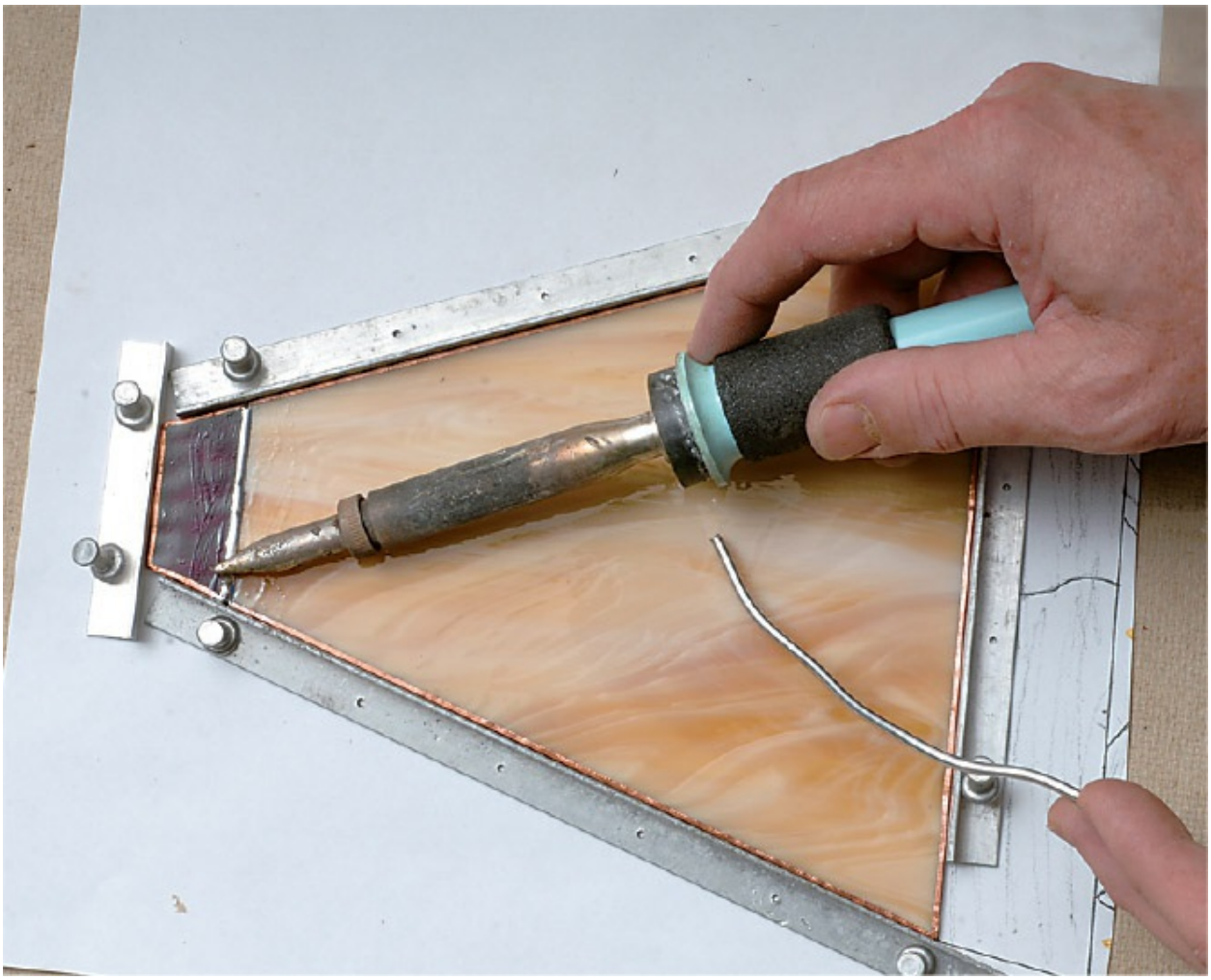
The pieces surrounding the grape clusters were all cut with the ring saw,

foiled, and soldered together.

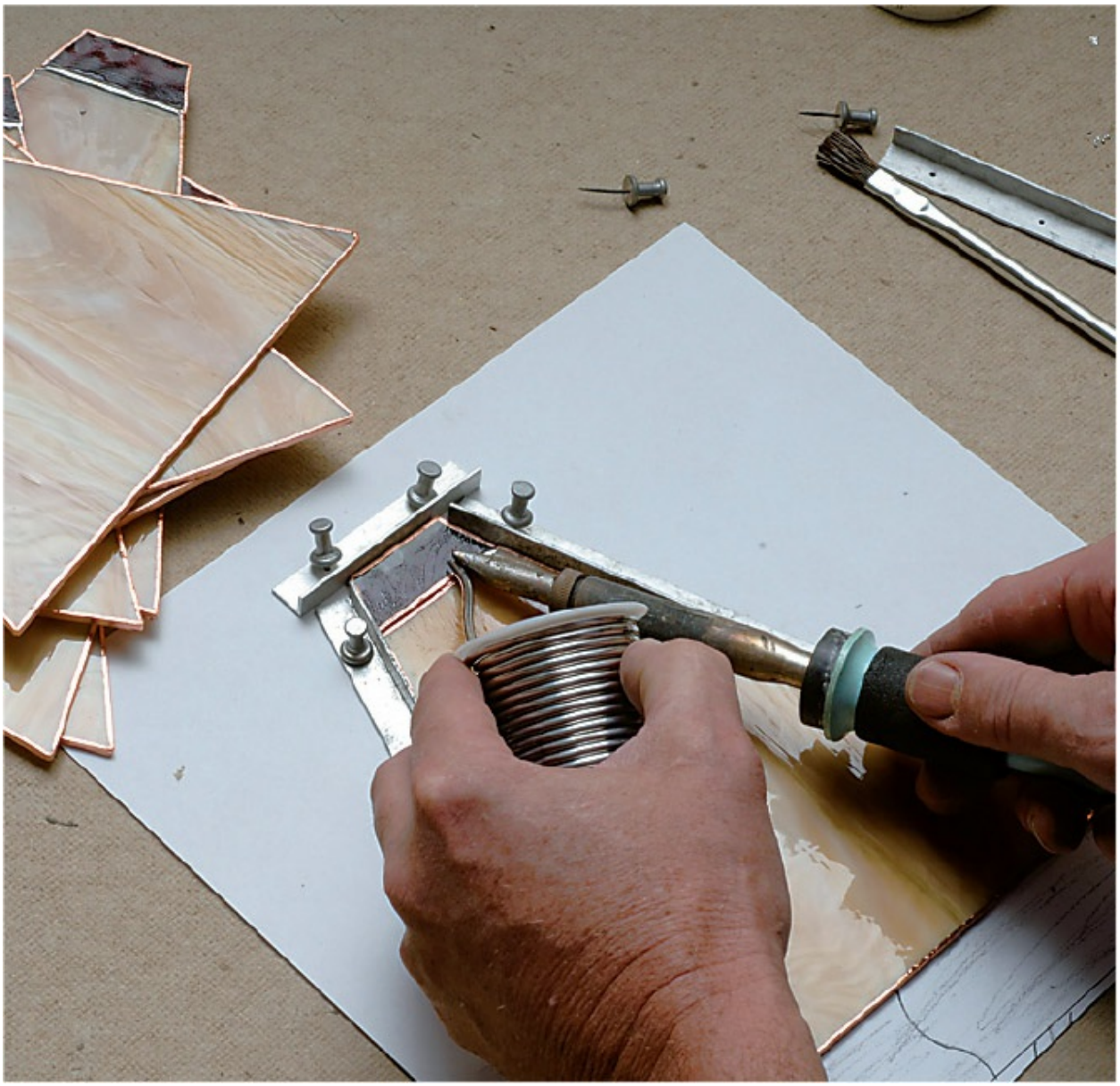
The finished lampshade contains eight cone sections, a middle band, four skirt pieces that feature grape clusters, and four skirt pieces that feature only leaves.

55. The two pieces that make up the cone sections were assembled and held together with metal braces secured with pushpins.

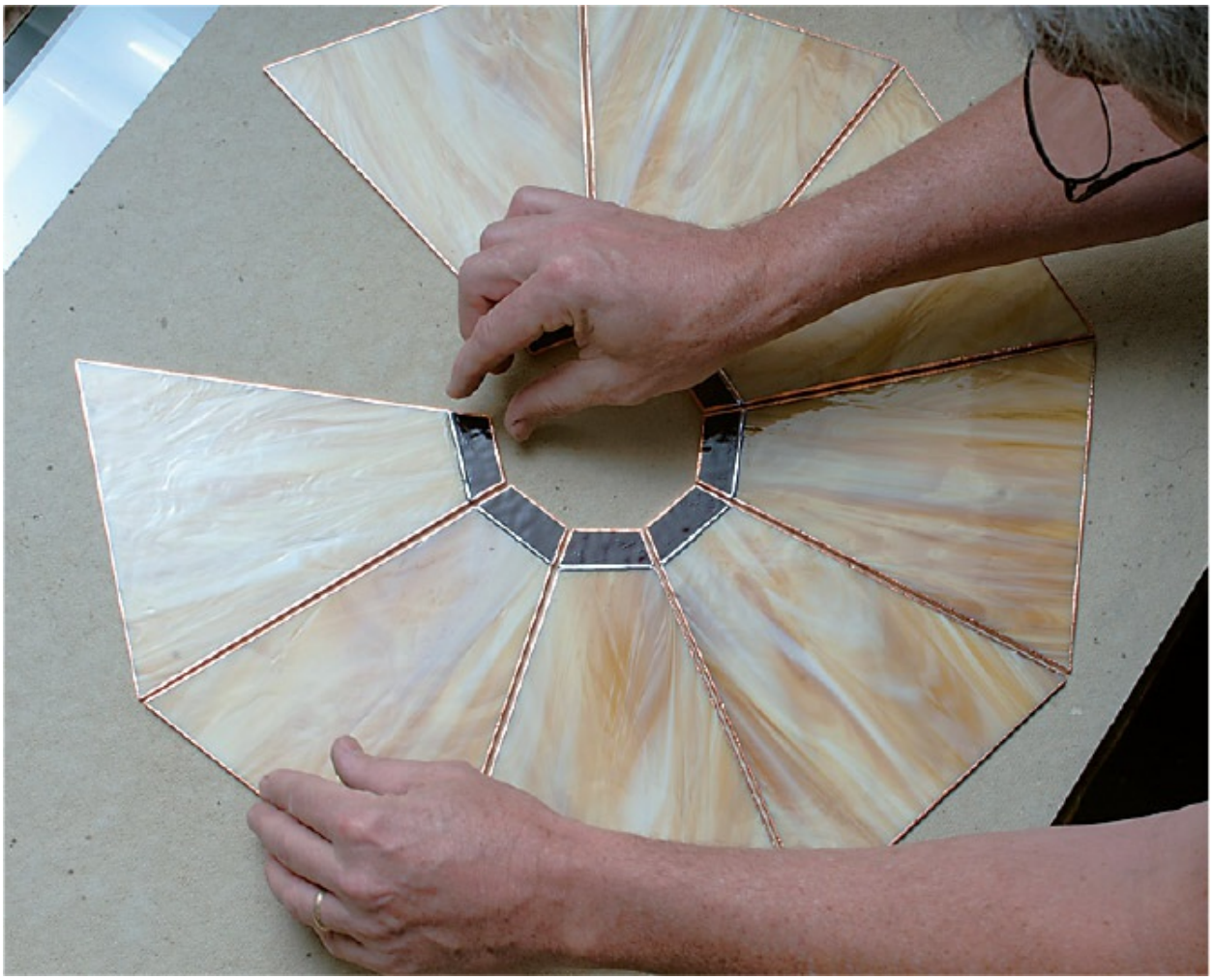
56. This keeps the edges aligned when the side is soldered together. Bead solder the connecting seam.



57. The other seven sides were created the same way.

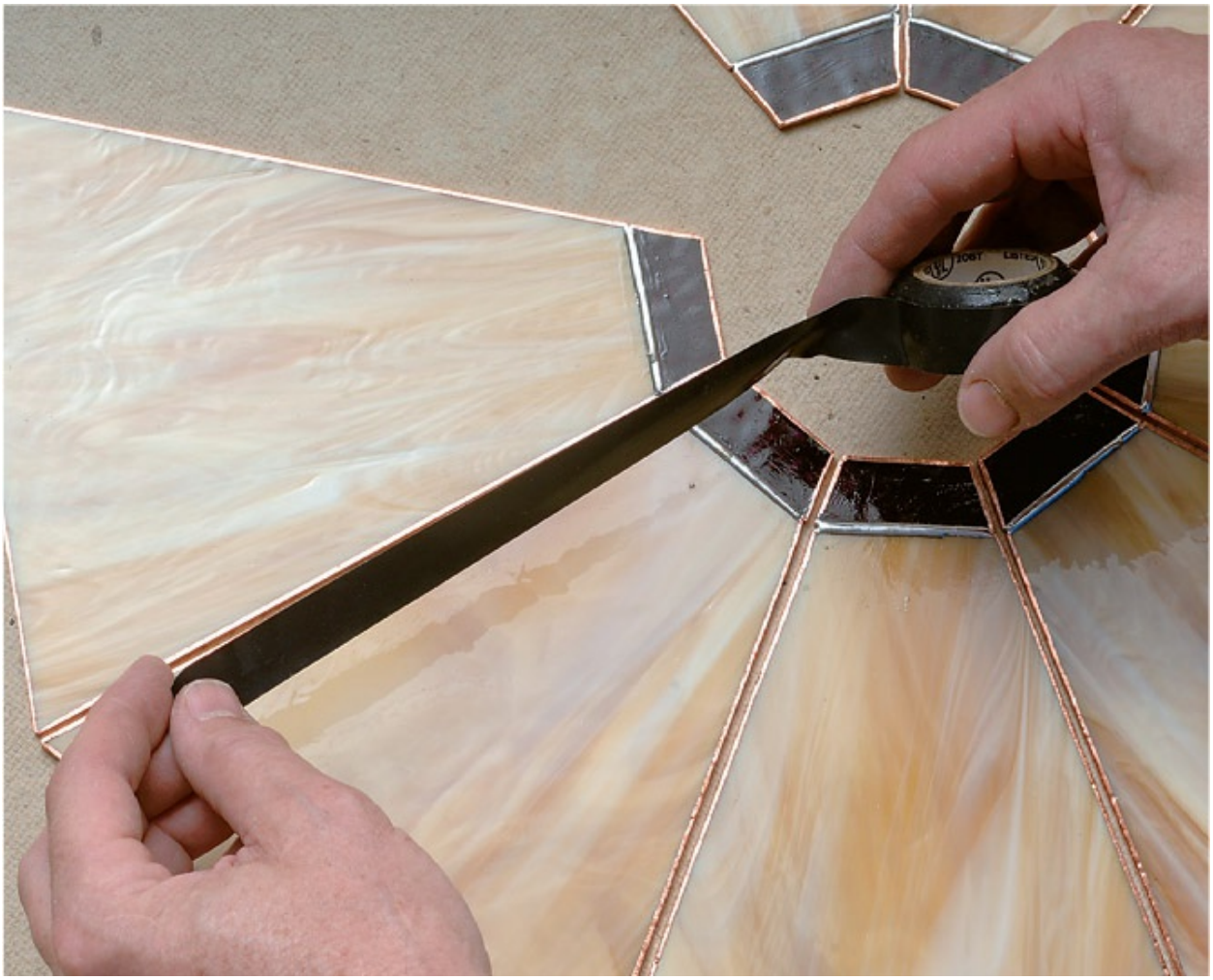


58. When all the sides are created, wipe the flux off them and lay them out on the work surface in a circular shape, as shown.



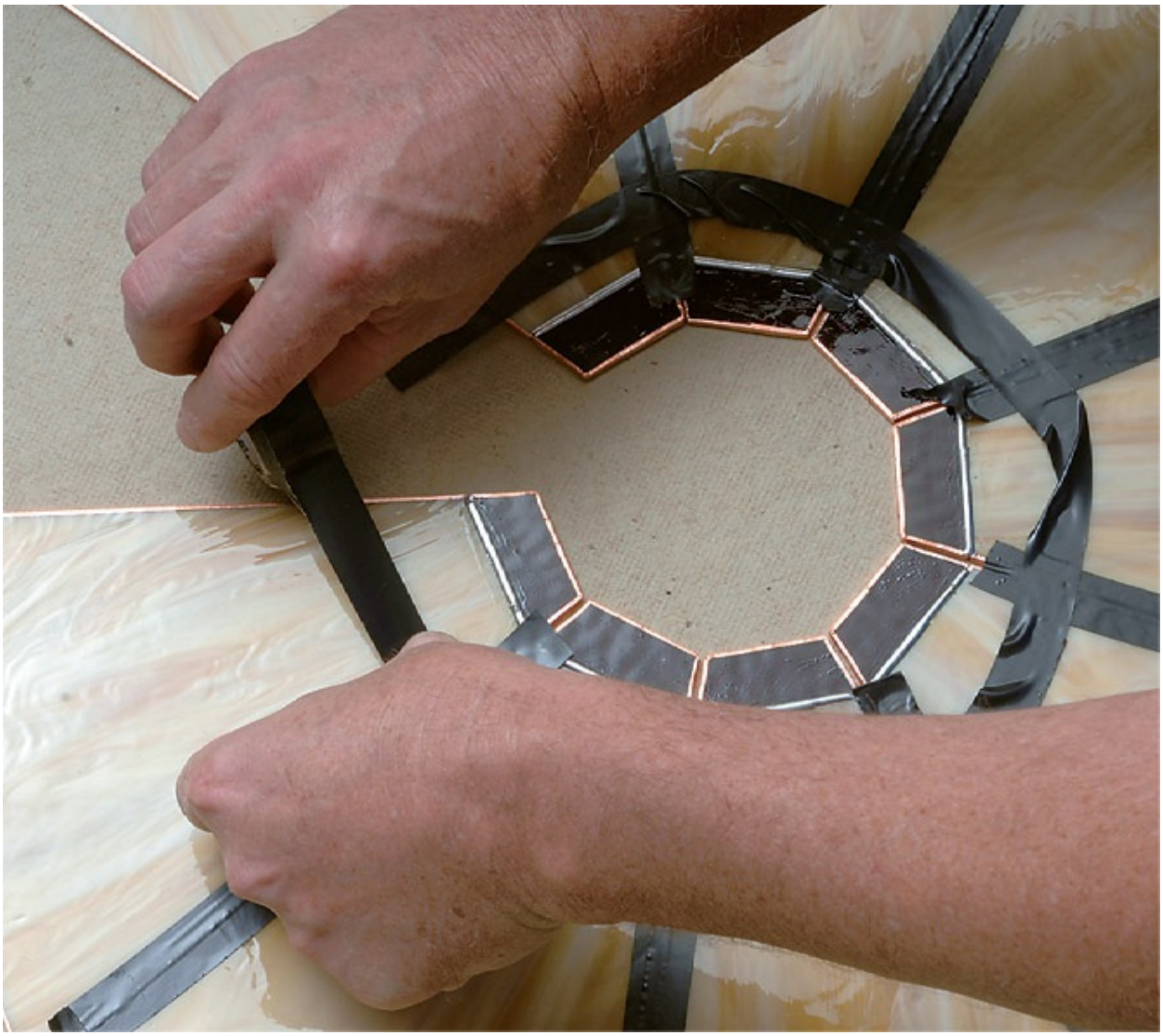
59. Make sure they are all properly aligned—but keep a⅛ -inch gap between them.

60. Use strips of plastic electrical tape along the long seams of the sides to hold the circle together. The ends of the strips should be about½ inch away from the shade's top and bottom.

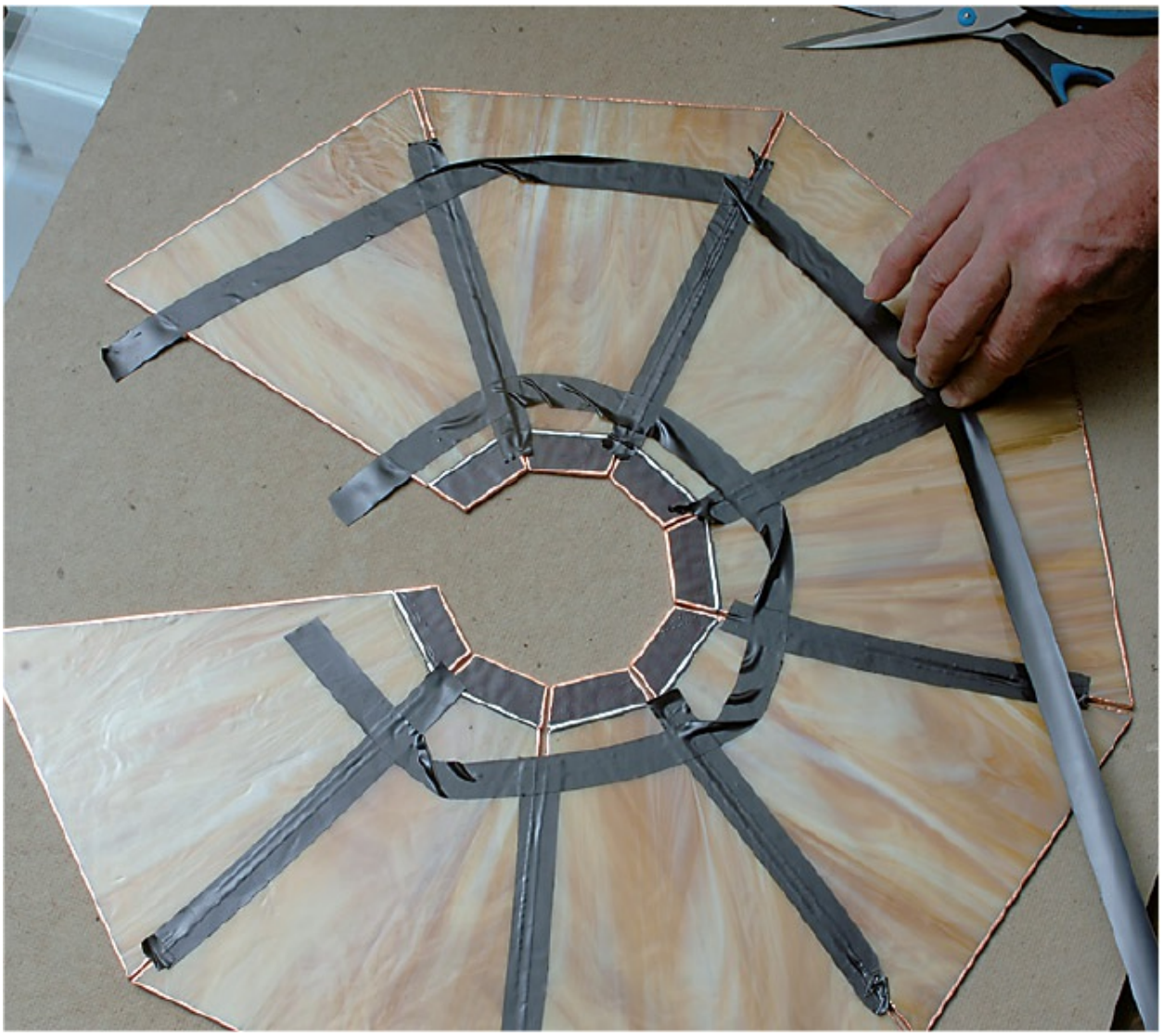


61. Cover each long seam, pressing the tape tightly to the glass.

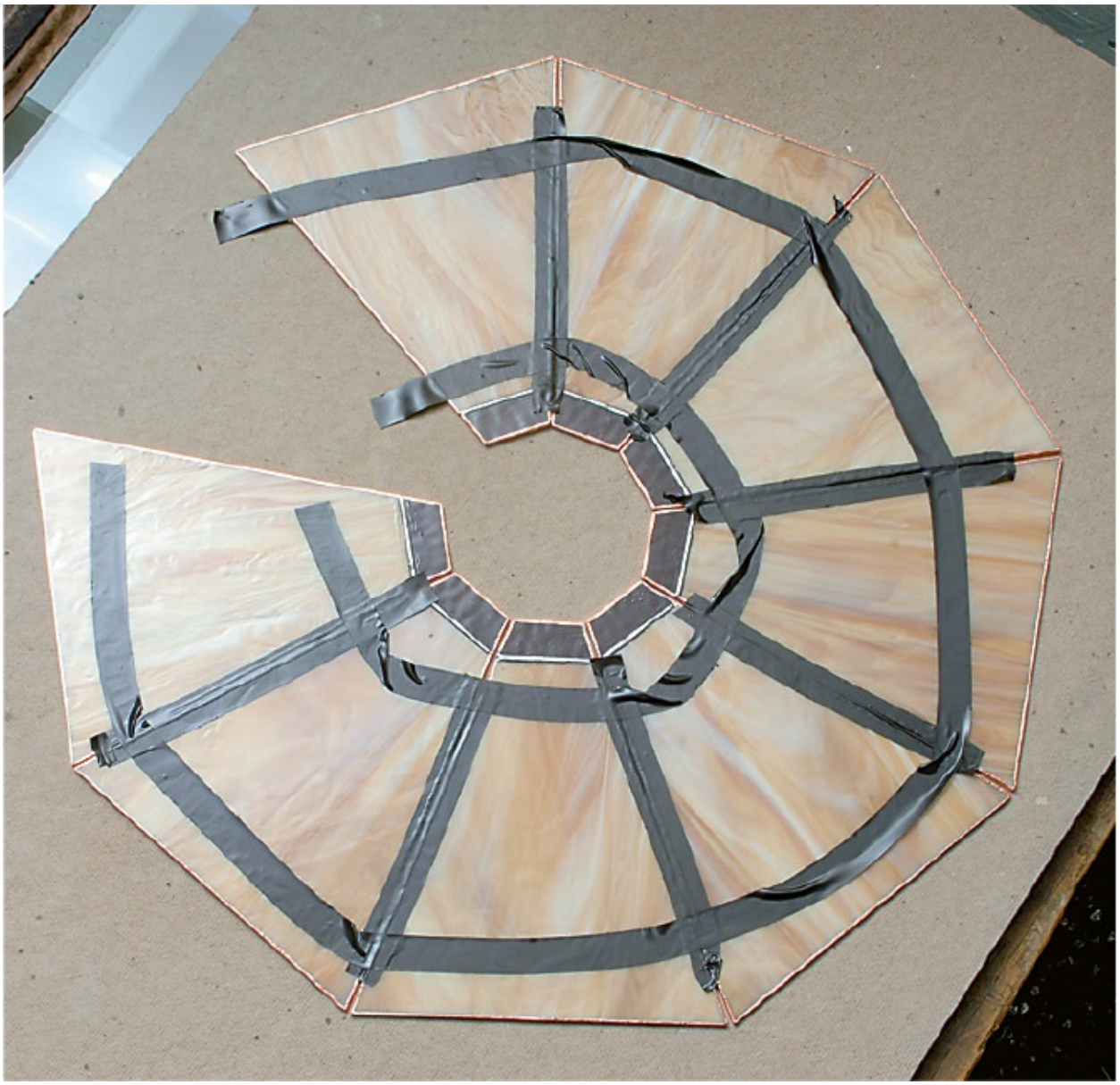
62. Add a strip of tape around 1 inch from the top of the cones to add strength. The end of this strip should extend an inch or so into the “empty” section.



63. Apply tape around the bottom of the cones too, again keeping about an inch hanging into the empty section.



The lampshade assembled and taped together.

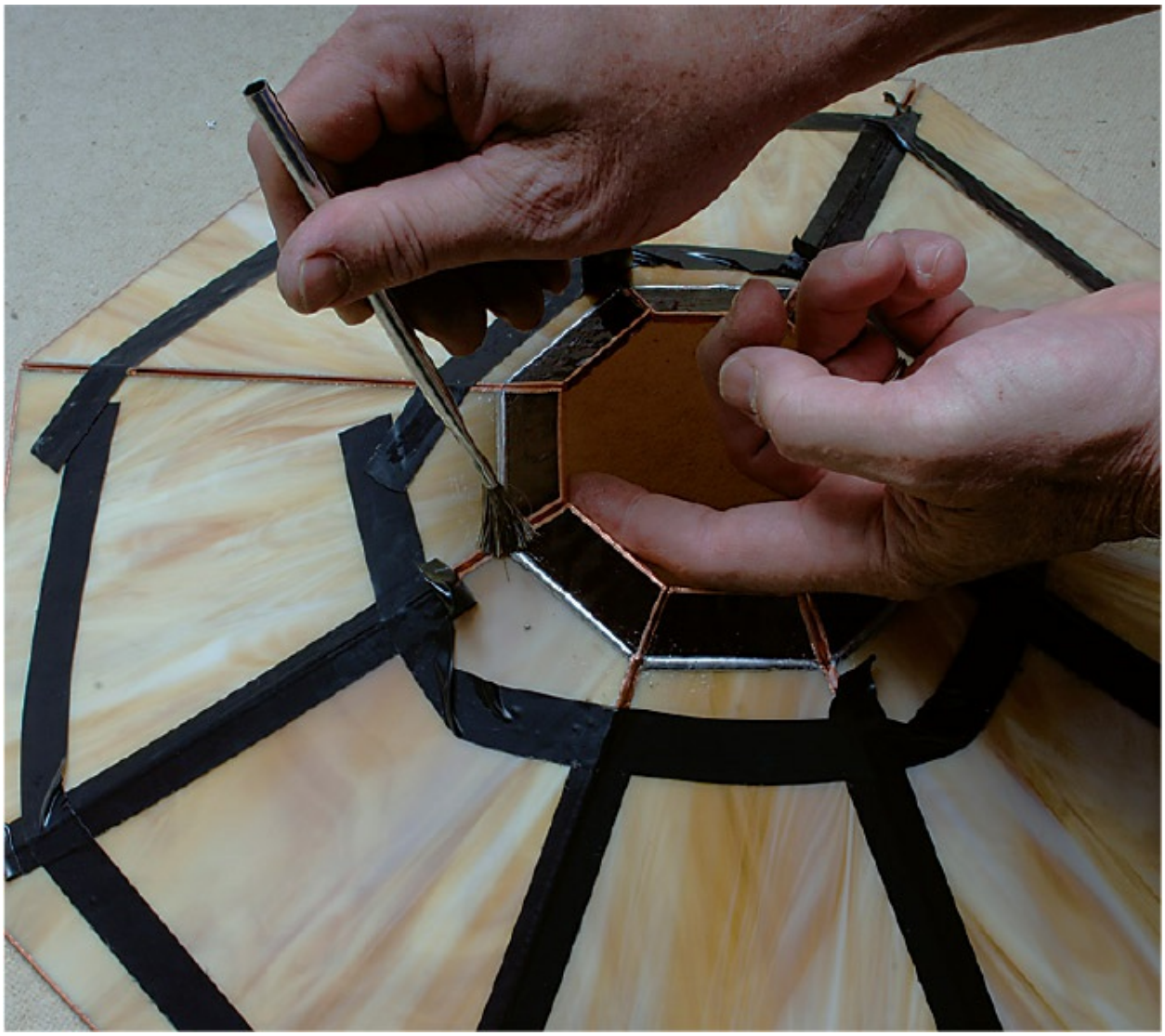


64. Slip your fingers underneath the glass near the center and gently lift, pulling the shade into an angled shape.

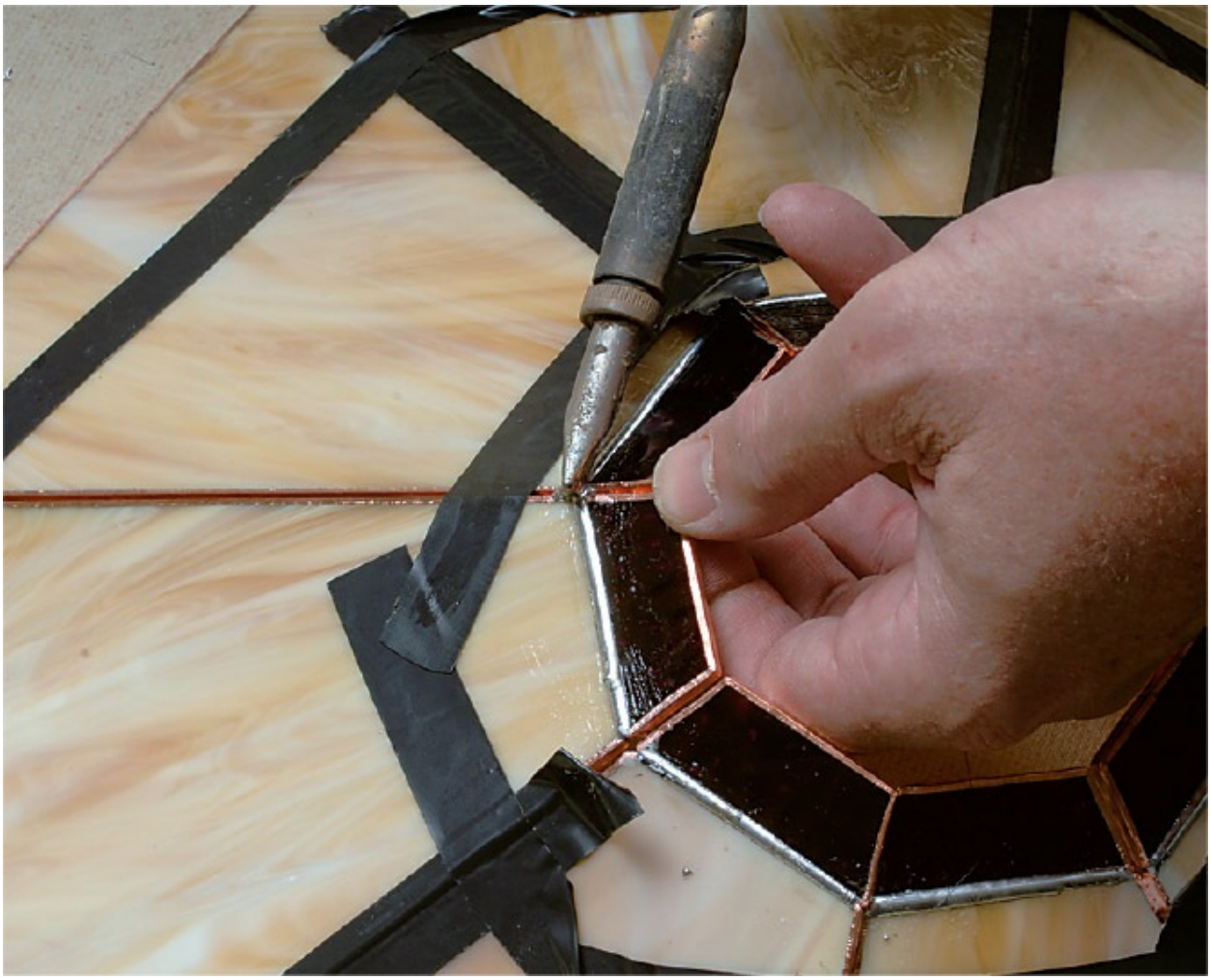
65. As the center is lifted, the shade will close and the “empty” space will disappear.

66. When the shade is in proper position, press down the tabs of the tape to hold the whole thing together. Adjust if need be so that the innermost edges of the seams are touching. You are now ready to tack solder the shade so it holds together permanently.

67. Flux the top of each seam.



68. Tack solder the seams.

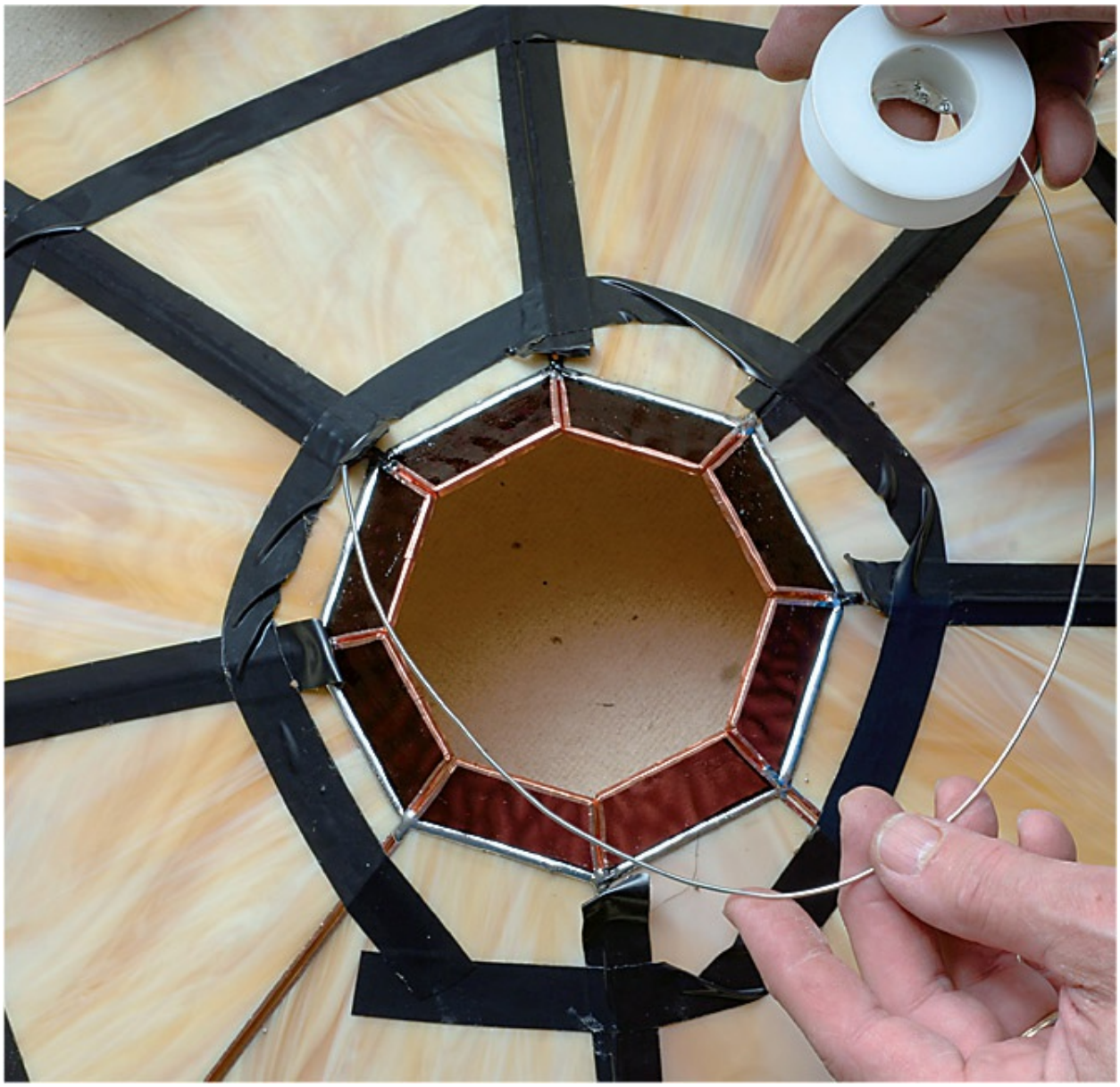


69. Then flux the ends of the seams on the bottom of the shade.

70. Tack solder these seams, making sure the back edges are even.

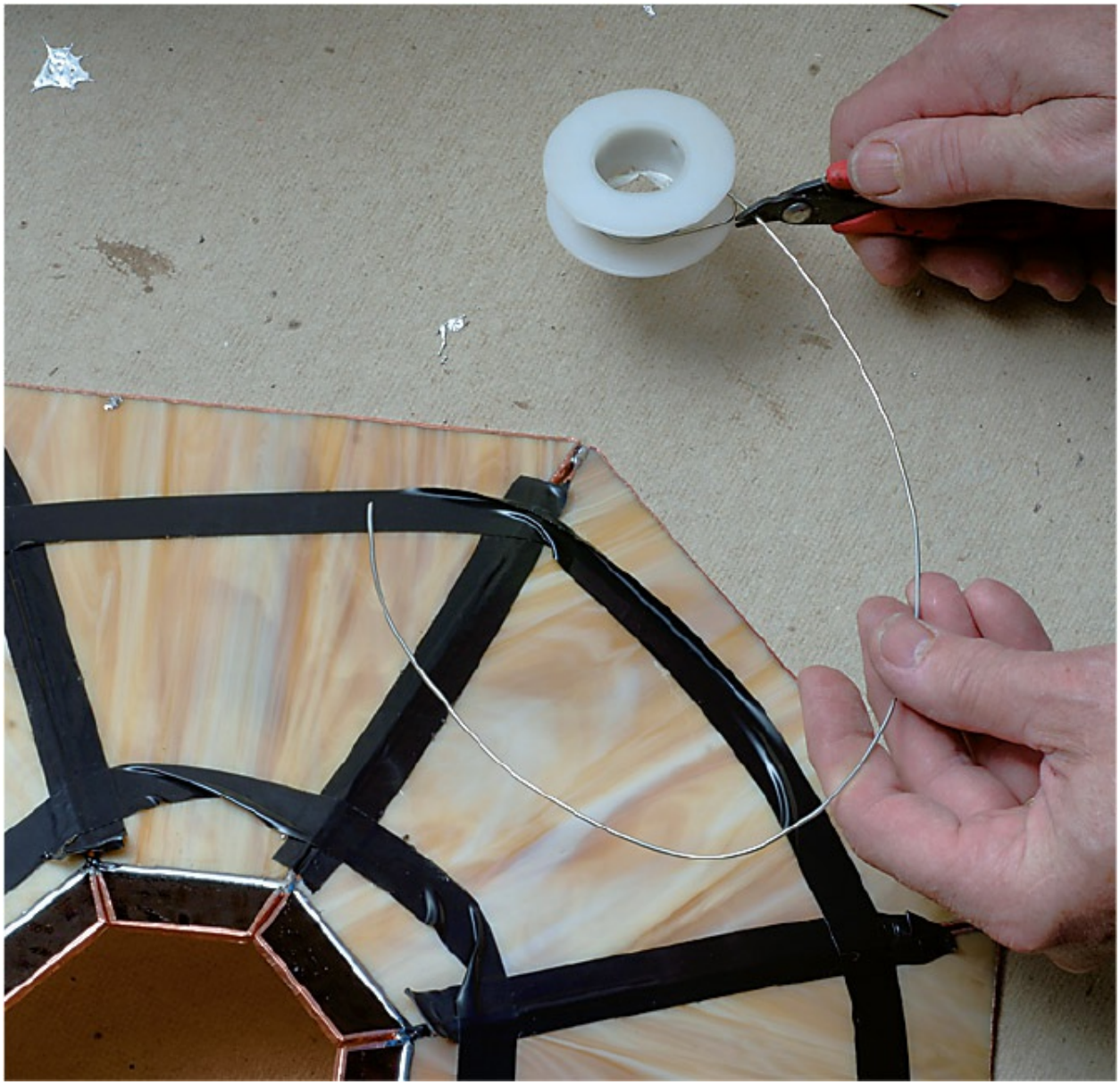
71. Make sure you create a good bond about ¼ inch to ½inch long.

72. You'll want to add reinforcing wire around the top of the cones and solder the inside of the shade.



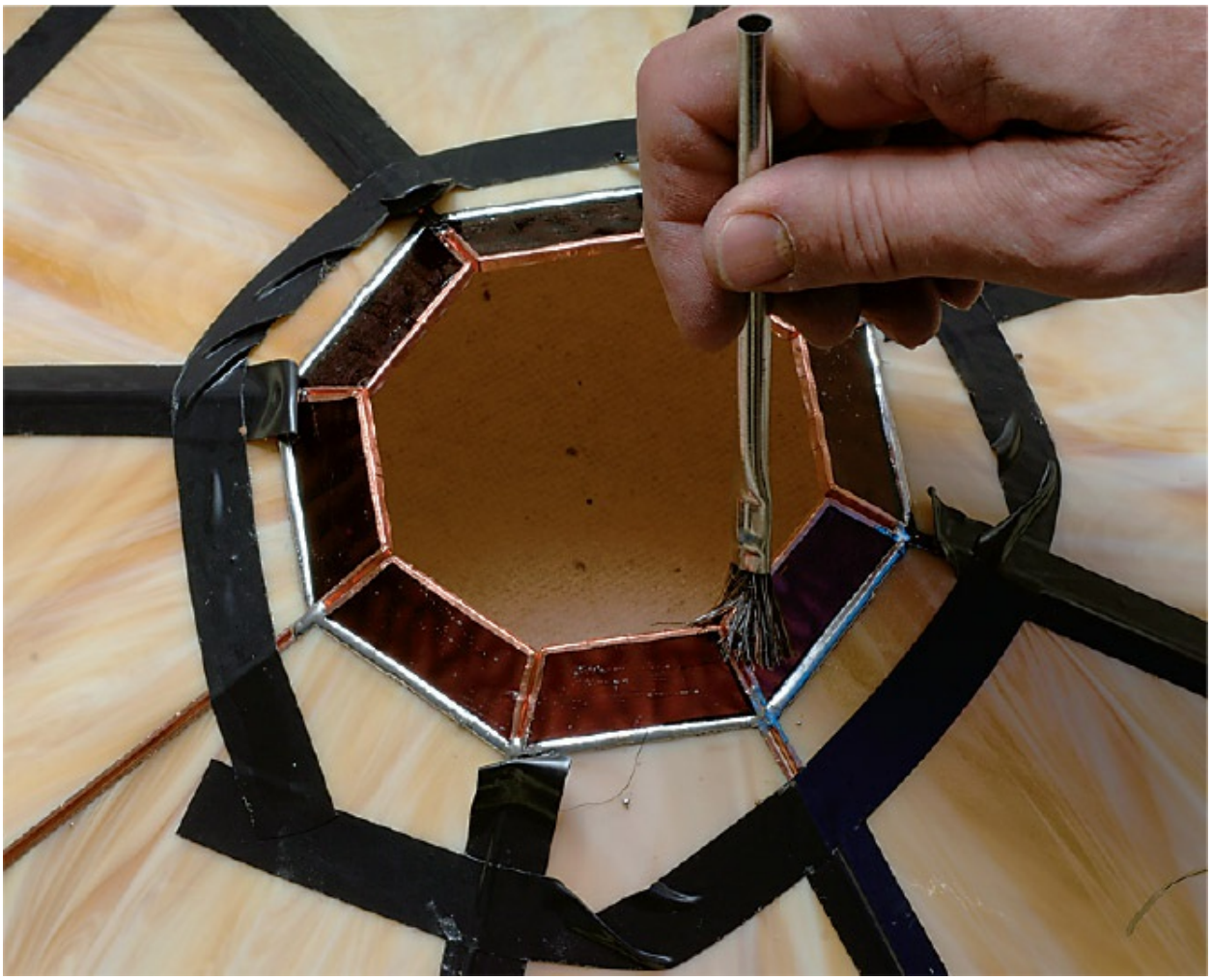
73. Estimate how much wire you'll need to encircle the center opening, adding a couple extra inches. A length of pretinned 18-gauge copper wire about 20 inches long is used here.

74. Trim the wire.

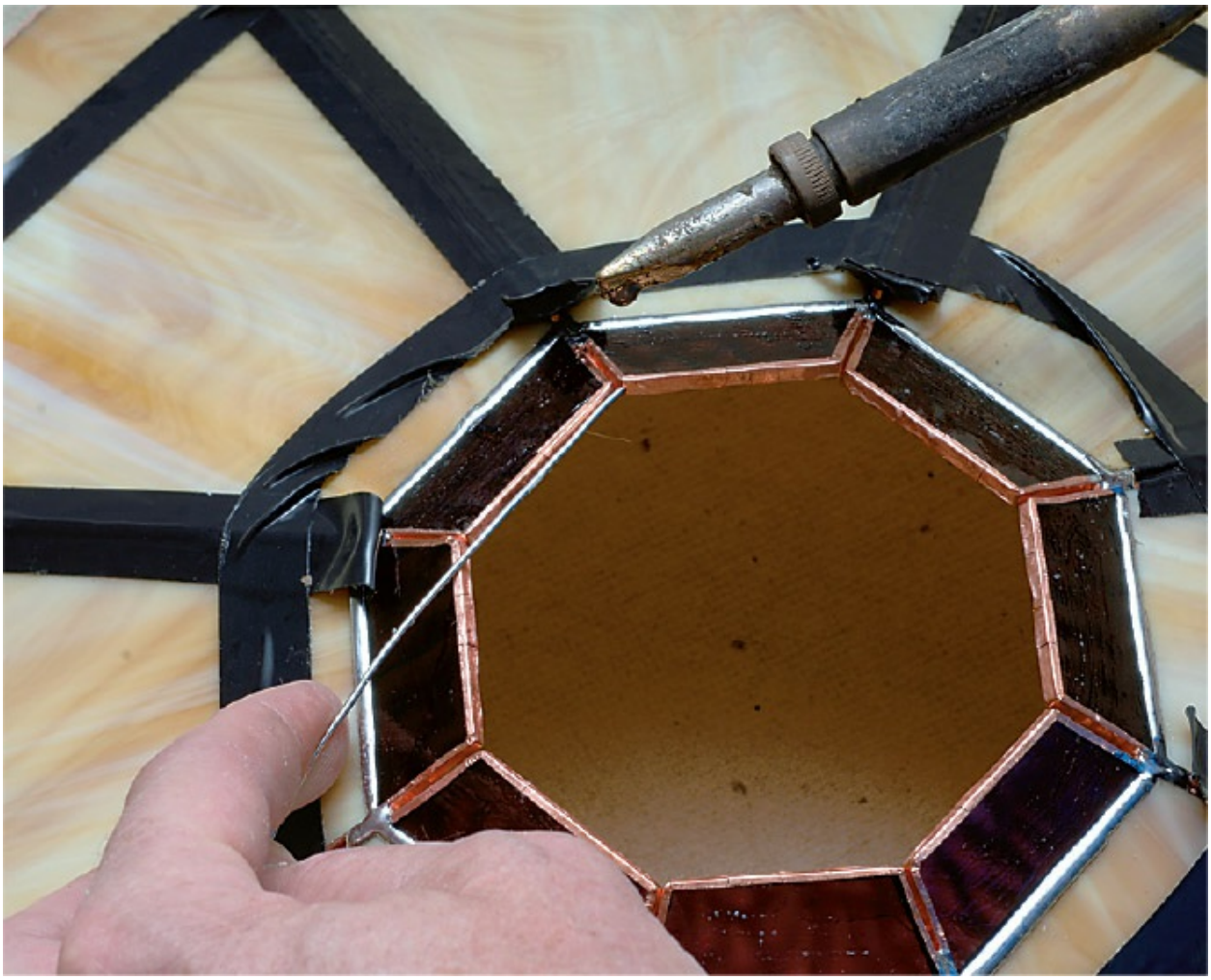


75. Flux the wire completely.

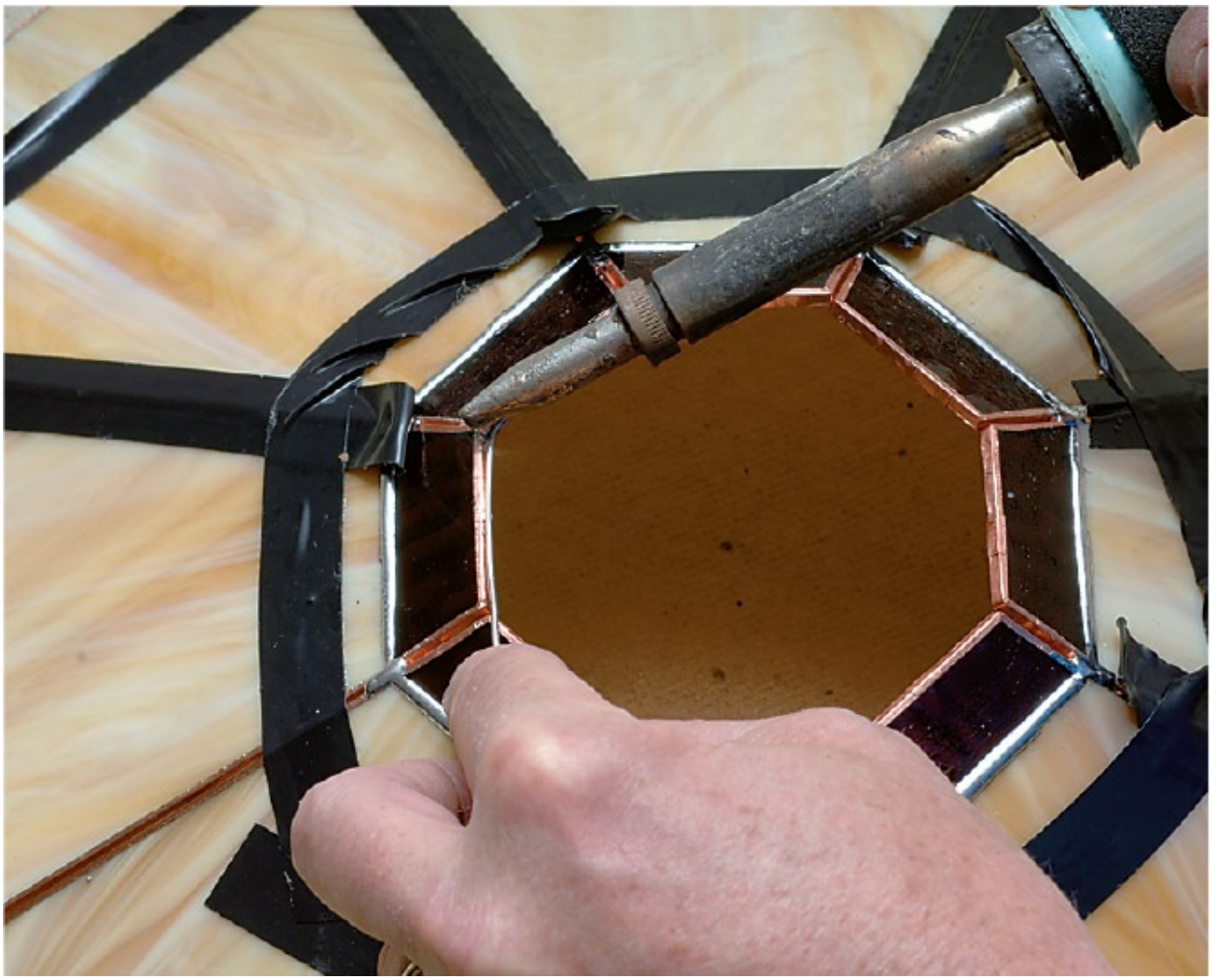
76. Flux the perimeter of the shade opening.



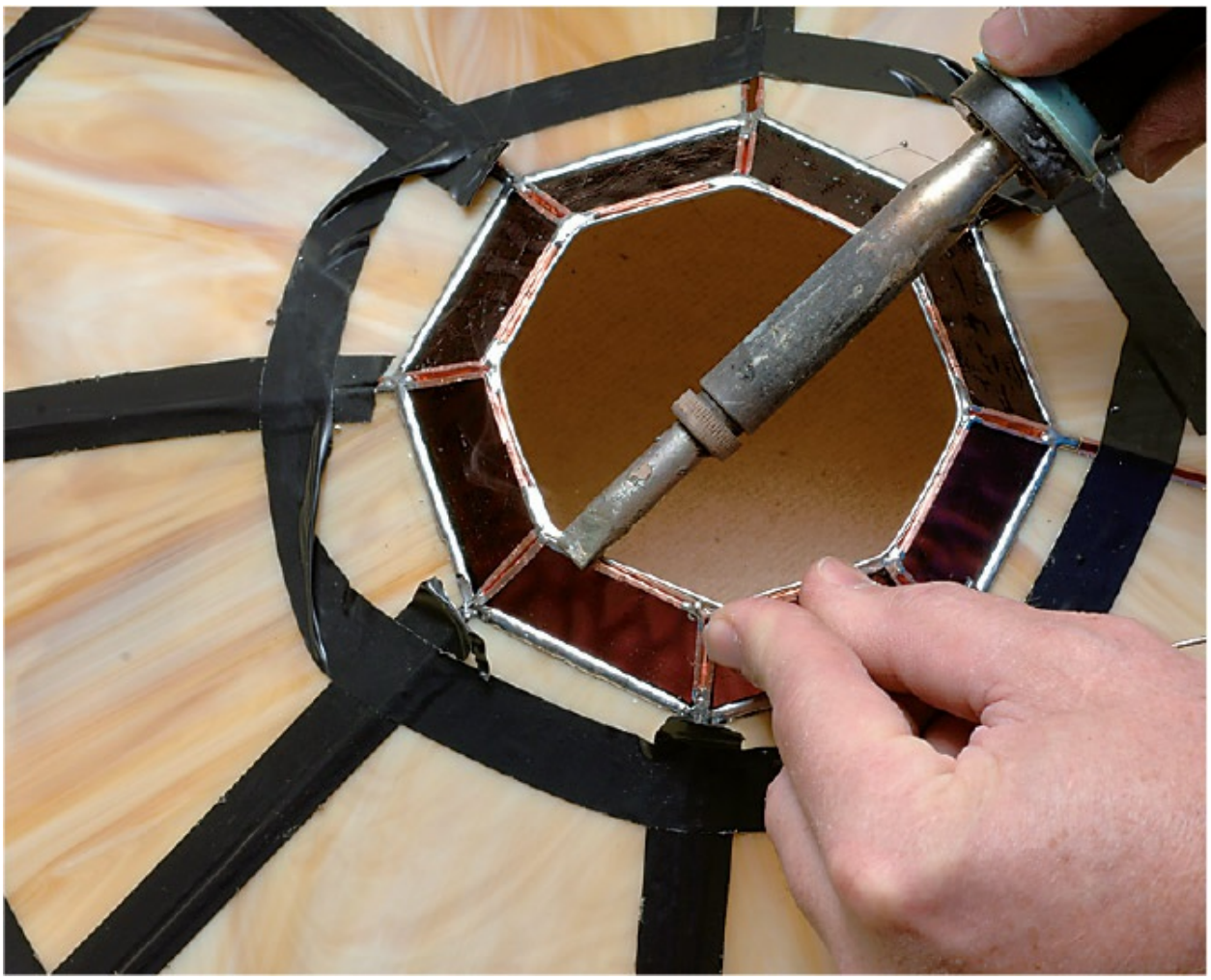
77. Tack solder the end of the wire to the innermost part of one of the seams. The wire should be positioned so that it is in the middle of the glass edges.



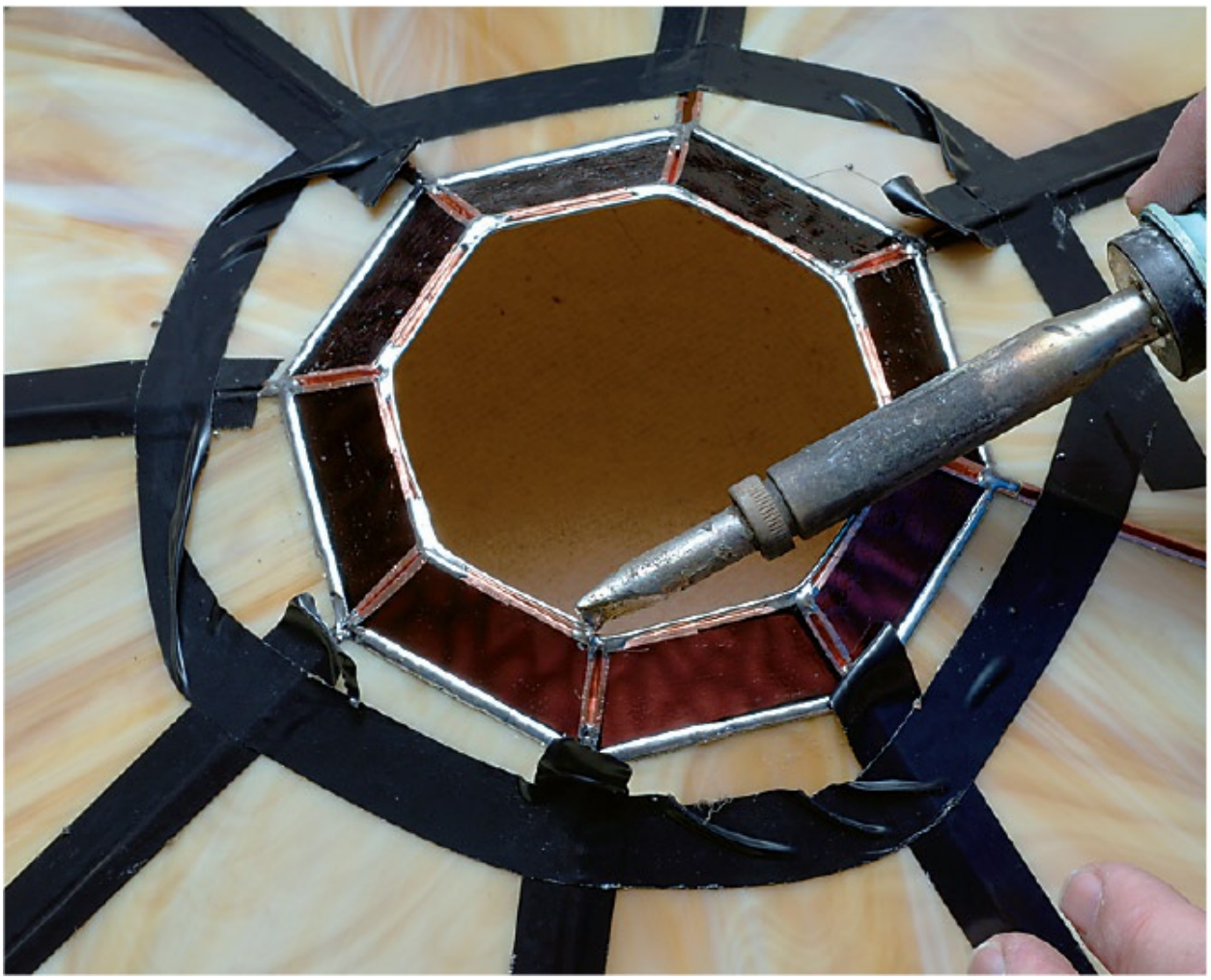
78. Bend the wire around the opening and tack solder it to the next seam.



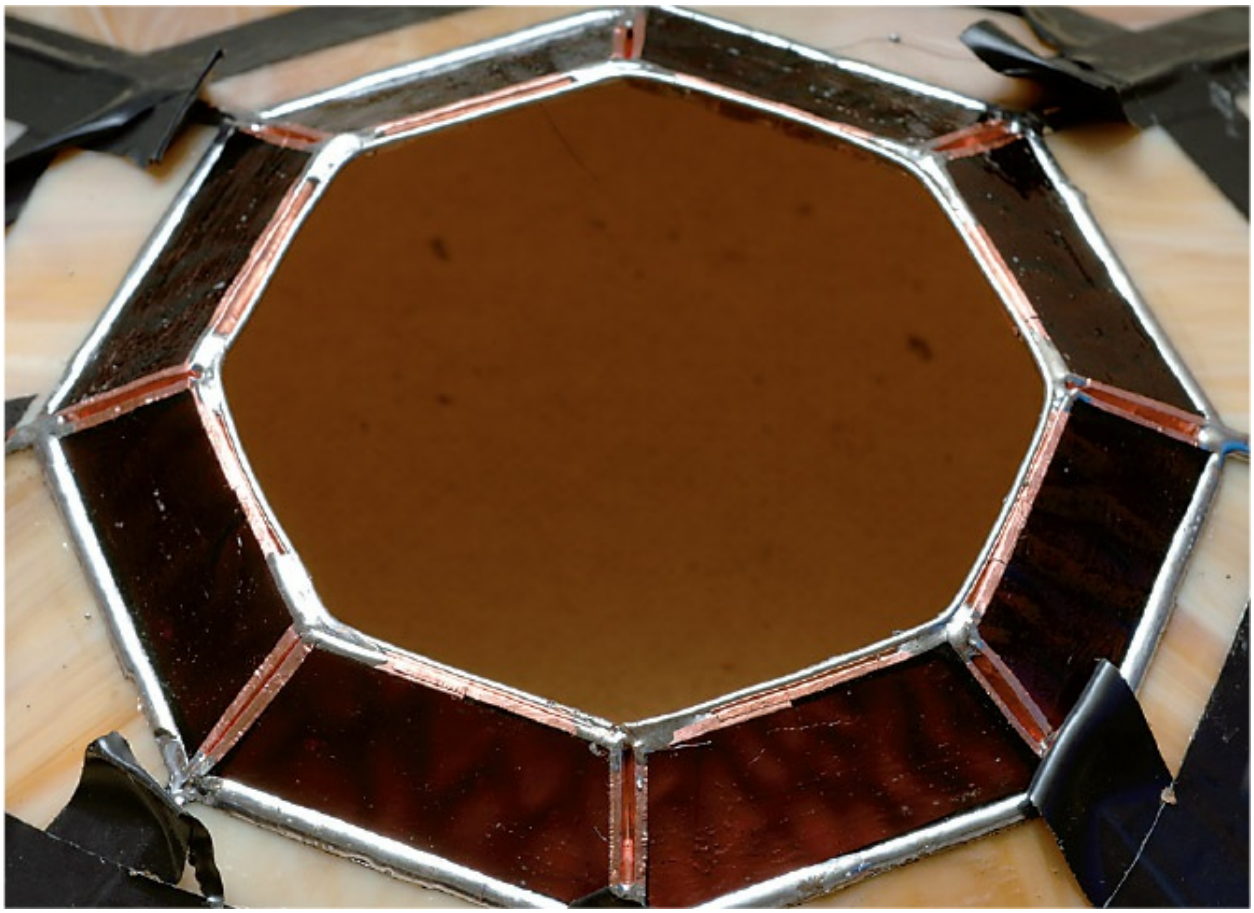
79. Solder the wire to each seam until you reach the first one and then trim it off.



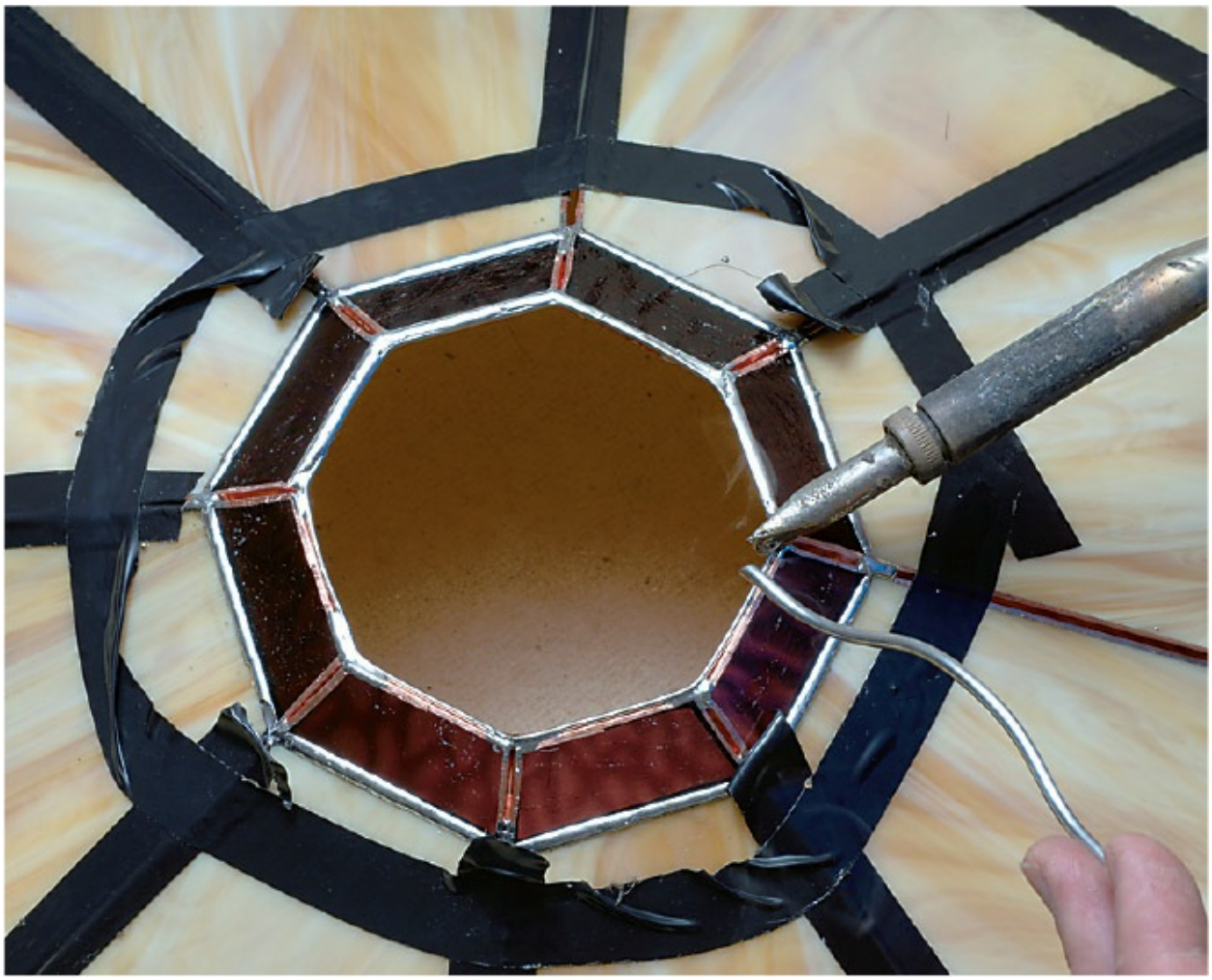
80. Solder the trimmed end to the seam where you started.

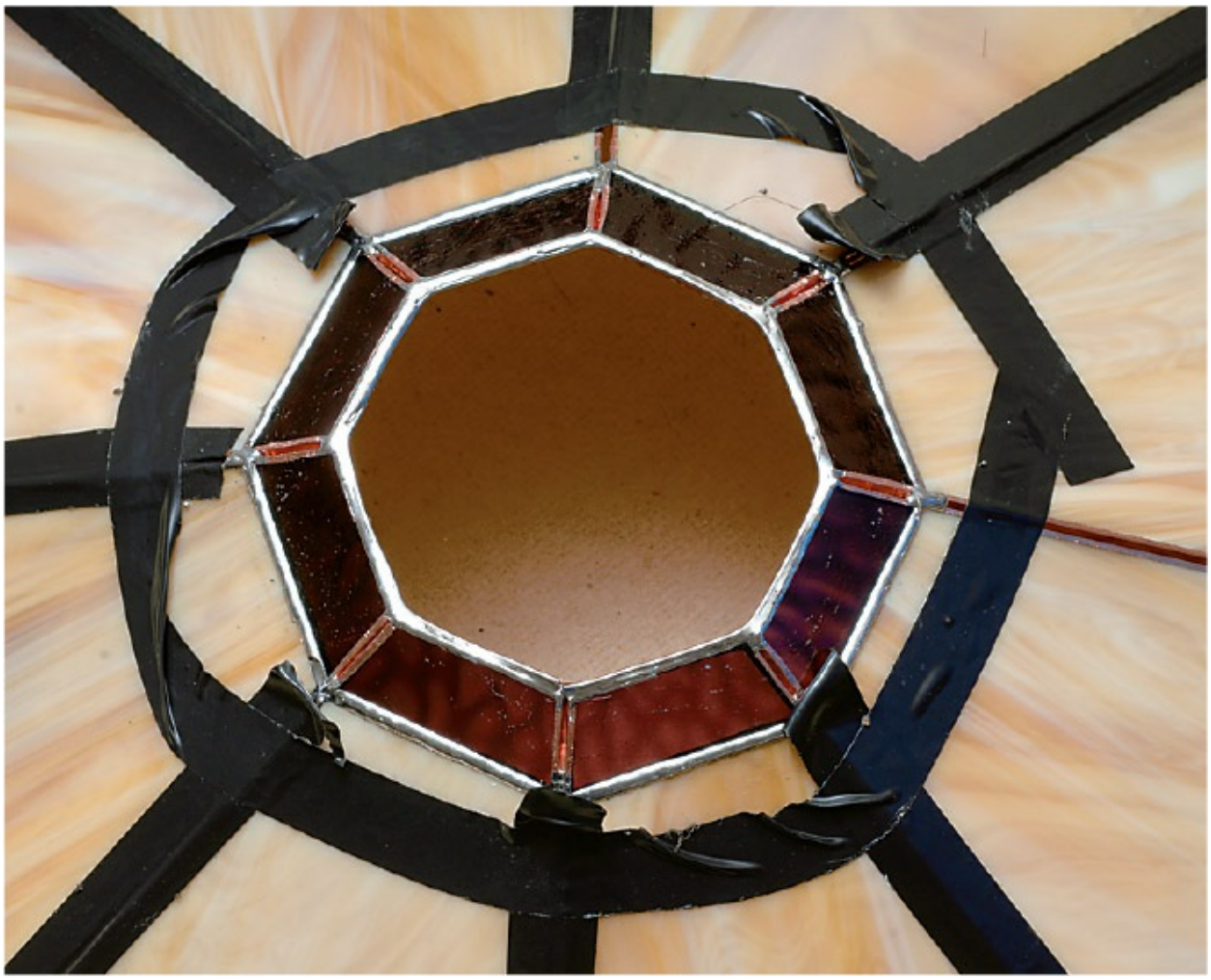


The reinforcing wire will help hold this heavy piece together.



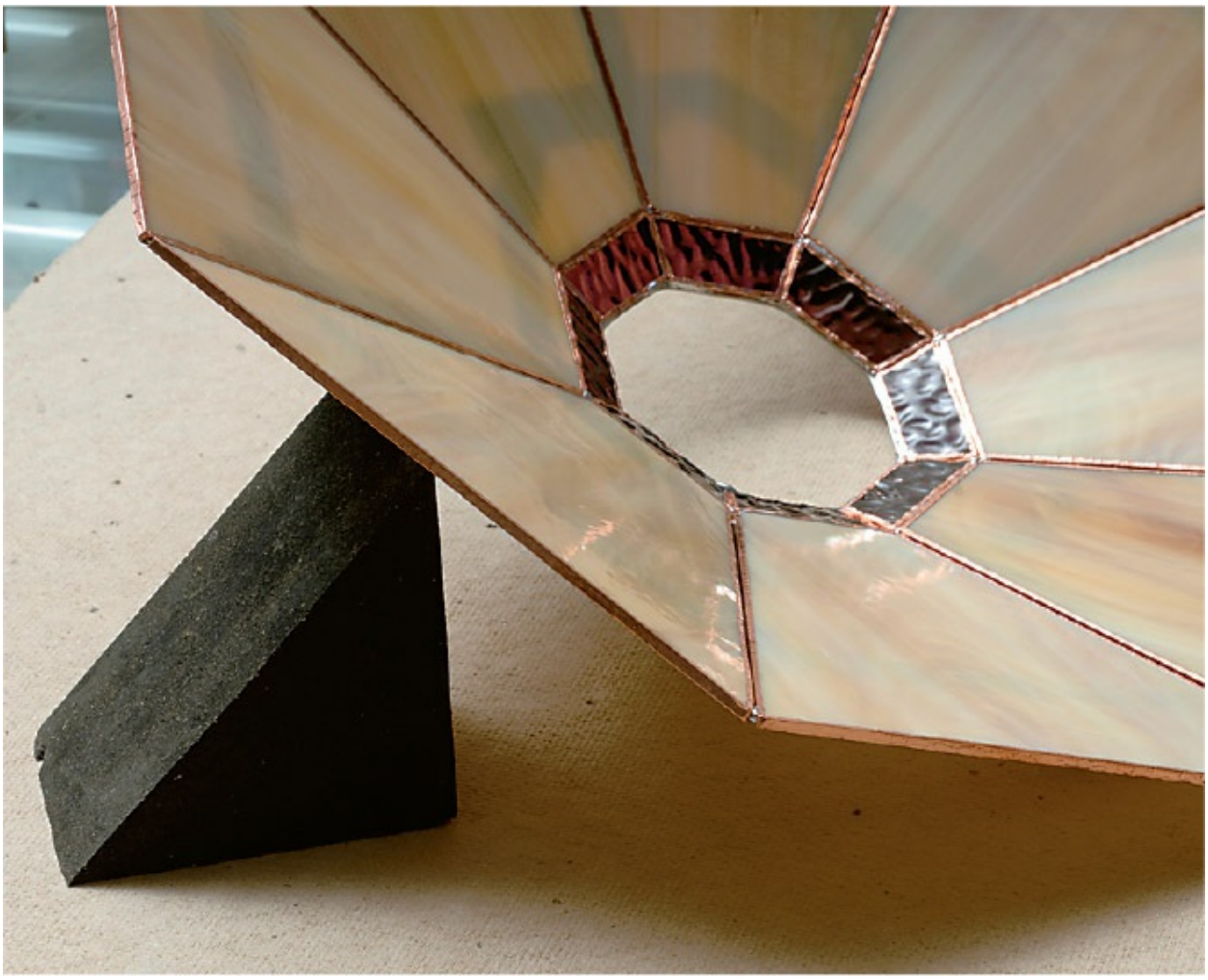
81. After the wire is tacked into place, cover it completely with solder.



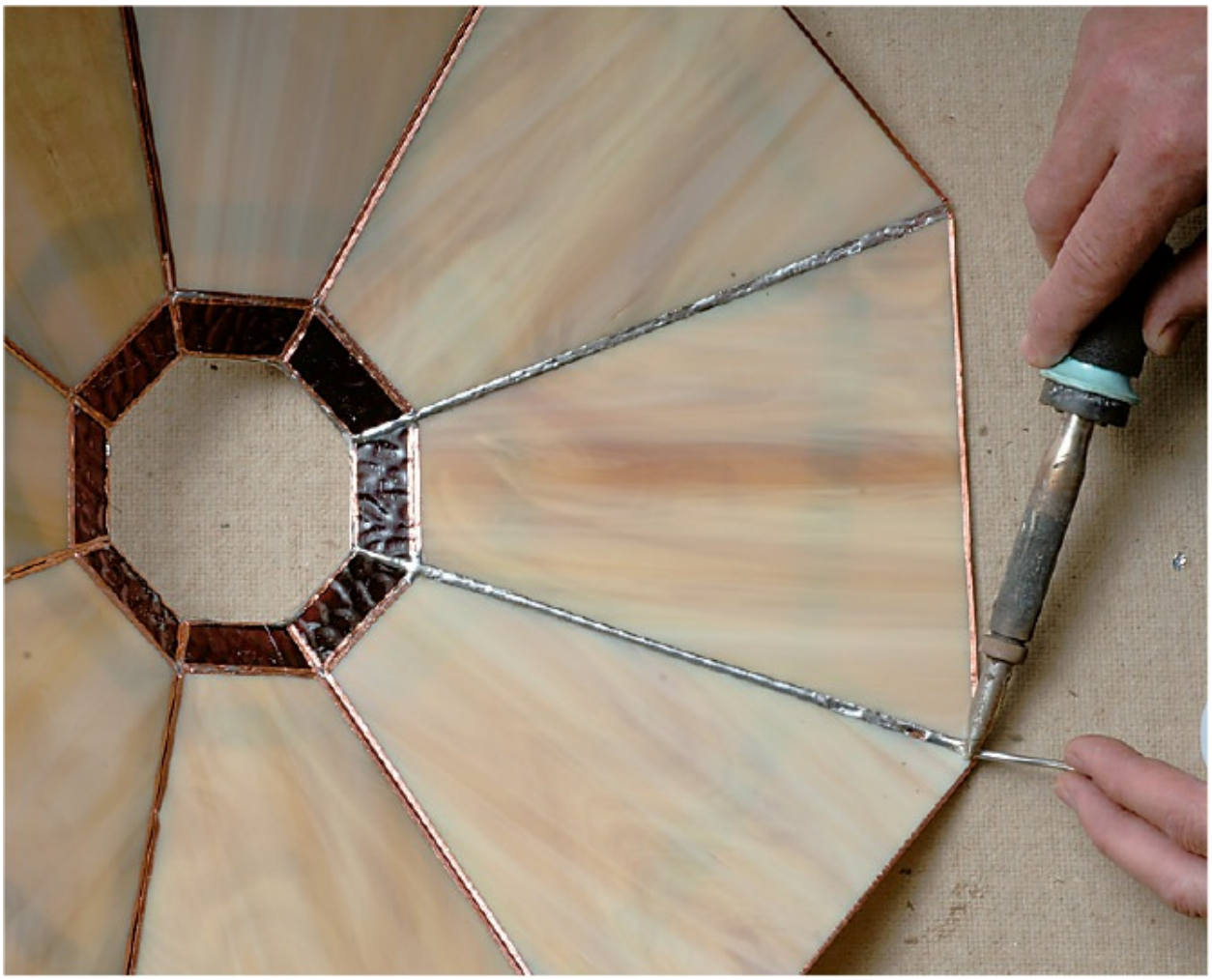


82. Turn the shade over and use Wedgies to support it so a seam is laying flat.

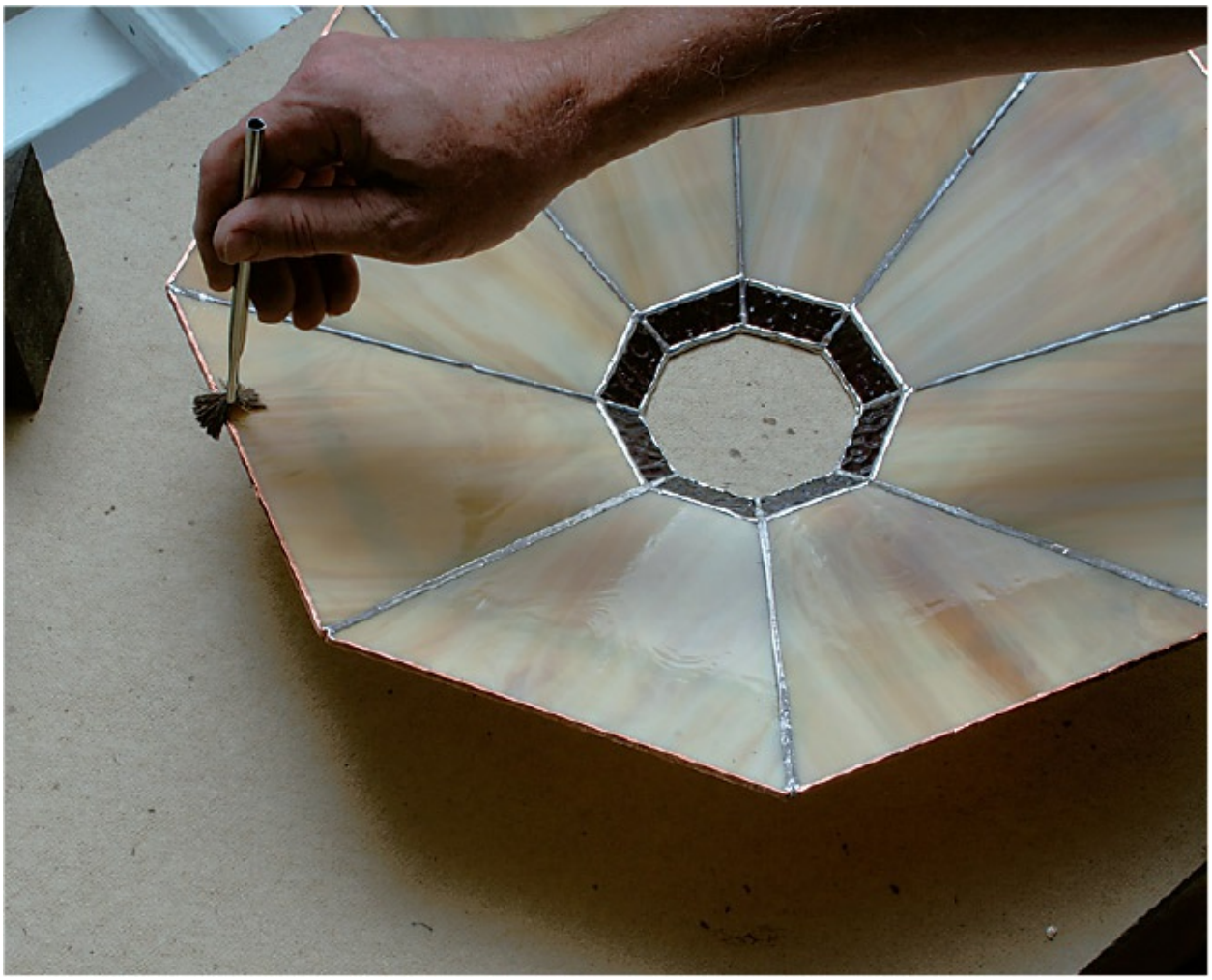

PUSH PINS



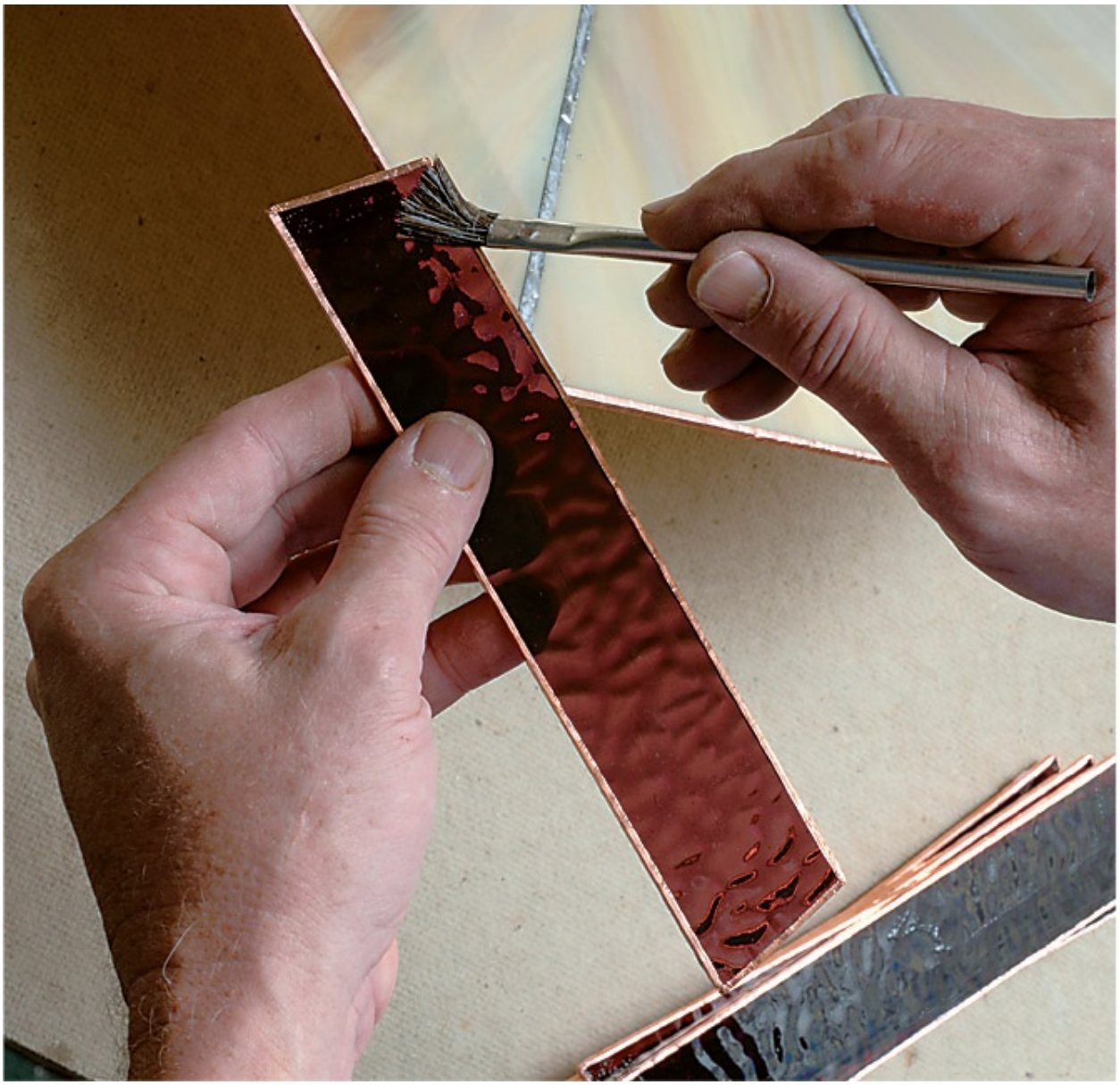
83. Flux and solder the inside seams, turning the lamp as you do so each seam is laying flat as you work on it.



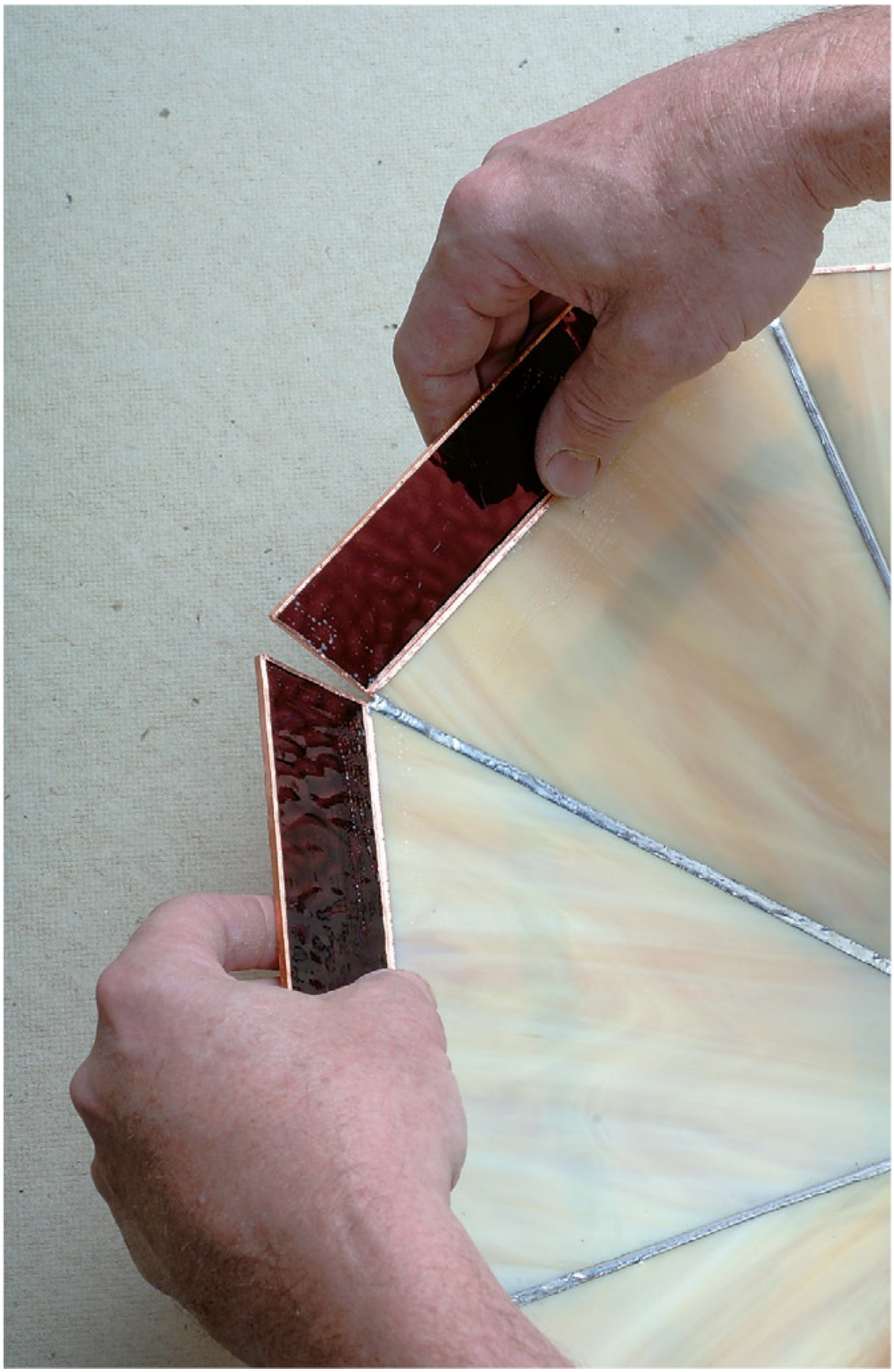
84. Flux the bottom edge. The pattern calls for colored strips of glass to be attached to the bottom edge of the cone. These strips will form the shade's middle band.



85. Flux the two shortest sides and the shorter of the two longer sides of one foiled strip.



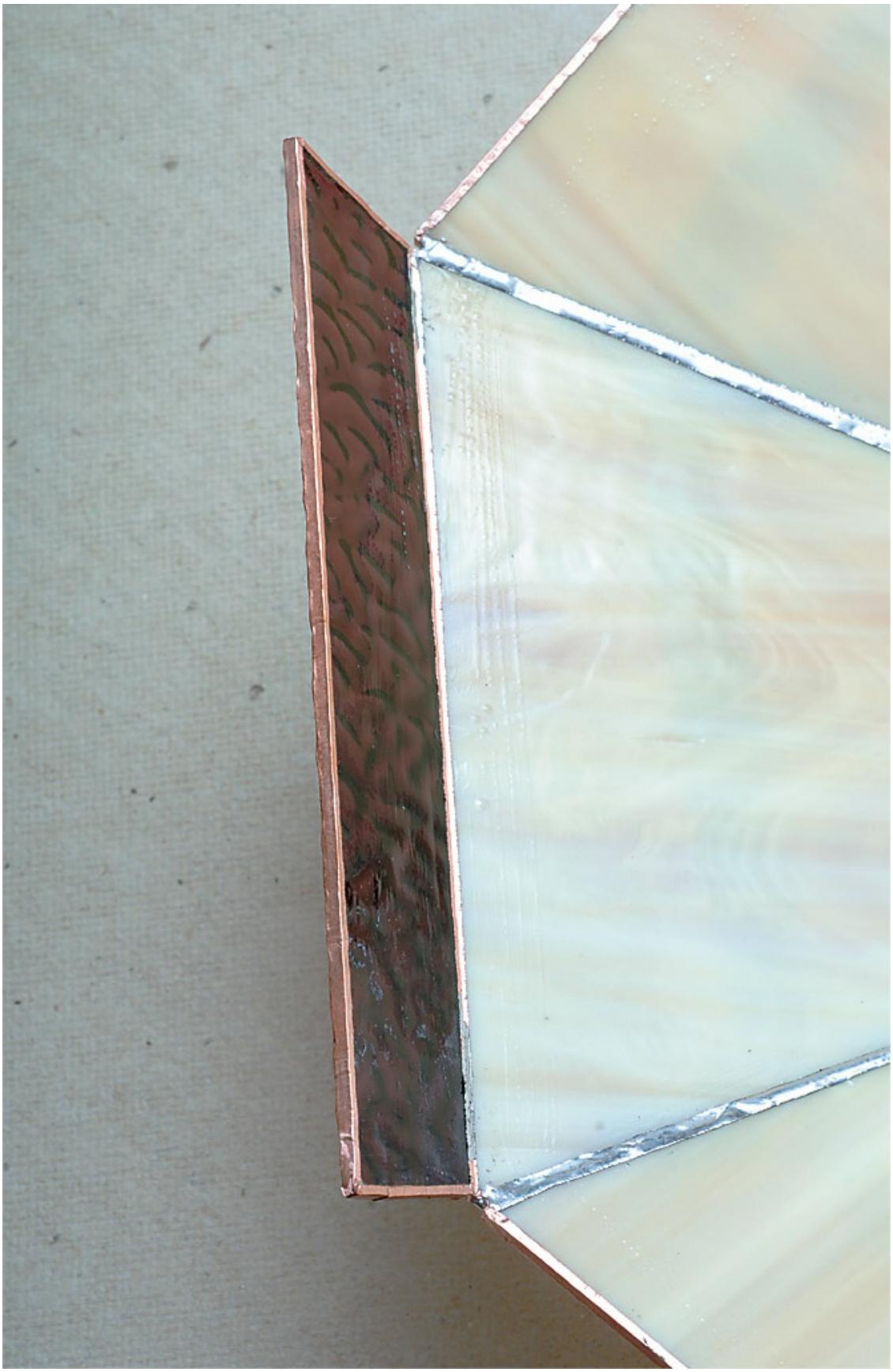
86. Place the strip’s longest fluxed side against the outside of the shade, as shown. Place another bar in position next to it.



87. Pull both of them up until their edges touch.

88. Keep the fluxed strip at that angle, set aside the second bar, and tack solder the seam between the strip and the shade. The back edges of each strip and cone piece should be even.

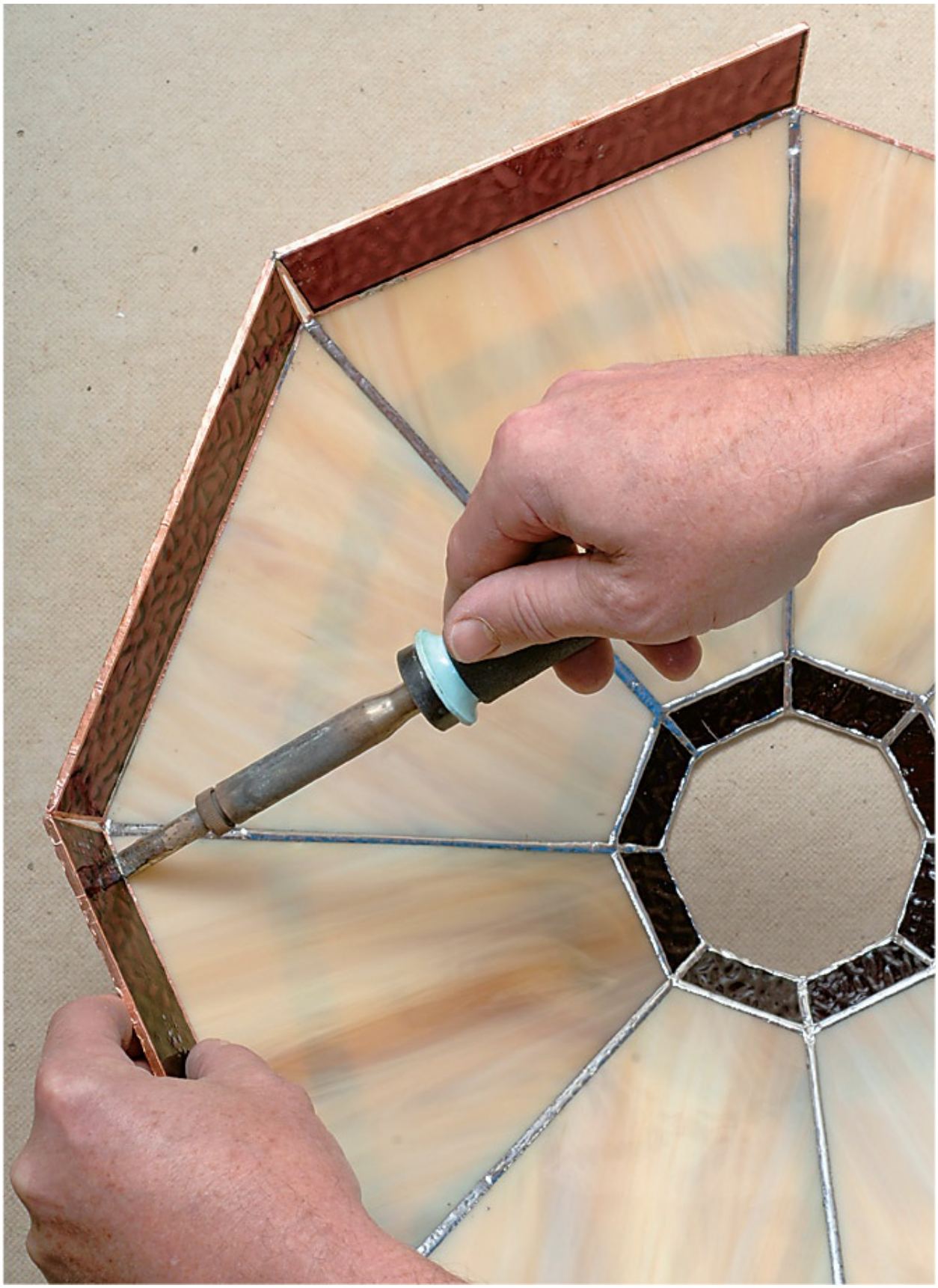
89. After soldering, the strip should hold its position.

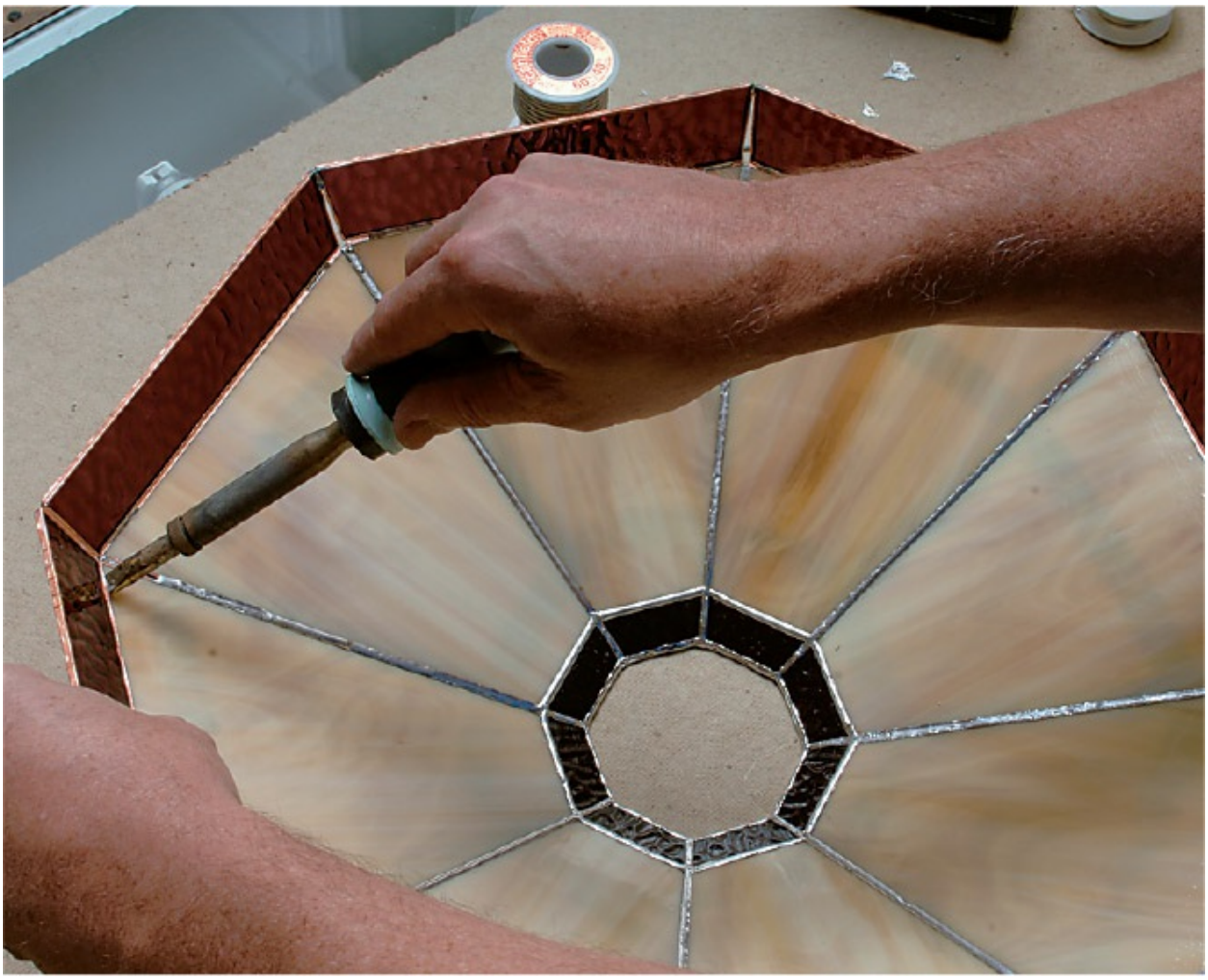


90. Flux and tack solder the adjoining strip in place.

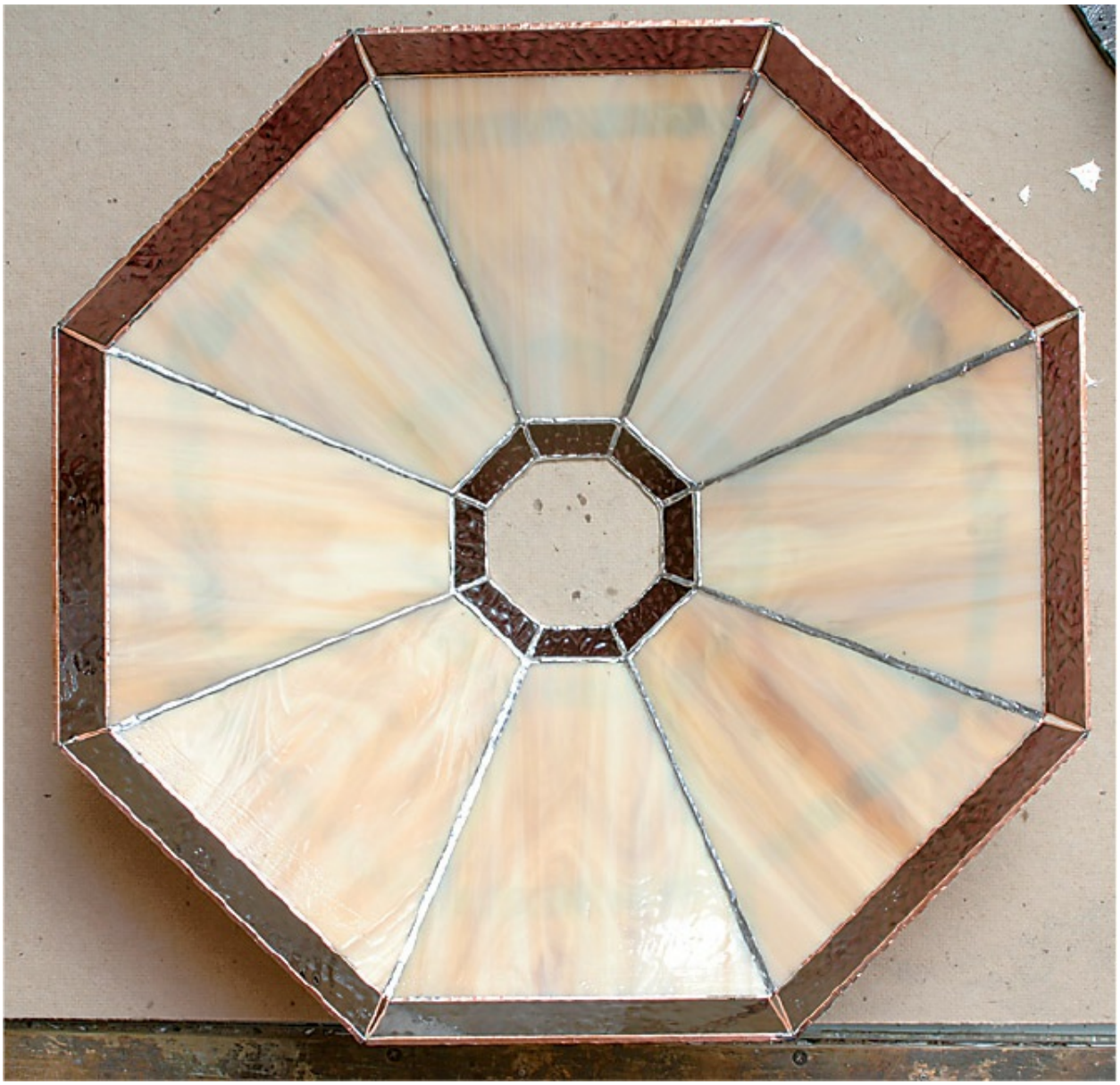
91. Don’t forget to solder the seam between the two strips.

92. Attach the next five strips the same way. Before you solder the next-to-last strip in place, make sure the final piece will fit, too. If it doesn't, you might have to remove the foil and trim it, or create another piece (once the seventh piece is soldered in place, it won't have enough give to accommodate the last piece if the last piece is too big).



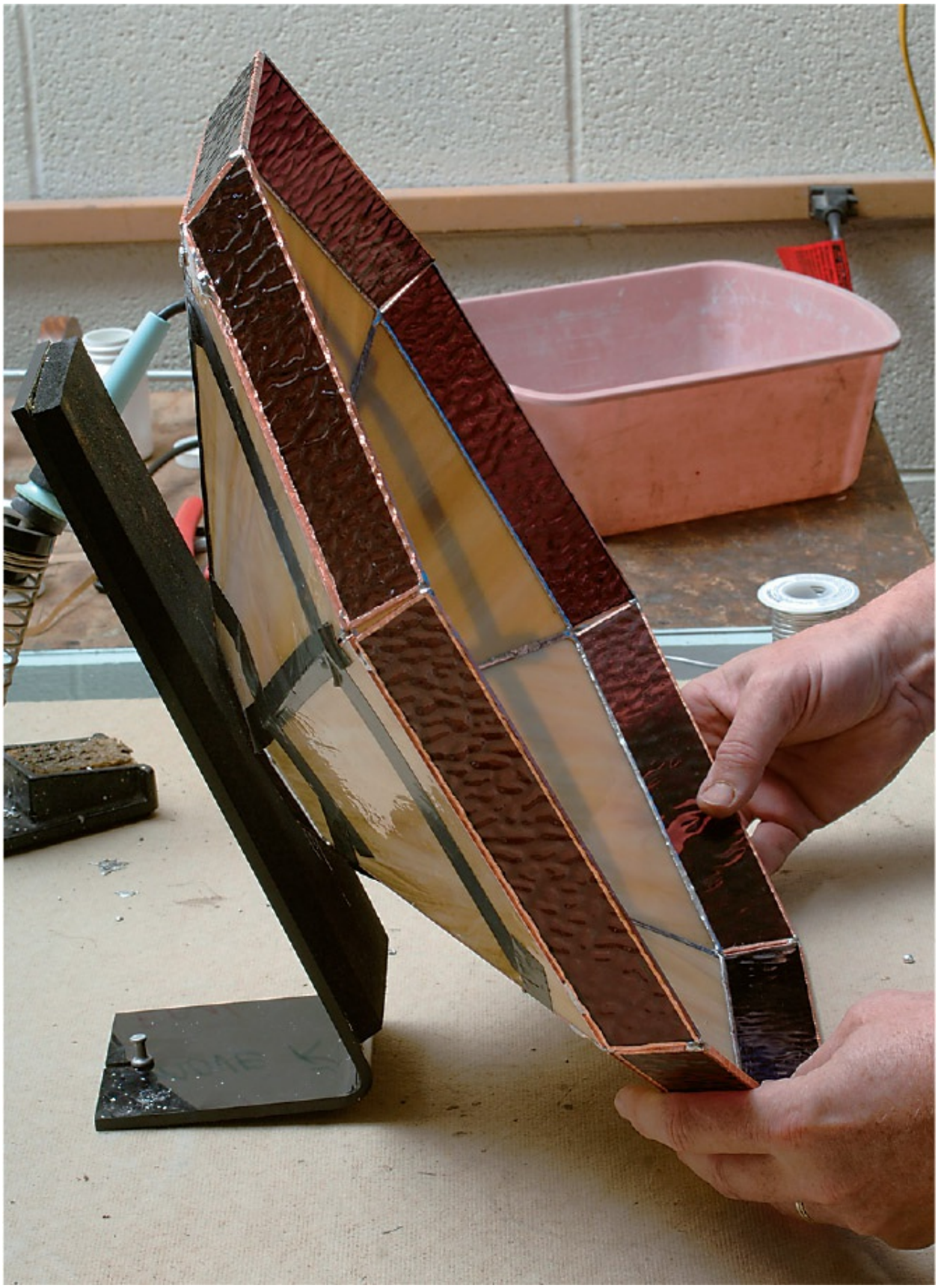


The shade with all the interior seams tack soldered.



93. The Lamp Wedgie will help you solder the inside of the lamp completely. Holes in the bottom of the brace allow you to fasten it to the work surface with pushpins.

94. Lean the shade against the brace, as shown.

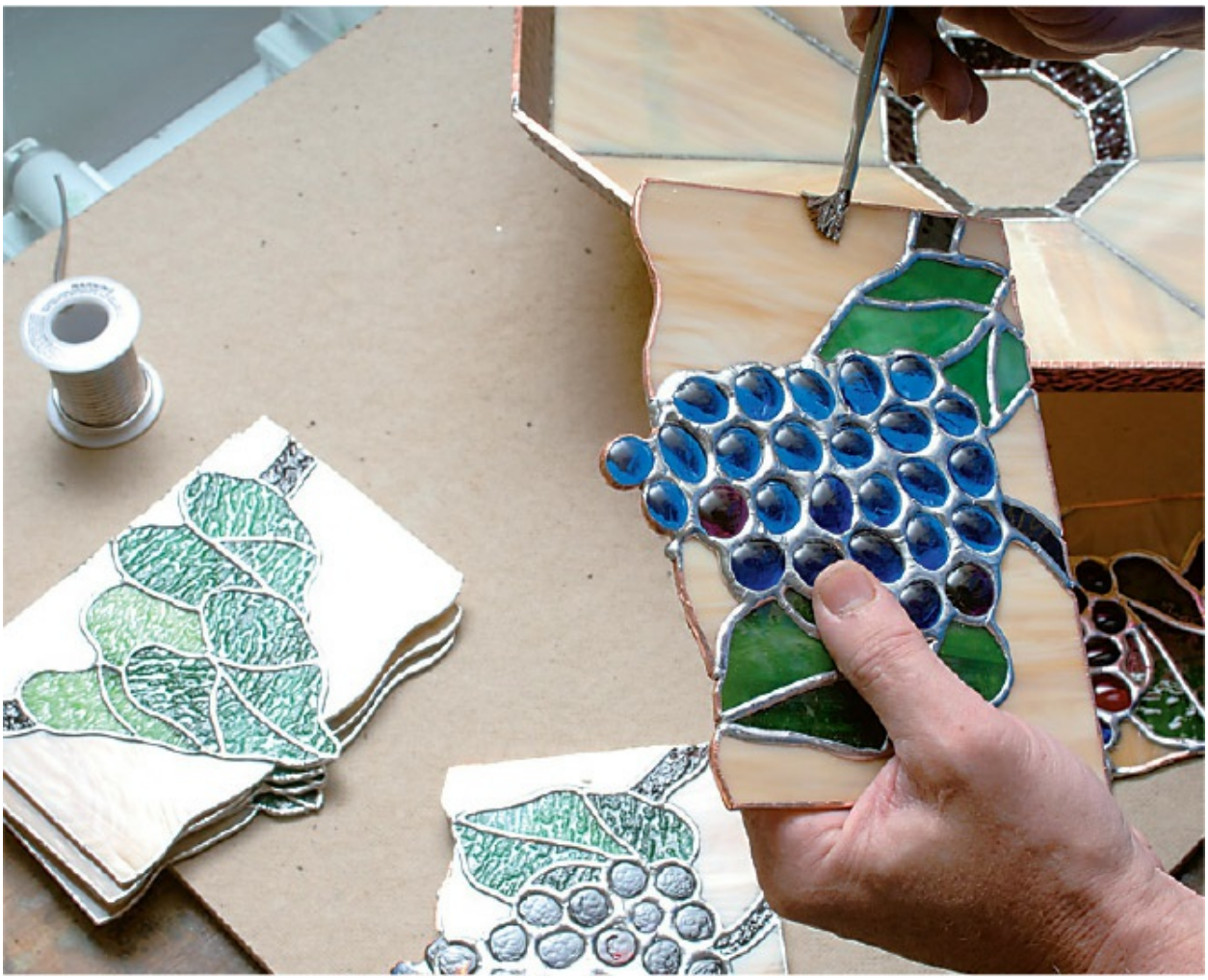


95. Solder the inside seams, turning the shade as you go.


RAINBOW VISION
Stained
Glass

96. The next step is to attach the side panels to the shade. They will alternate: Grape cluster, then leaves, then grape cluster, and so on. Also, the two blue grape clusters will be directly opposite each other, as will the purple clusters.

97. These panels are attached the same way the strips were. First, flux the top of the panel and the two sides.

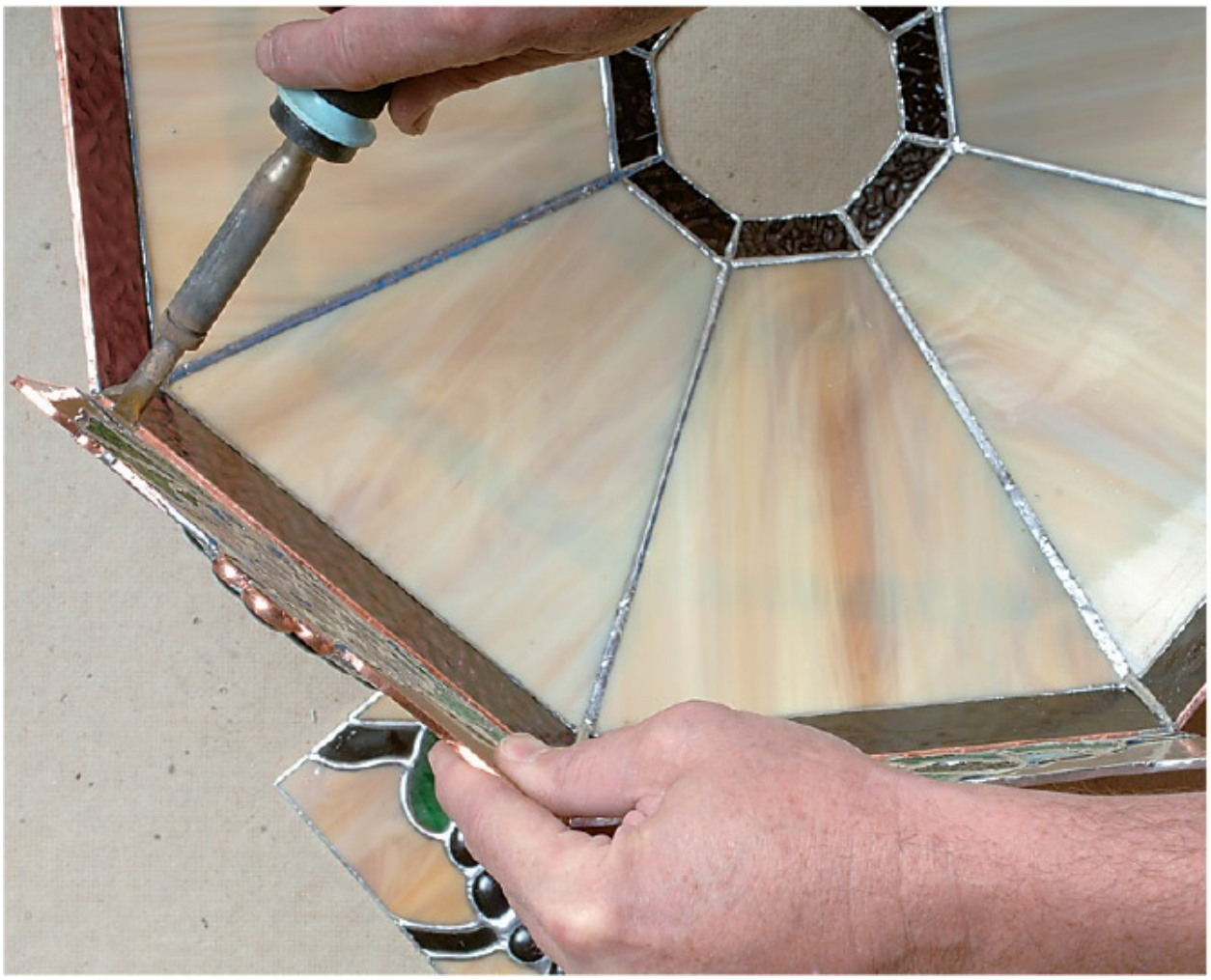


98. Flux the shade where the panel will attach.

99. Use two panels to determine the proper angle; it should be close to 90 degrees.

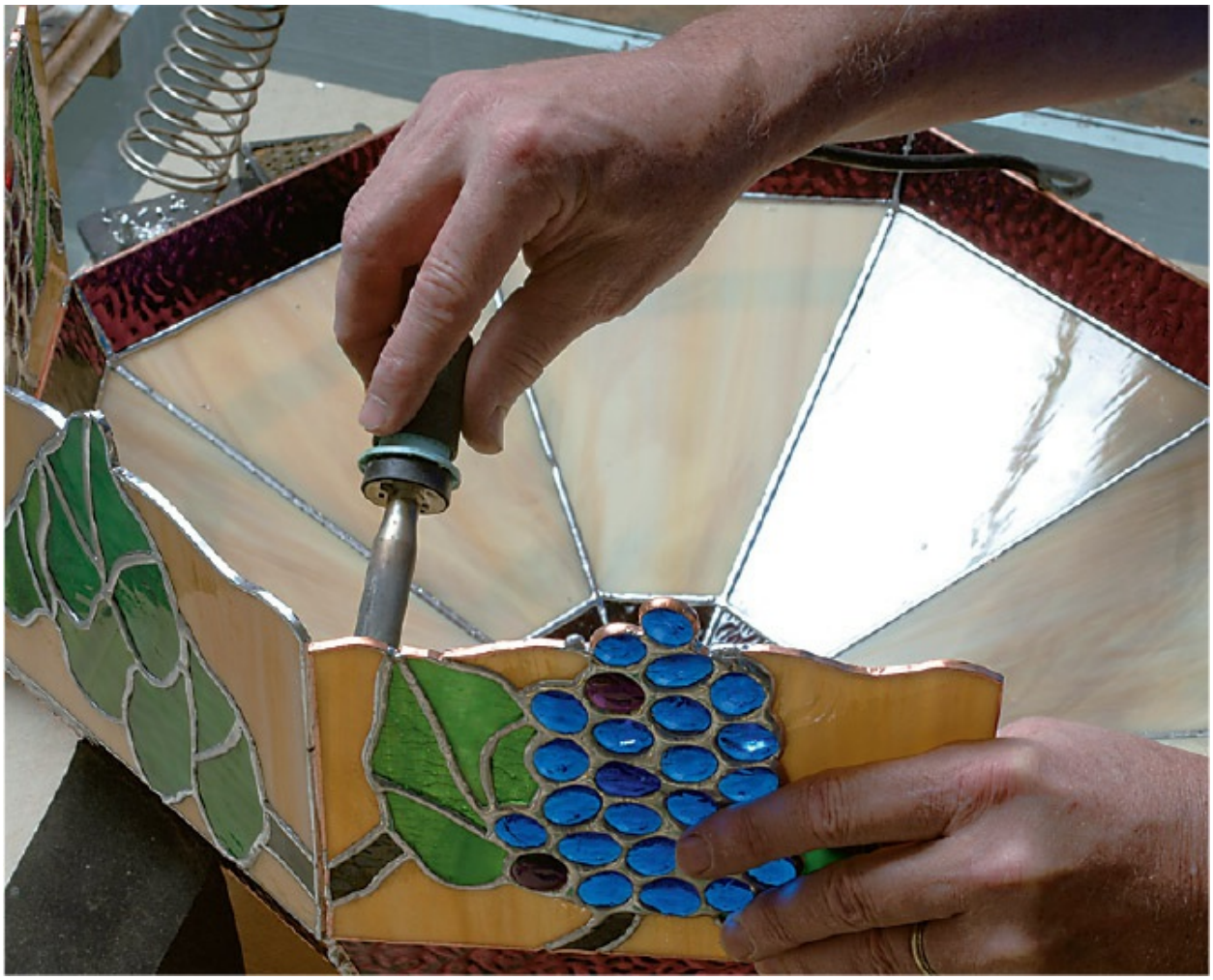
100. Tack solder the fluxed panel in place.

101. Attach an adjoining panel.

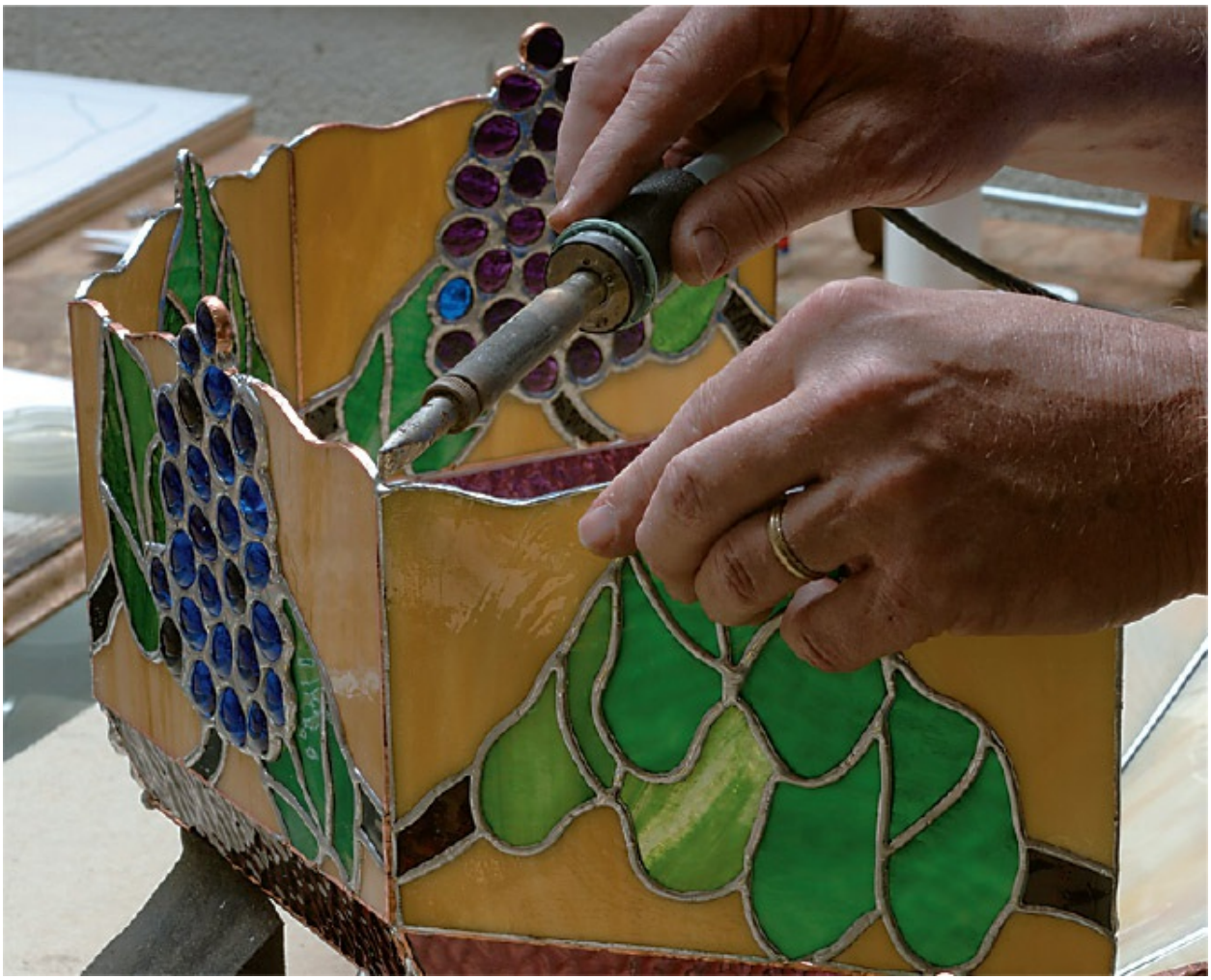


102. Solder the seam where they connect.

103. As you add panels, use foam blocks to keep the shade upright or it will lean over where the panels were attached.

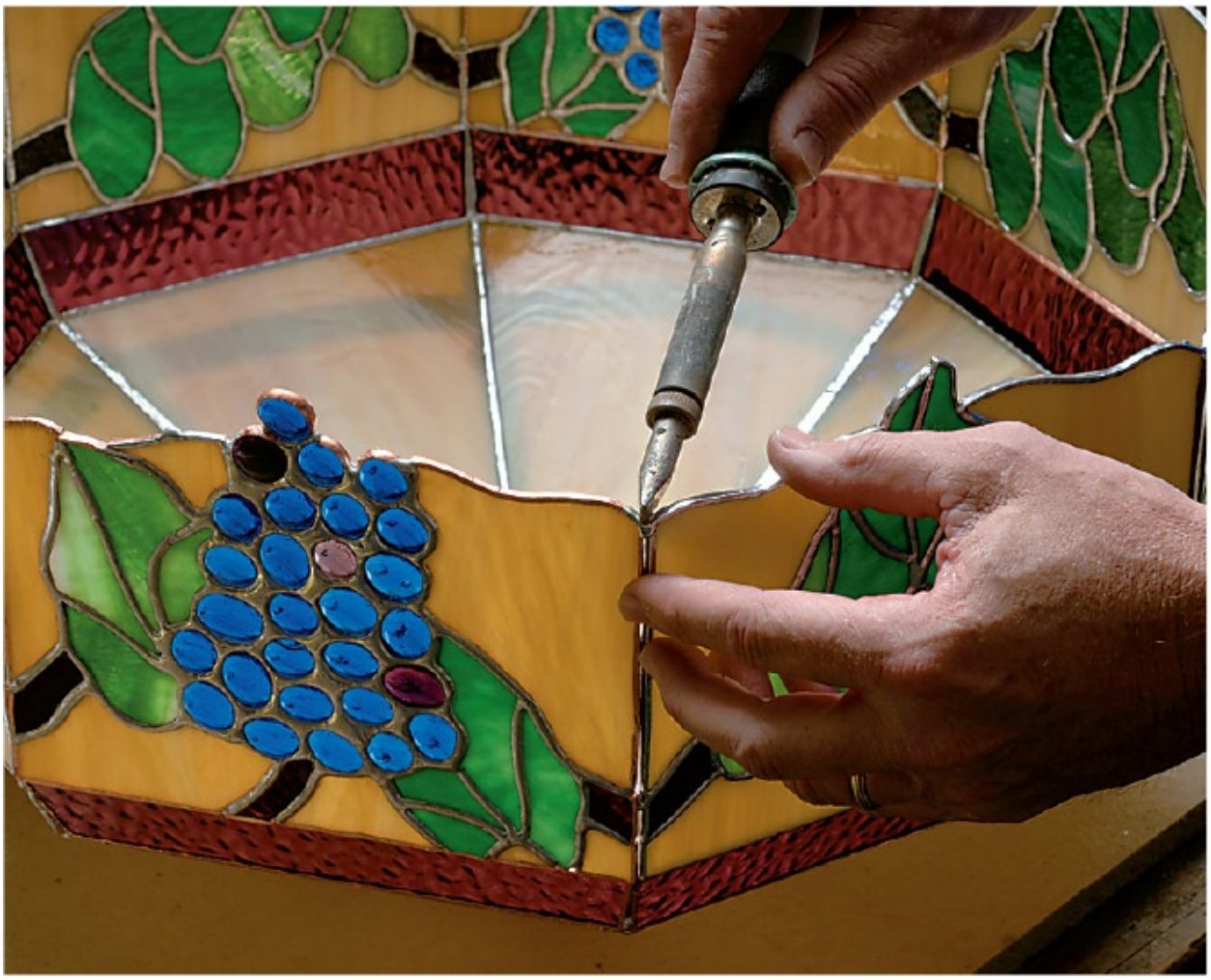


104. Make sure you follow the pattern and keep the panels in order to complete the design.

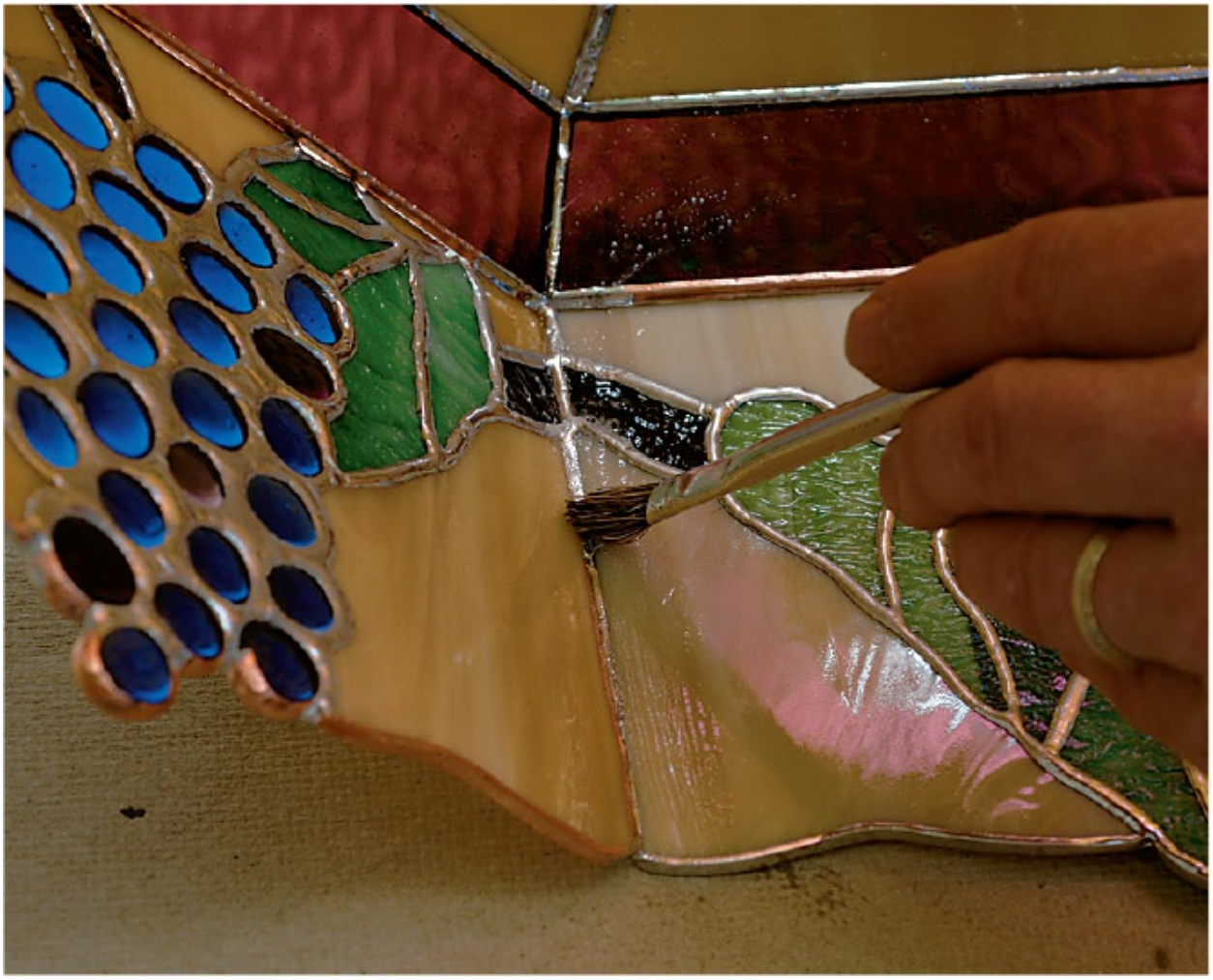


105. Test fit the next-to-last and last piece to make sure they both fit, as you did with the strips.

106. When everything is in place, solder the final piece.



107. Solder all the interior seams.



108. Work carefully, repositioning the foam blocks as needed.

109. The soldered shade is heavy—handle it gingerly—but if you soldered it correctly, it will be quite sturdy.

110. A long piece of reinforcing wire will be soldered to the entire bottom rim of the shade. This will add strength—the weight of the hanging lamp will put pressure onall the side seams. Pretinned 20-gauge copper wire is used here. It's slightly thinner than the reinforcing wire used inside the lamp so that it can be more easily bent around the bottom's irregular shape.

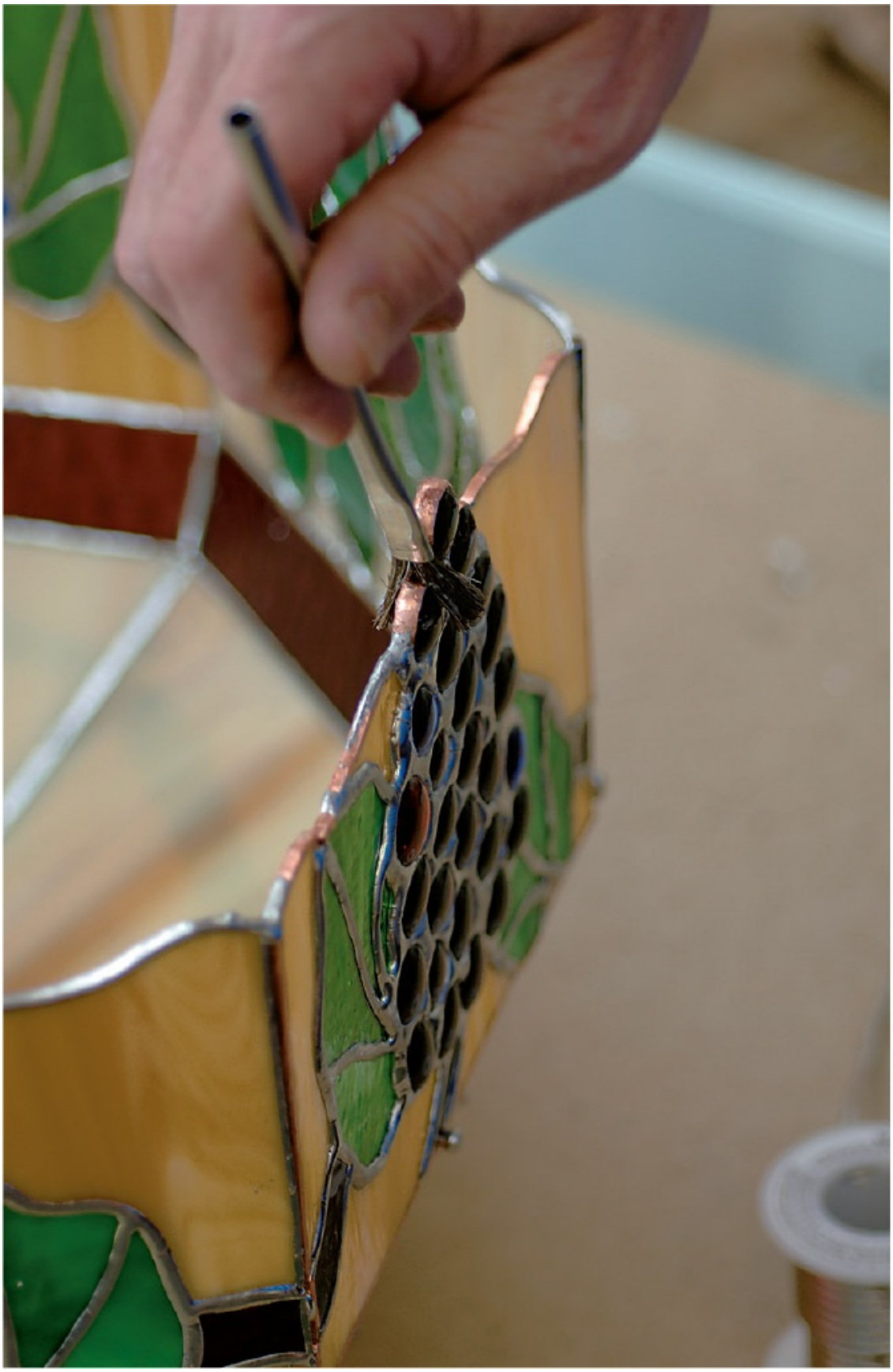
111. Determine how much wire you'll need by comparing it to the rim. Be generous; the curved rim will use up a lot of wire.

112. Cut off what you need and attach one end of the wire to the bench clamp and pull it firmly to eliminate kinks.

113. A good 5-foot length is used here.

114. After the wire is straight, flux it thoroughly.

115. Then flux the rim of the lamp.



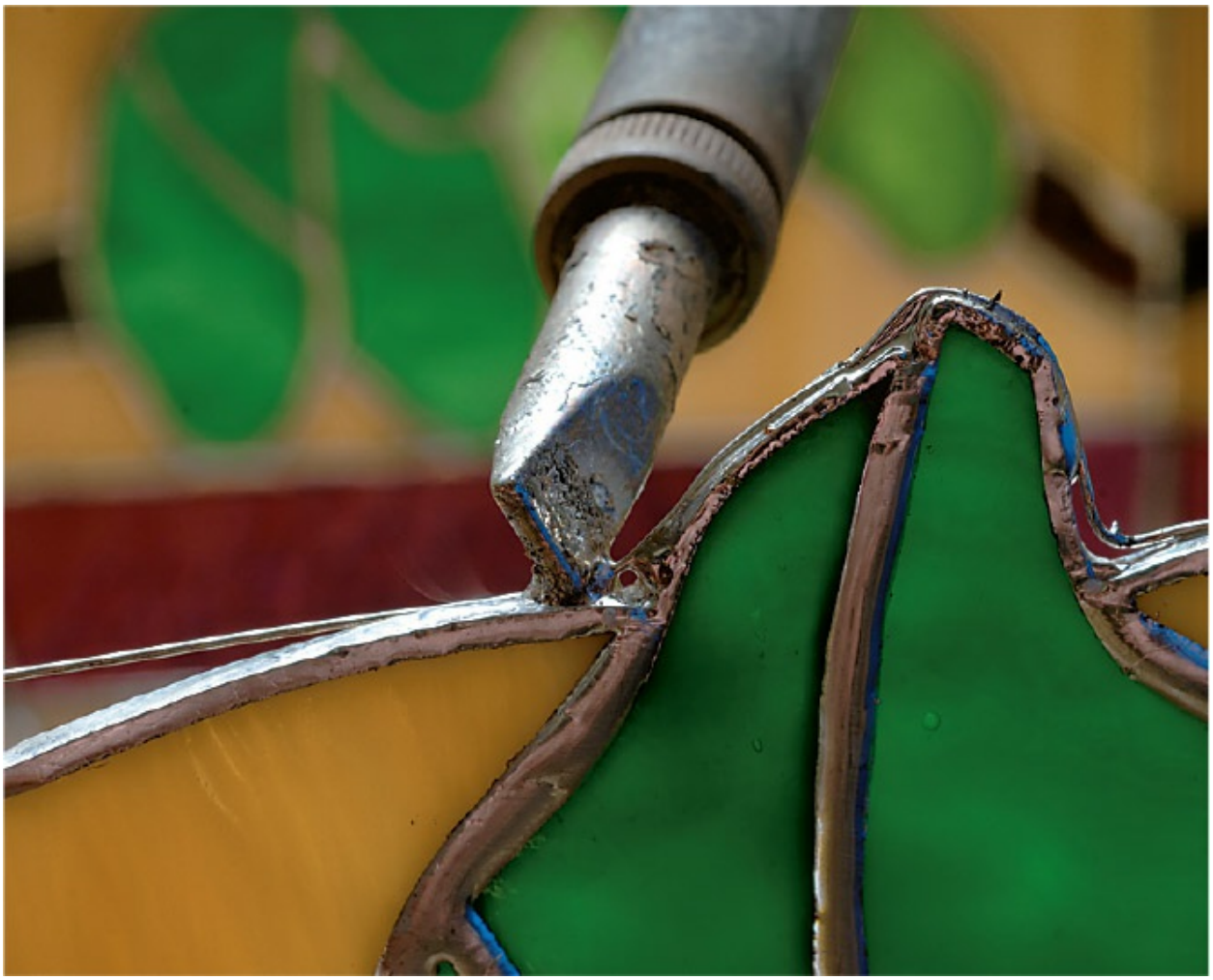
116. Tack solder the end of the wire to the rim at a corner. The wire should be positioned in the middle of the glass edge.

117. Tack solder the rim every inch or so, pressing the wire into place along the rim as you go.

118. Go slowly, attaching just a short length of wire at a time, especially around the curved grapes.

119. You won’t be able to follow the rim’s every curve and angle, but try not to leave any large gaps between the wire and the rim.

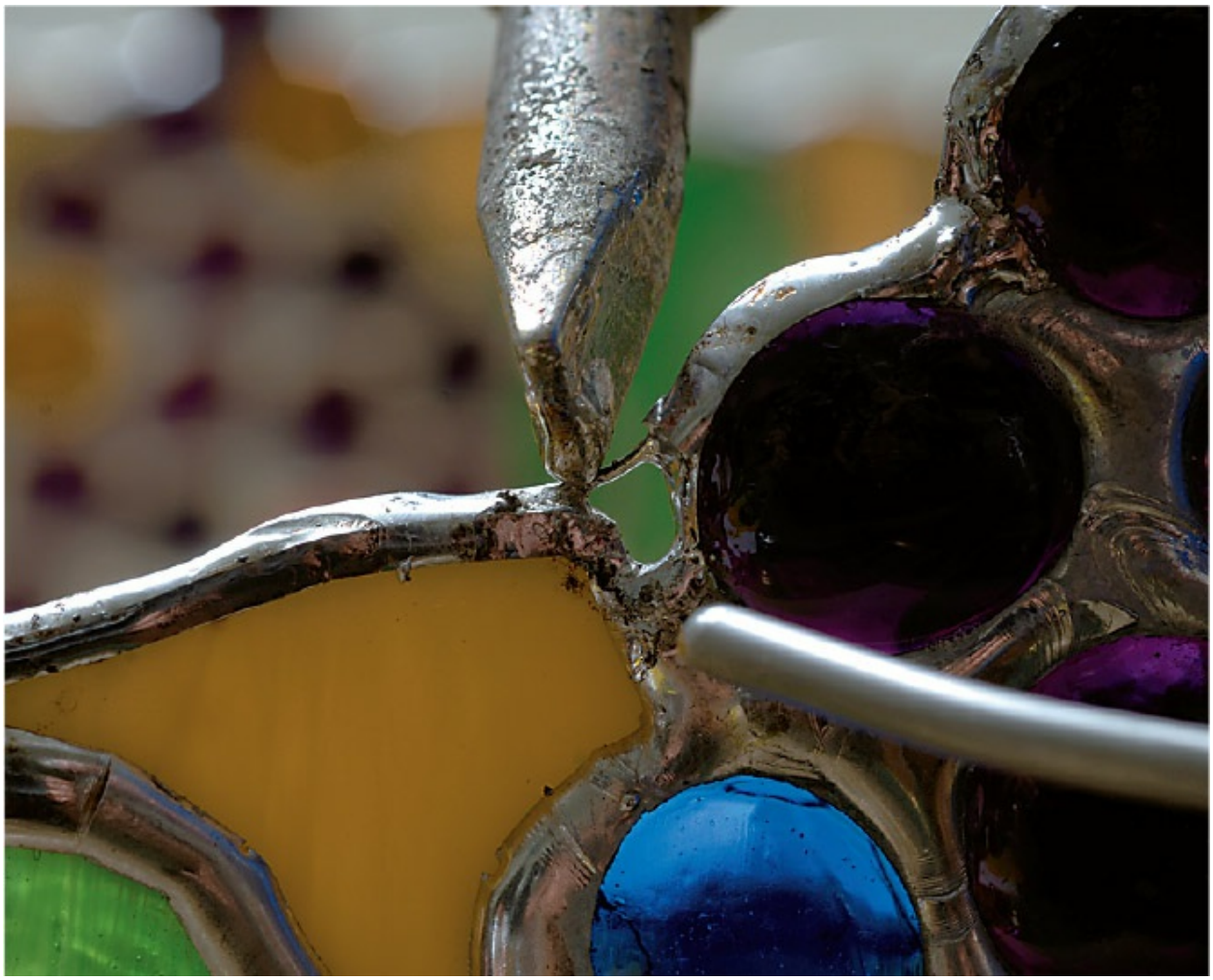
120. Small gaps will be filled with solder later.



121. When you've tack soldered the wire to the entire rim, cut off the excess. Then go back and solder the wire completely.

122. To fill in gaps, get a hunk of solder on the iron’s tip.

123. Touch the wire, letting the molten solder flow down over the gap.

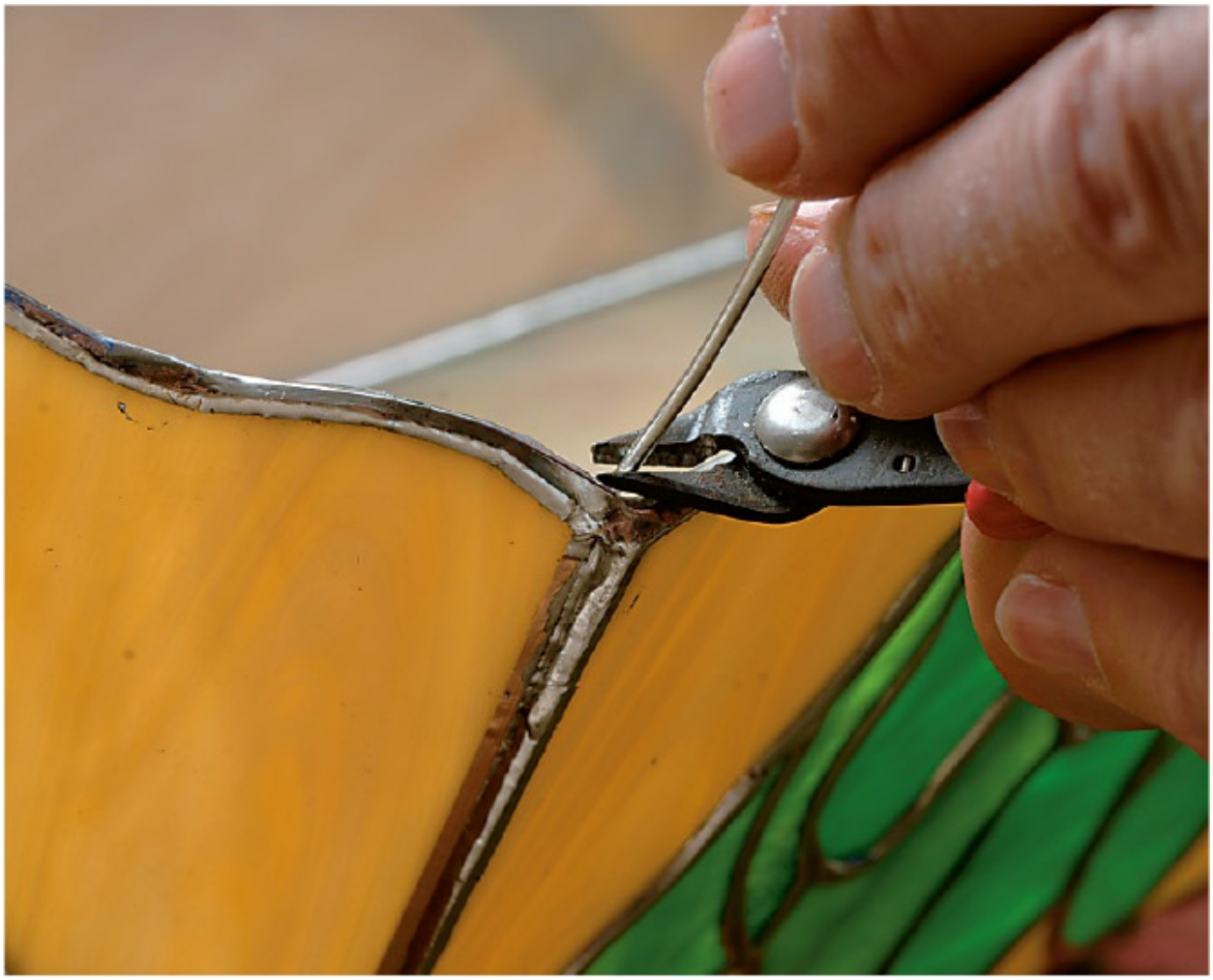


124. You might have to make two passes . . .

125. . . . until the gap is filled completely.

126. Shorter lengths of wire are used to reinforce every other seam inside the lampshade. They should run from the top to the bottom.

127. Cut, flux, and tack the wires to these seams as you did the others.



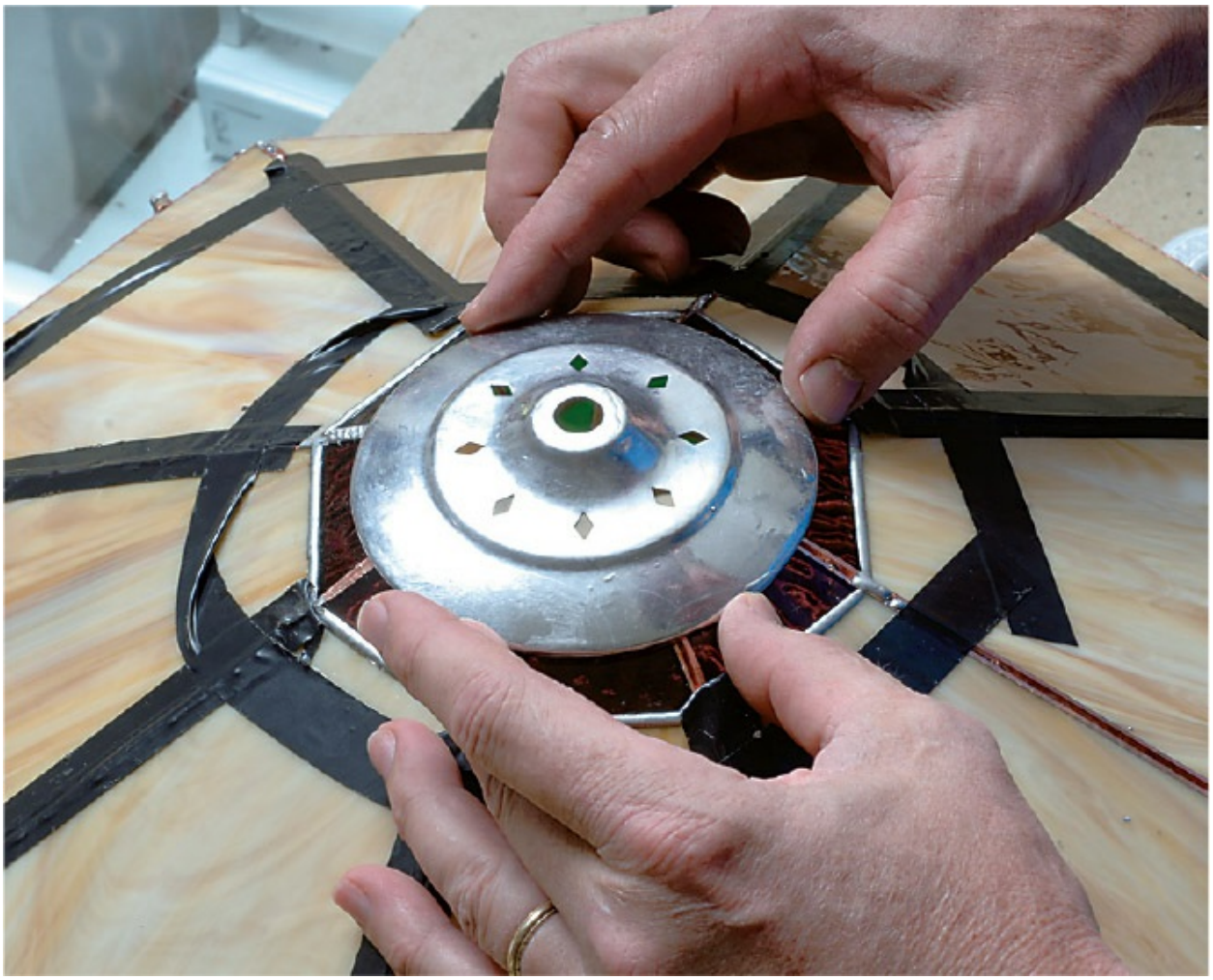
128. Then solder them completely.

129. The next step is to tin the brass cap that will cover the shade's center opening.

130. Rub the outside of the cap with steel wool until it shines. Then cover the entire top surface with solder. As you work, keep the iron in contact with the cap at all times to maximize the heat, allowing the solder to flow properly.

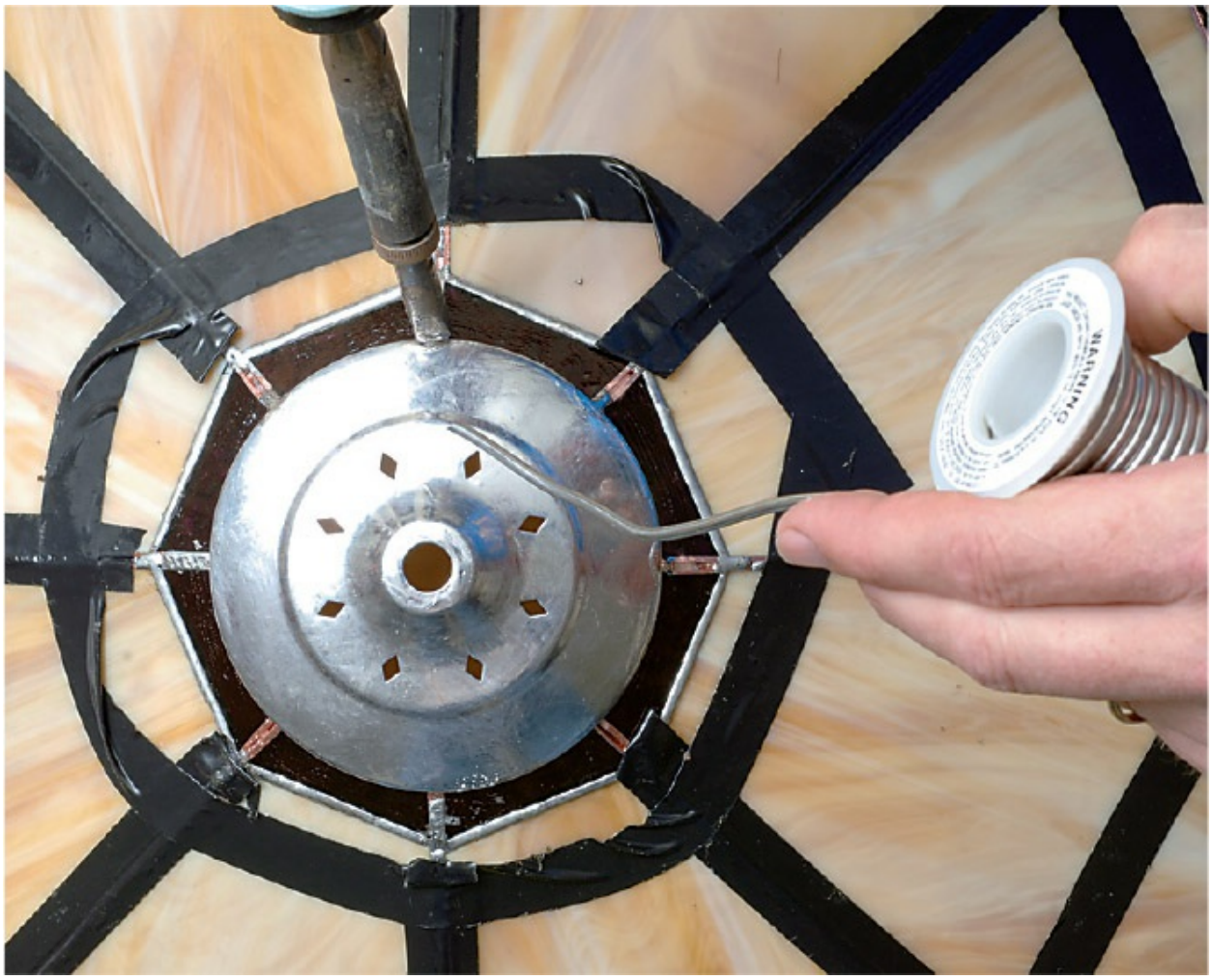
131. If you need to, hold the cap in place with the end of the flux brush as you work. Don’t touch the cap with your fingers—it gets very hot. Remove any lumps by applying flux and re-melting the solder.

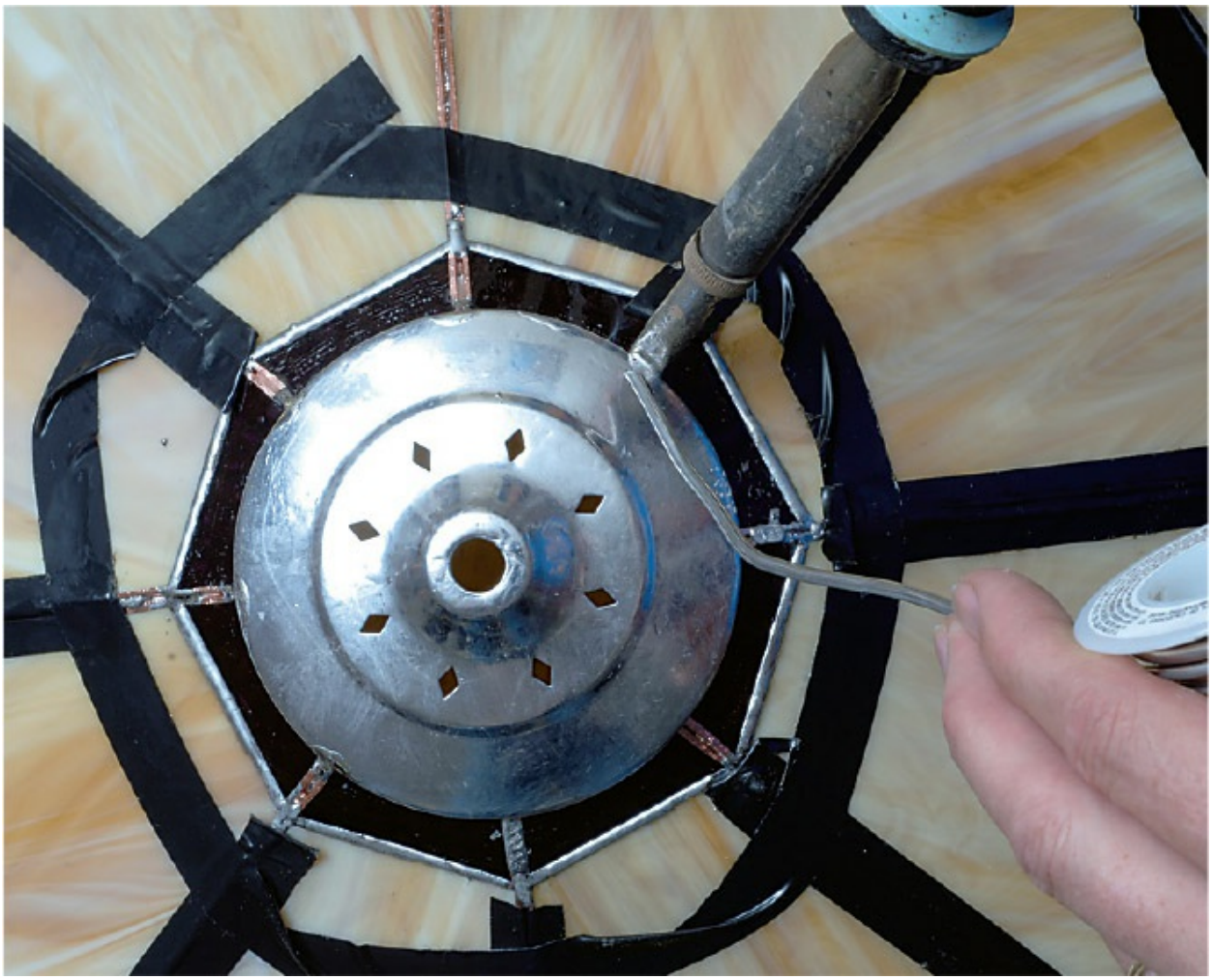
132. When the cap is covered and cool, place it over the shade's center opening.

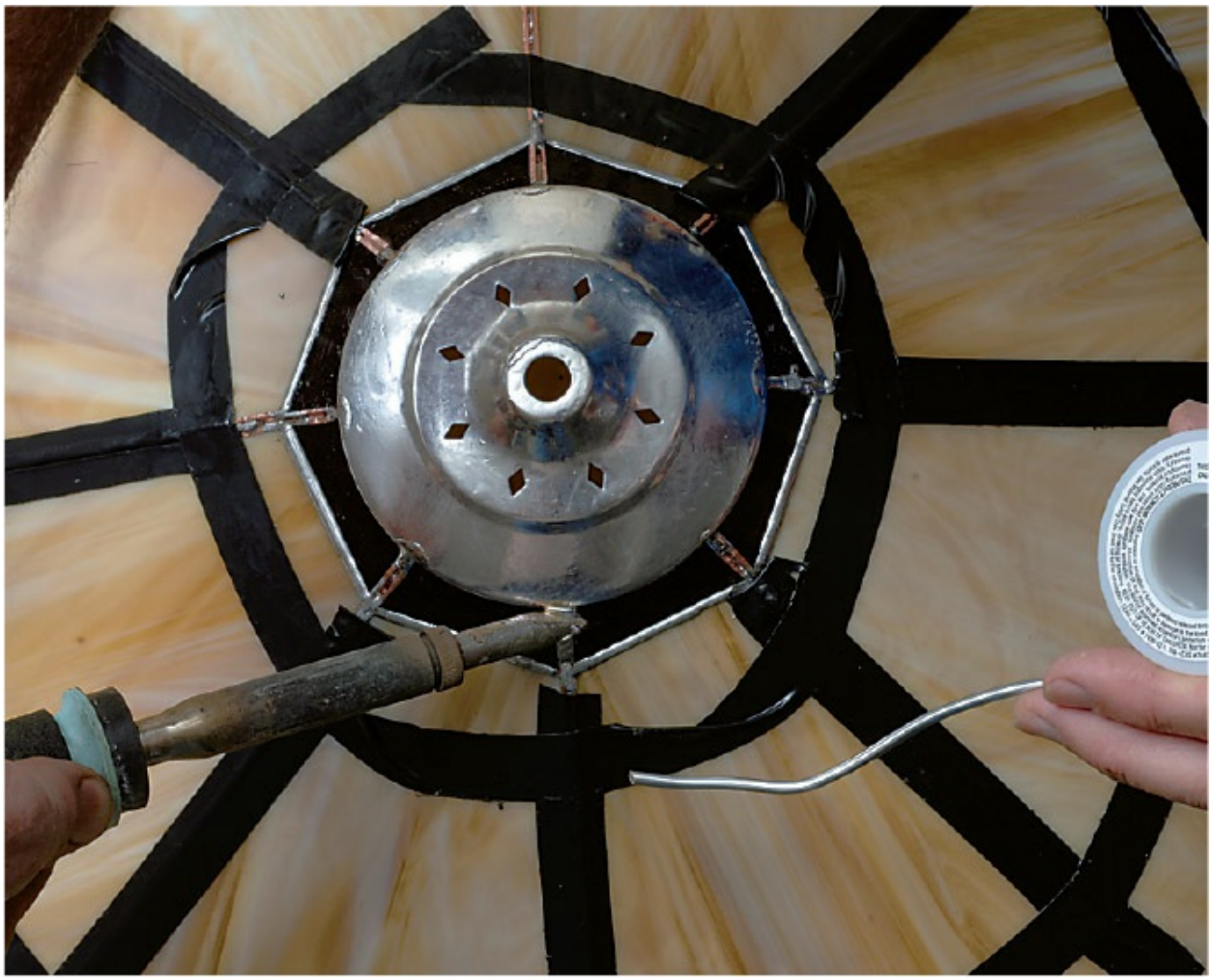


133. Flux each spot where the shade's seams touch the sides of the fitting.

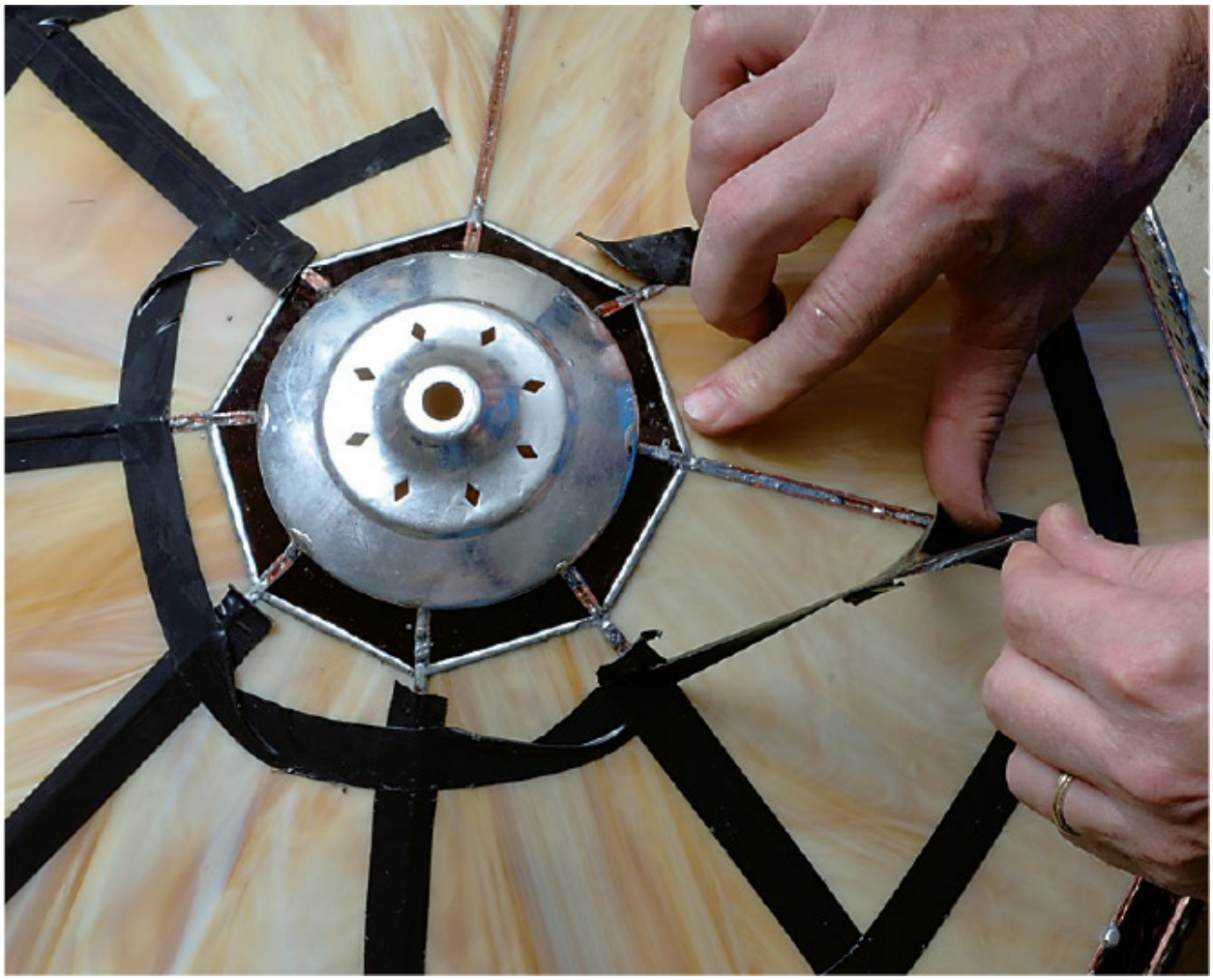
134. Solder the cap in place at these points.



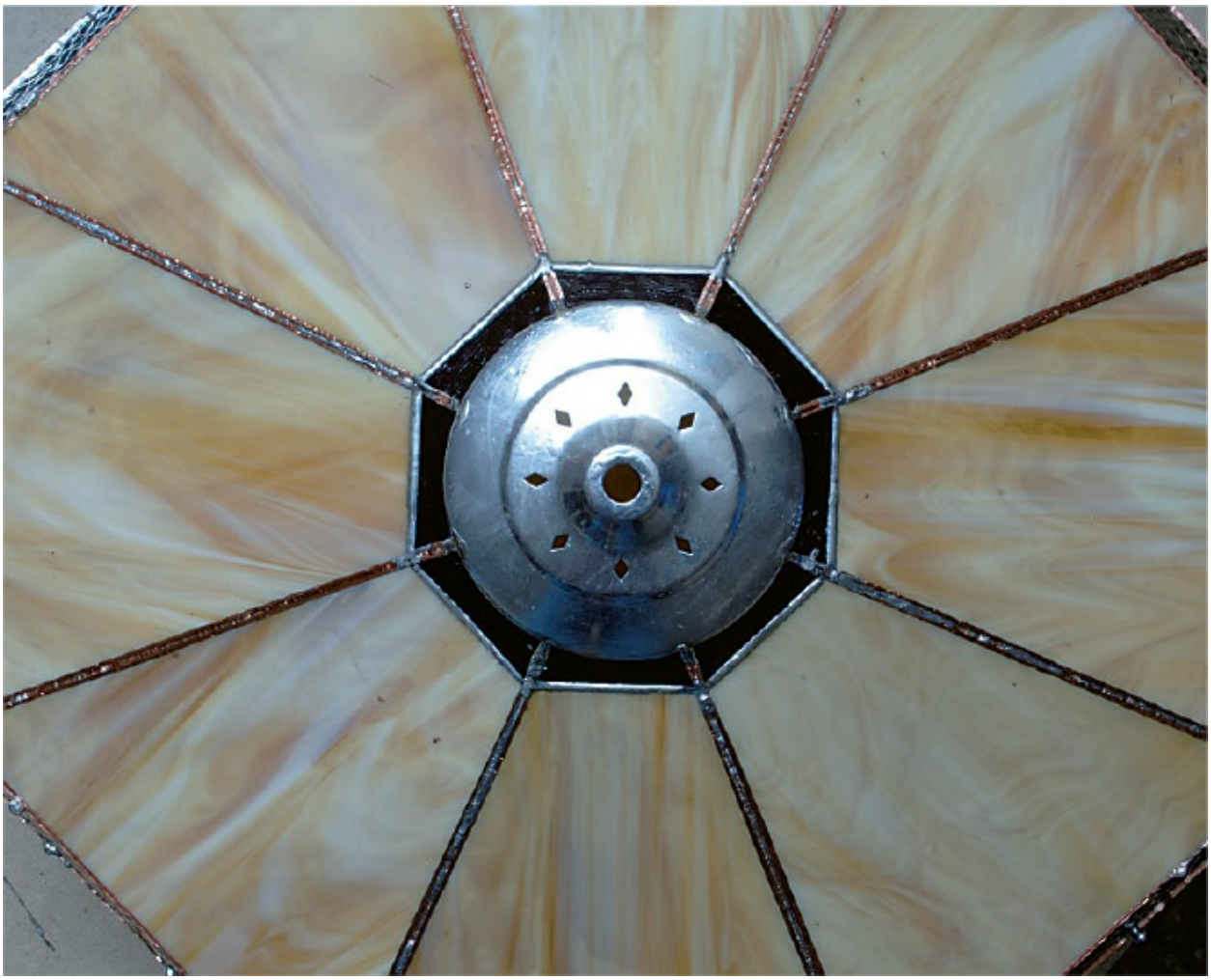




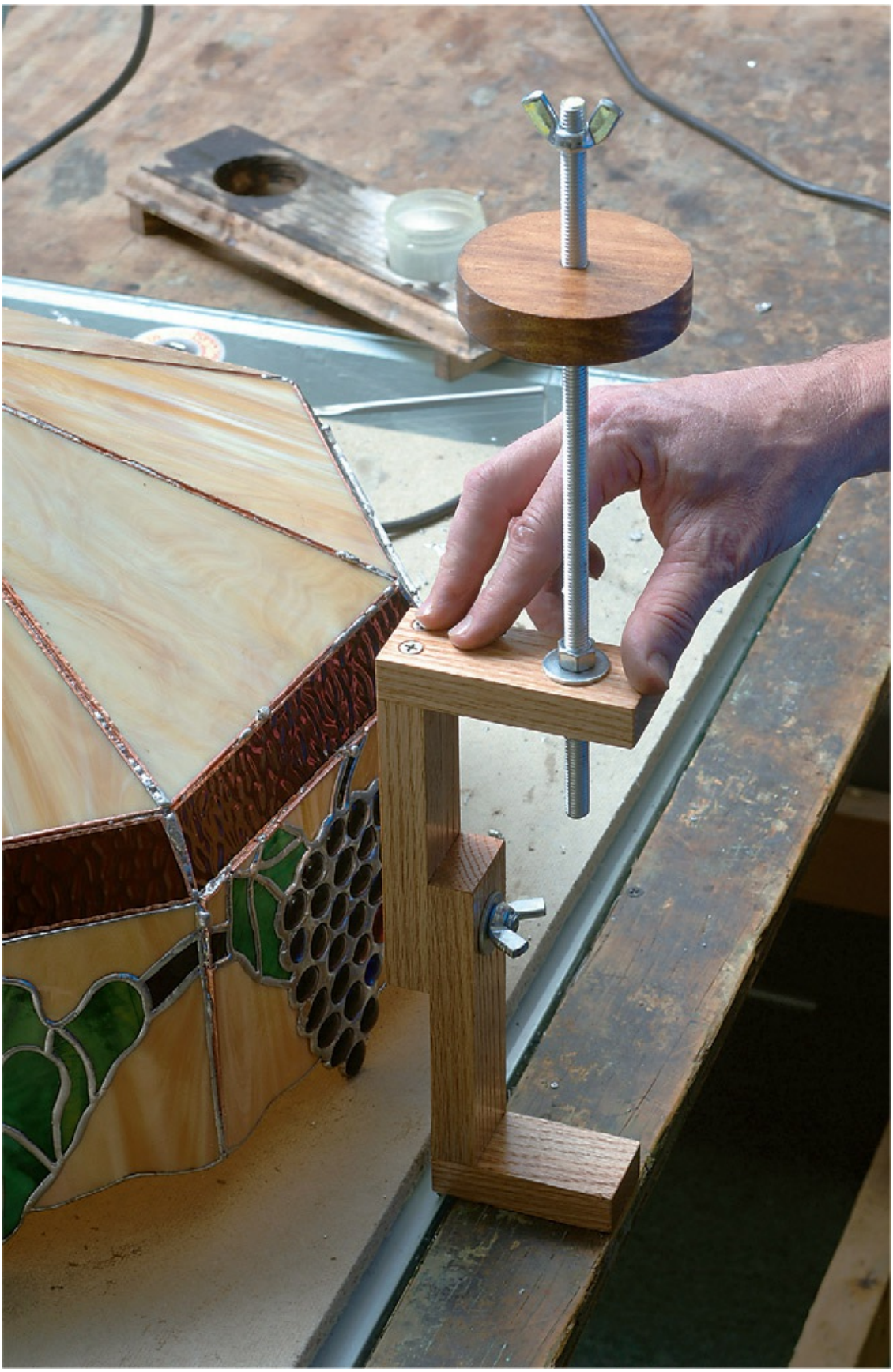
135. You can then remove all the tape from the shade.



136. The next step is to finish the soldering.



137. A lamp jig will allow you to solder the outside of the shade.



138. Clamp the jig securely to the edge of your work surface.


ADJUSTABLE

139. Remove the jig's top screw. Place the shade on the jig so the post goes through the lamp fitting's hole, as shown. Make sure the shade is raised above the work surface. The jig's circular stop rests on a second screw; turn it to raise the stop if necessary.


ADJUSTABLE

140. Replace the top screw and secure it lightly to hold the shade in place. If you overtighten the screw, you risk cracking the shade.

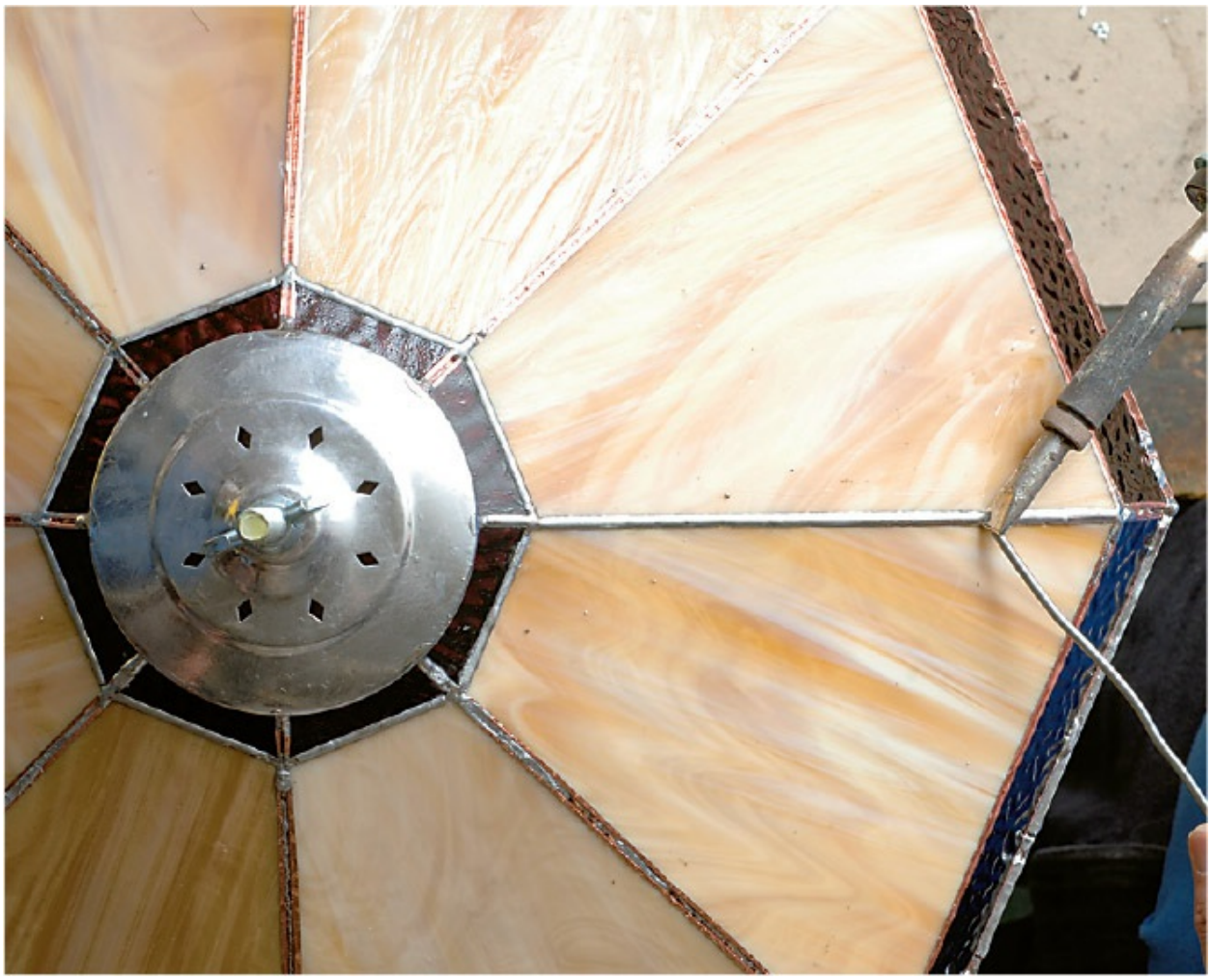
141. Loosen the screw that holds the two pieces of the jig together— do it carefully, and just enough so you can move the top piece.

142. Gently lower the shade so that one of the top seams is parallel to the work surface, as shown.

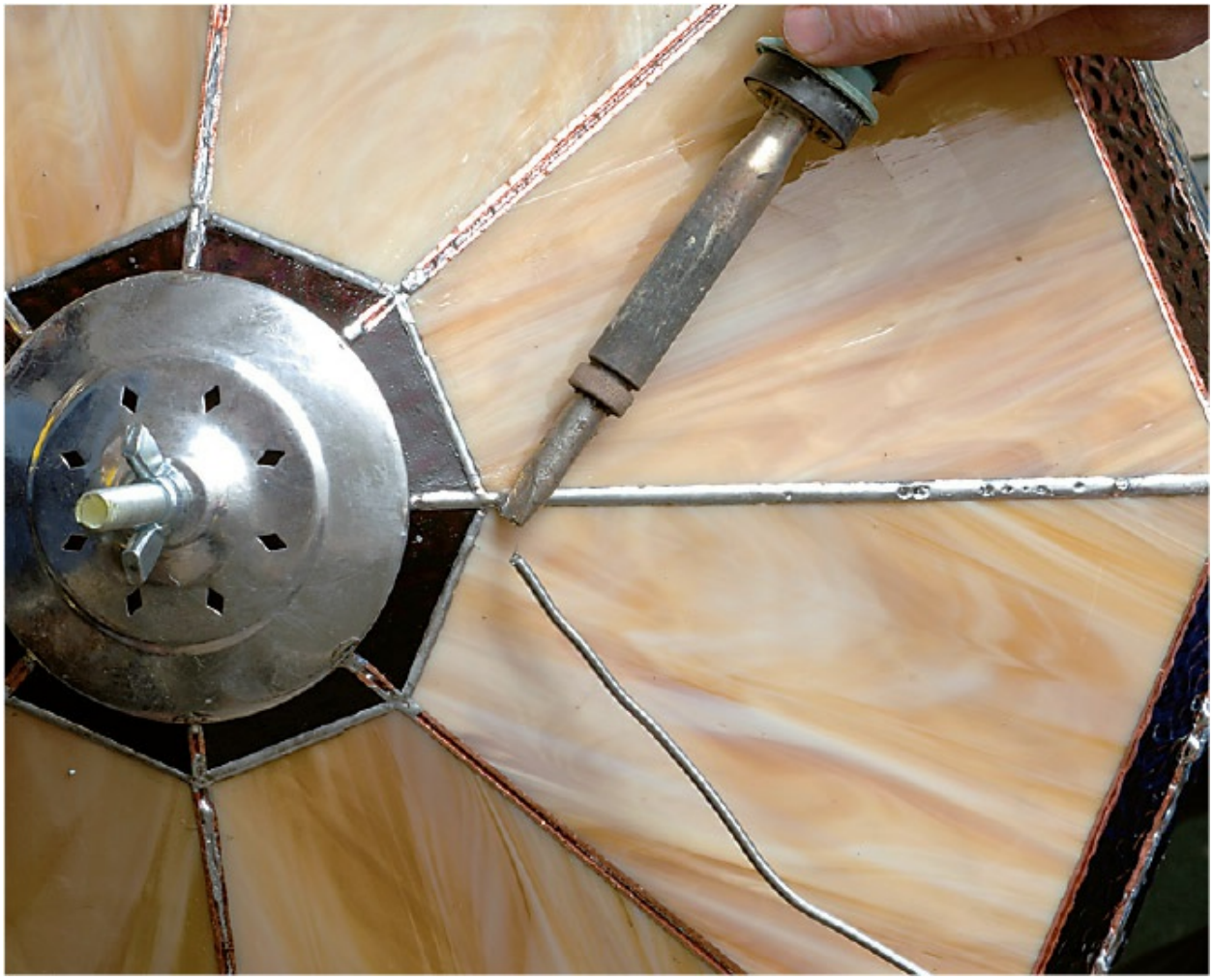

ADJUSTABLE

143. Then tighten the jig screw to hold the position.

144. The jig holds the lamp at a convenient angle for you to flux and solder the uppermost seam.



145. Run a smooth line of solder all along the seam. Do this with two applications to prevent excess solder from dripping.



146. Remember, if the solder isn't smooth, you can go over it again with the hot iron—and some more solder if needed—to get the seam the way you want it.

147. Reposition the jig to bring each seam into easy reach.

148. Solder each seam one by one.

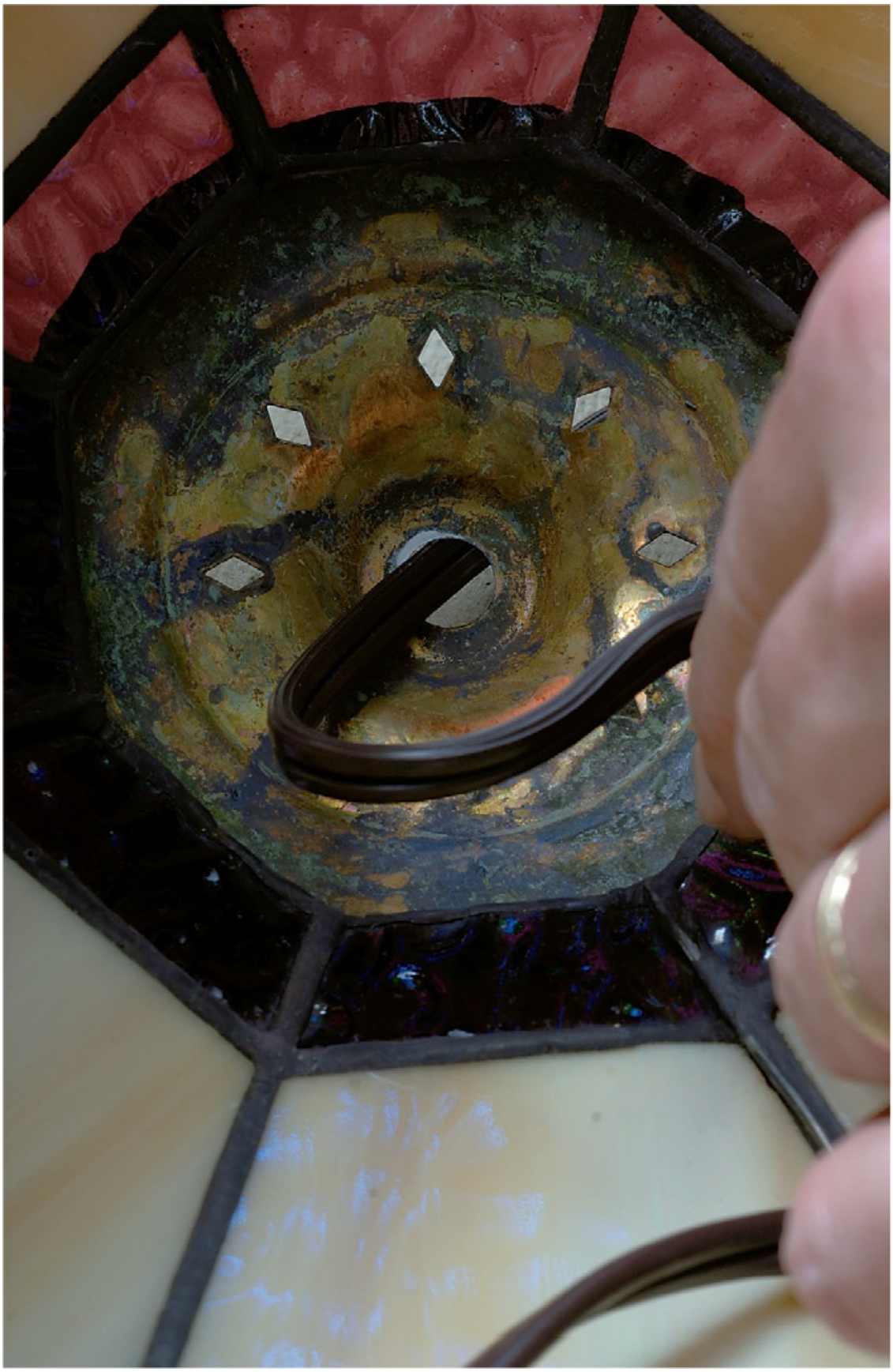
149. Shine the completed shade with finishing compound. After the shade has been waxed, you might need to scrub some of the excess off the grape clusters. Use an old soft-bristled toothbrush.

150. Scrub until the clusters are clean.

151. The completely assembled and finished lampshade.

152. A standard three-bulb light fixture can be attached to the shade to complete the piece.

153. Feed the fixture’s wire through the hole in the lamp cap.



154. Pull the wire through the hole until the fixture is tight against the underside of the cap.

155. Thread the wire through the finial.

156. Attach the finial to the cap by screwing it into the cap's hole.

157. Use a standard pair of pliers to open up the end link of the chain, which should have a break in it.

158. Hook the opened link onto the finial.

159. Then use the pliers to squeeze the link closed.

160. Make certain the break is completely shut.

161. Thread the wire through the links of the chain.

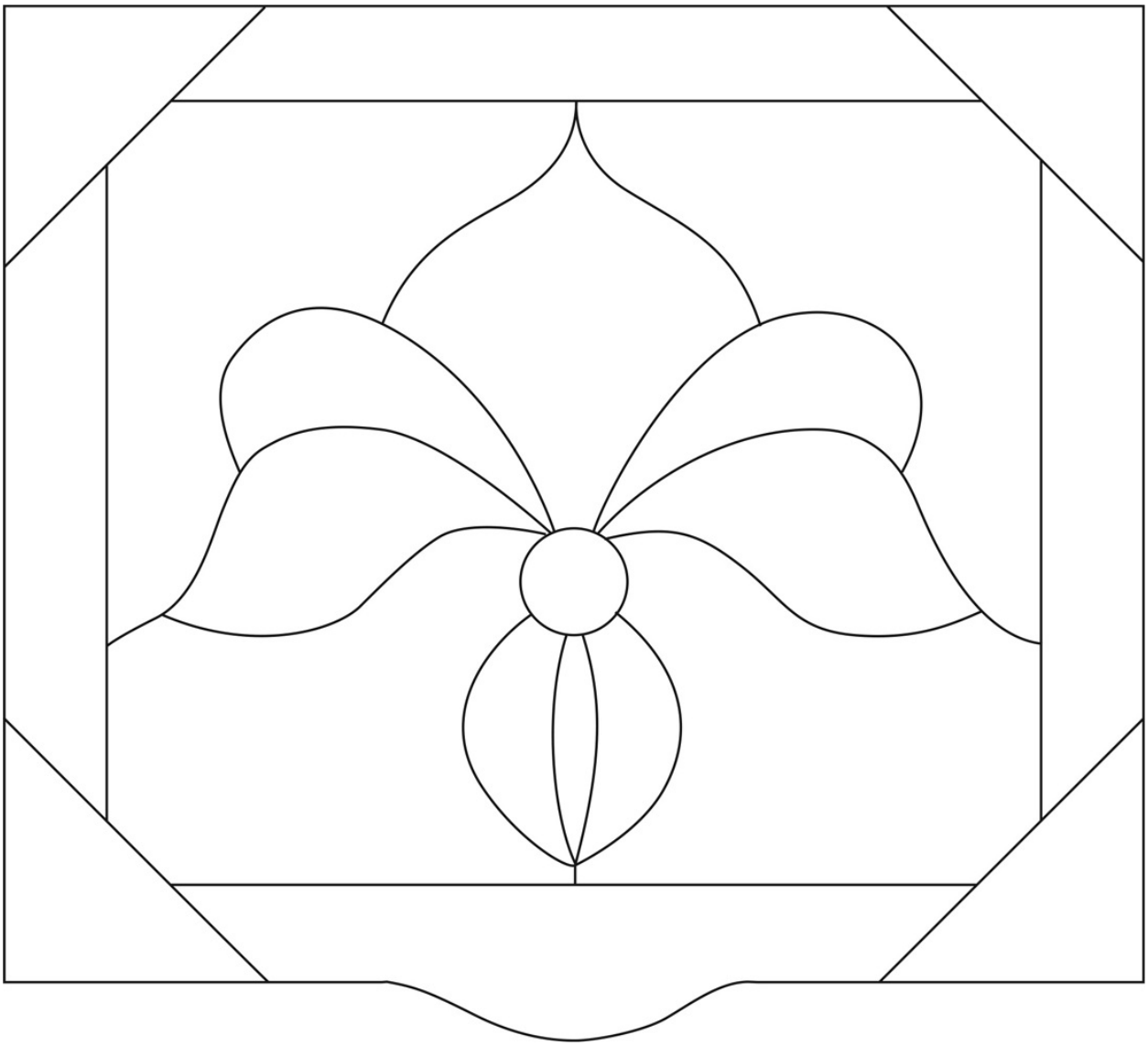
The completed lamp, ready to install.

6

Stained Glass Box with Hinged Lid

his sparkling stained glass box includes tinned legs, a chain that holds the

T lid open, and an inside bottom of mirrored glass. Thin brass tubes cut, bent, and soldered into place form sturdy and smoothly functional hinges. A lip on the lid makes opening the box easy. The glass that makes up the lid's design was cut by hand and includes a single glass jewel. Once you know the basics of box and hinge construction, you can make glass boxes of any size, for almost any purpose.



Enlarge 150%

Enlarge 150%

Materials and Equipment

SILVER CHAIN AND BAR

A length of silver chain is attached using a thin silver bar to keep the lid from flopping all the way open.


Sprayway®
No. 209
INDUSTRIAL
Mirror
Edge
Sealant
Protects Mirror Edge From Blackening
NO CFC's
CONTAINS NO OZONE
DEPLETING CHEMICALS!
DANGER:
HARMFUL OR FATAL IF SWALLOWED
EXTREMELY FLAMMABLE
CONTENTS UNDER PRESSURE
Read carefully other cautions on back panel
NET WT. 10.5 OZ. (298 GRAMS)

MIRROR SEALANT

Used to cover the backside of a mirror to keep the reflective coating from getting damaged. Approximate cost: $10.

BRASS BALL CHAIN

A ball chain soldered around the perimeter of the lid to dress up the box.

BRASS LEGS

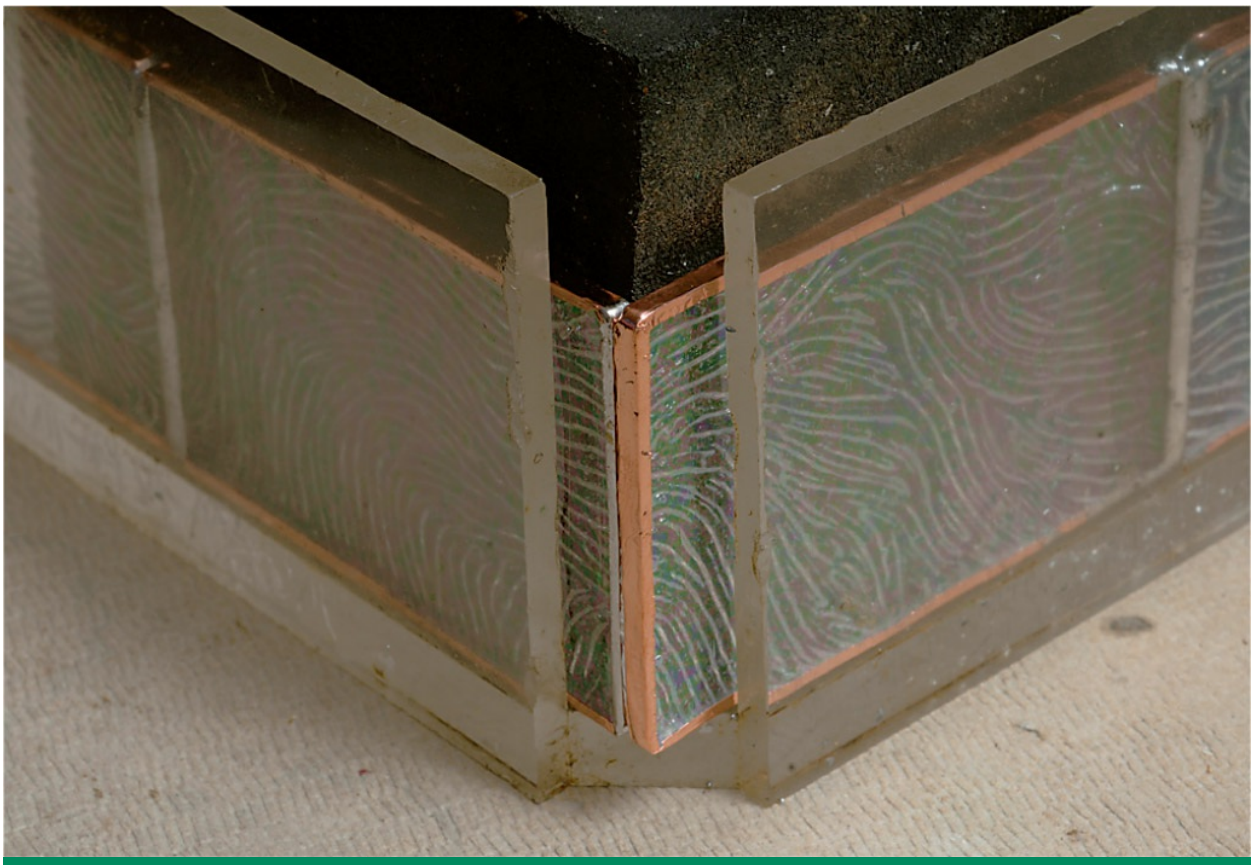
Brass legs are tinned and soldered to the corners of the box's base.

BRASS TUBES

Two diameters ($^{3}/_{16}$ inch and $^{3}/_{32}$ inch) of brass tubing are used to create the hinges on this box. Such tubes come in foot-long lengths.

PROFESSIONAL BOXER BRACES

Nonflammable plastic braces used in conjunction with Wedgies to keep the corners of a box square during construction. Approximate cost: $25.

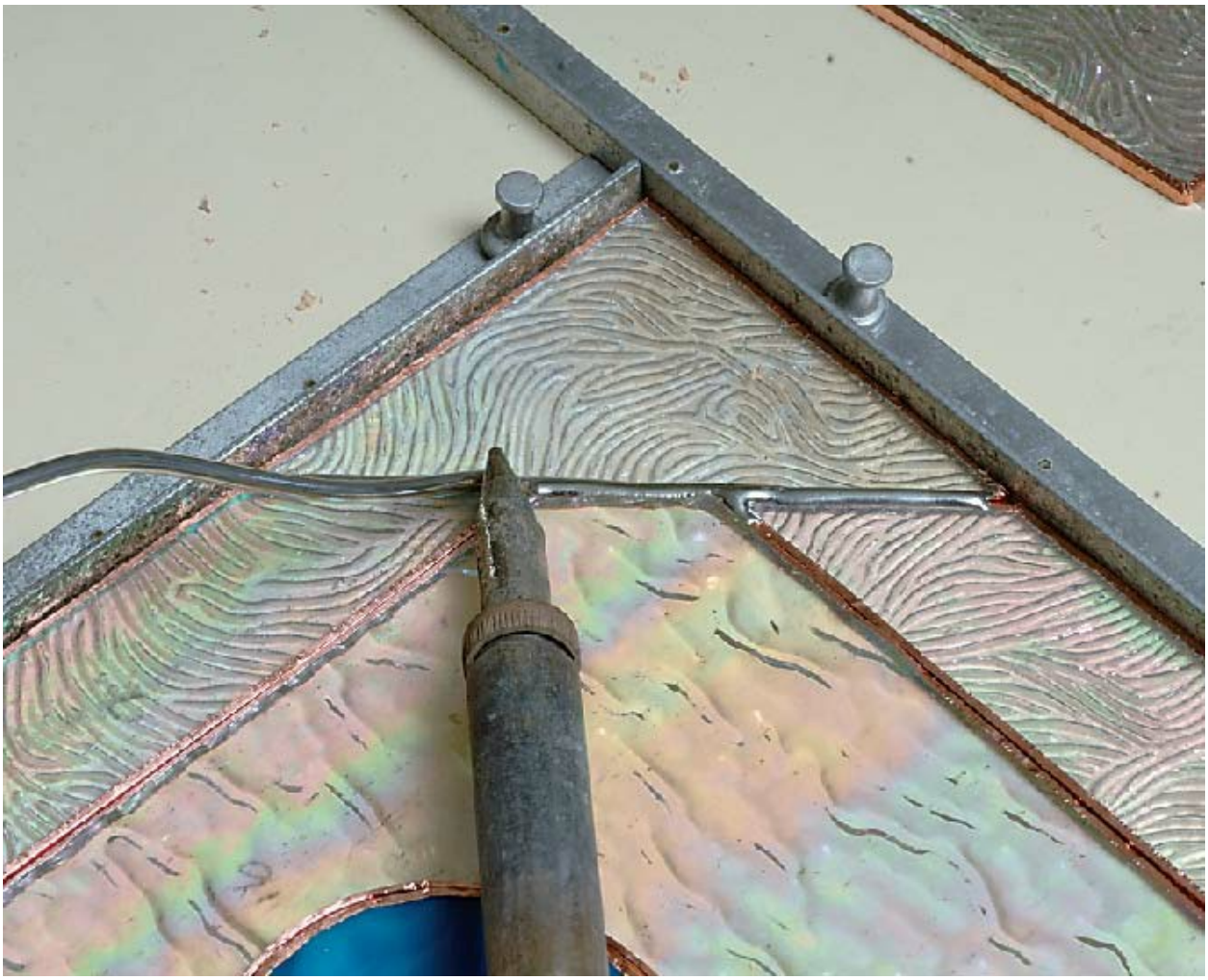


Stained Glass Box with Hinged Lid

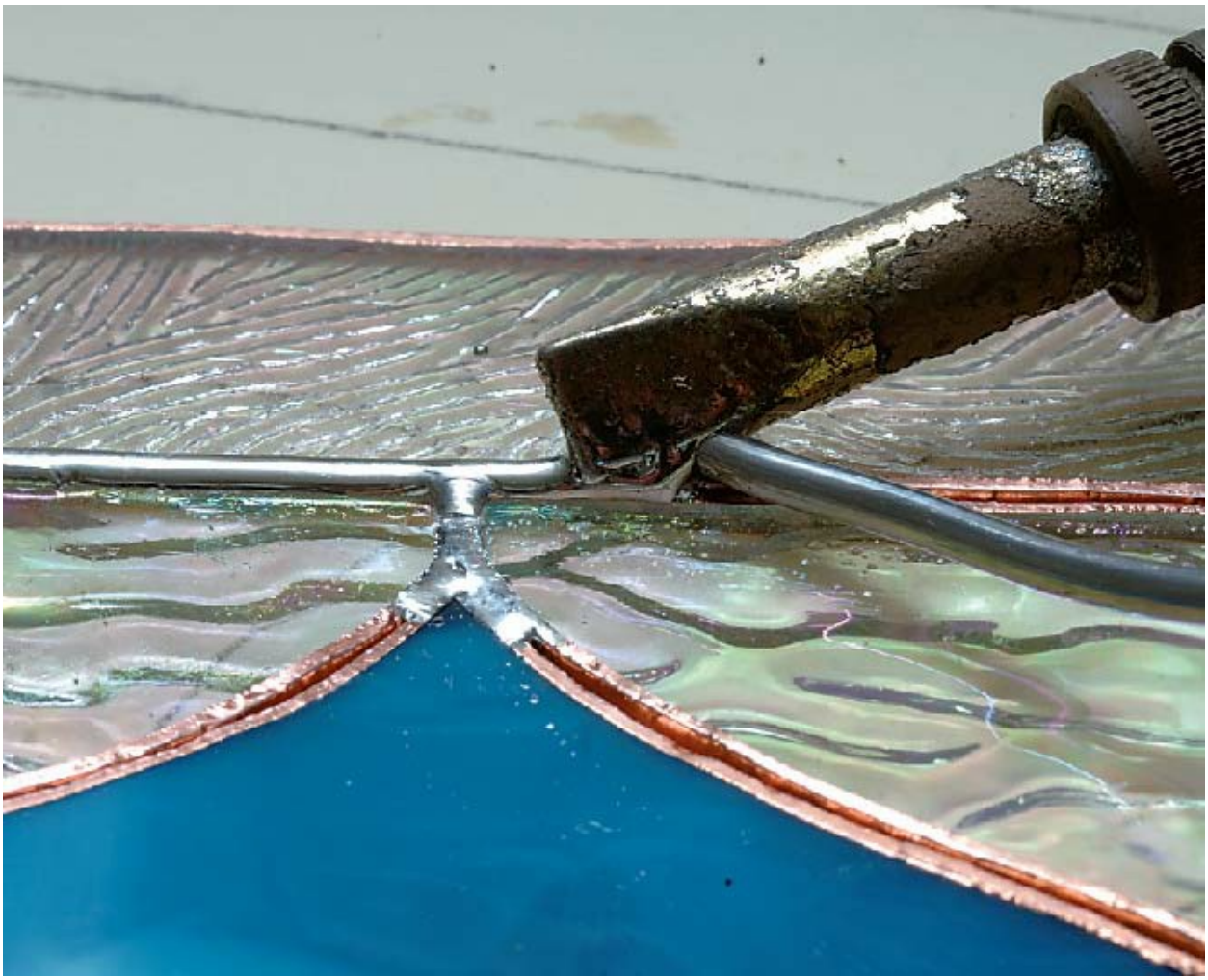
When the individual pieces of the top of the box are foiled, laid out, pinned into place, and tack soldered, you are ready to finish the soldering.

1. Start anywhere; 60/40 solder is used here.

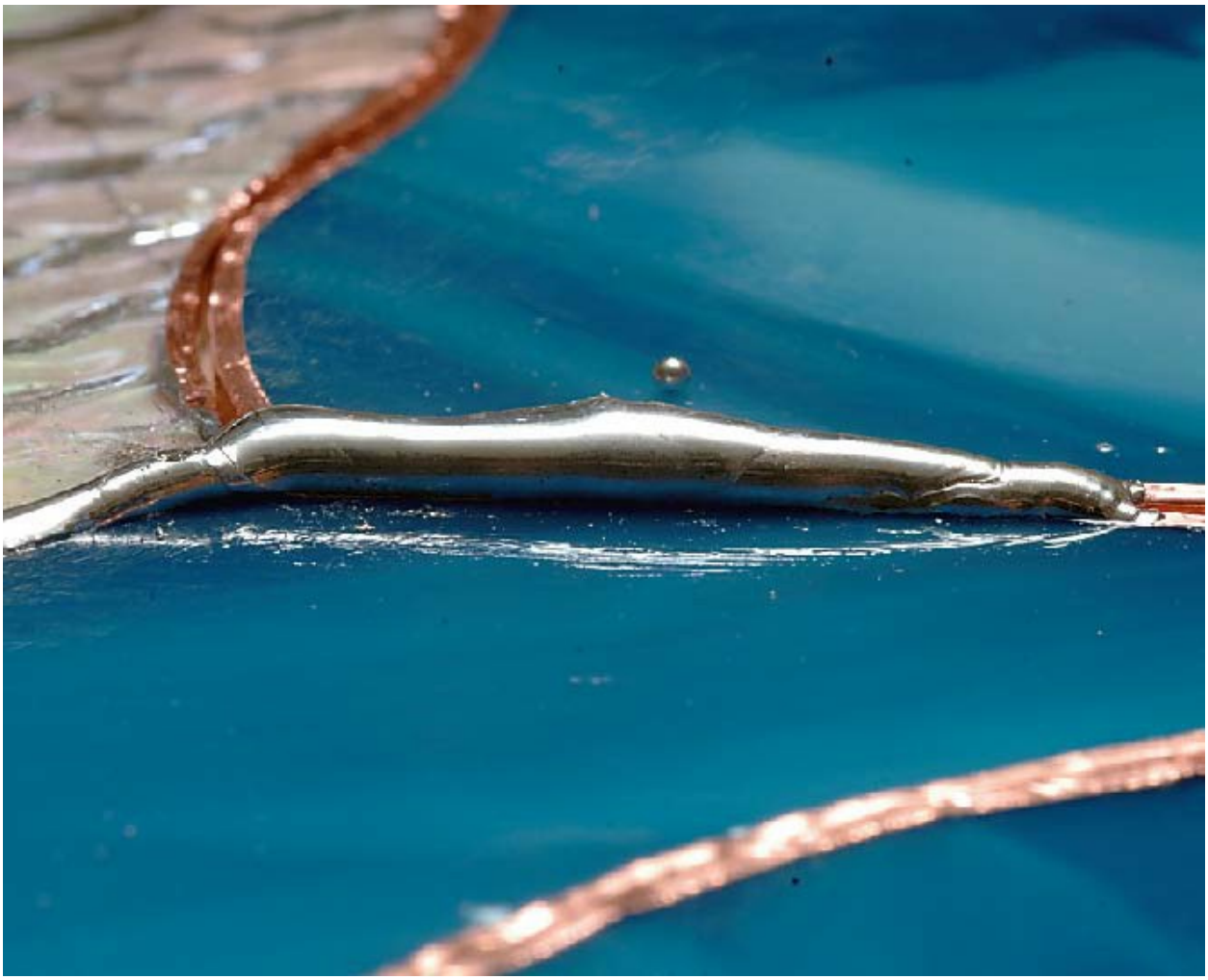
2. Move steadily along all the seams, laying down a smooth line of solder as you go.



3. Go over the tacked corners, covering them with a smooth line.

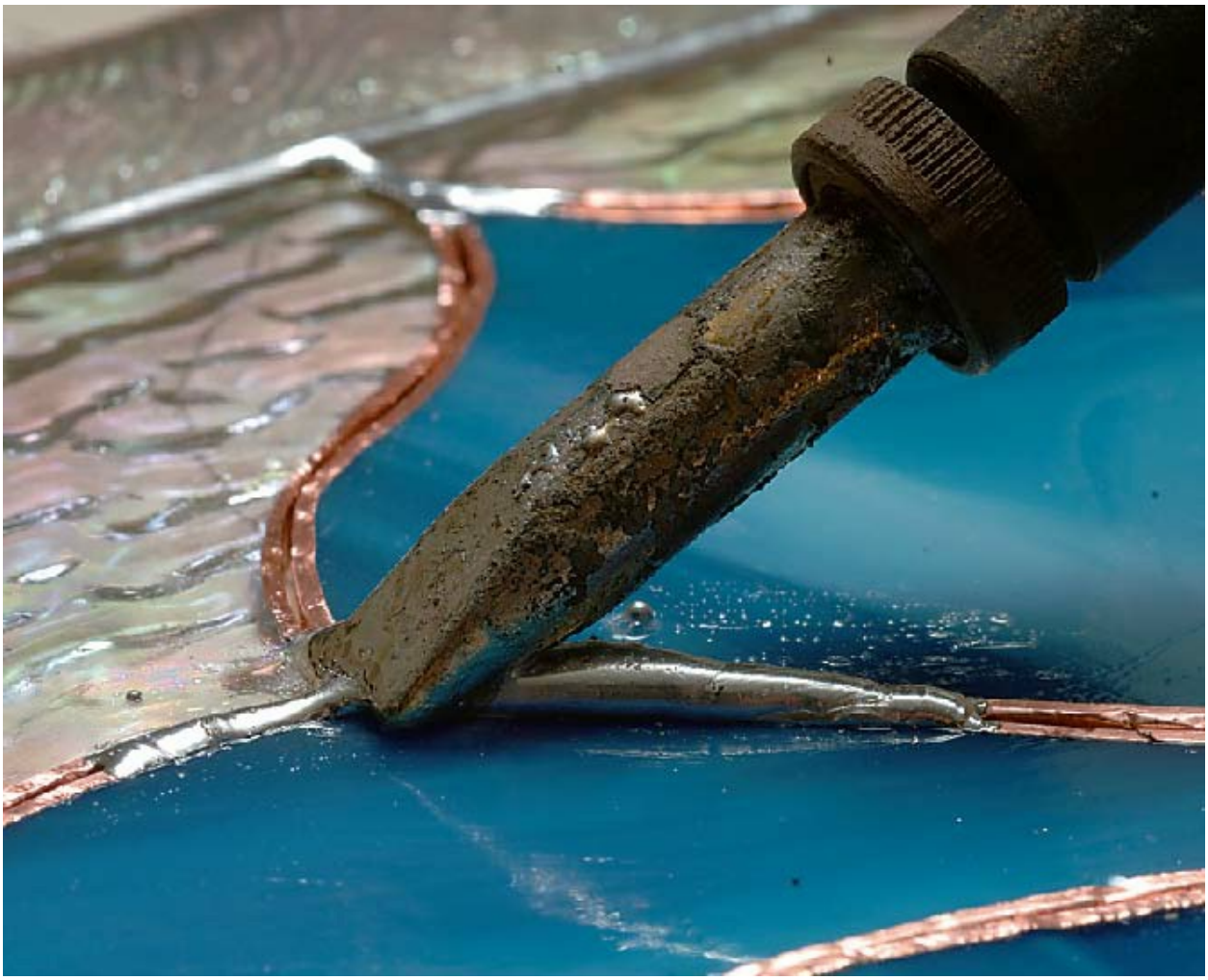


4. Occasionally, you'll get too much solder on a seam, as shown here.

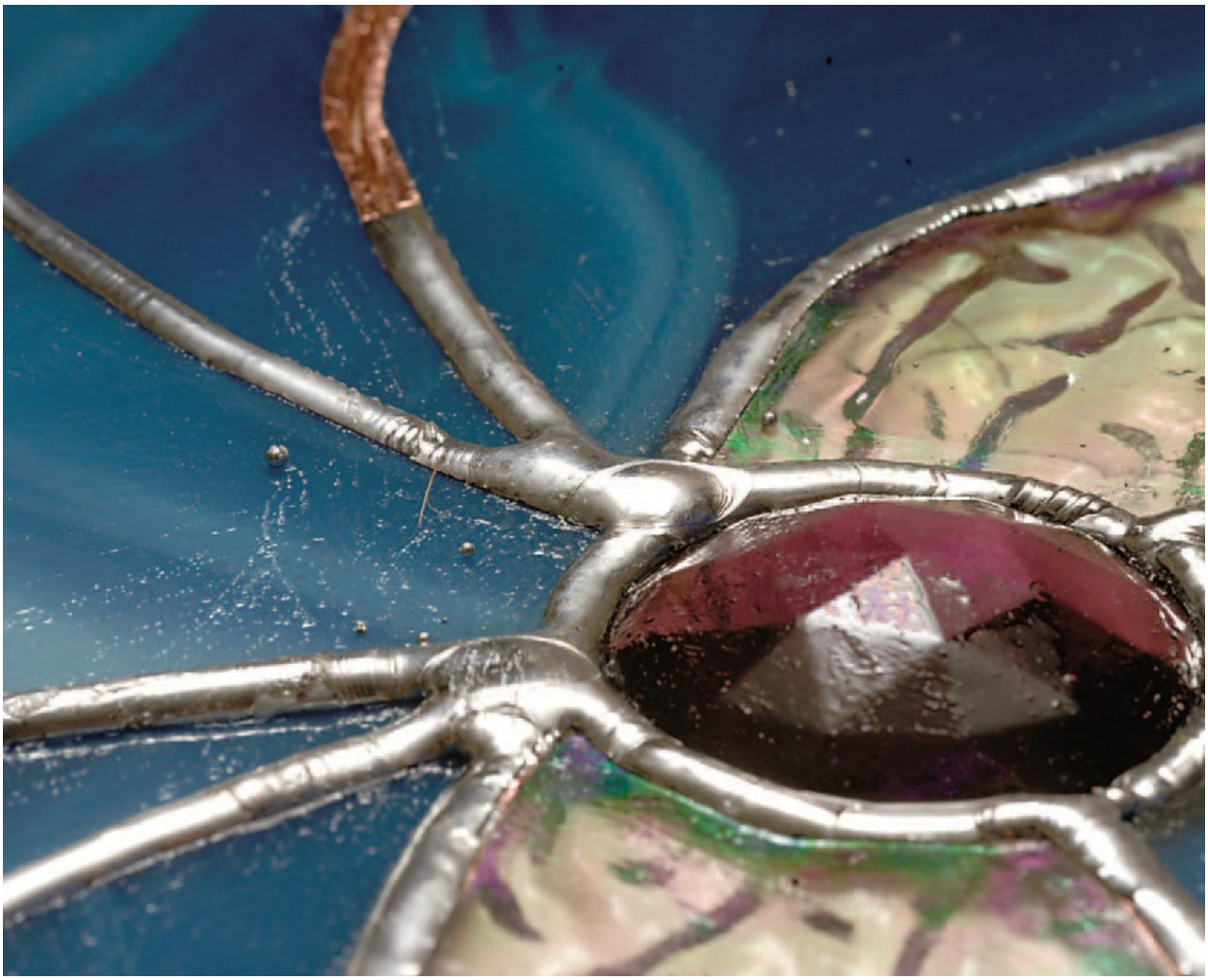


5. If you do, simply brush the excess solder with flux.

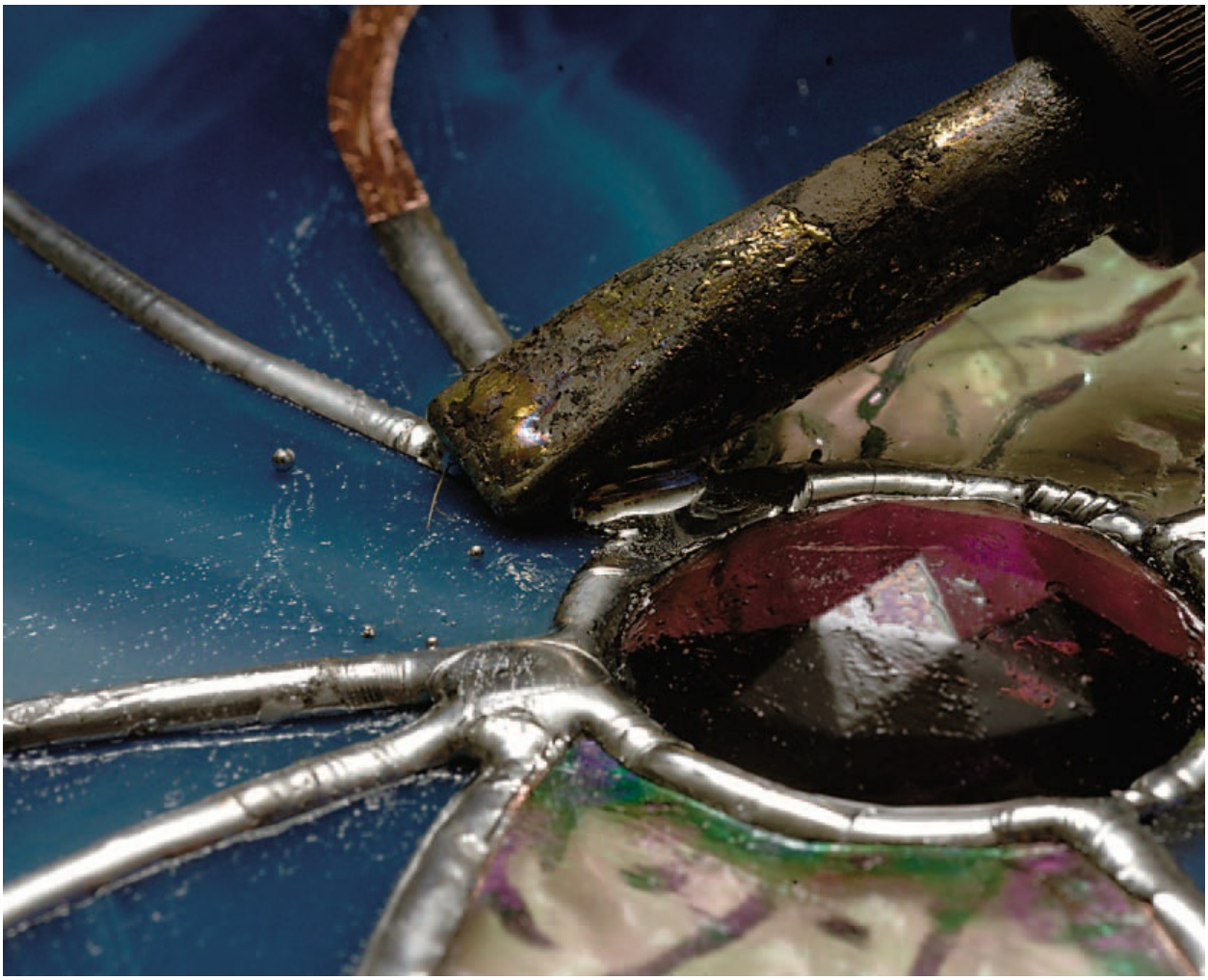
6. Run over the seam with the soldering iron so it flows evenly.

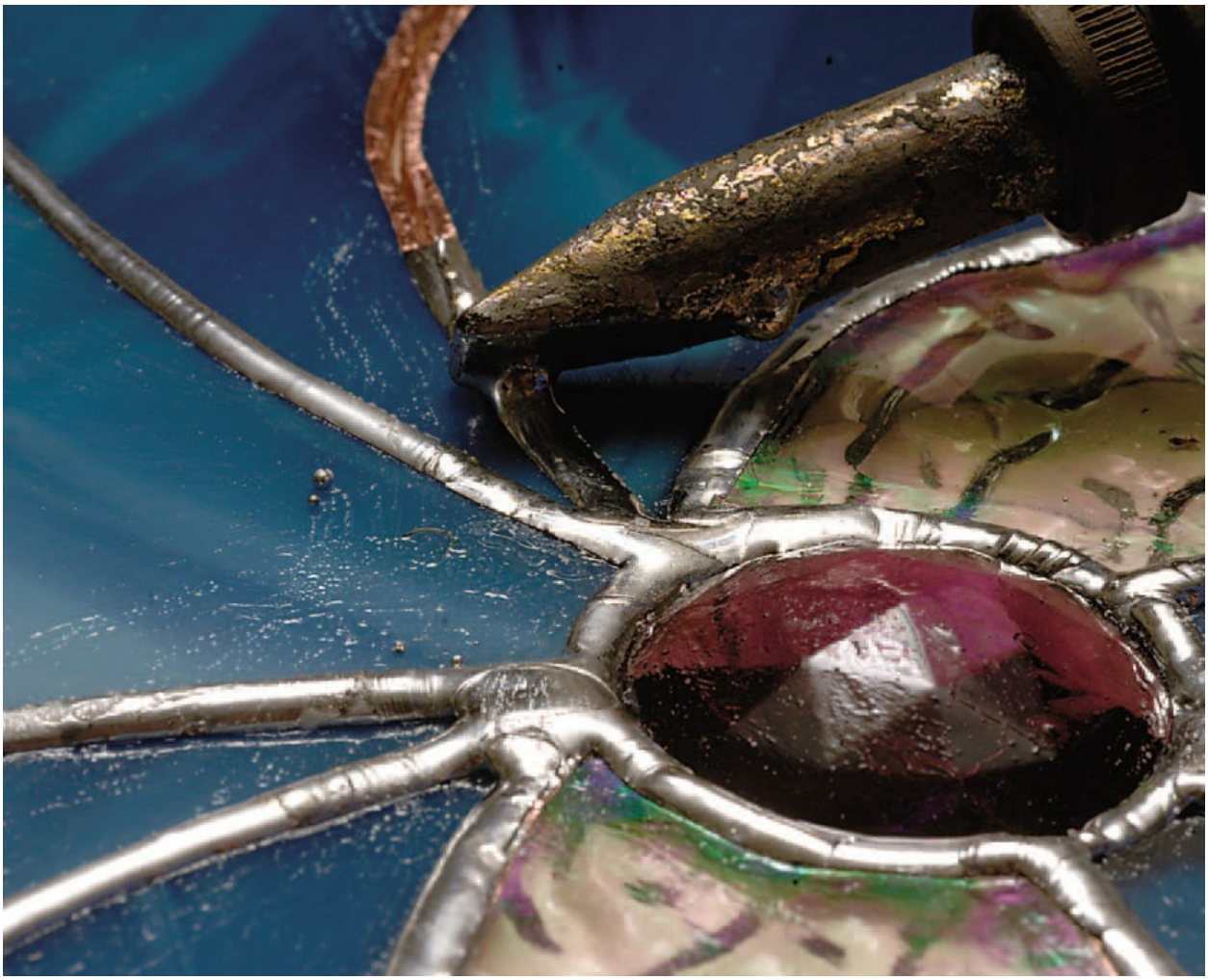


A buildup of excess solder at the corners where several pieces of glass meet is common.



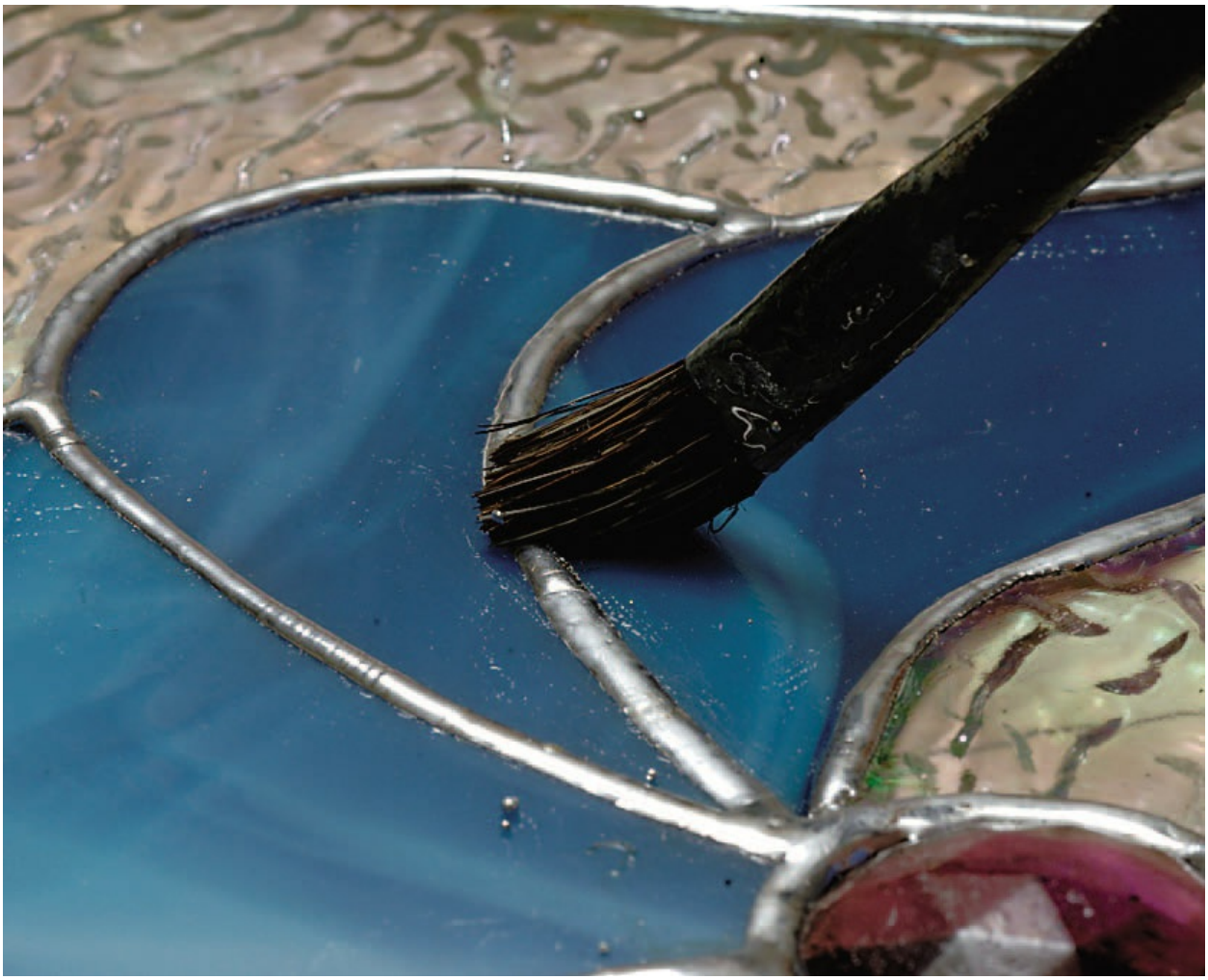
7. Flux and solder the buildup, running the iron from the buildup to an unsoldered seam in order to eliminate the excess.

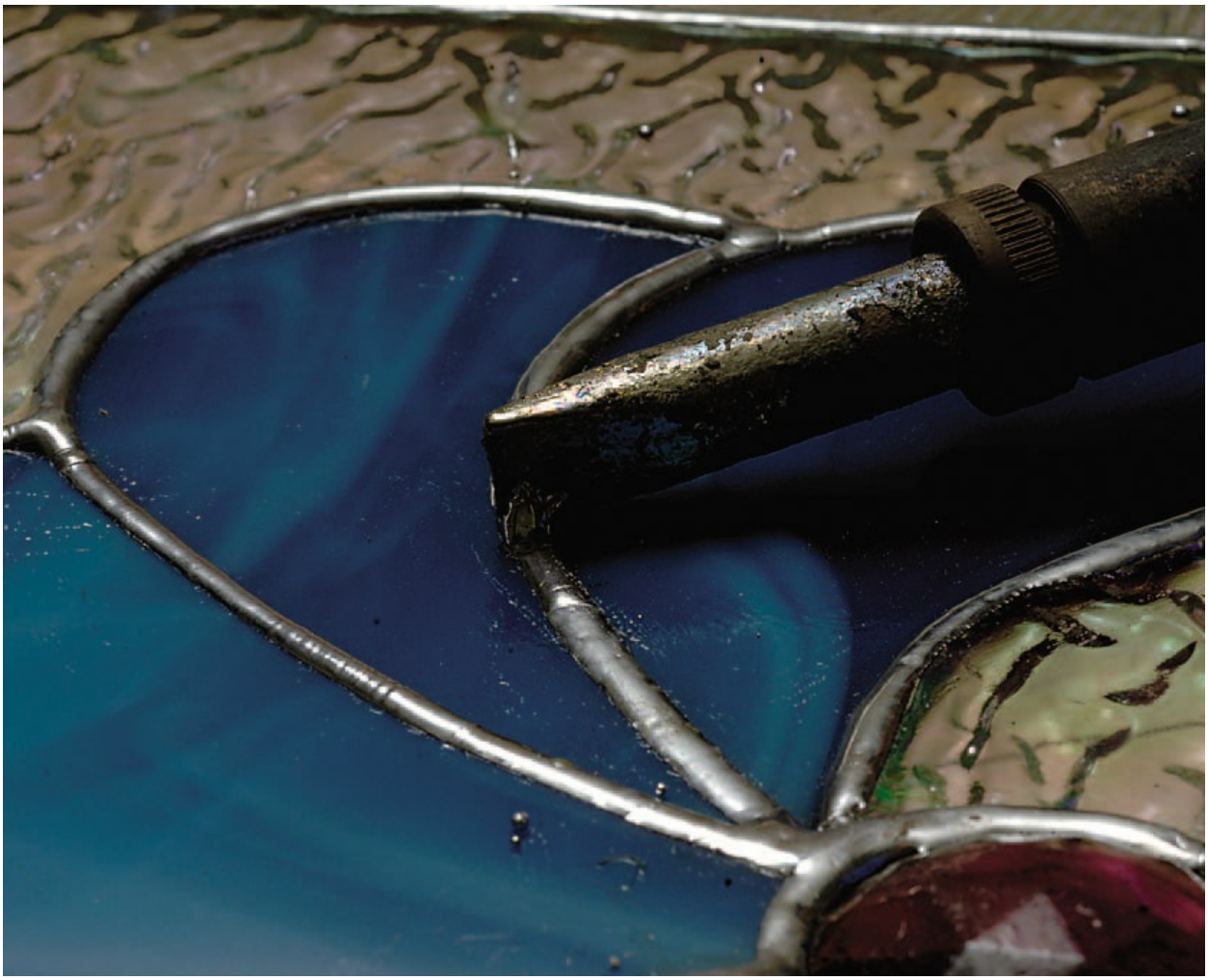


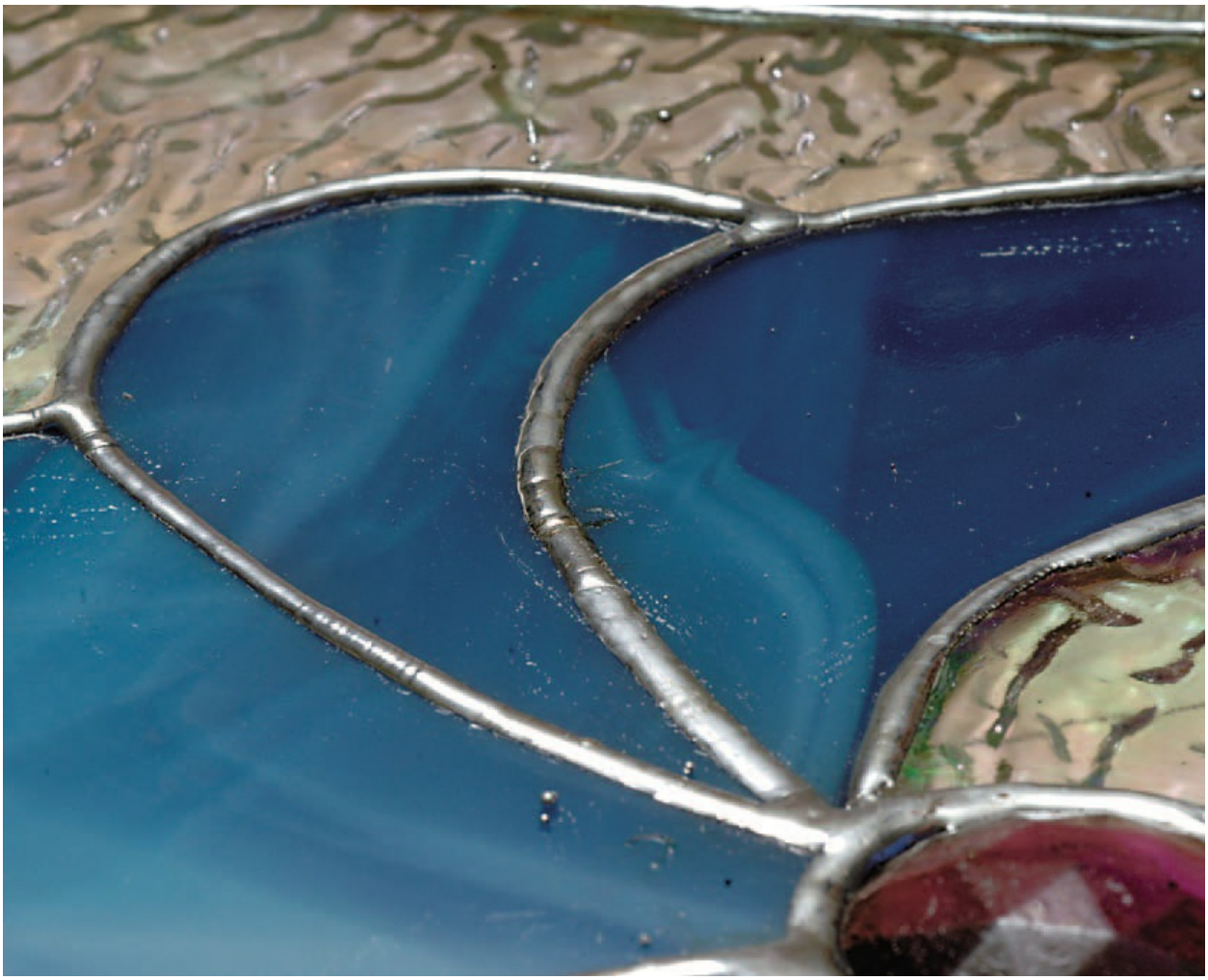


8. When you finish soldering, run a finger along all the seams, feeling for bumps.

9. To eliminate a bump, flux it and then touch it with the iron until it's gone.



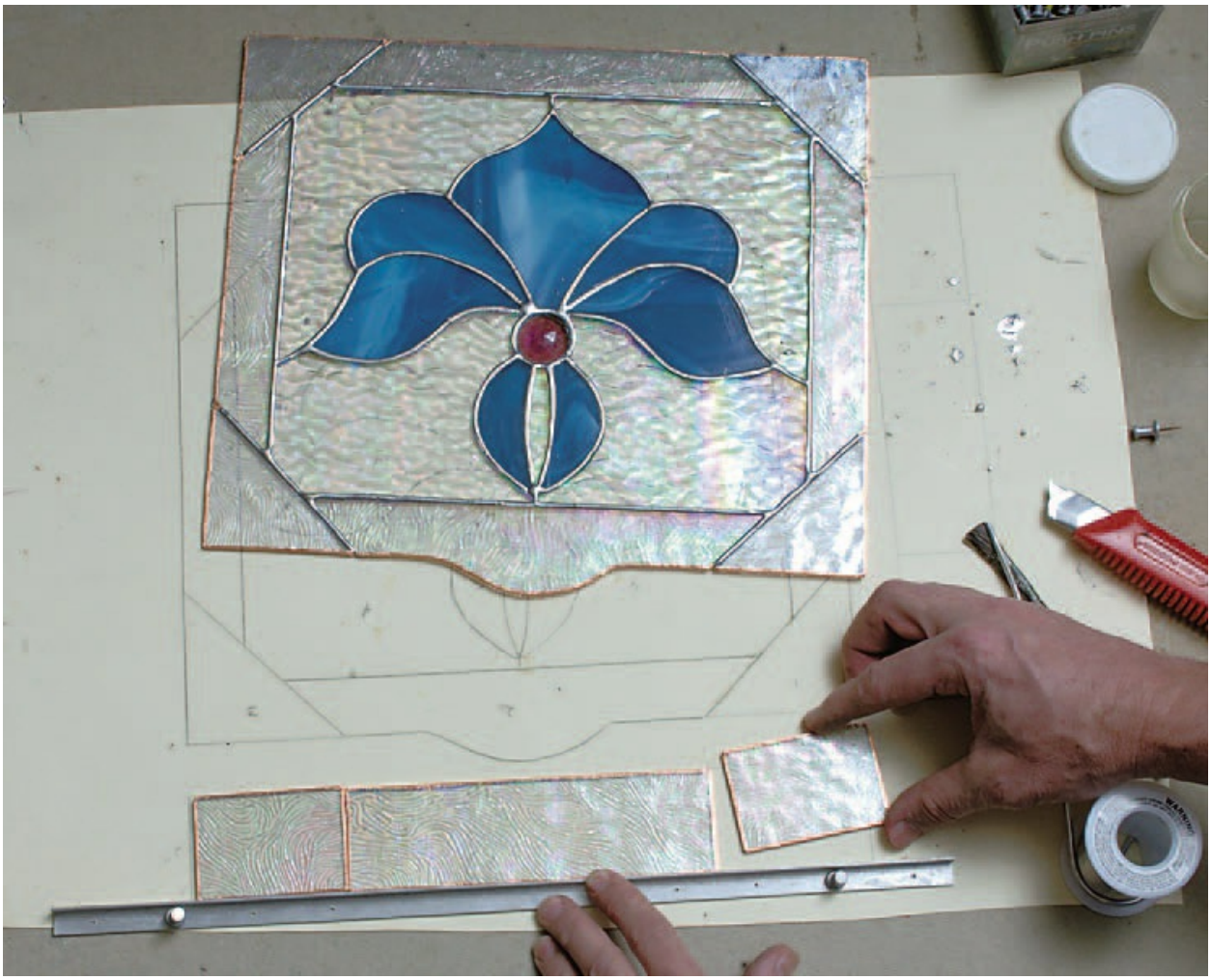




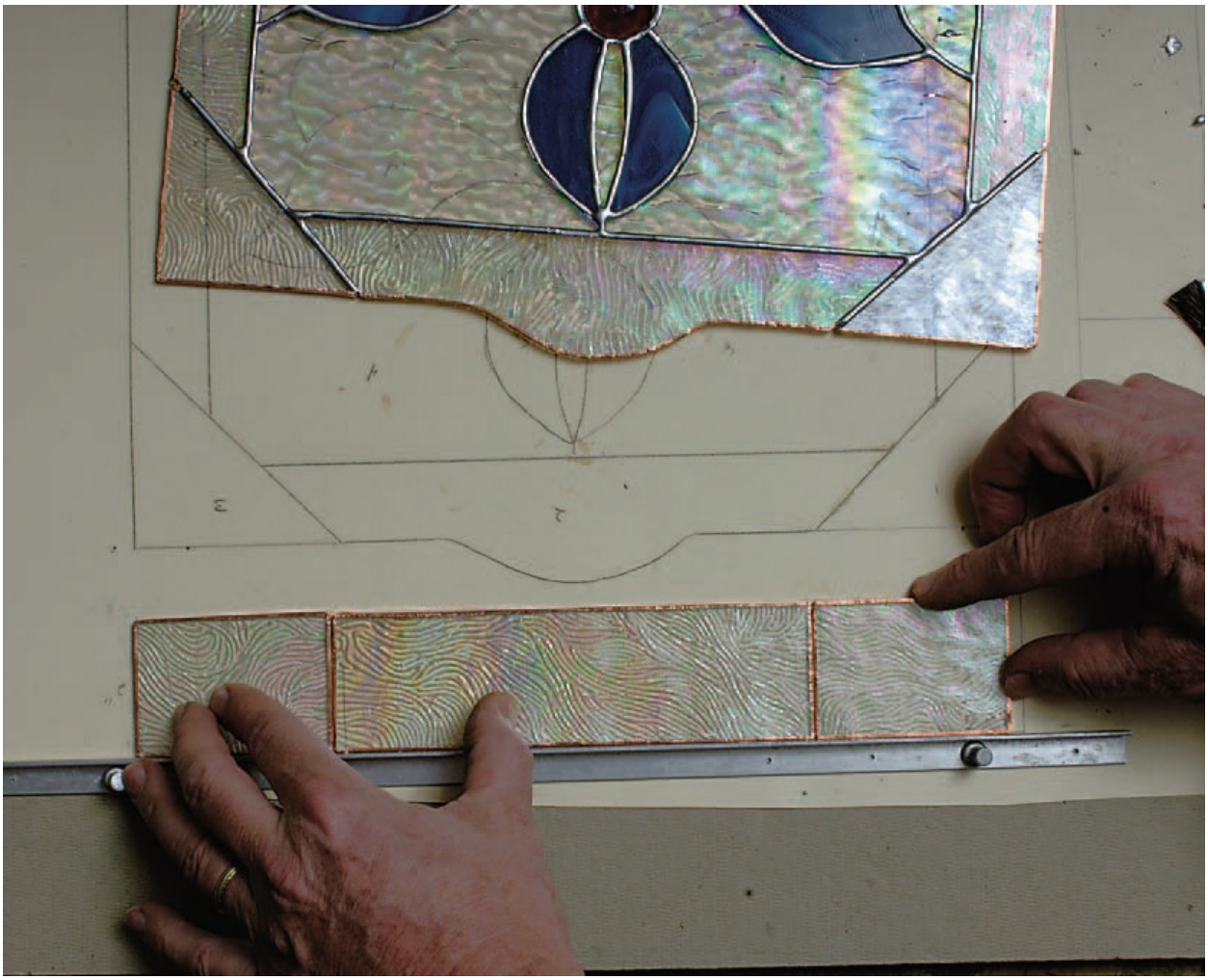
10. Remove hardened drops of solder on the glass with a fingernail or the end of the flux brush. Be careful not to scratch the glass.

11 The box lid is now completely soldered and all bumps and drops have been eliminated.

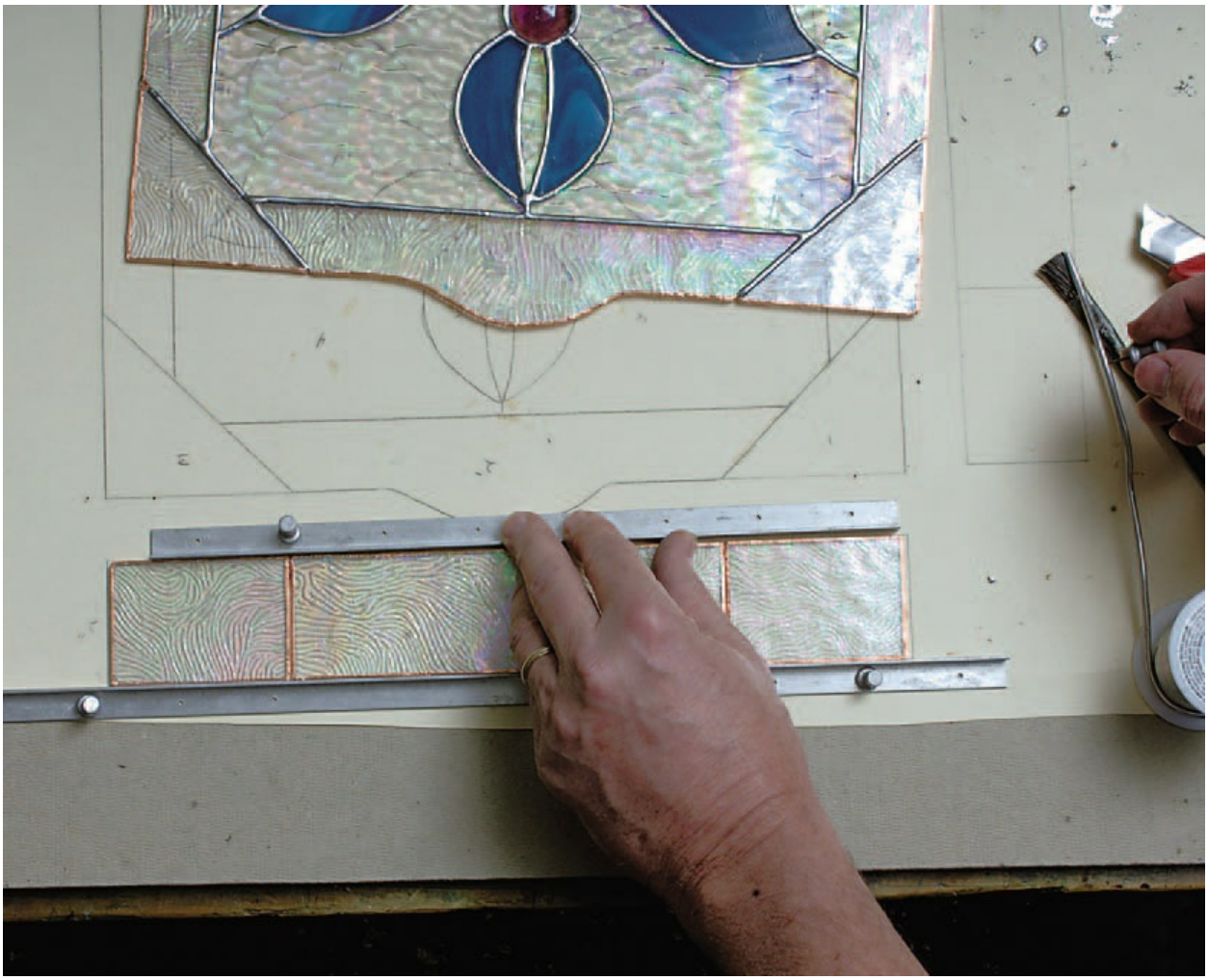
The next step is to assemble the four sides of the box.



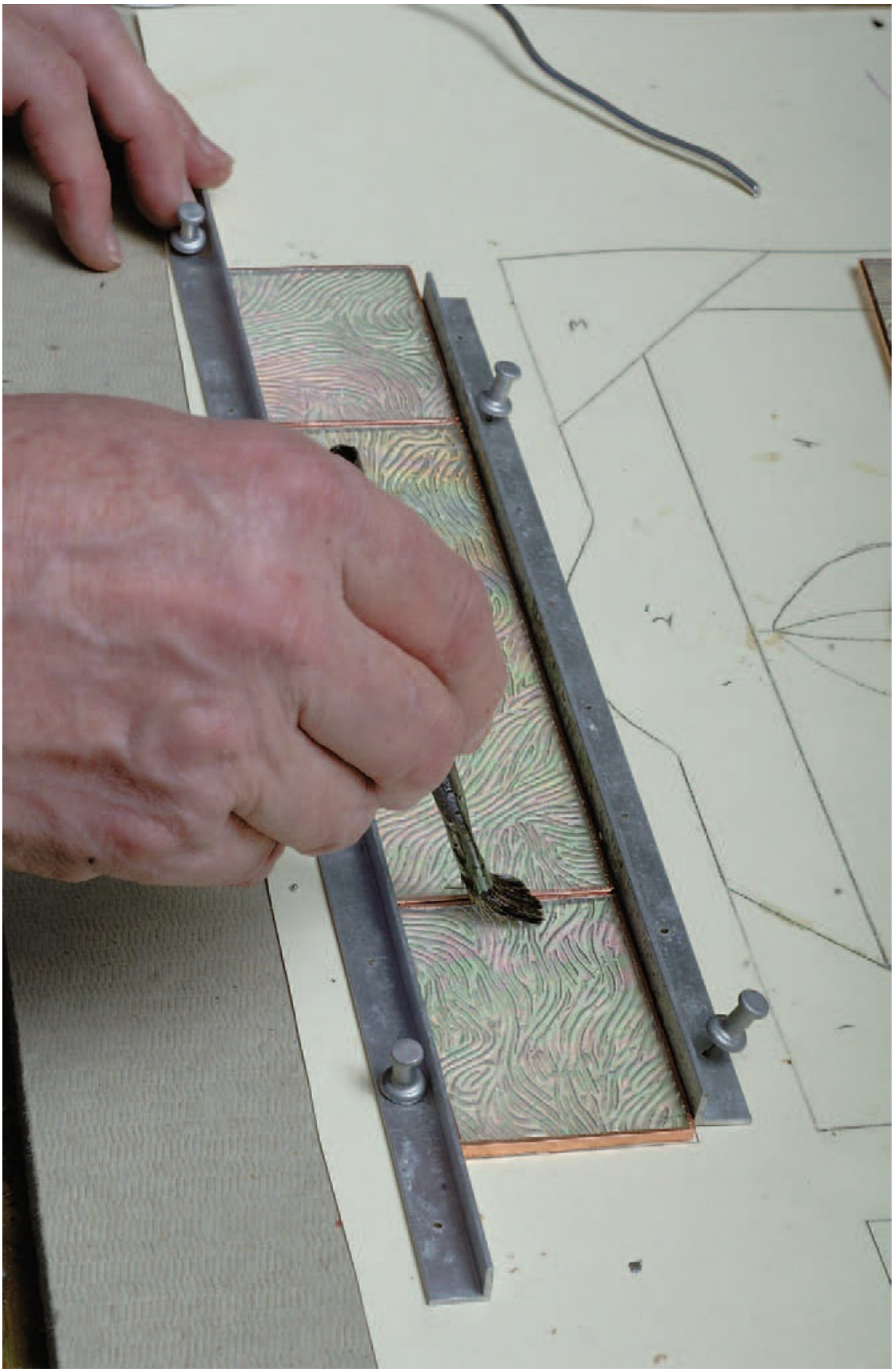
Each side consists of three pieces of glass, which are foiled.



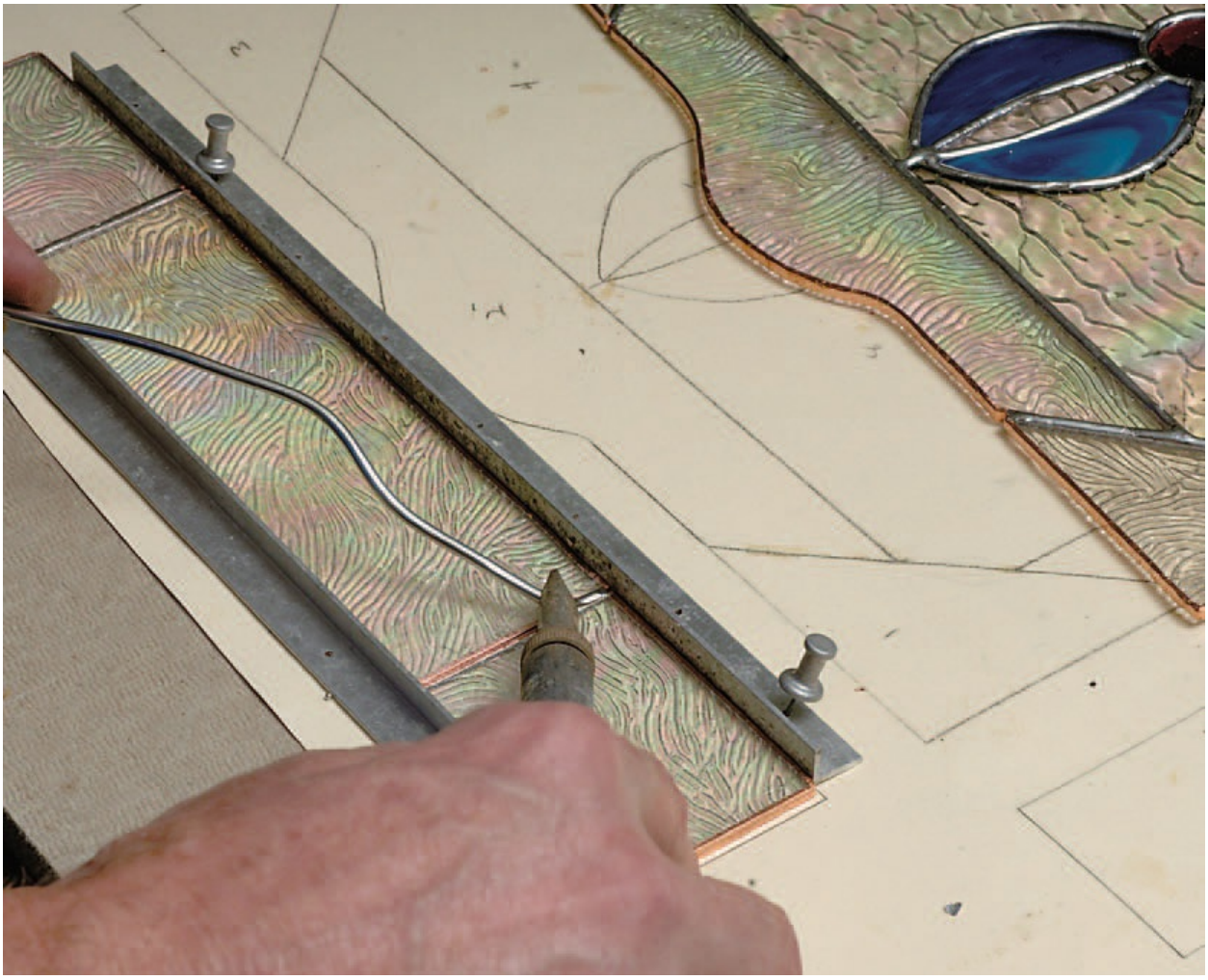
12. Place the pieces of one end on the pattern and pin them into place.



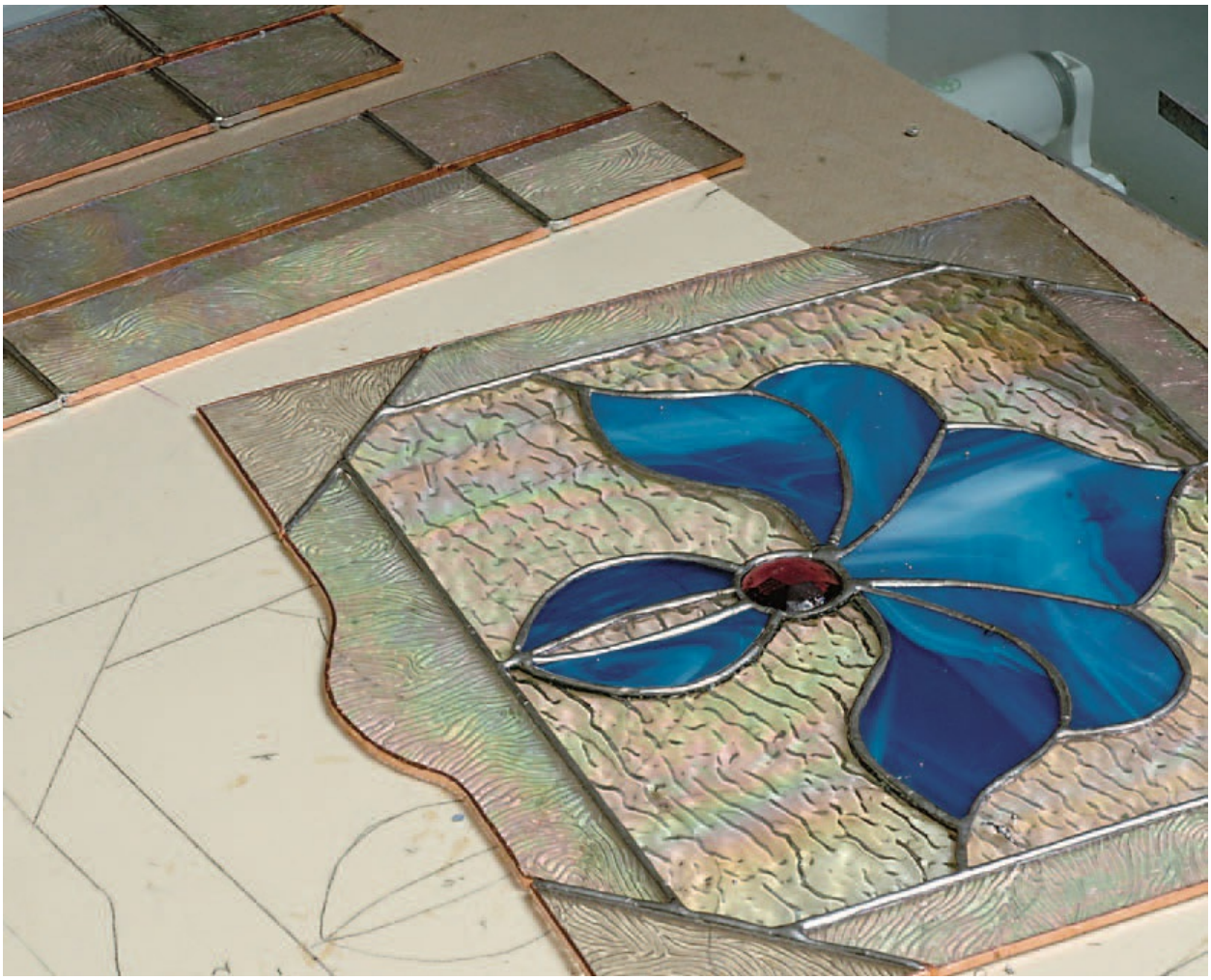
13. Flux the two interior seams.



14. Solder the seams with 60/40 solder.



15. Assemble and solder the other three sides the same way.

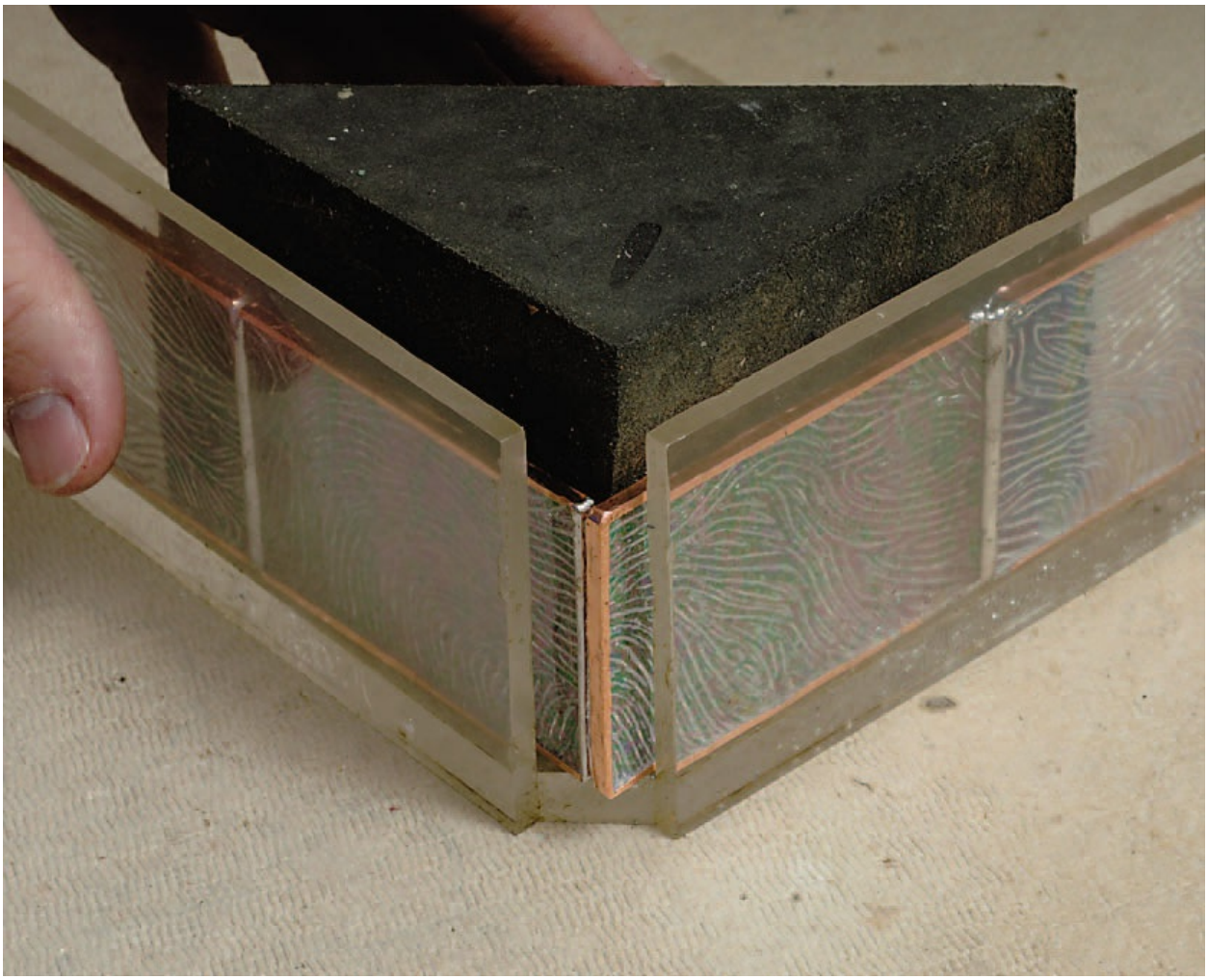


When the sides of the box are positioned, with the front panel overlapping the side panel, notice that the foiled edge of the side panel is visible behind the glass of the front panel. This edge needs to be tinned before the corners are permanently joined together.

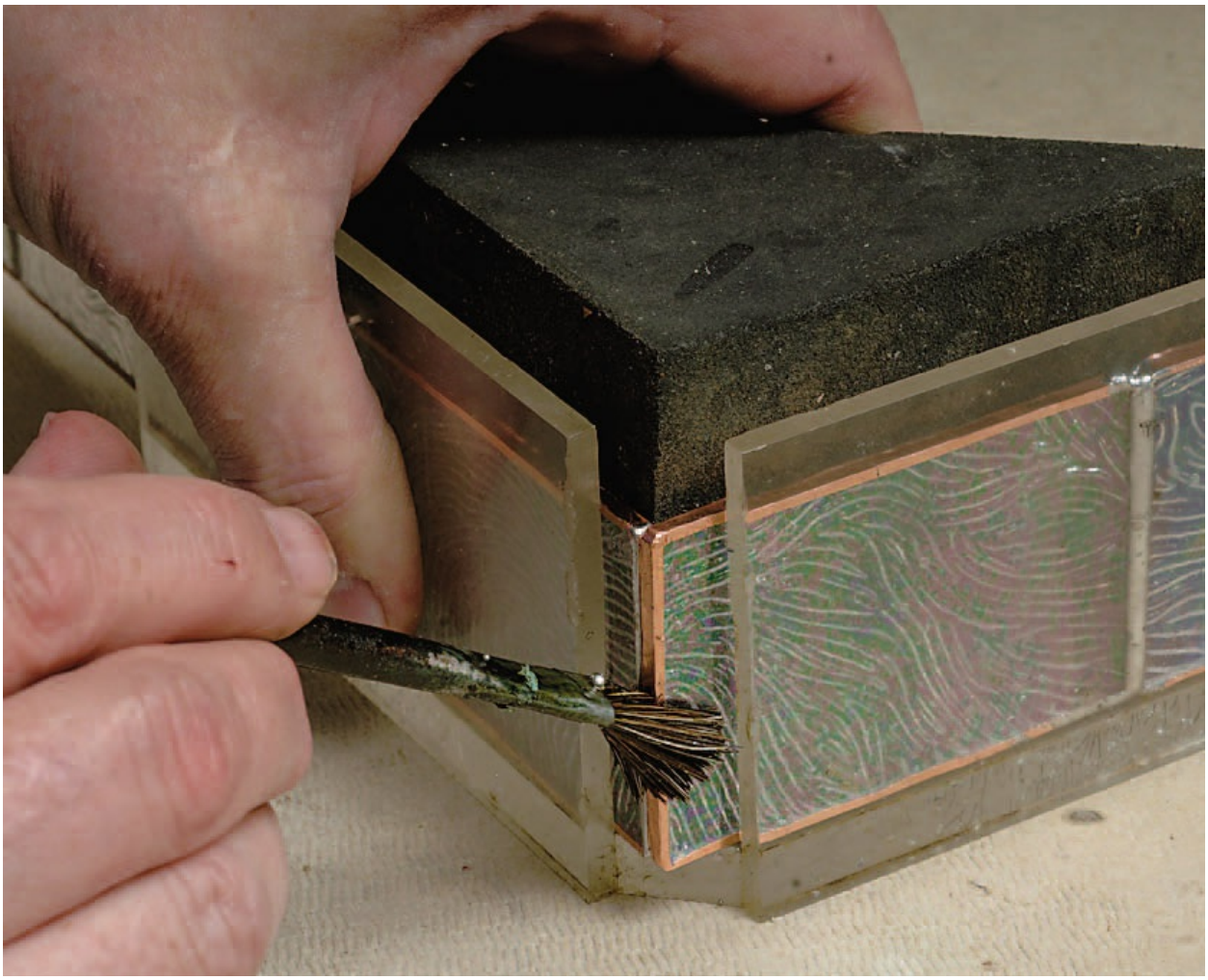
16. Flux the two outside edges of the side panel pieces. Get some solder on the tip of the iron.

17. Coat the edge with the solder. Now when the corner is assembled, the copper foil won't show through the glass.

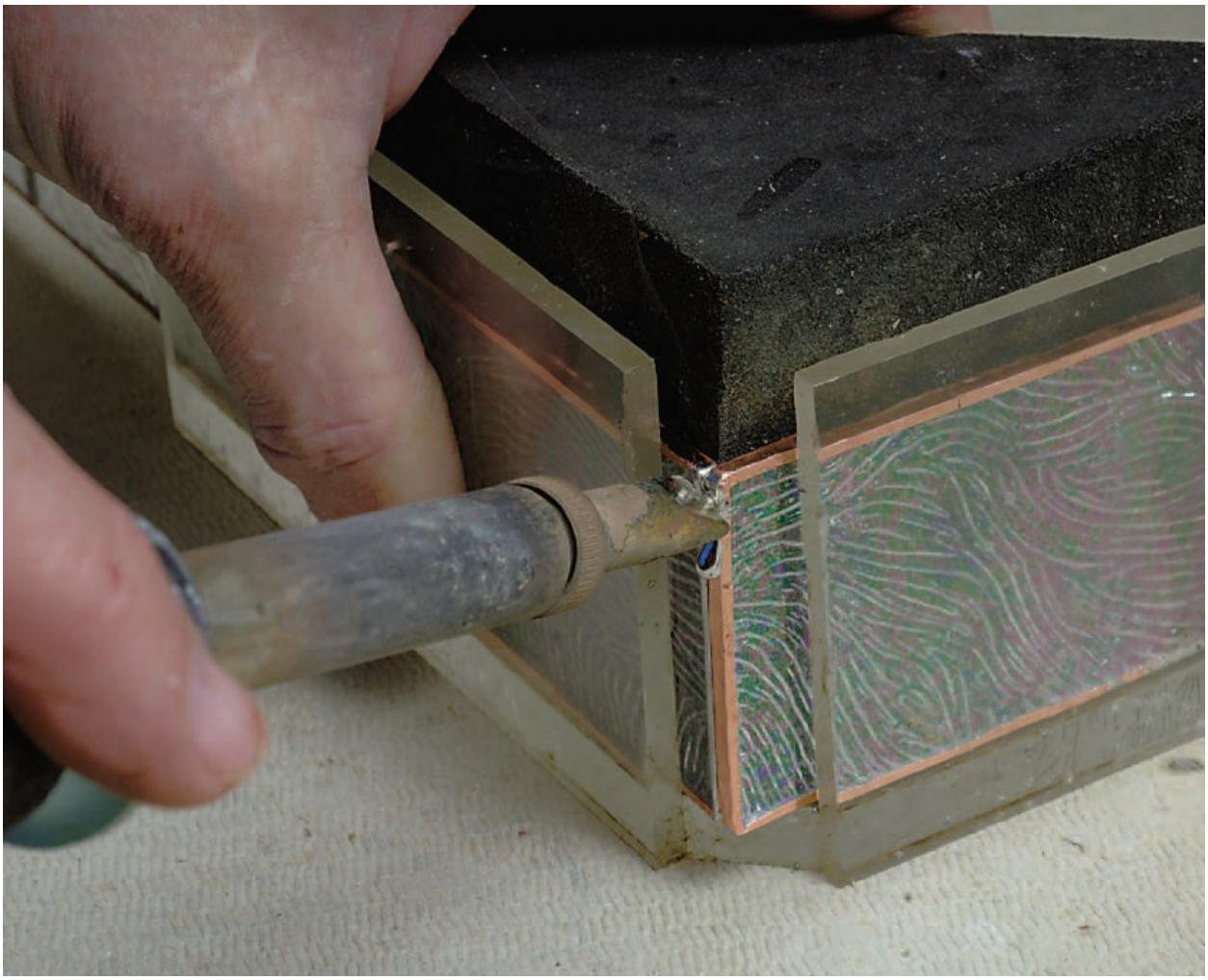
18. Professional Boxer braces and Wedgies are used to hold the two sides of the box in position as the corner is soldered. Notice that the front panel overlaps the side panel.

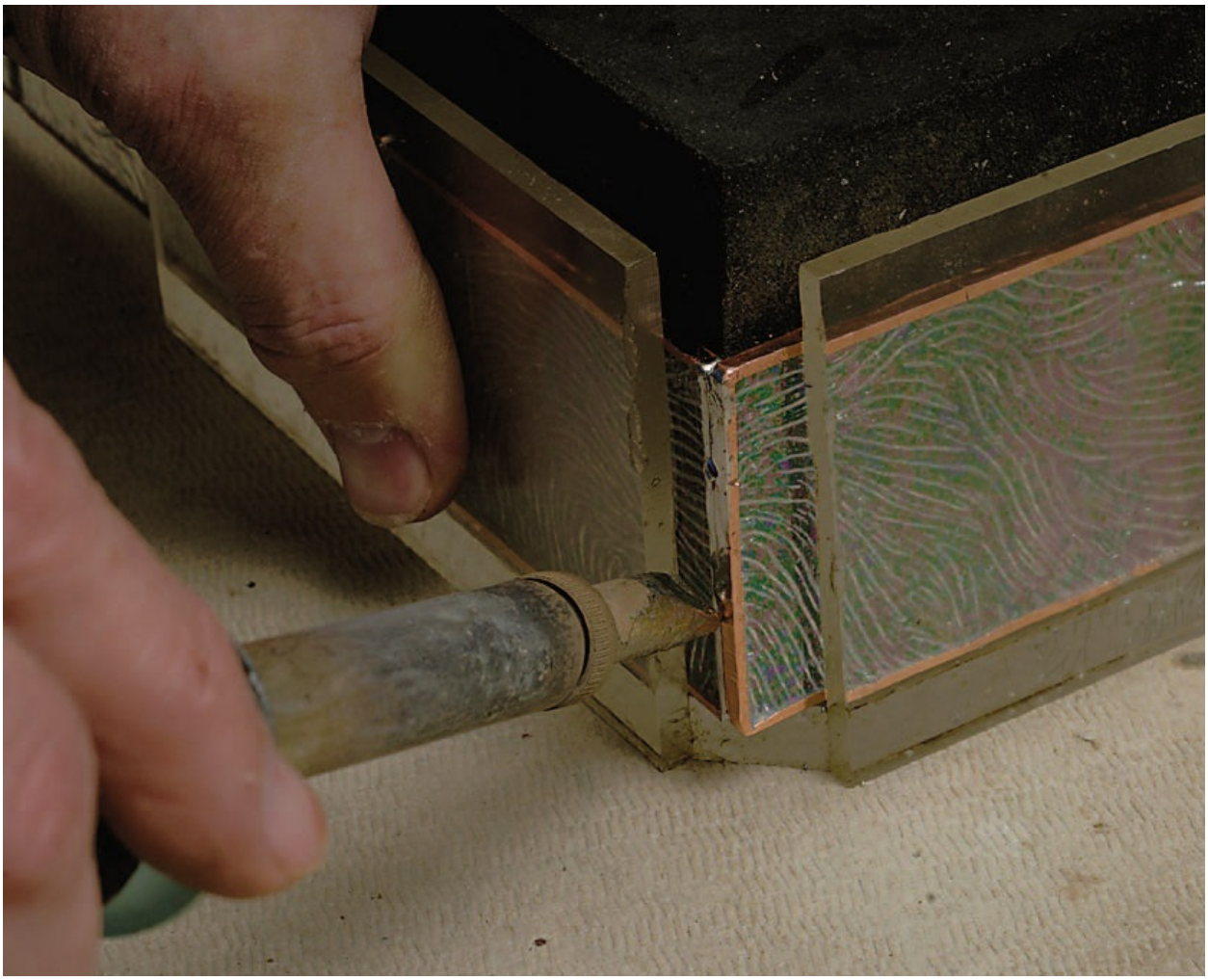


19. Flux the corner.

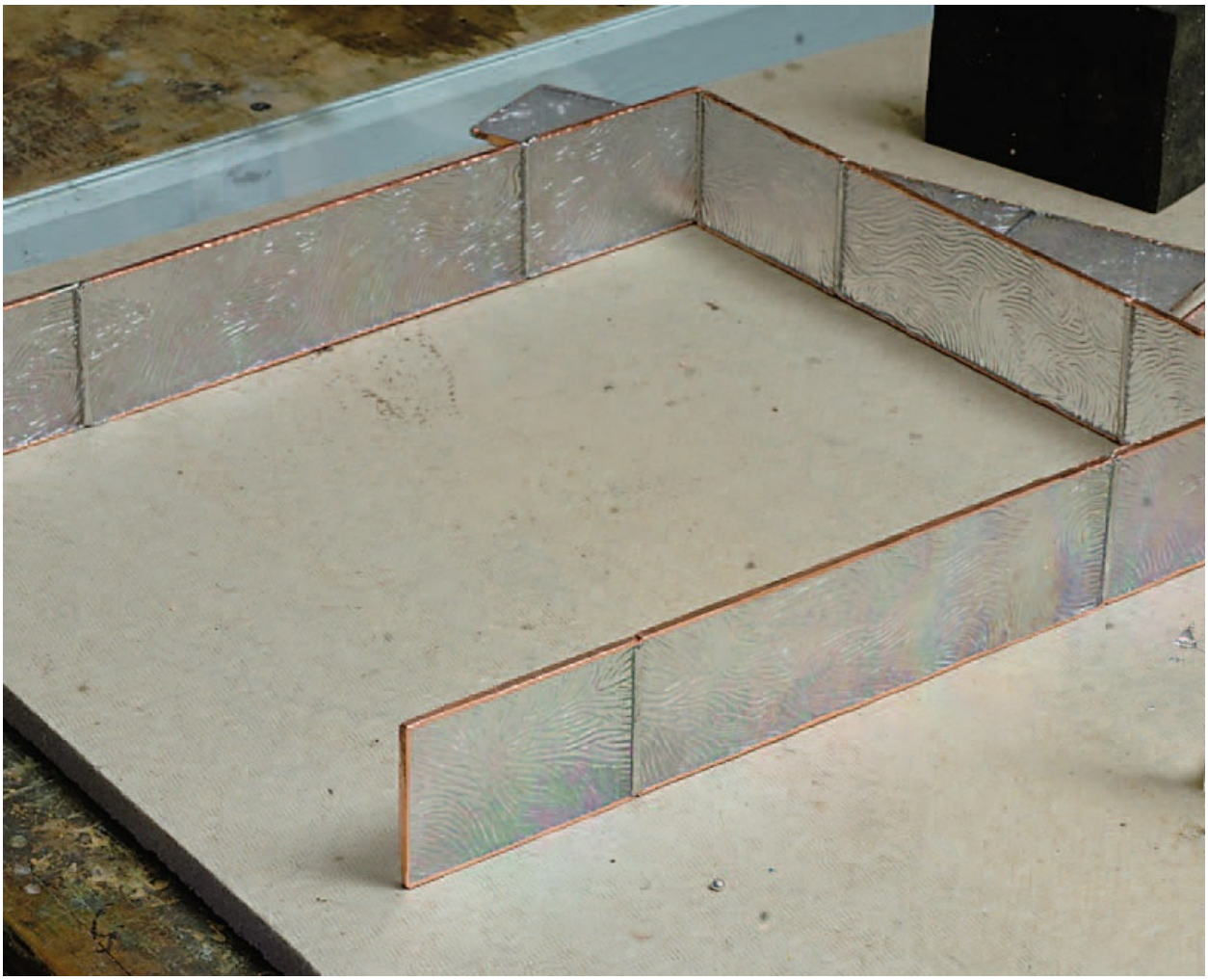


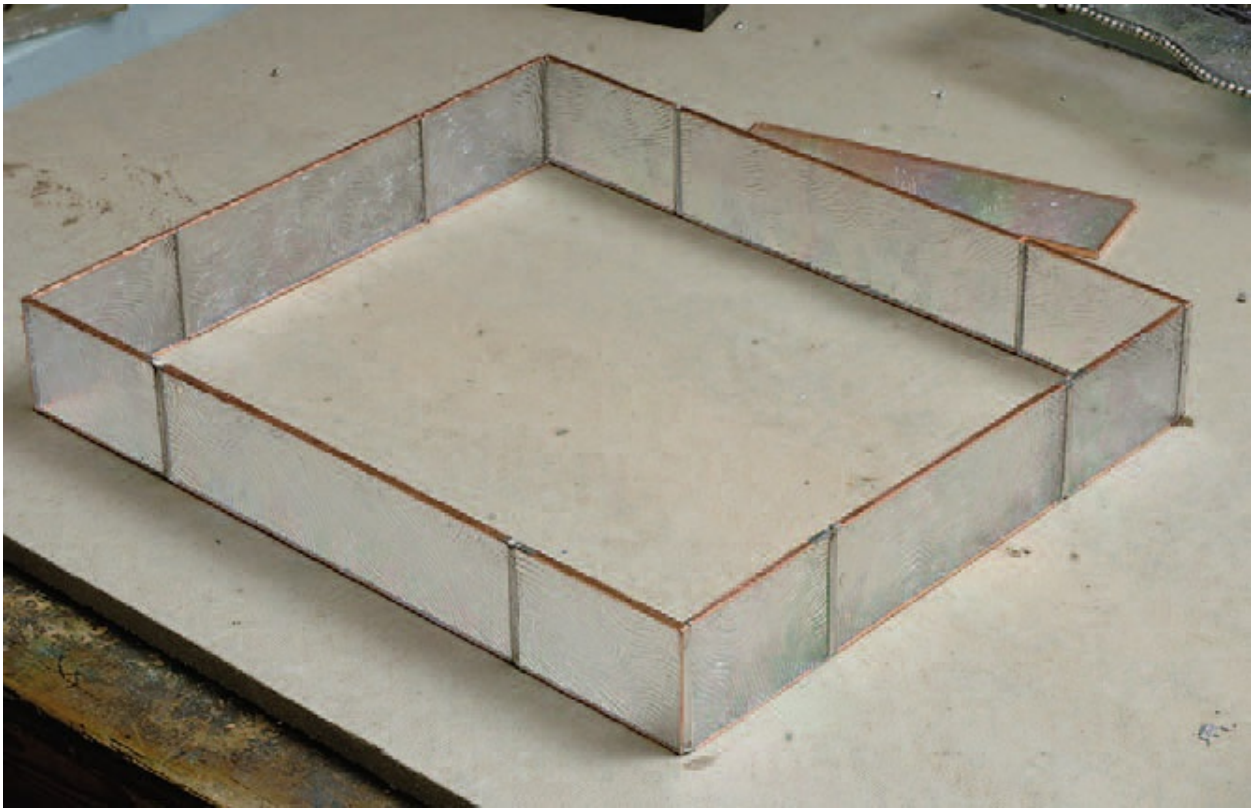
20. Solder it together.





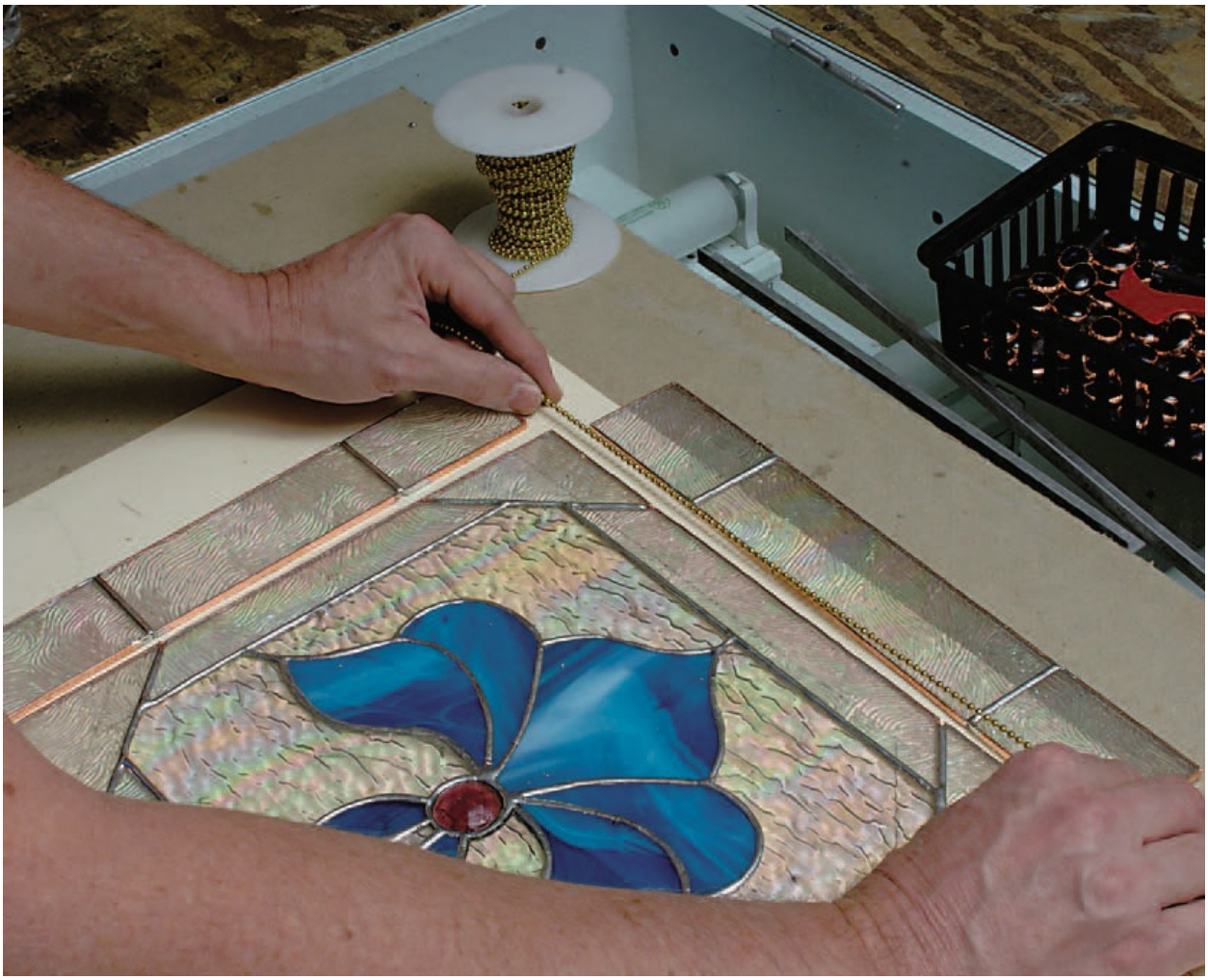
21. Do the other corners the same way.





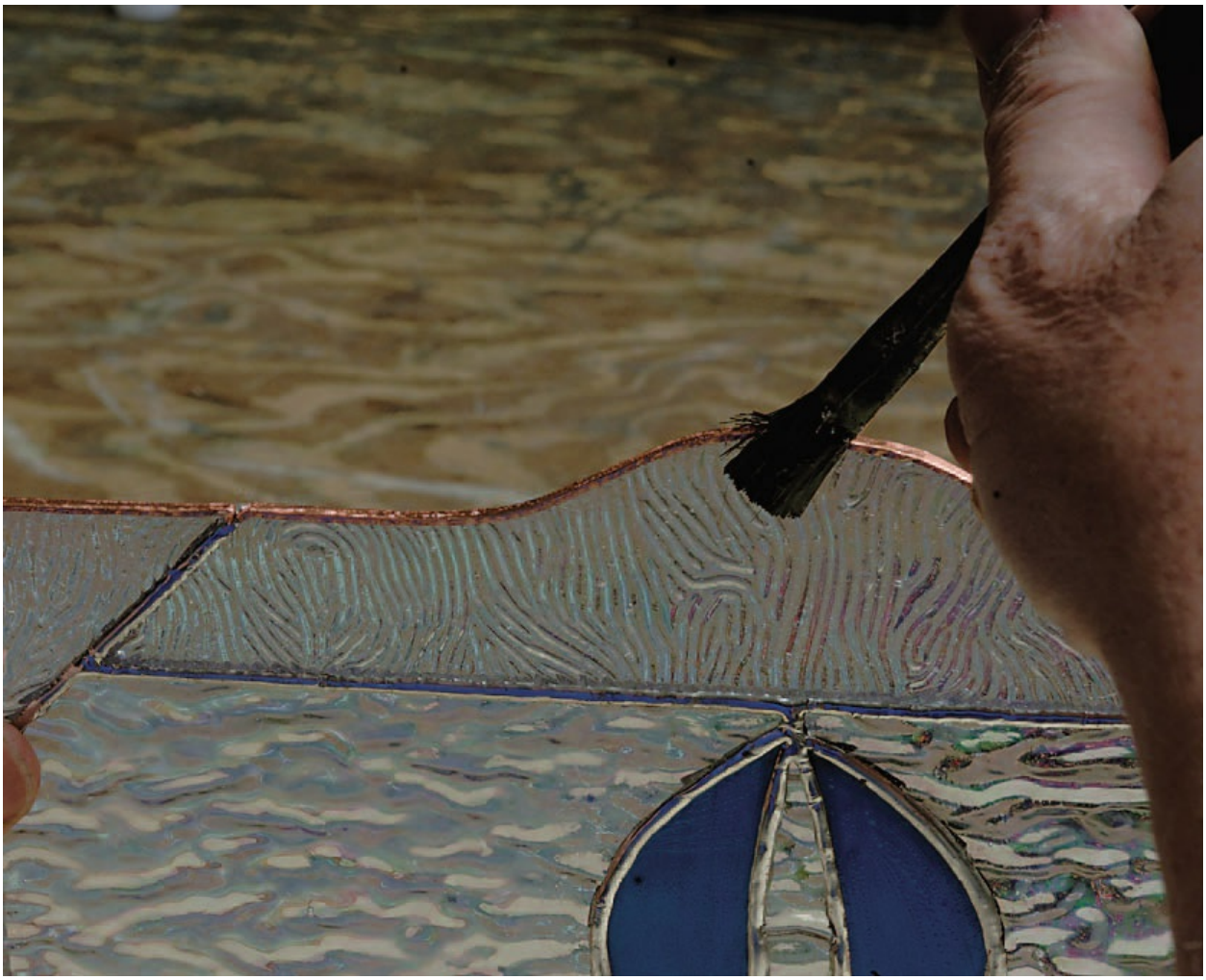
22. To dress up the edge of the box lid, solder a strand of ball chain to the perimeter. Estimate how much chain you'll need by running a length along the short edge and then doubling it.

23. Run a length along the long edge and then double it.



24. Add 3 or 4 extra inches to be certain the chain will go all the way around the lid (for this project, about 50 inches is used) and then trim the chain with wire cutters.

25. Flux the entire edge of the lid.



26. Make certain you cover the top and sides of the edge foil.

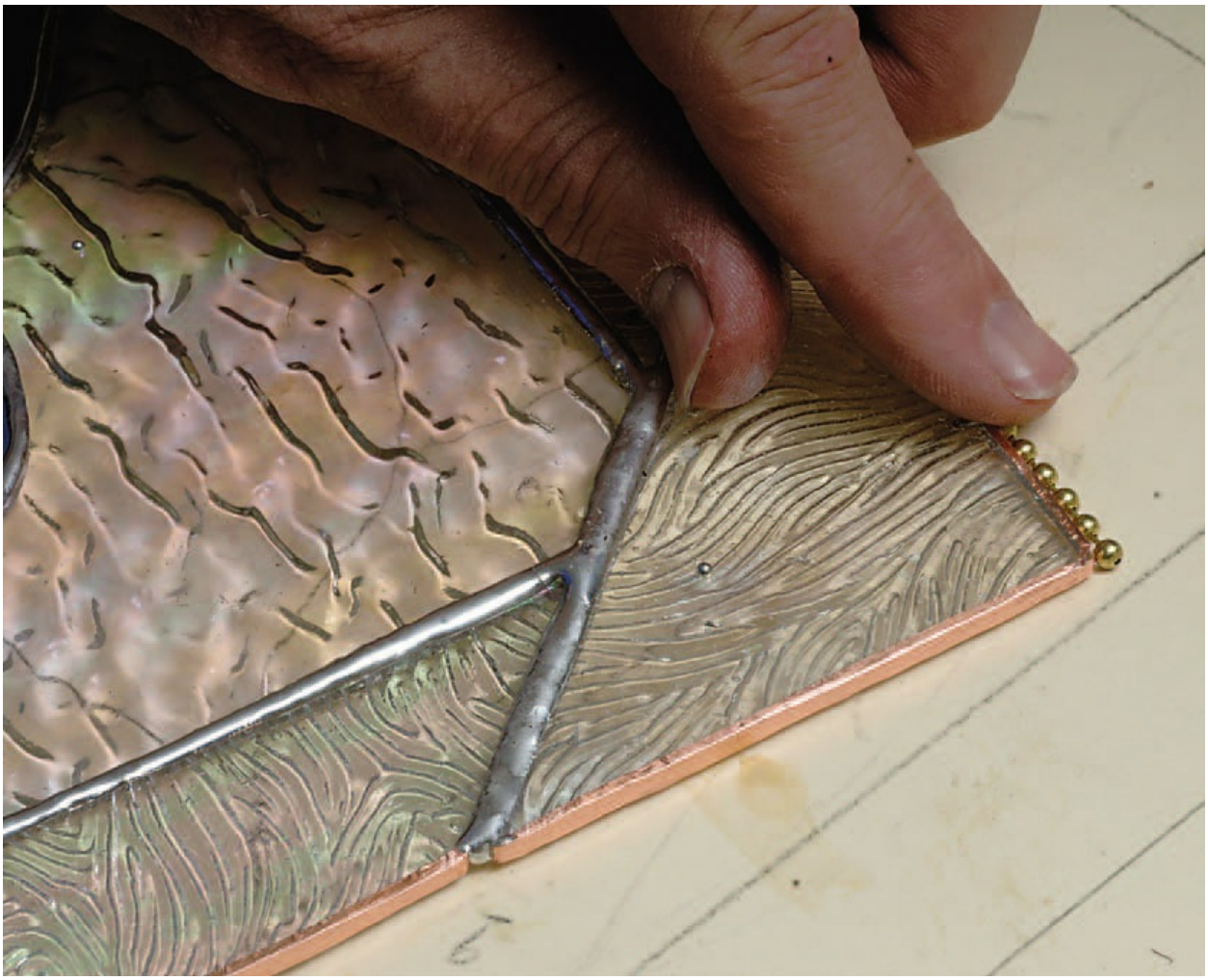
27. Flux the chain. Press one end of the chain to the work surface with a brush that's covered with flux.

28. Pull the chain through the brush until the chain is coated.

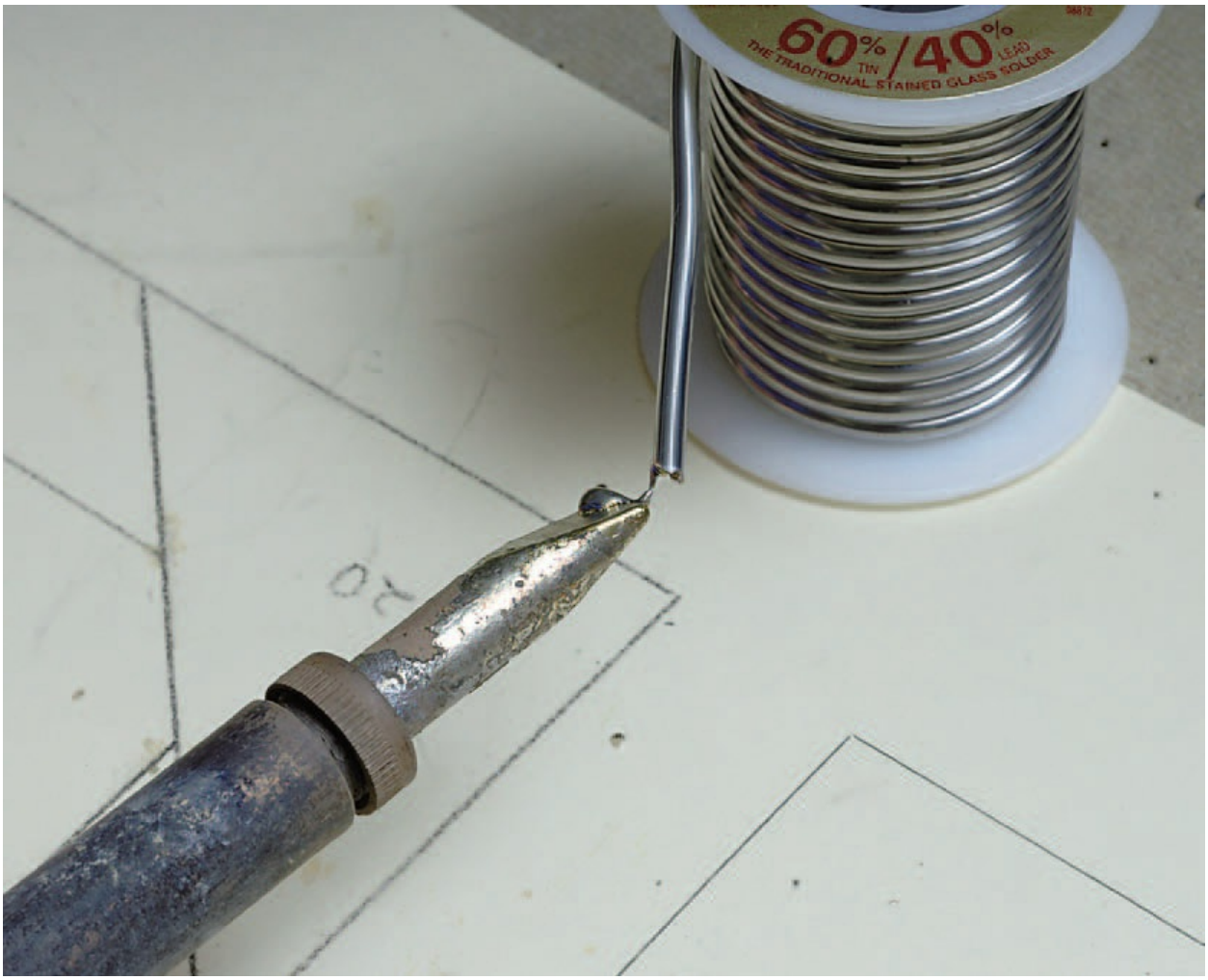
29. About halfway along the chain, you'll probably need to stop and get some more flux on the brush.

30. Finish fluxing the chain.

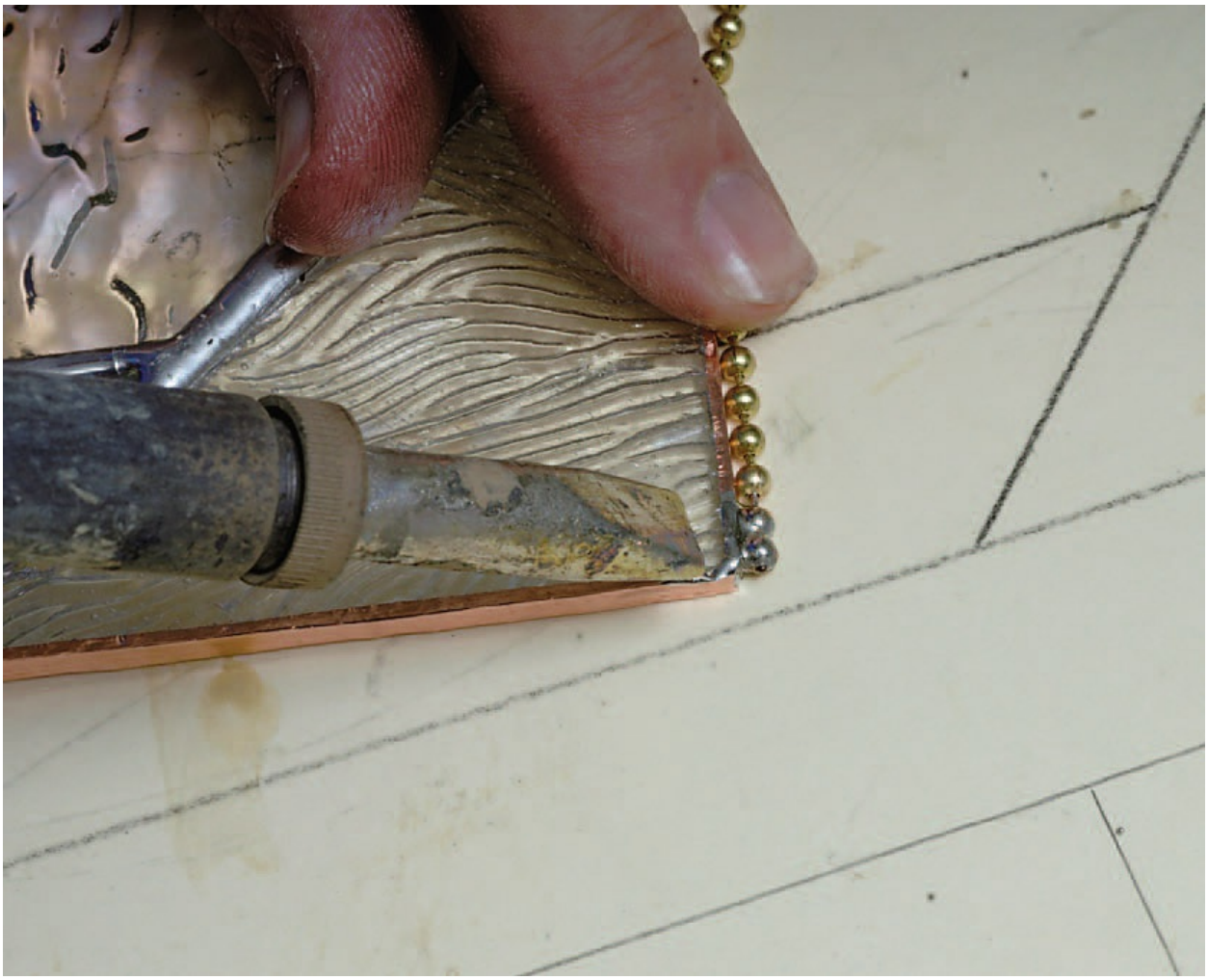
31. To solder the chain, lay it along one side of the lid so the very last ball is at one of the lid's corners, as shown.



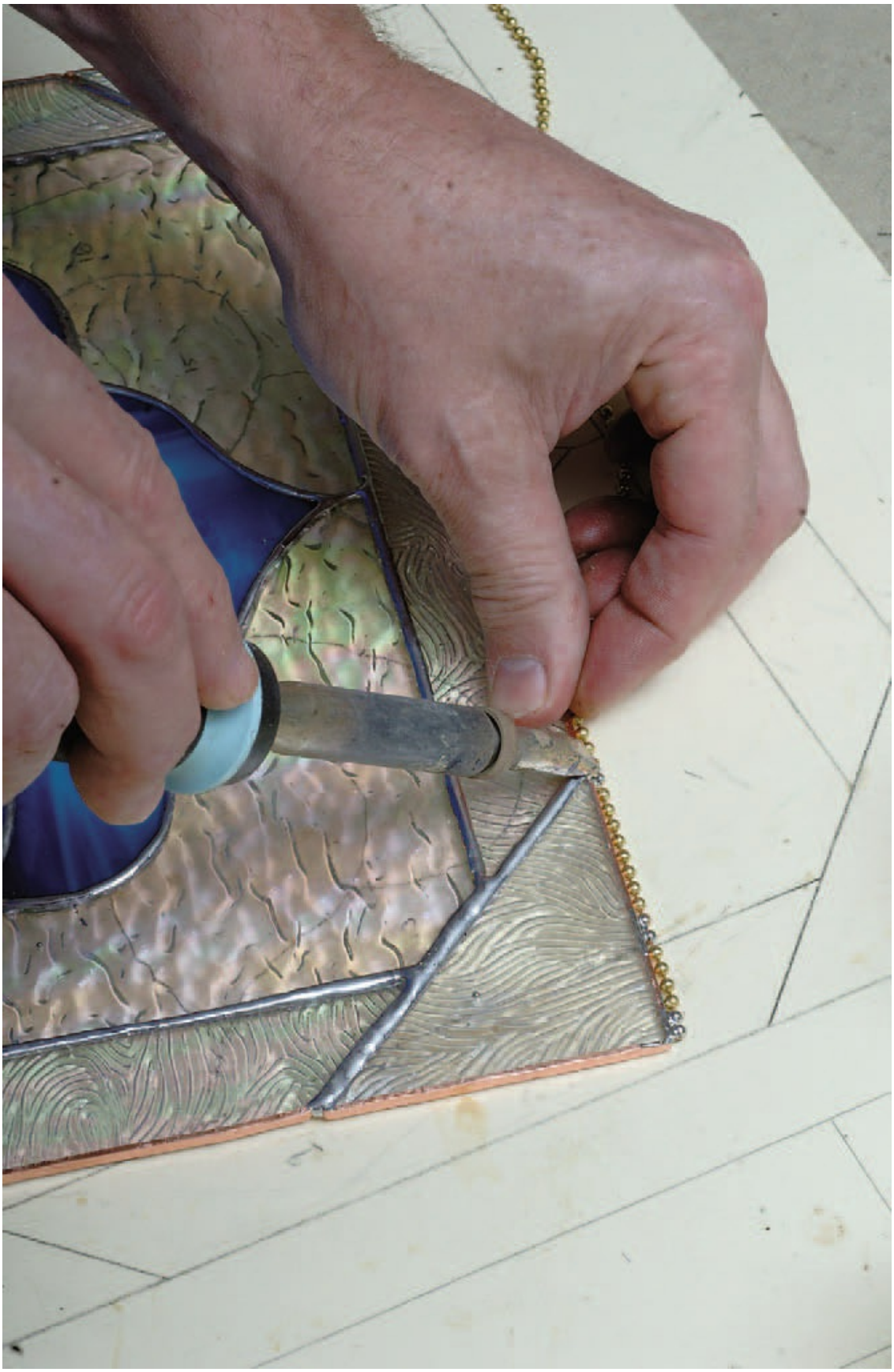
32. Get a bit of solder on your iron.



33. Tack solder the end of the chain to the lid.

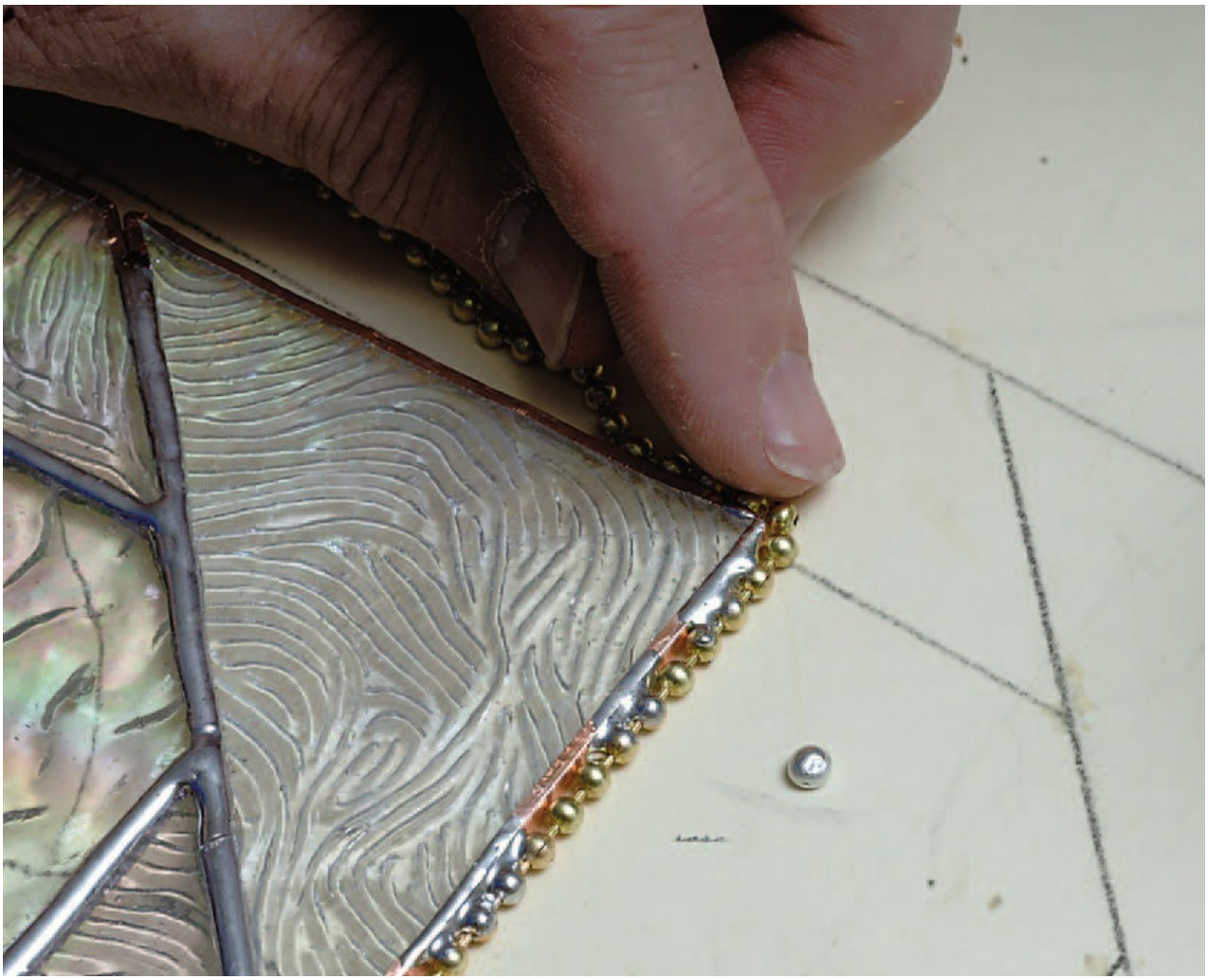


34. Pull the chain along the edge of the lid, keeping it flat against the edge. Then tack solder the chain to the edge every few inches, making certain it's tight against the lid edge its entire length.

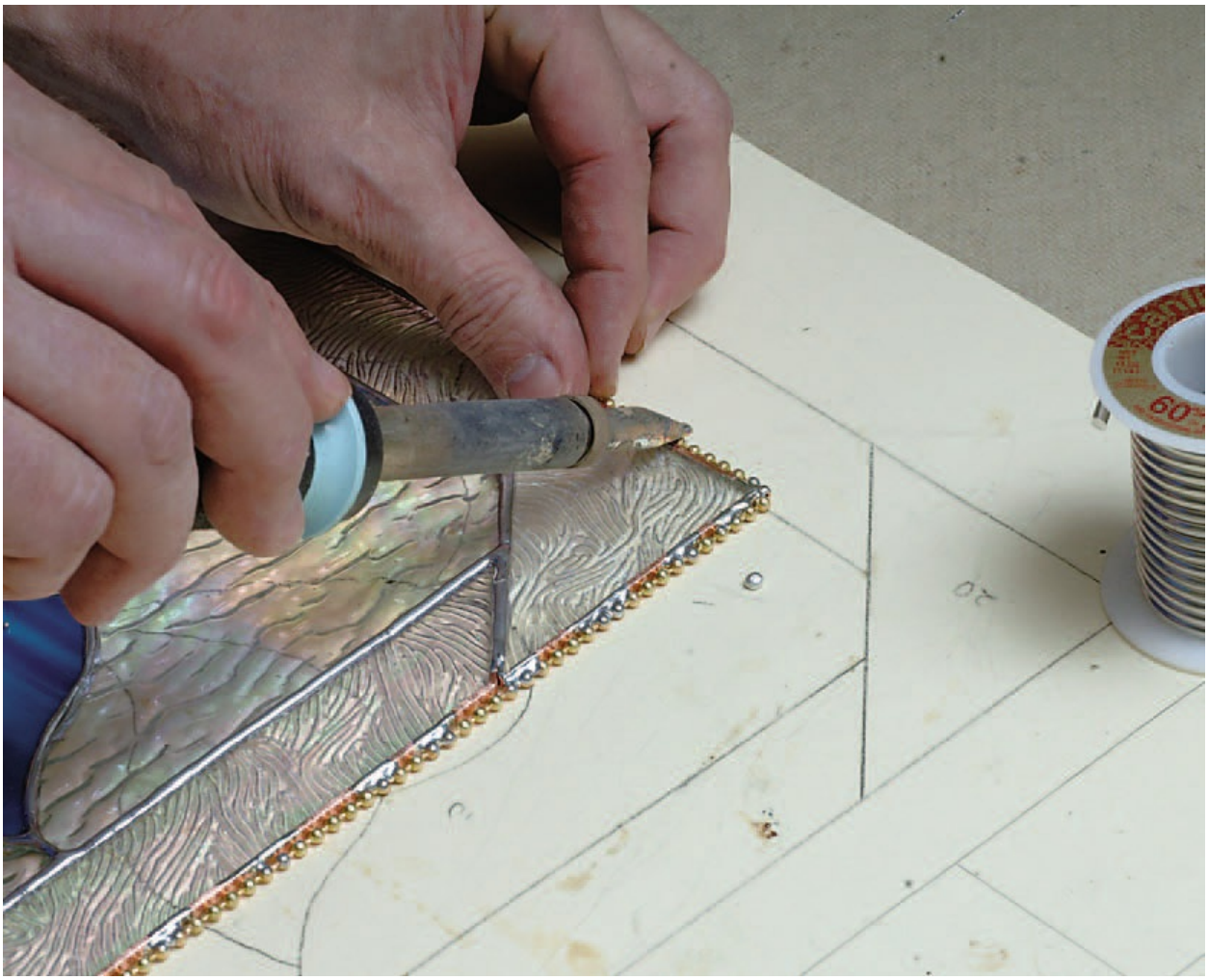


35. When you reach the corner of the first side of the lid, cut the chain. It's difficult to keep the chain tight against the edge if you try to bend it around a sharp corner.

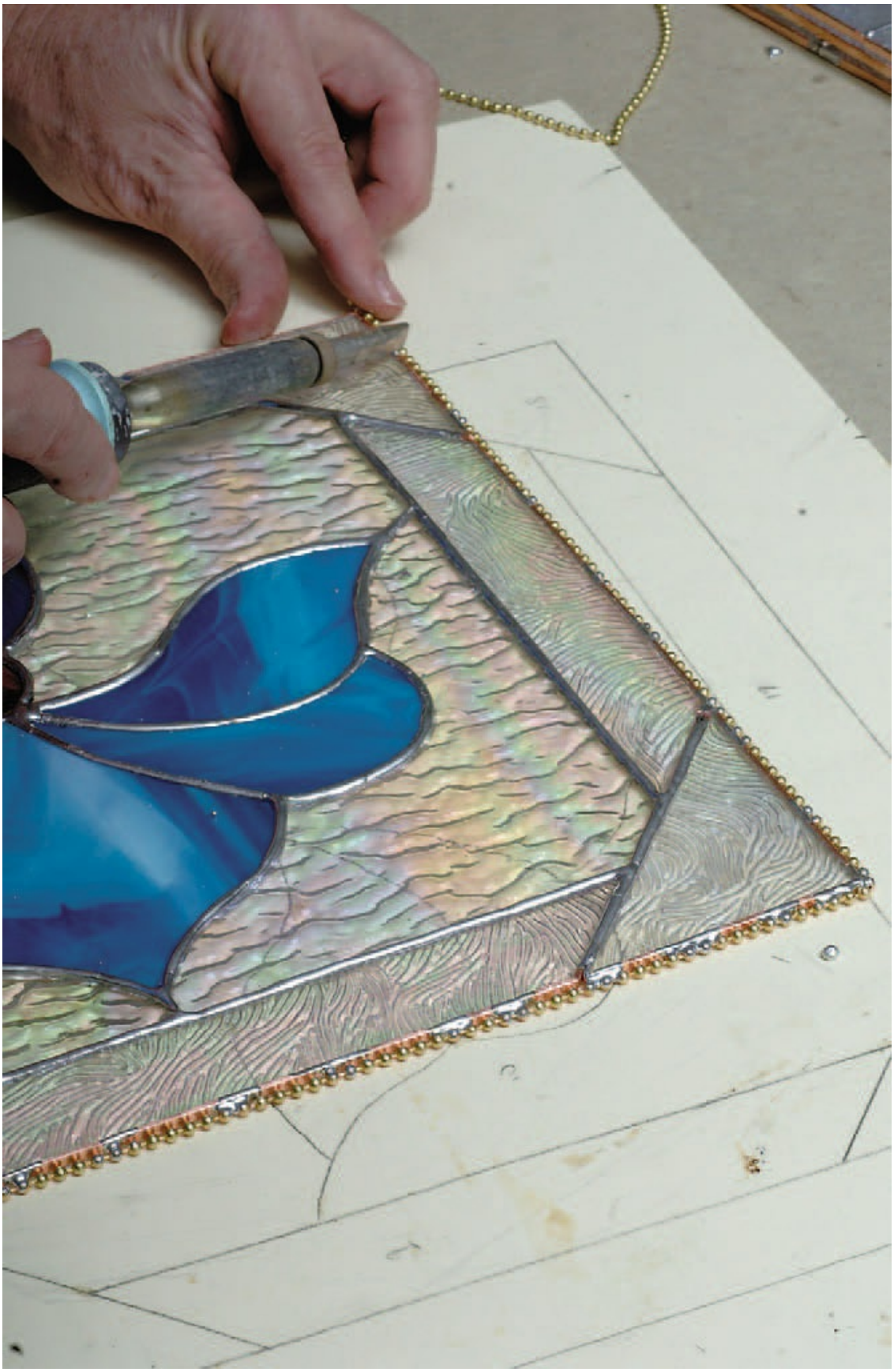
36. Lay the end of the chain at the corner of the next second edge of the lid.



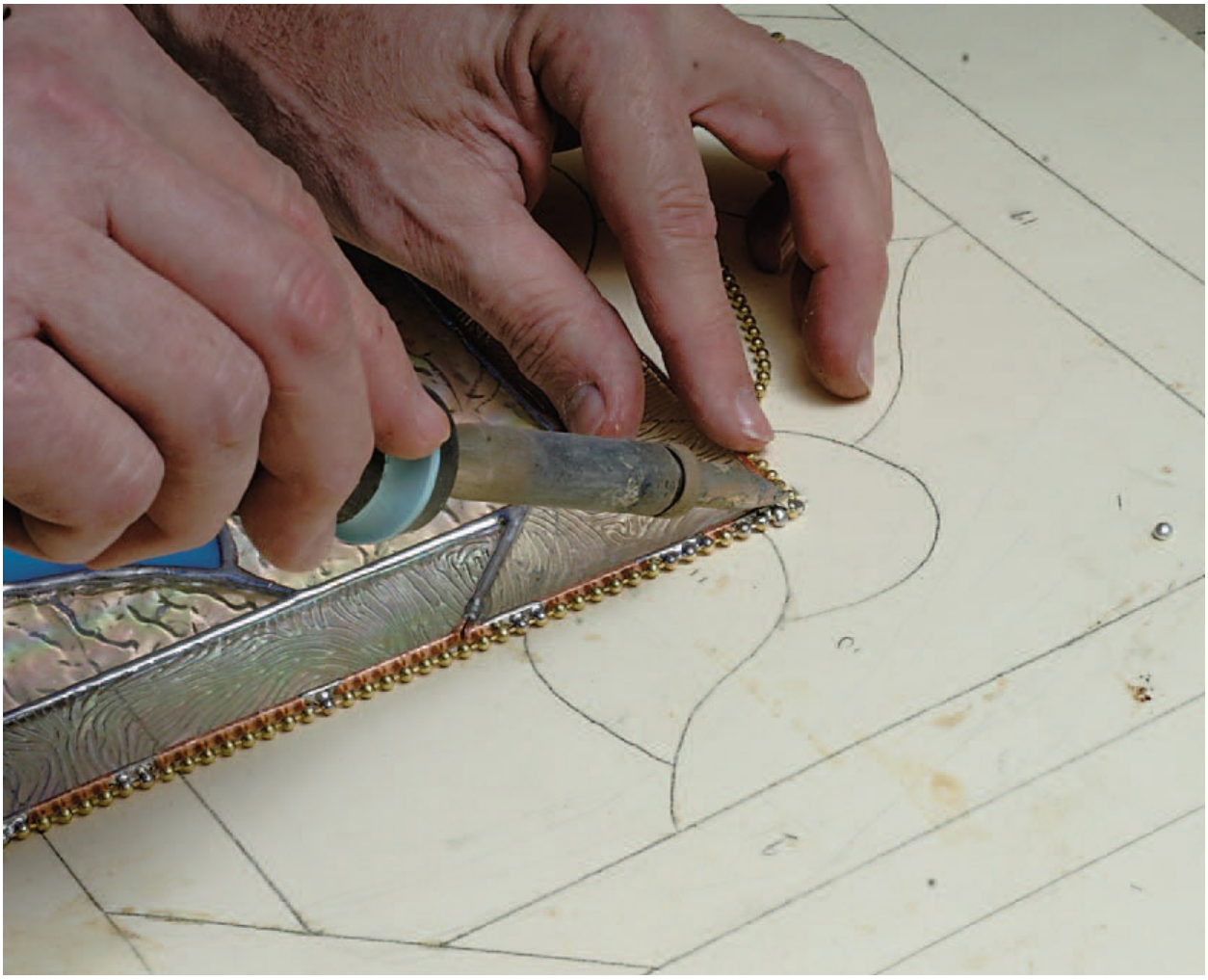
37. Tack solder it into place.



38. Then tack solder the chain all along the second edge of the lid.

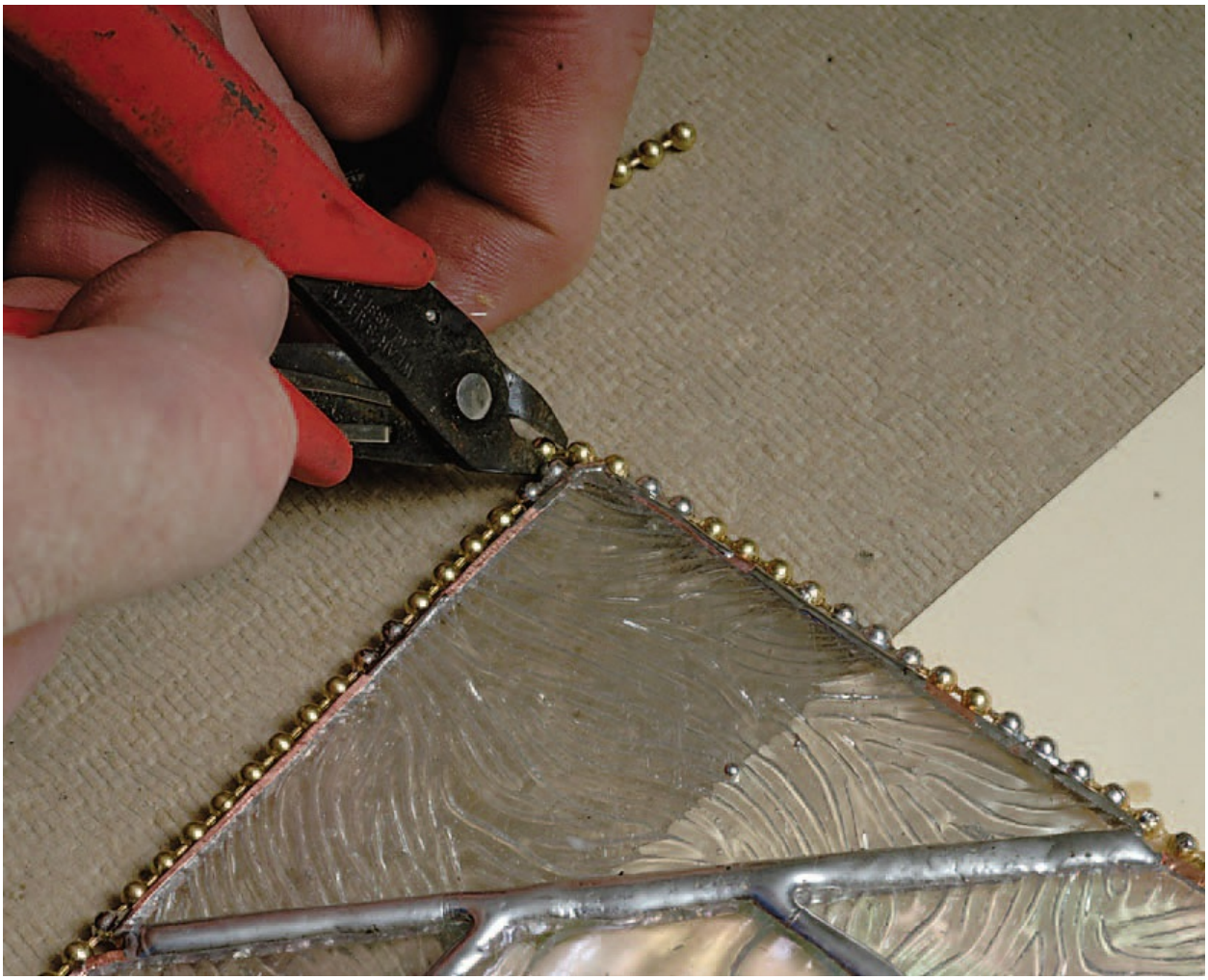


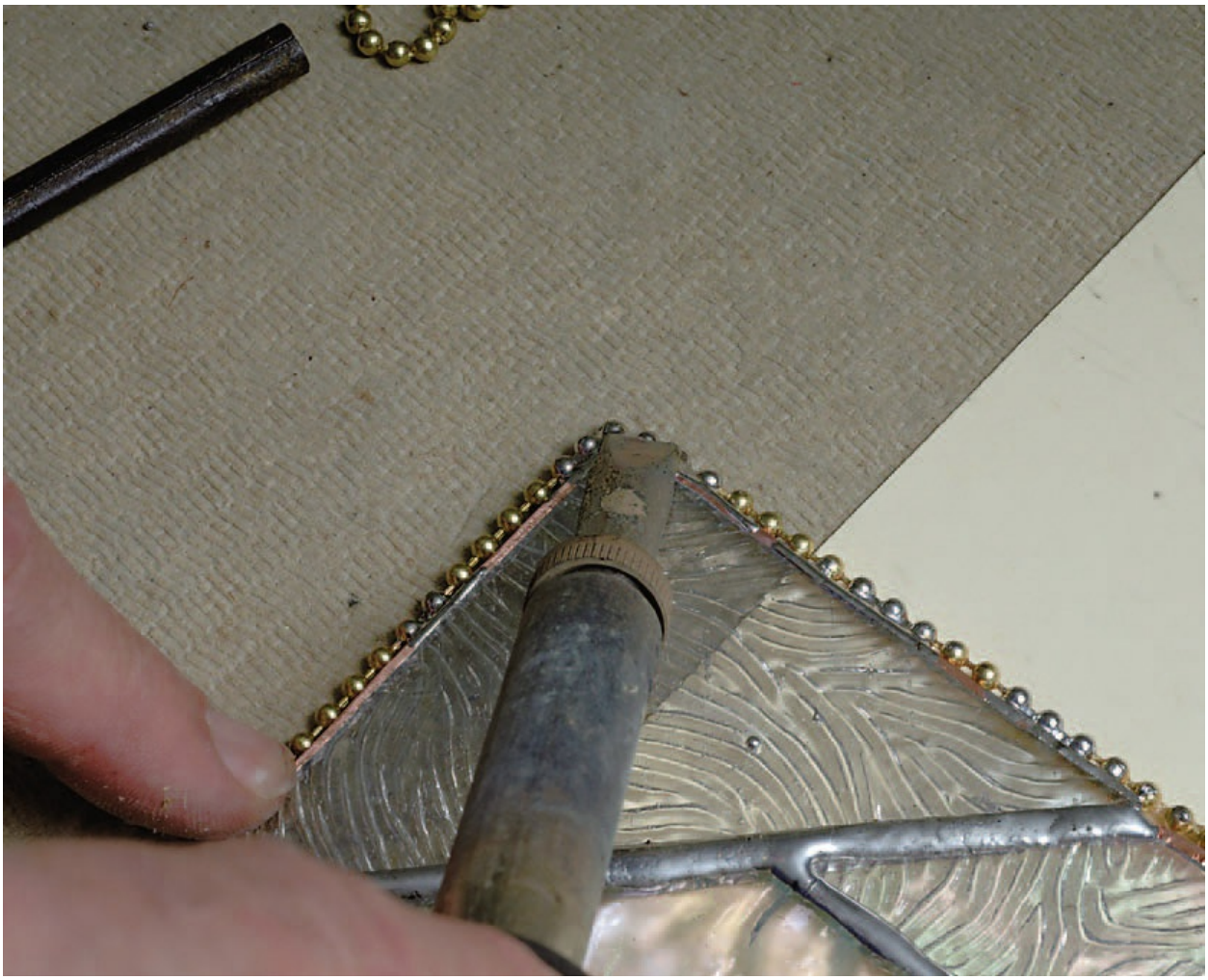
39. Do the third and fourth edges of the lid the same way.



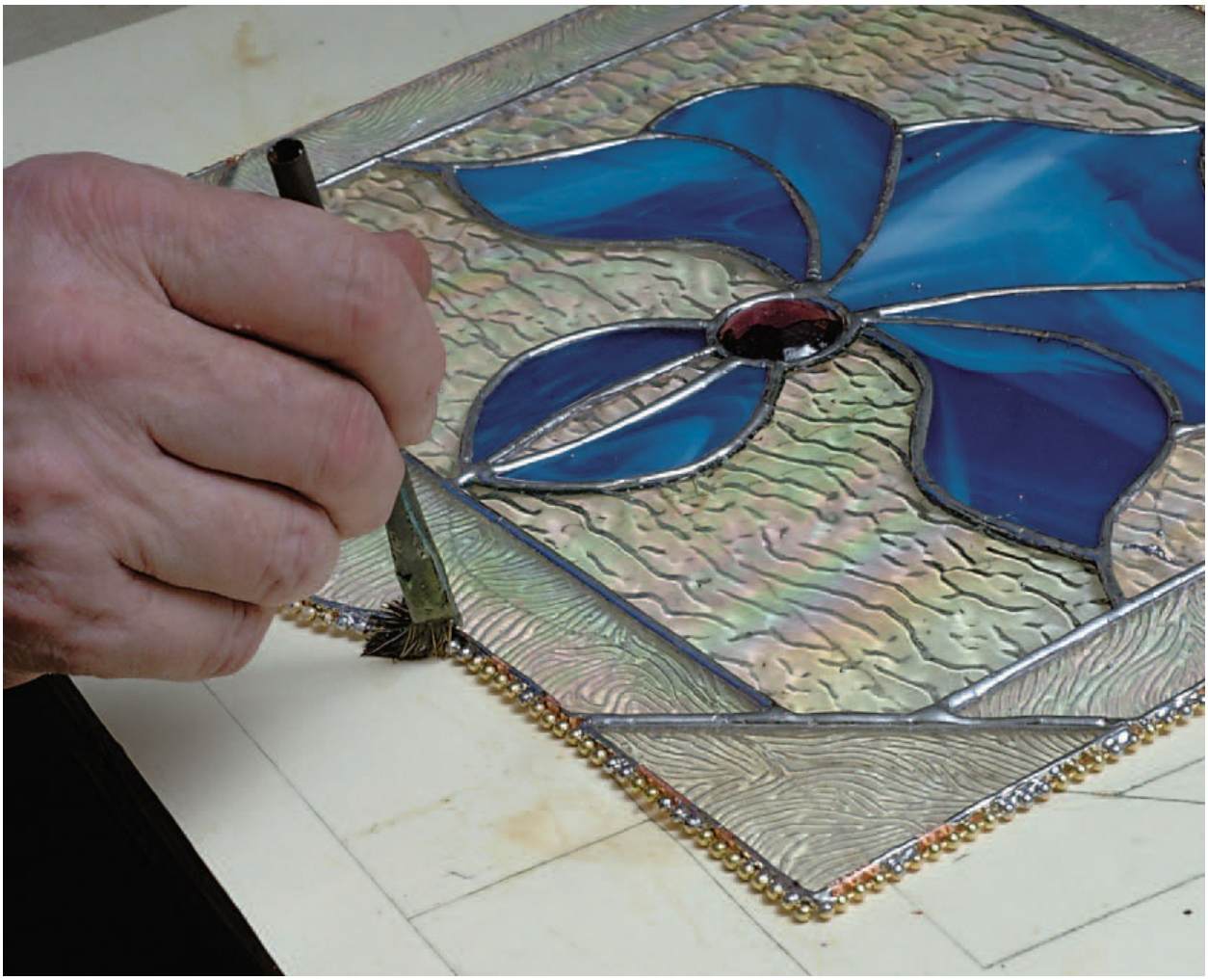
40. Notice that the chain should go smoothly over the curve that forms the lid's handle.

41. Cut the chain at the final corner and solder it securely in place.

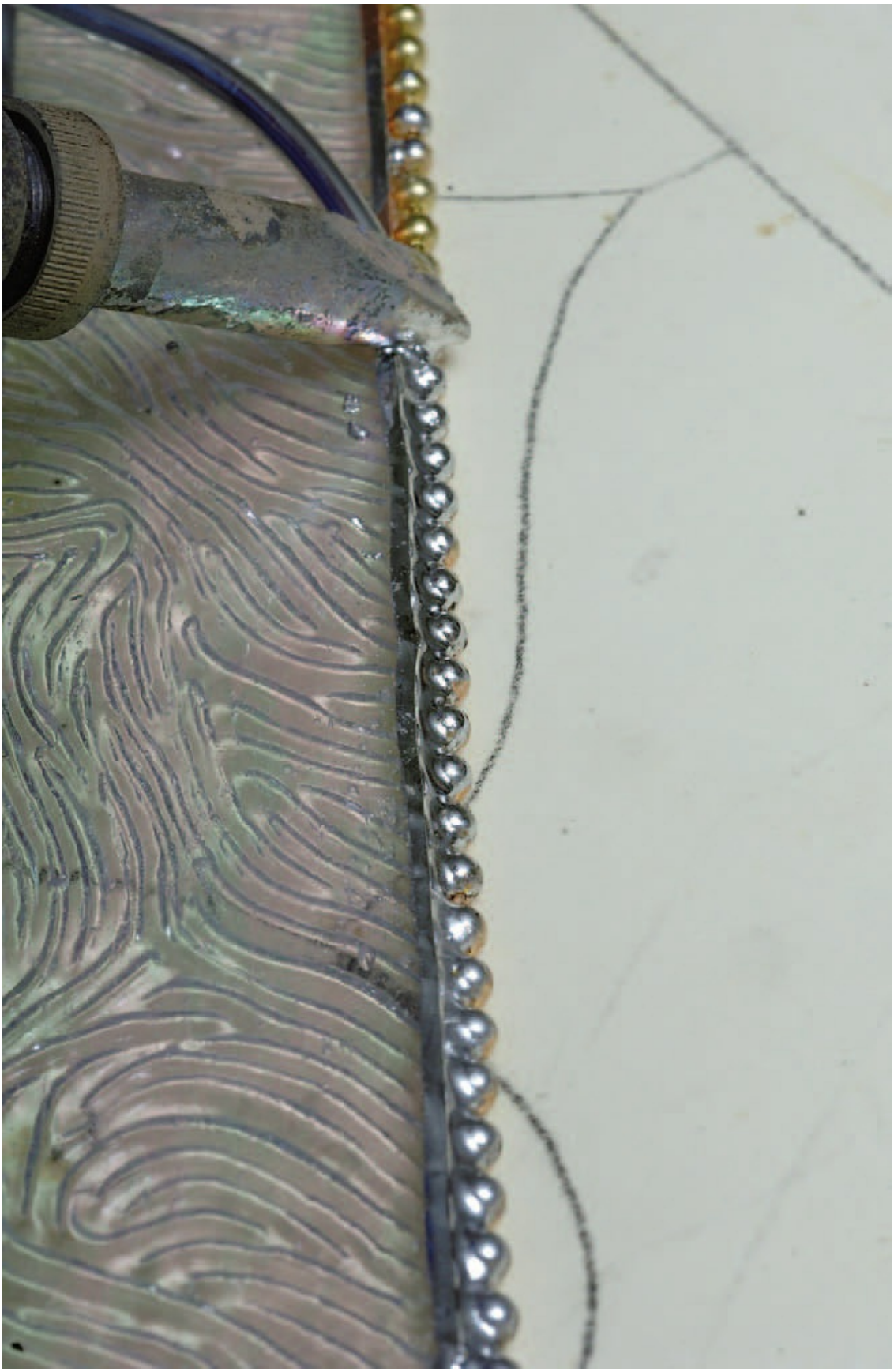




42. You are now ready to completely solder the chain into place. First, flux the entire chain.



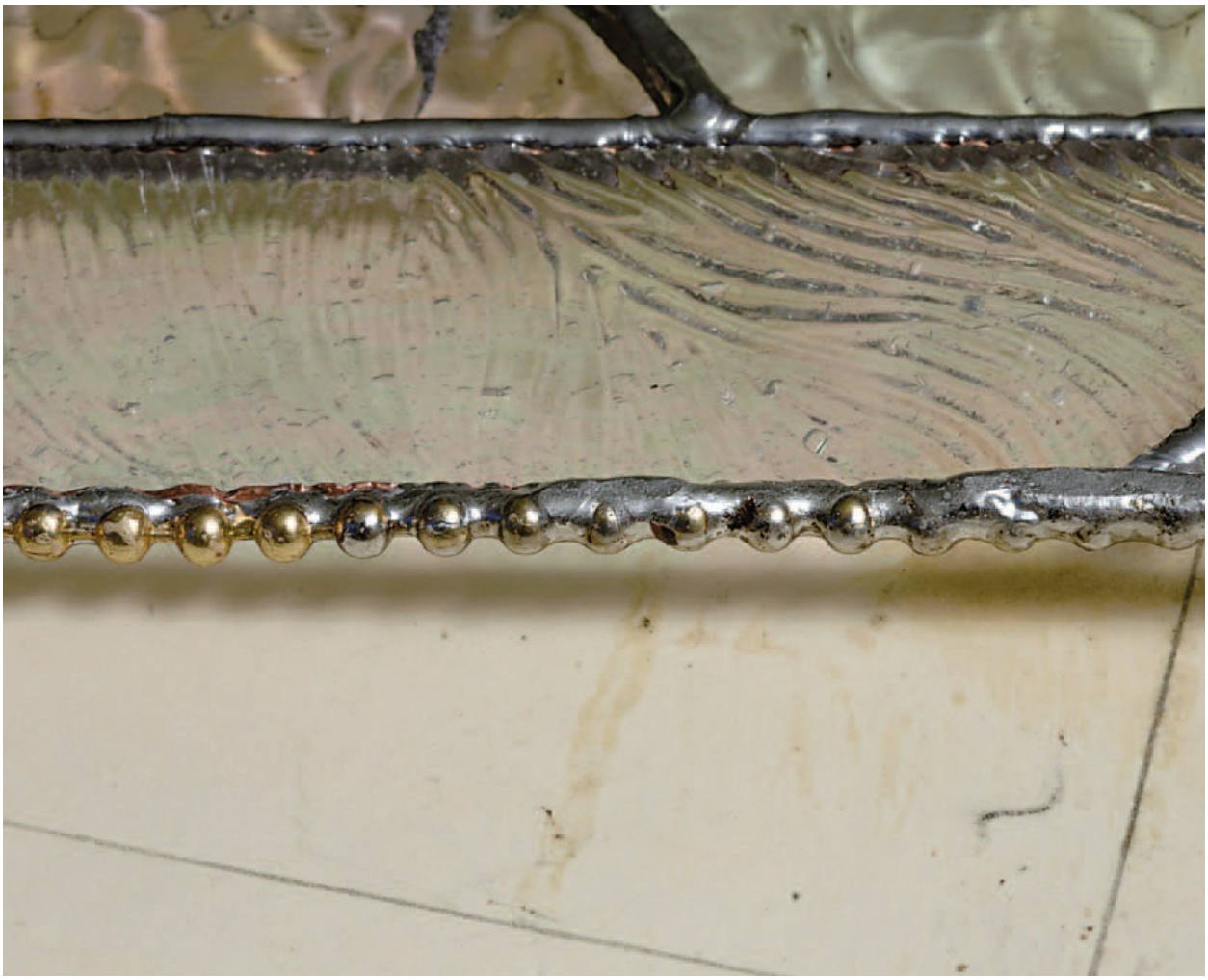
43. To solder the chain, touch the iron to the solder and let it flow down over the balls, completely covering their tops and the sides.



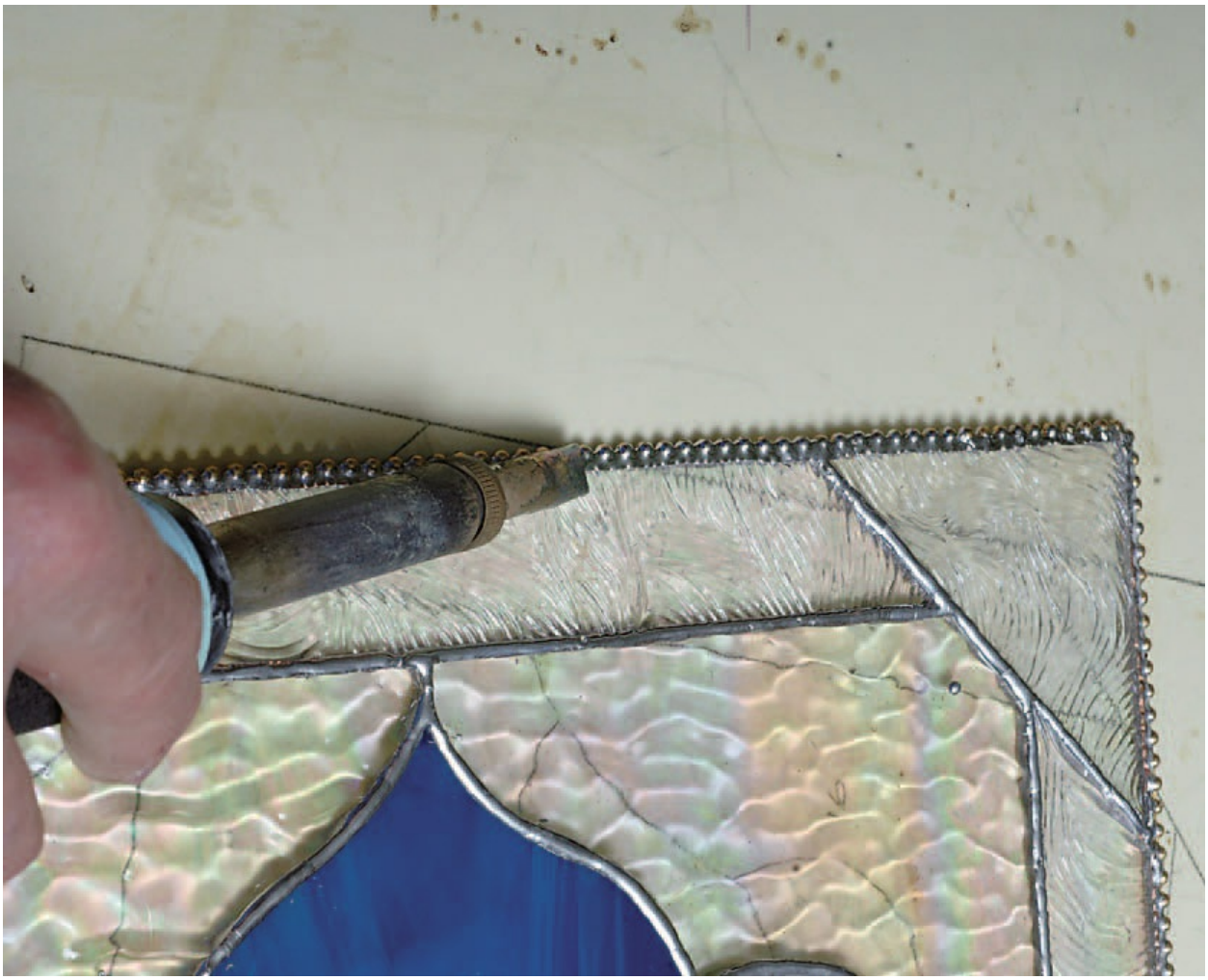
44. Go slowly but keep moving so you don’t get a buildup of solder in one spot.

45. After the chain's been soldered, each ball in the chain should be distinct and separate, with no excess solder between one ball and another.

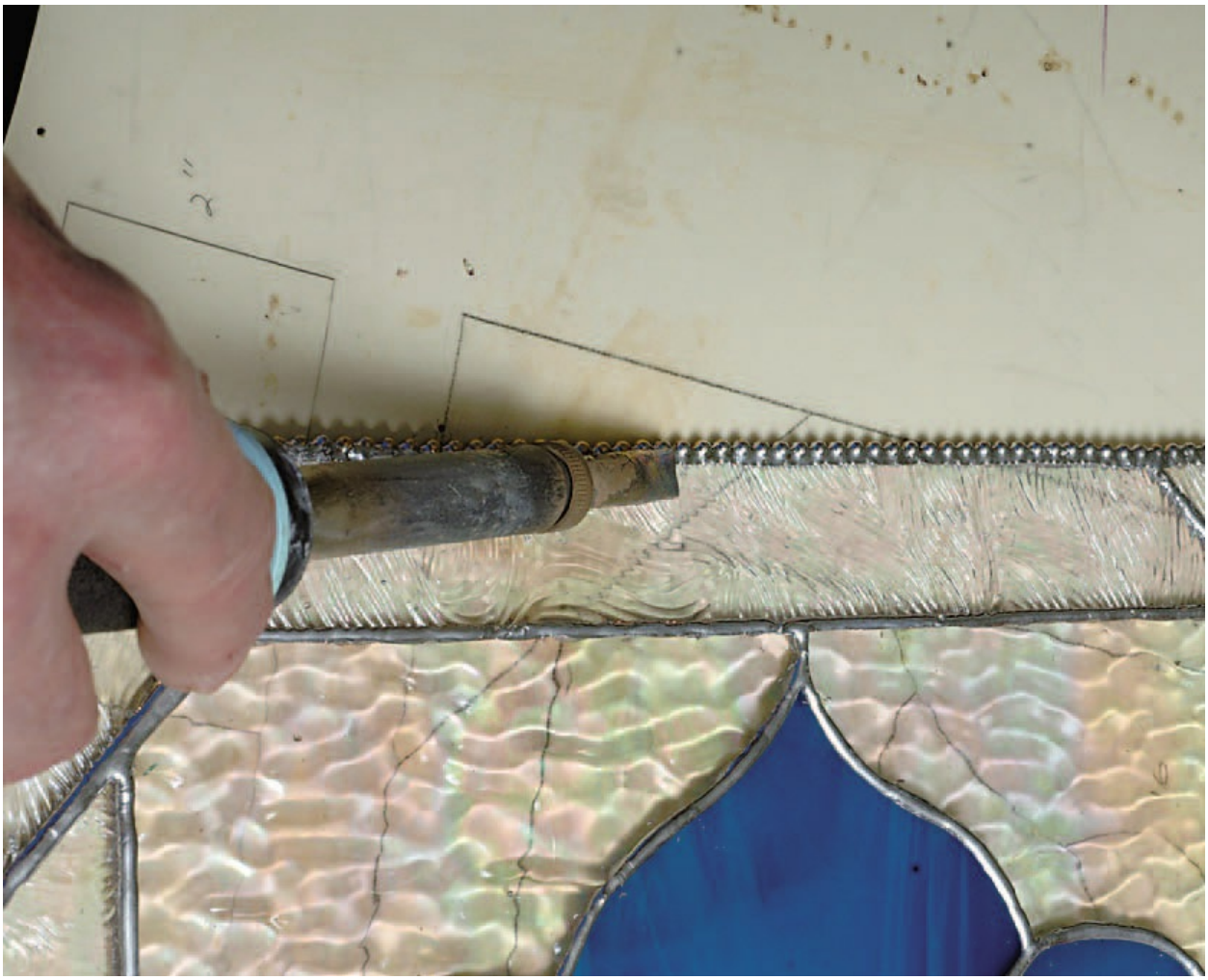
46. Despite your careful work, you still might get a buildup of solder, as shown here.



47. To eliminate the buildup, touch it with the iron . . .



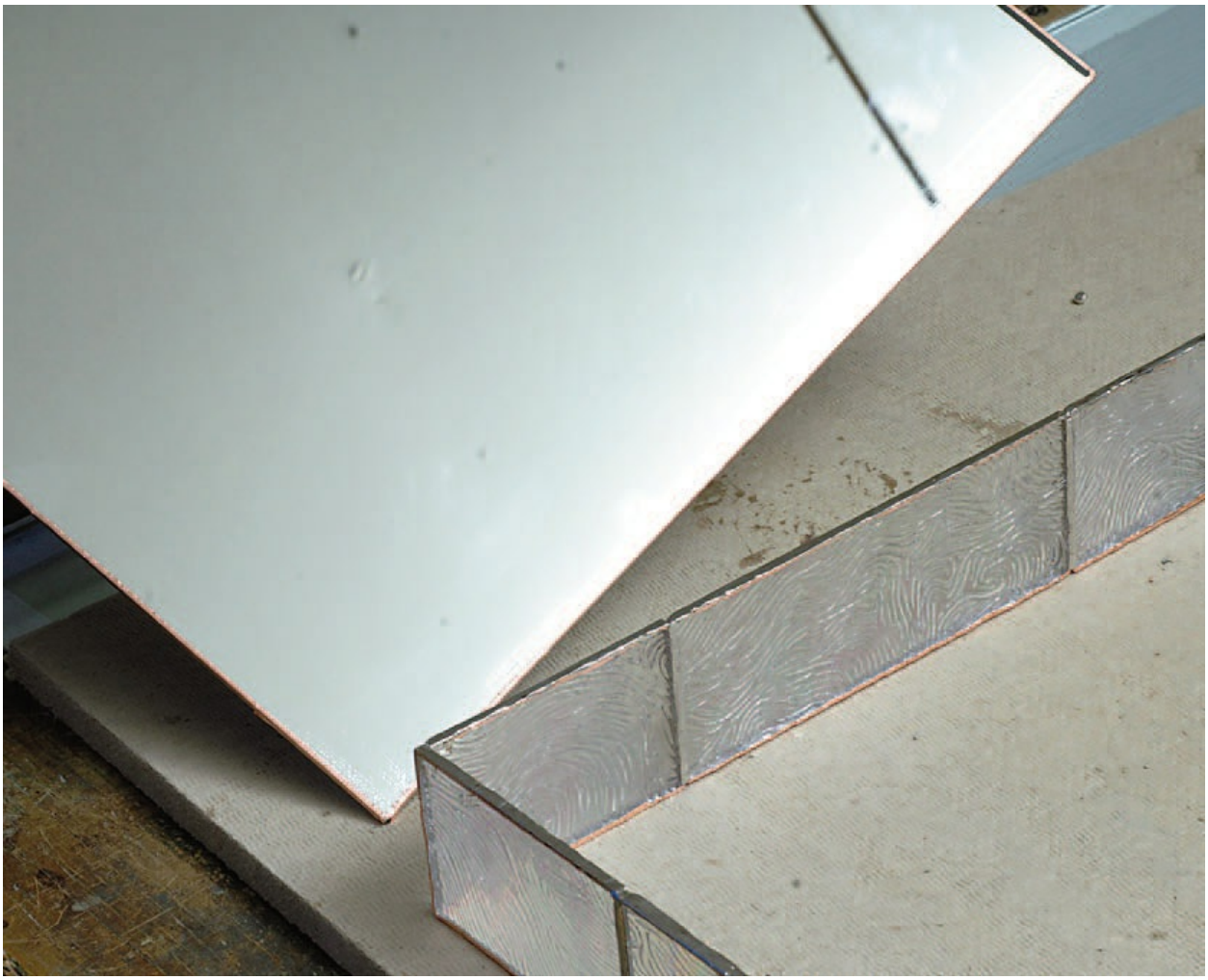
48. . . . and pull the solder toward an unsoldered spot.



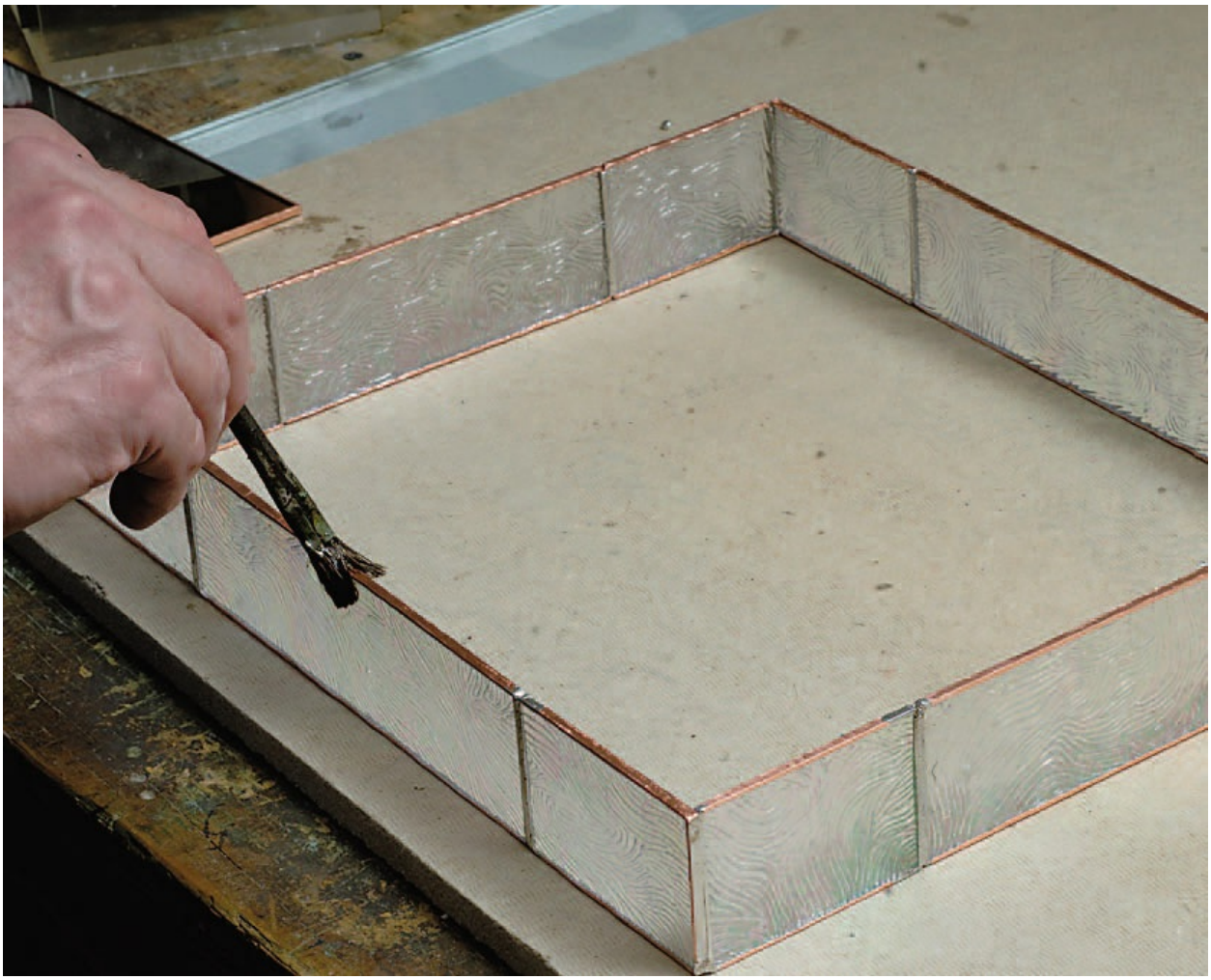
49. Solder the entire chain and then use your finger to check for bumps.

50. The box has a base of mirrored glass. To prevent chemicals from dissolving the mirrored glass's backing, you must spray the edges of the back of the mirror with protective spray.*This is an important step* —if the backing flakes off or is otherwise removed, it's impossible to replace it, and the mirrored side will look scratched. When the spray is dry (check the directions on the can to see how long this takes), foil the edges of the mirrored glass.

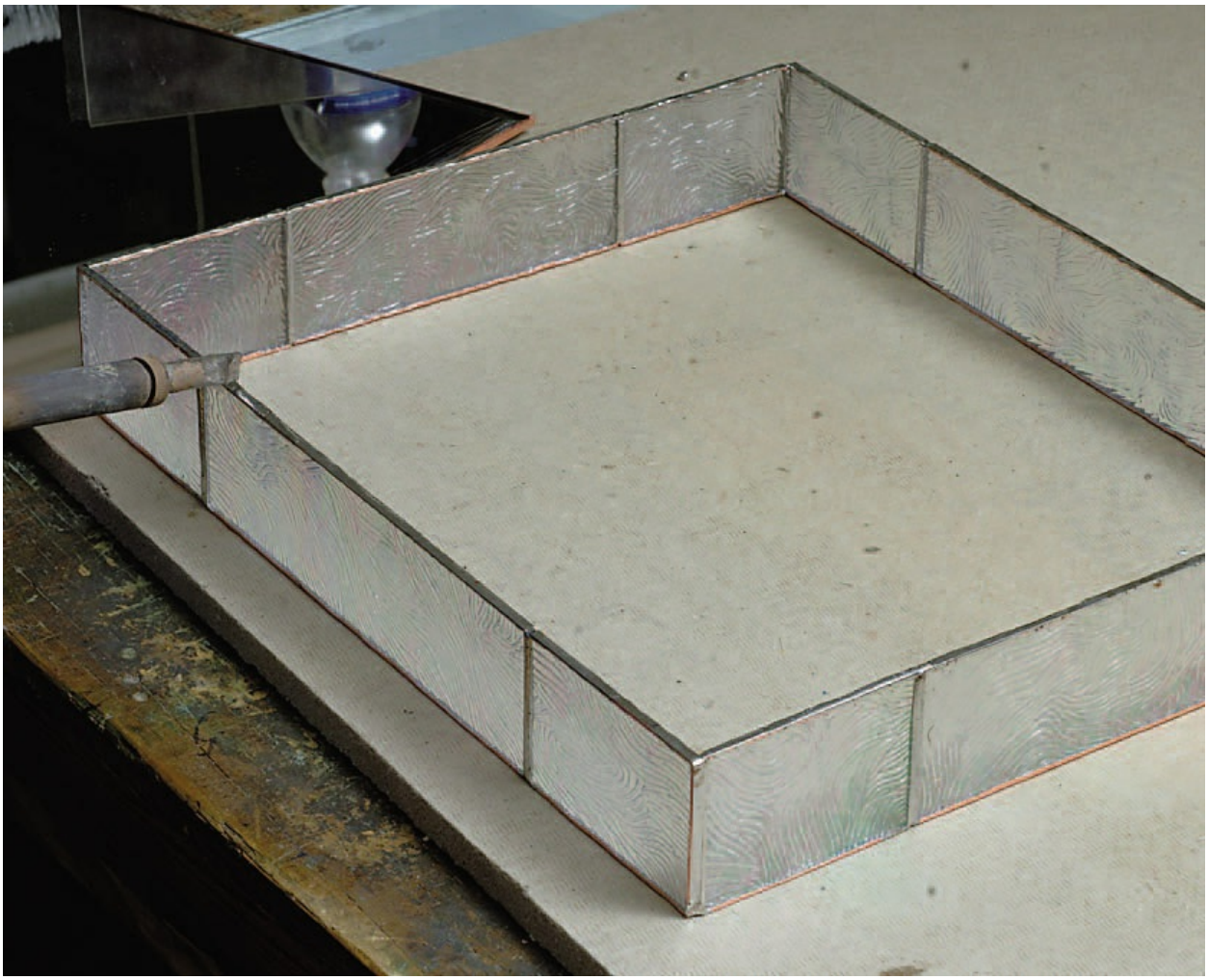
Because the mirror will reflect the foiled edge along the bottom of the box's sides, that edge needs to be covered with solder before the mirror is attached.



51. Flux the uppermost edge of the entire perimeter of the base.



52. Then apply a layer of solder.



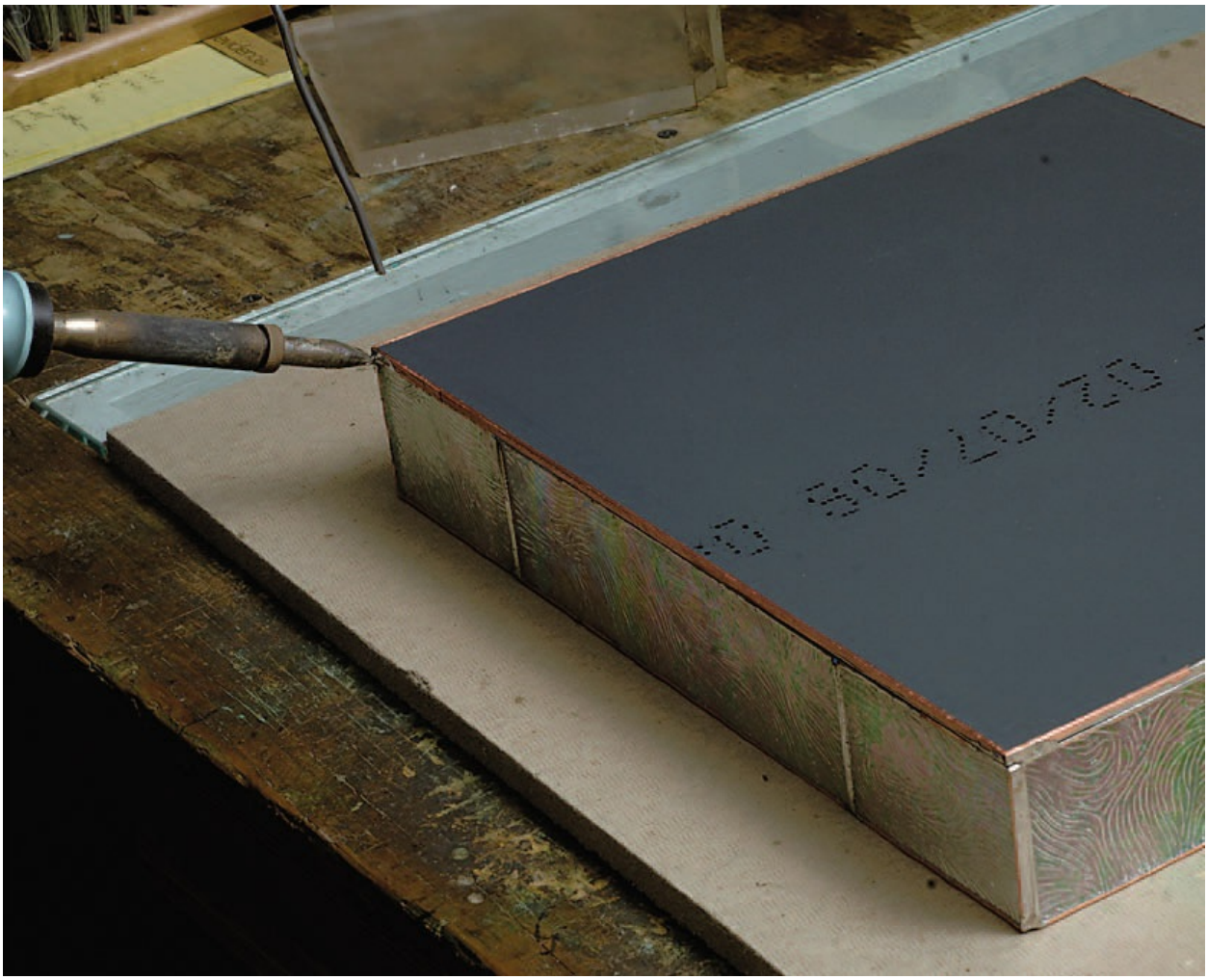
53. Next, flux the foiled perimeter of the glass bottom.

54. Then apply a layer of solder that covers the side of the foil that overlaps the mirror.

55. Lay the bottom on top of the box sides, mirror side down, to confirm that it’s the correct size and that it doesn’t overlap anywhere.

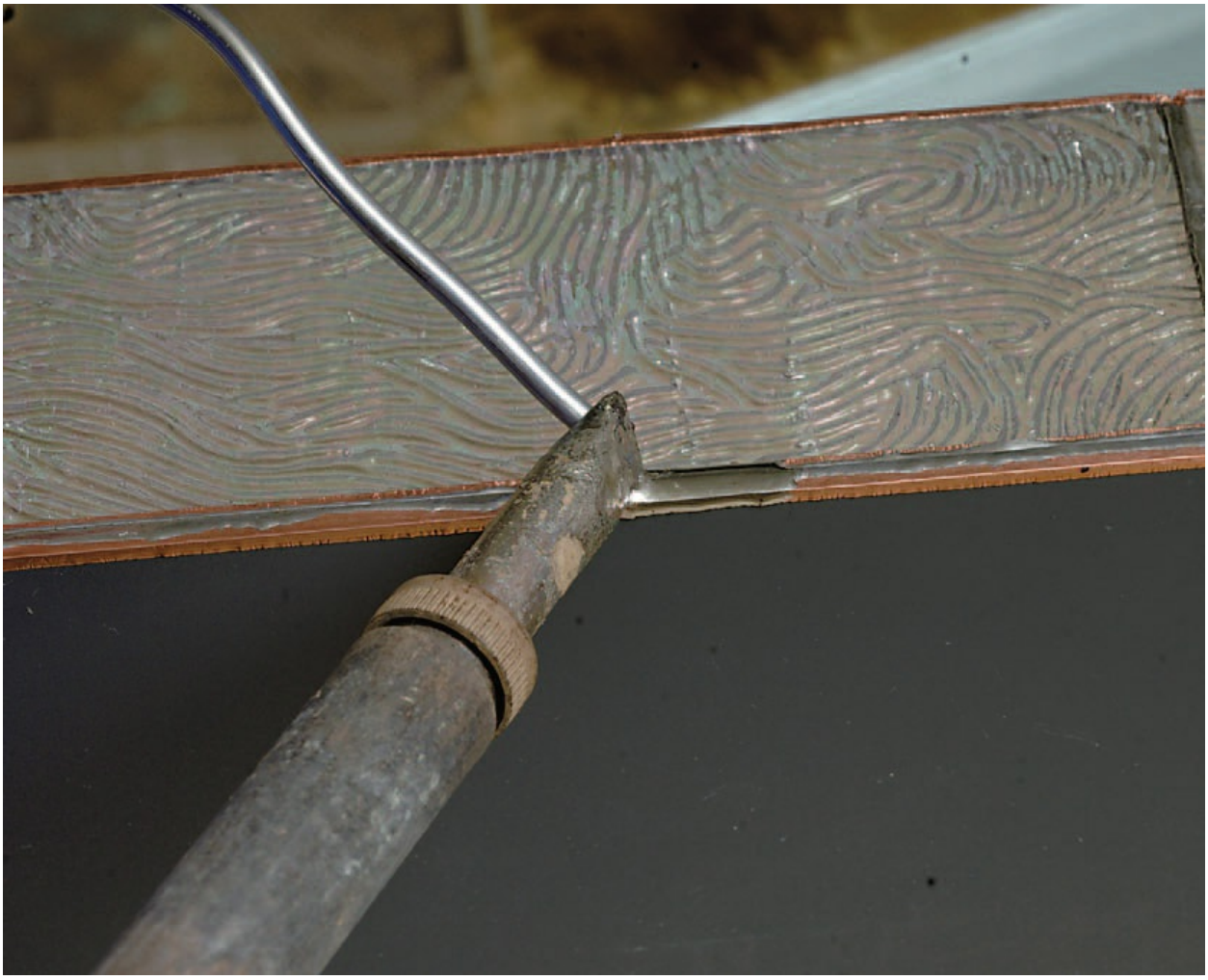
56. Brush flux along all sides of the edge of the bottom's foil and on the foil that overlaps the unmirrored side.

57. Tack solder each corner where the sides and bottom meet.

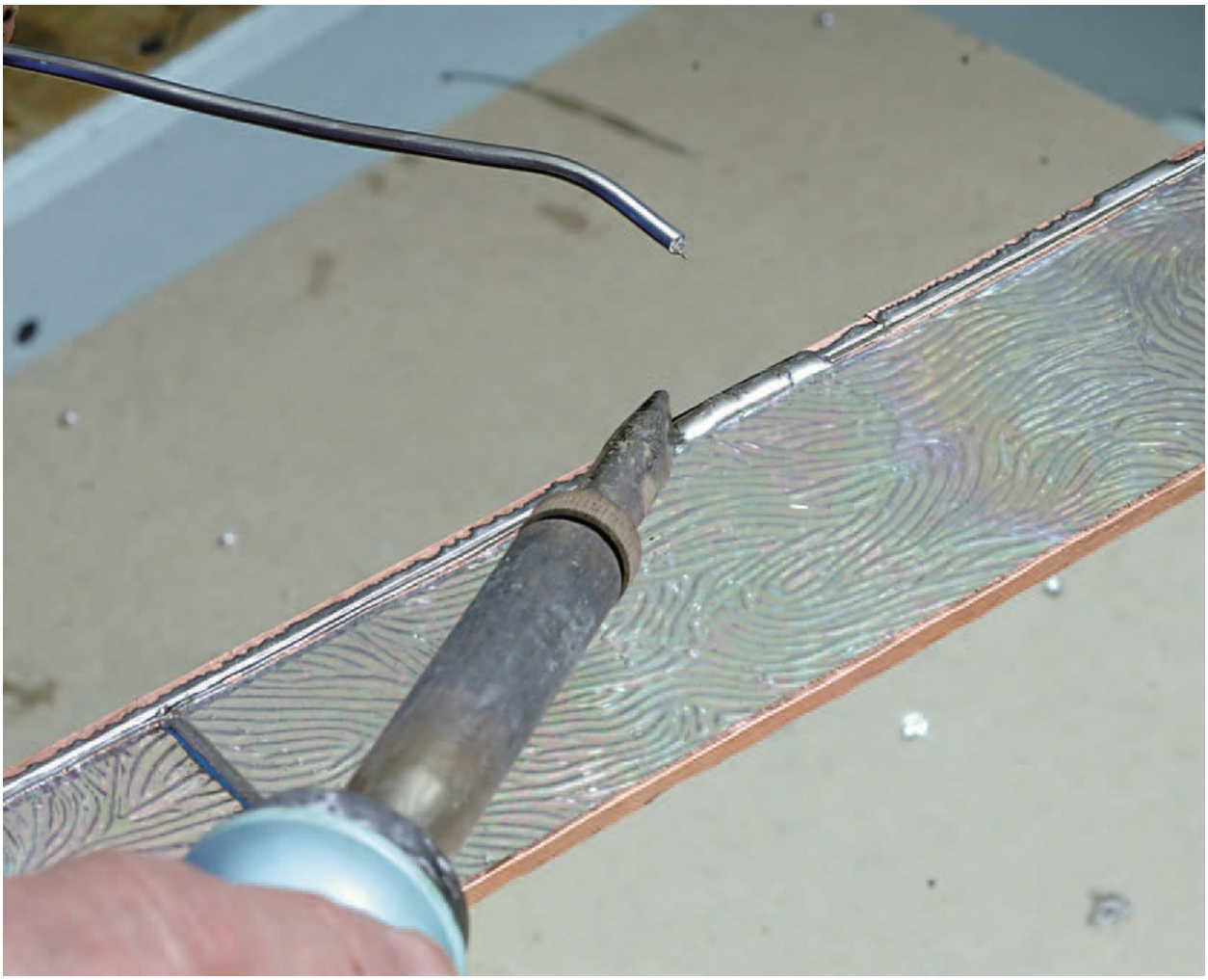


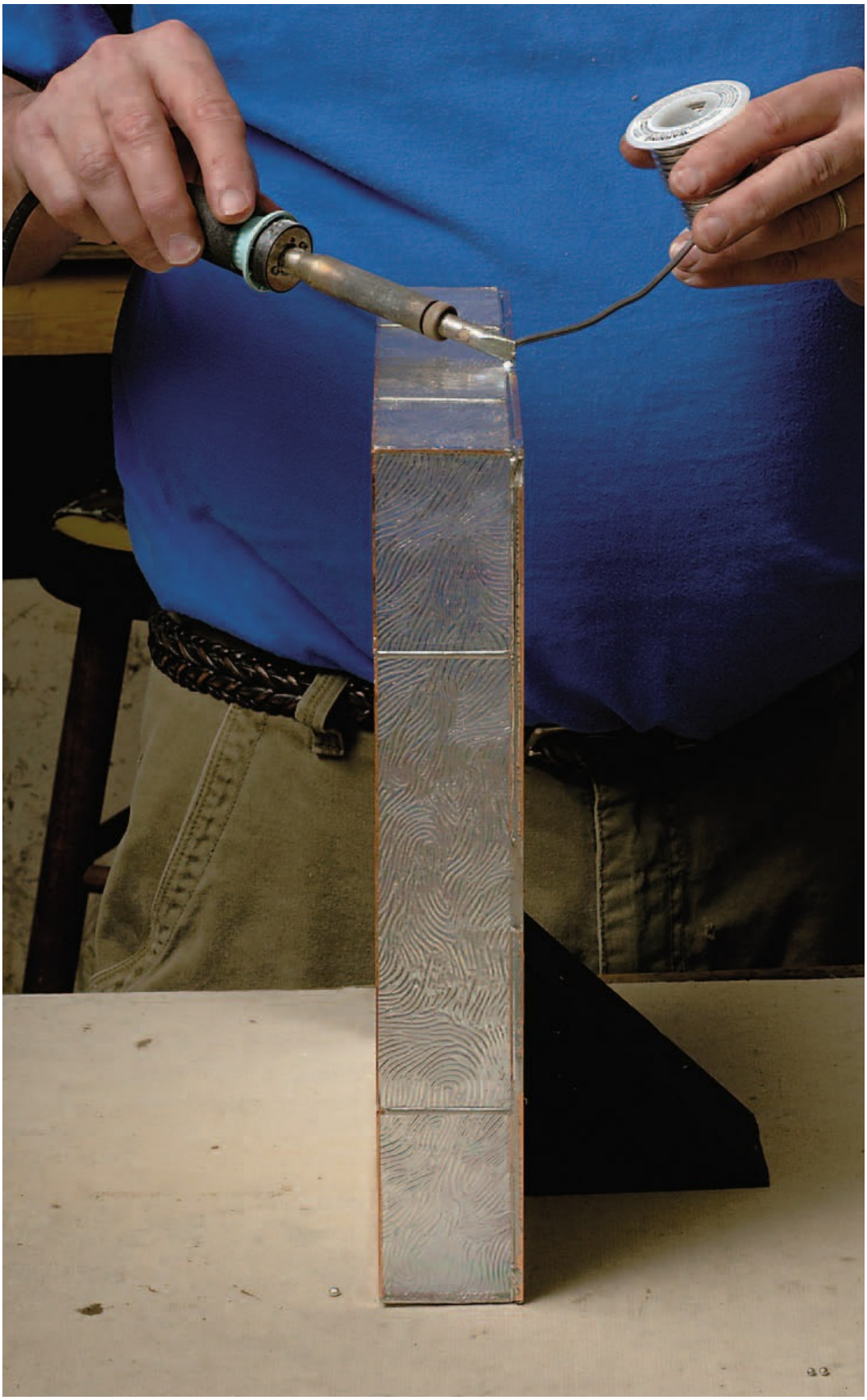

WARNING

58. Turn the box on one side and solder the entire side seam.

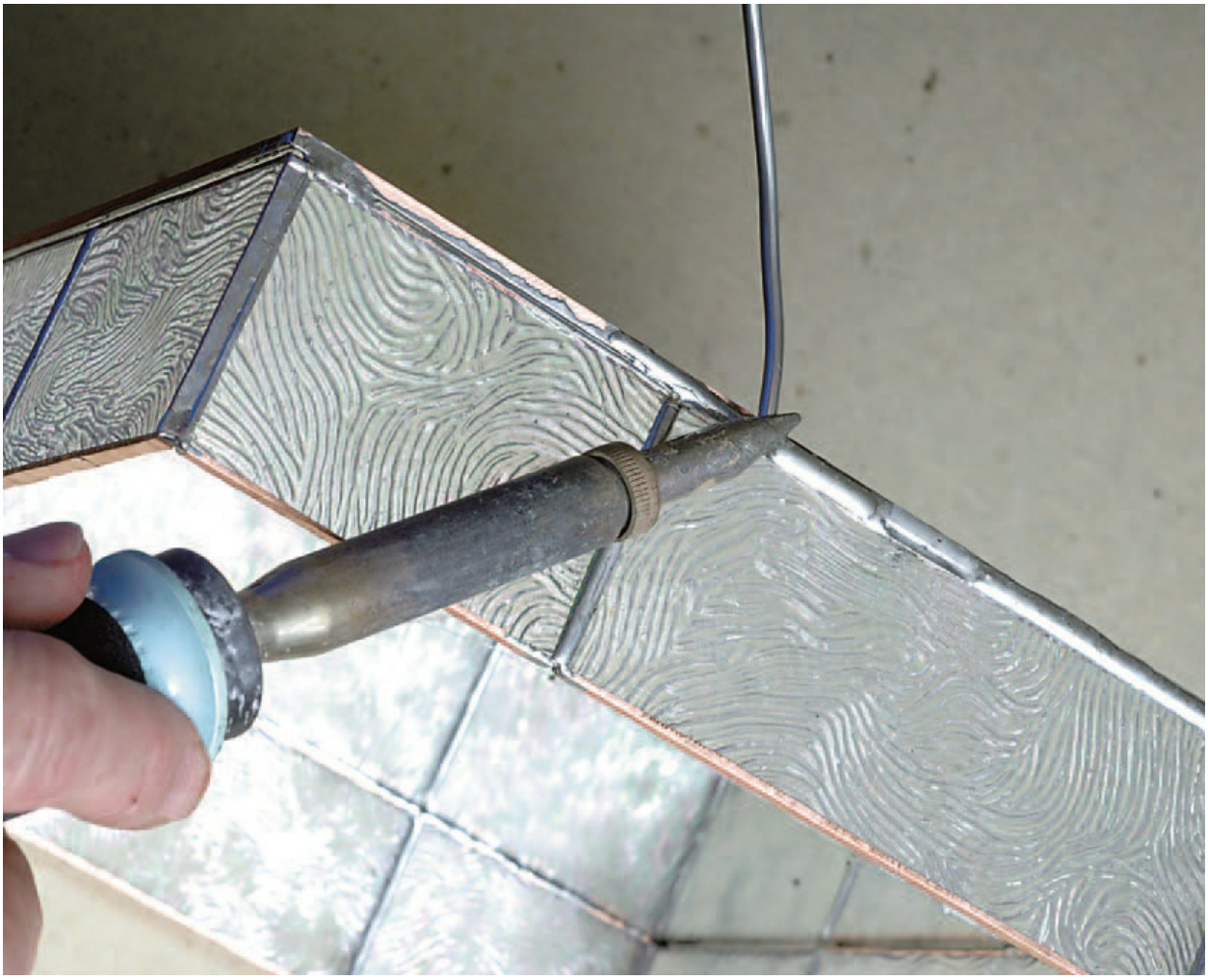


59. When one side is done, reposition the box and do the next side.

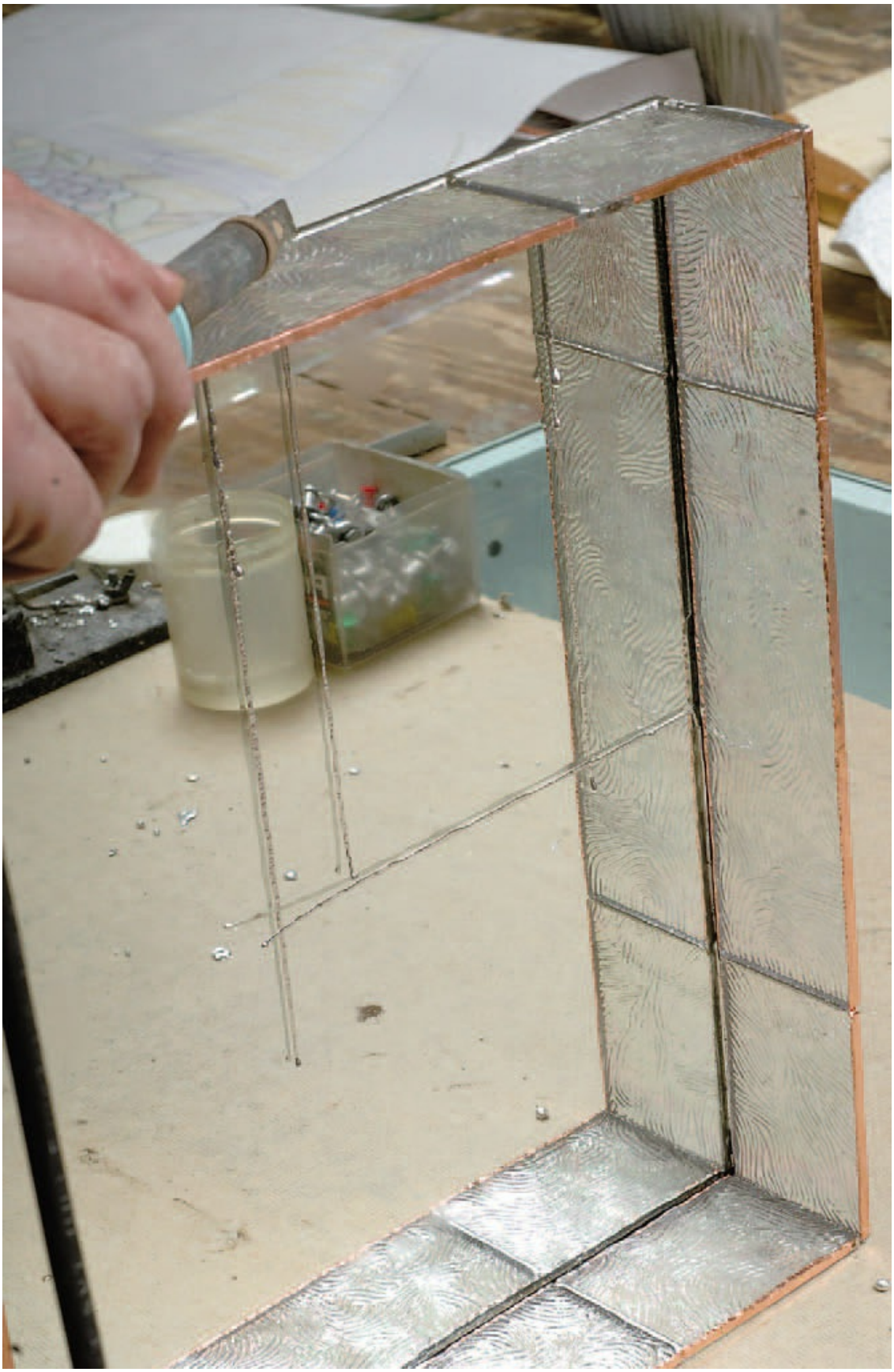




60. Solder the rest of the side seams the same way.

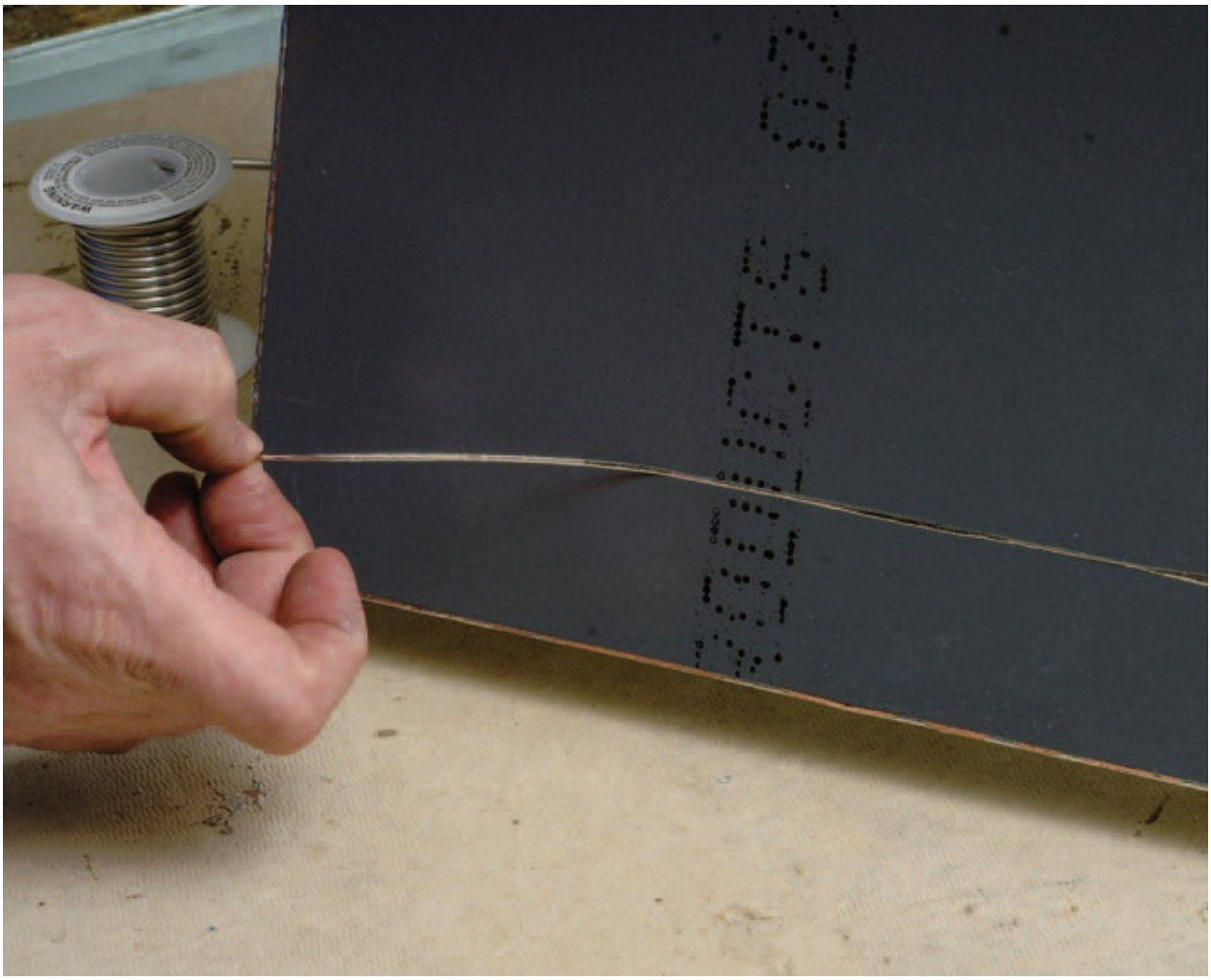


61. To solder the sides, set the box on its side and hold it in place with a Wedgie.

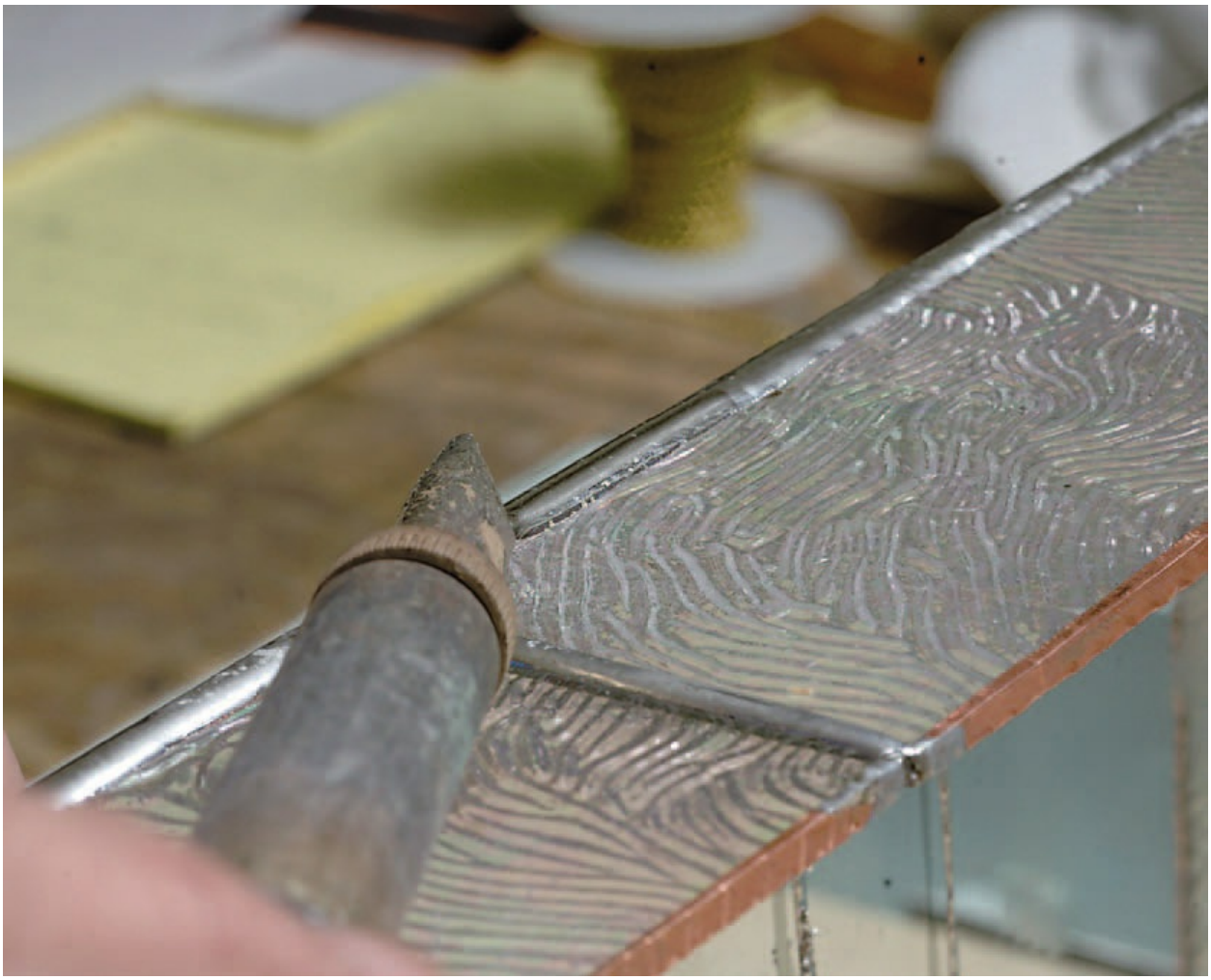


62. Cover the sides of the bottom.

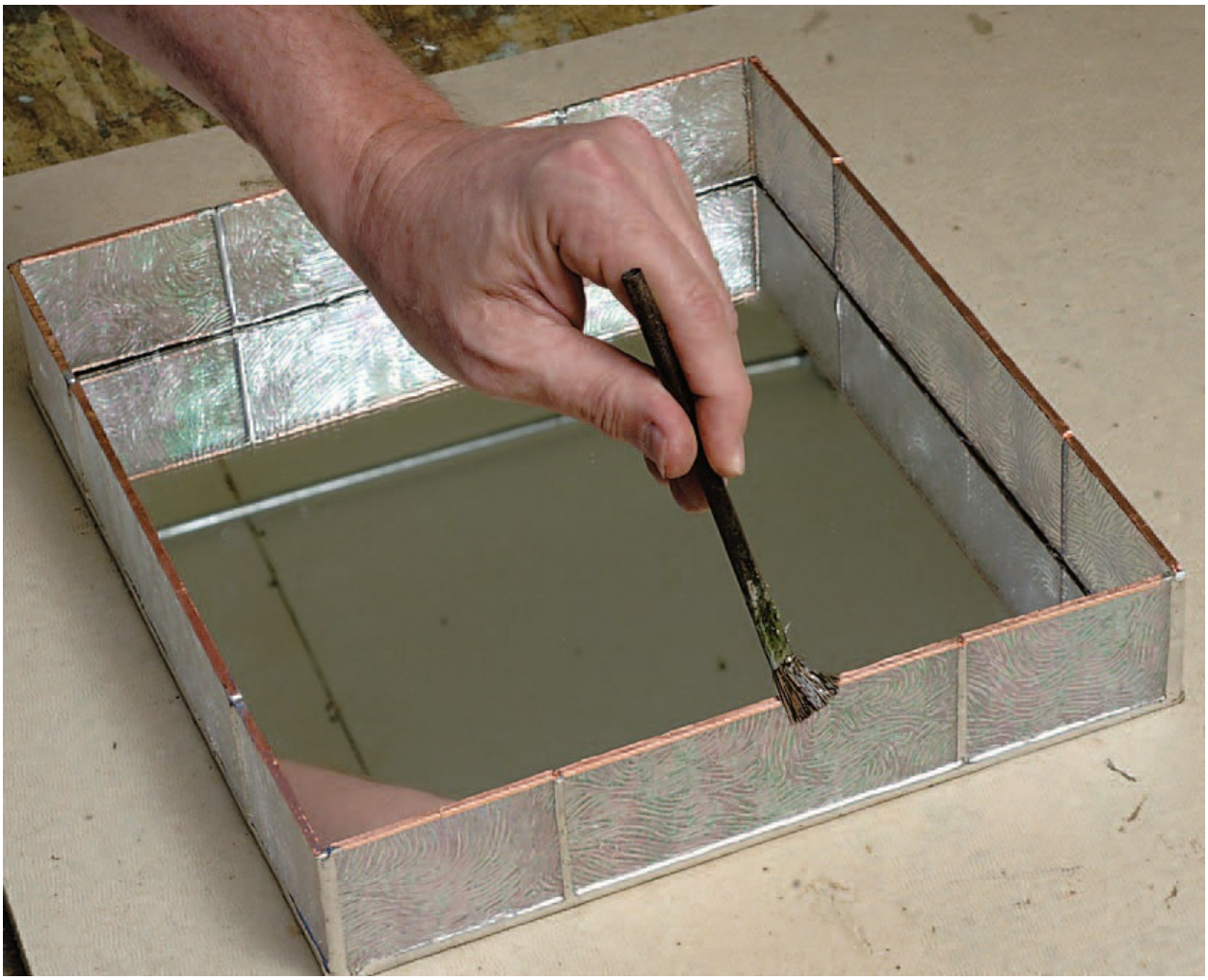
63. When you're finished soldering the bottom, you'll probably see that solder has dripped down the mirror or its back. You can usually pull these streaks off with your fingers.



64. Touch up any bumps or rough spots.

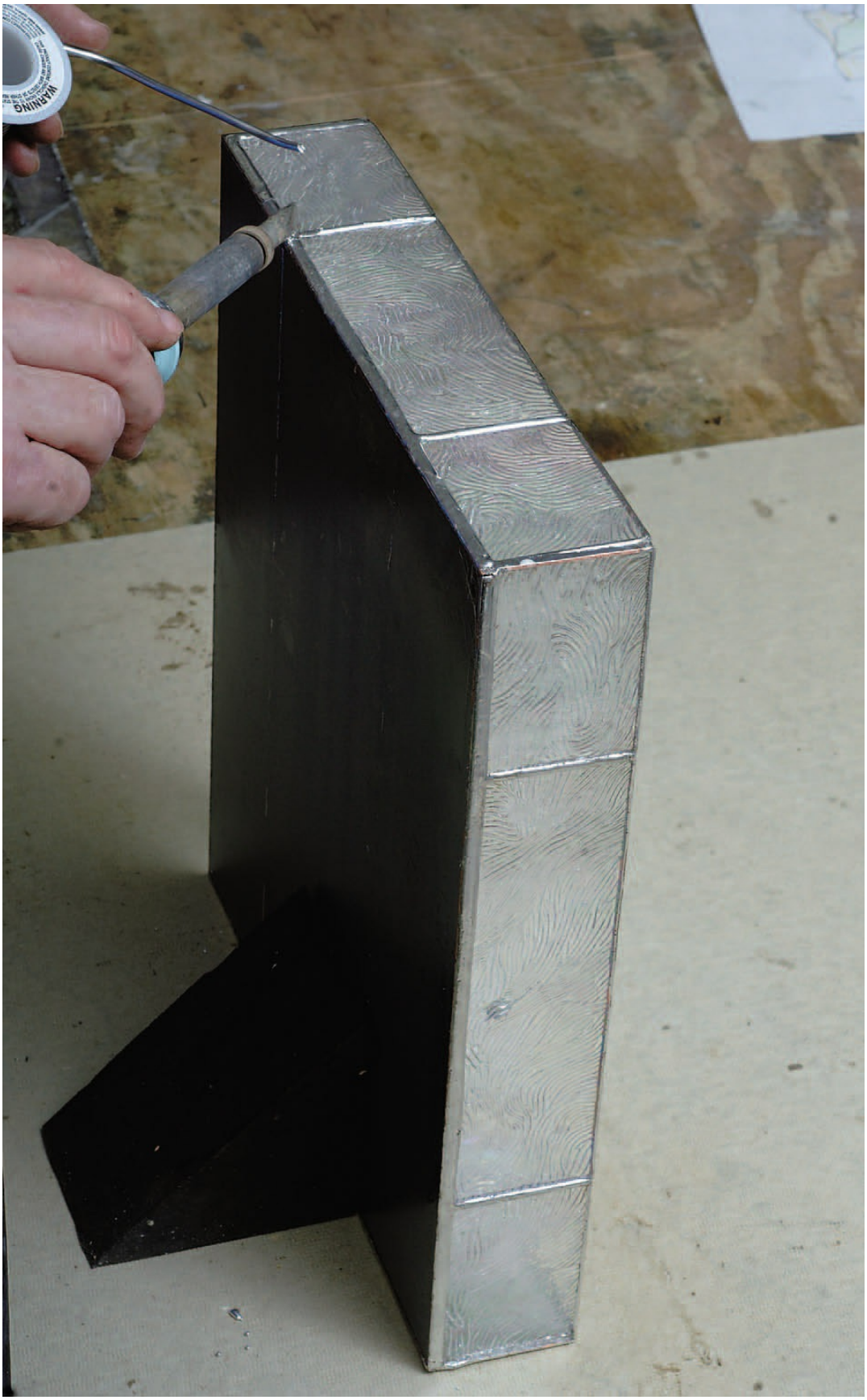


65. Set the box right-side up and flux entire top edge.



66. Then cover it with a bead of solder.

67. Set the box on its side and prop it with a Wedgie.


WARNING

68. Then solder the sides of the top edge.

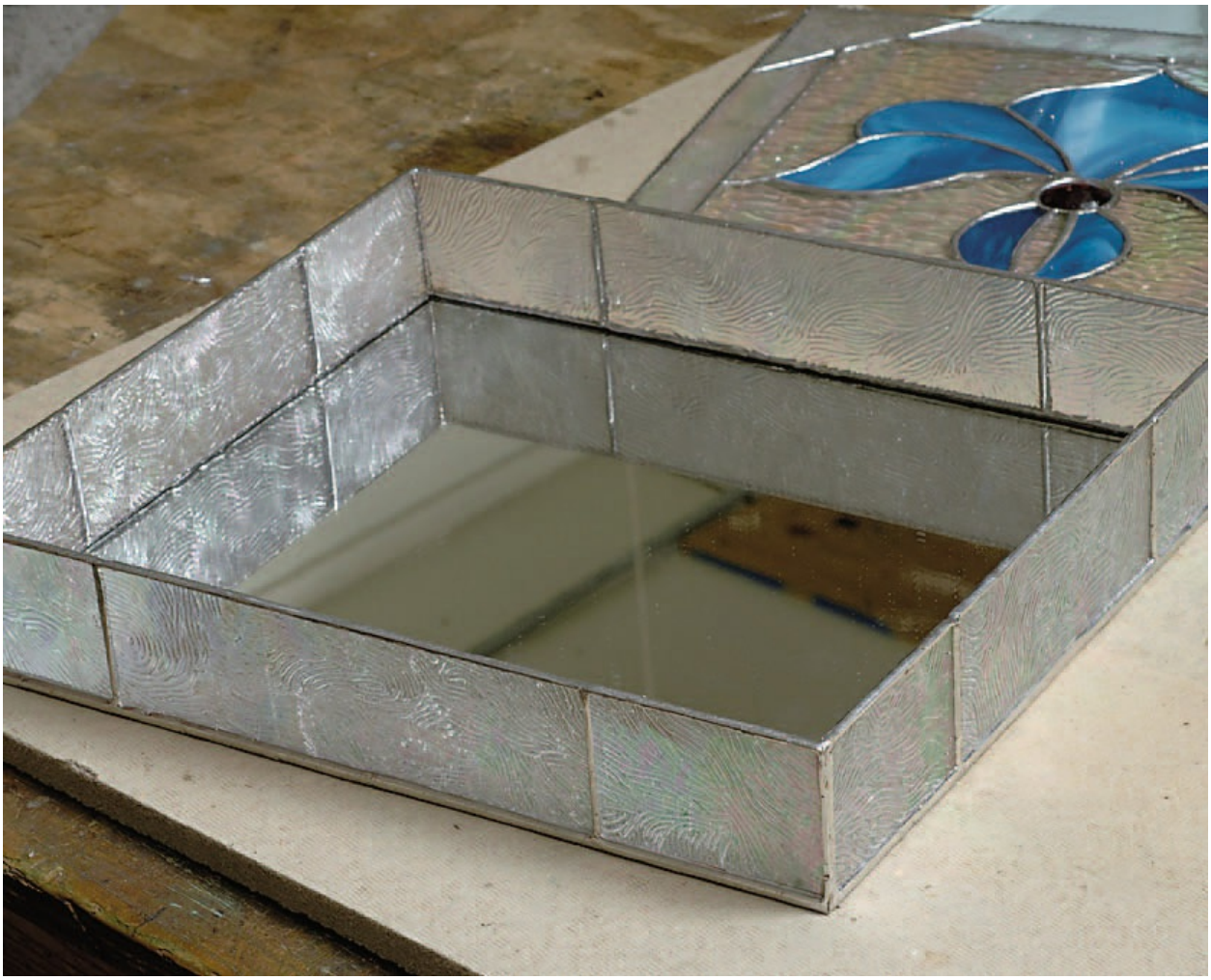

WARNING

69. Flux the inside seams.

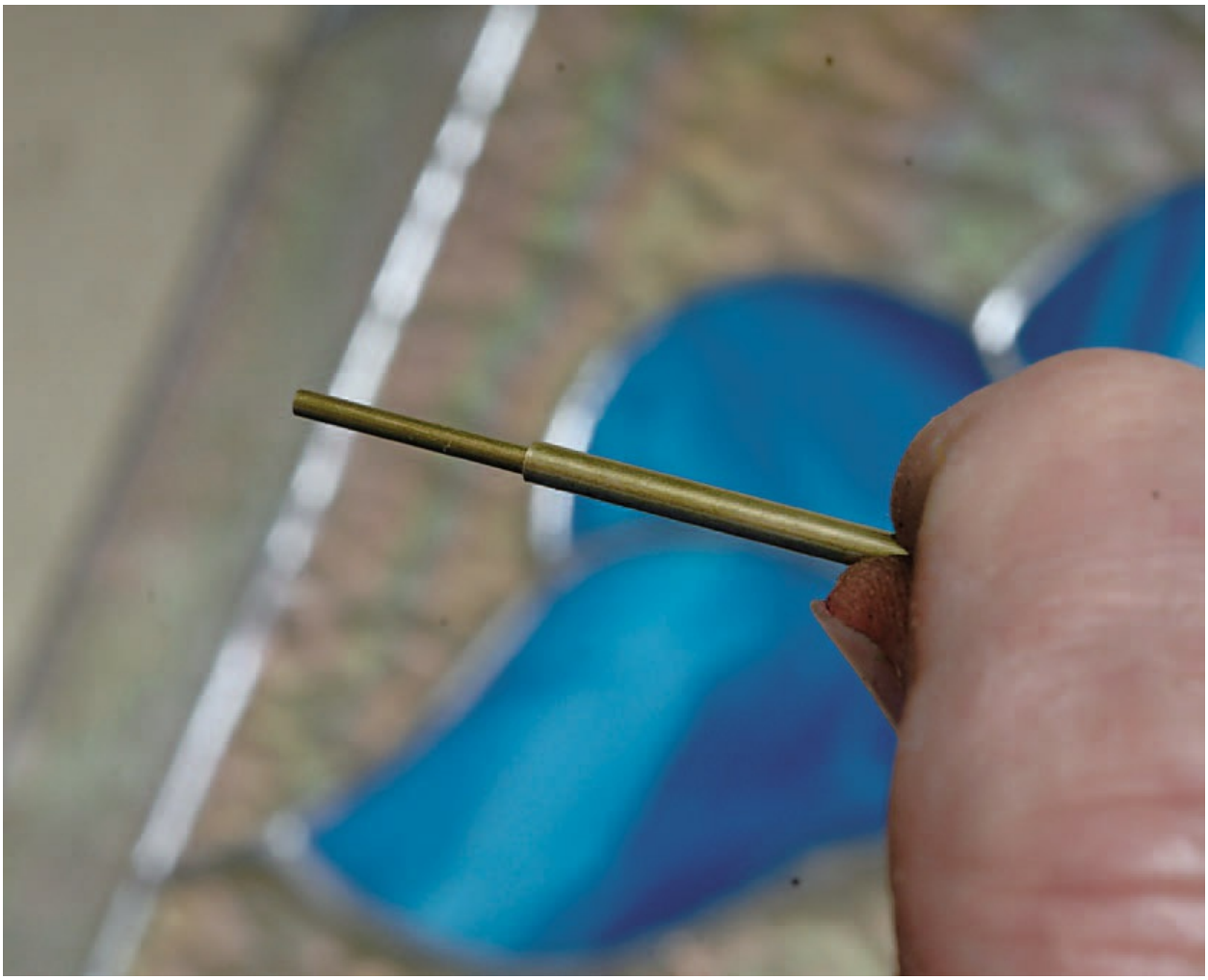

WARNING

70. Solder them, too.

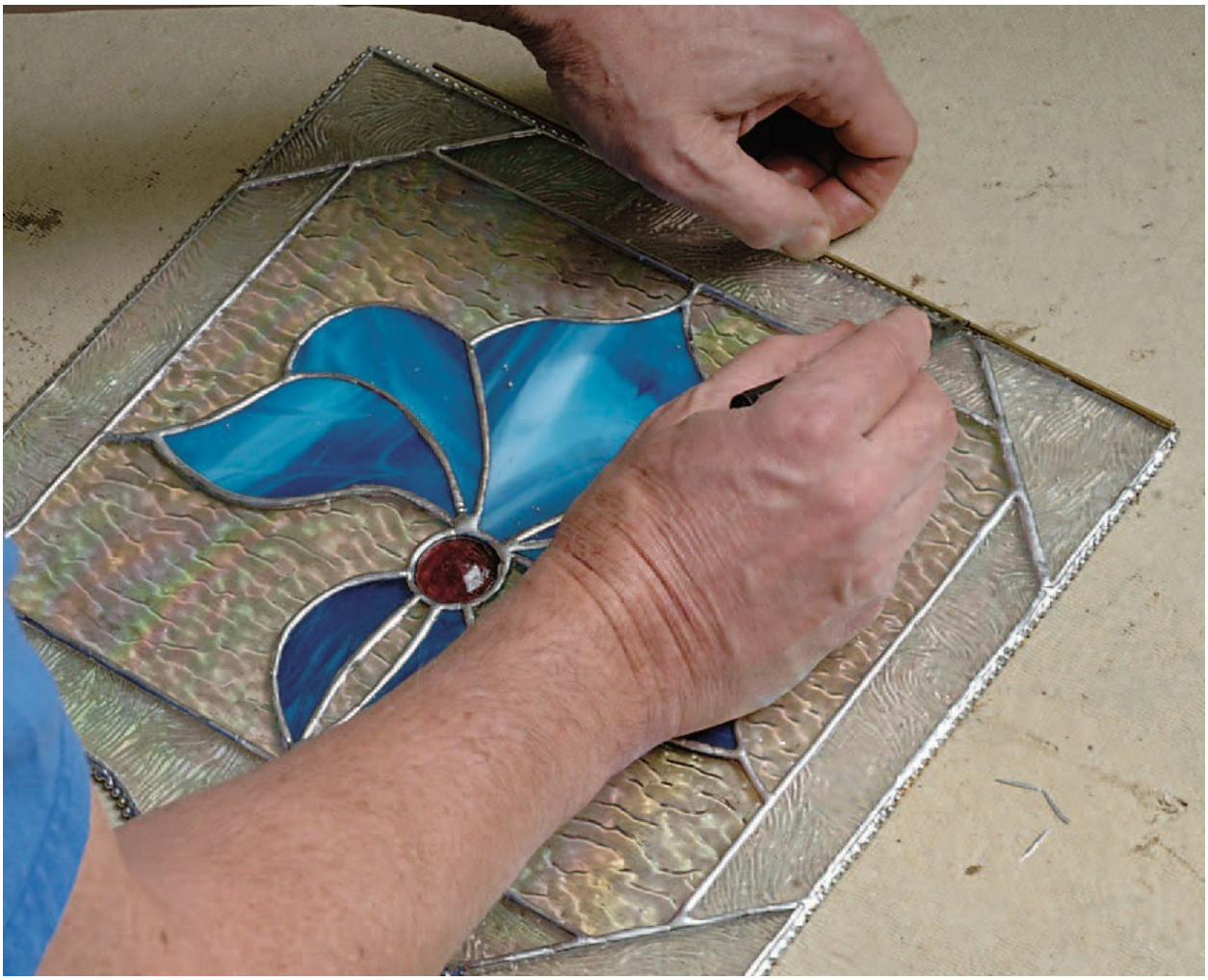
When you're finished, every bit of copper foil should be covered. The mirrored bottom will be firmly attached to the sides of the box.



The box's lid will be attached using copper hinge tubes. These tubes come in a variety of diameters. The two sizes used for this project allow the smaller one to fit snugly inside the larger one.



71. To prepare the tubes, lay a length of the larger tube along the back edge of the lid with the end of the tube approximately 3/16 inch away from the edge of the lid.



72. Make a mark on the tube about 3 ⅛ inches from the end. You can use a marker or an X-Acto knife to make a scratch.

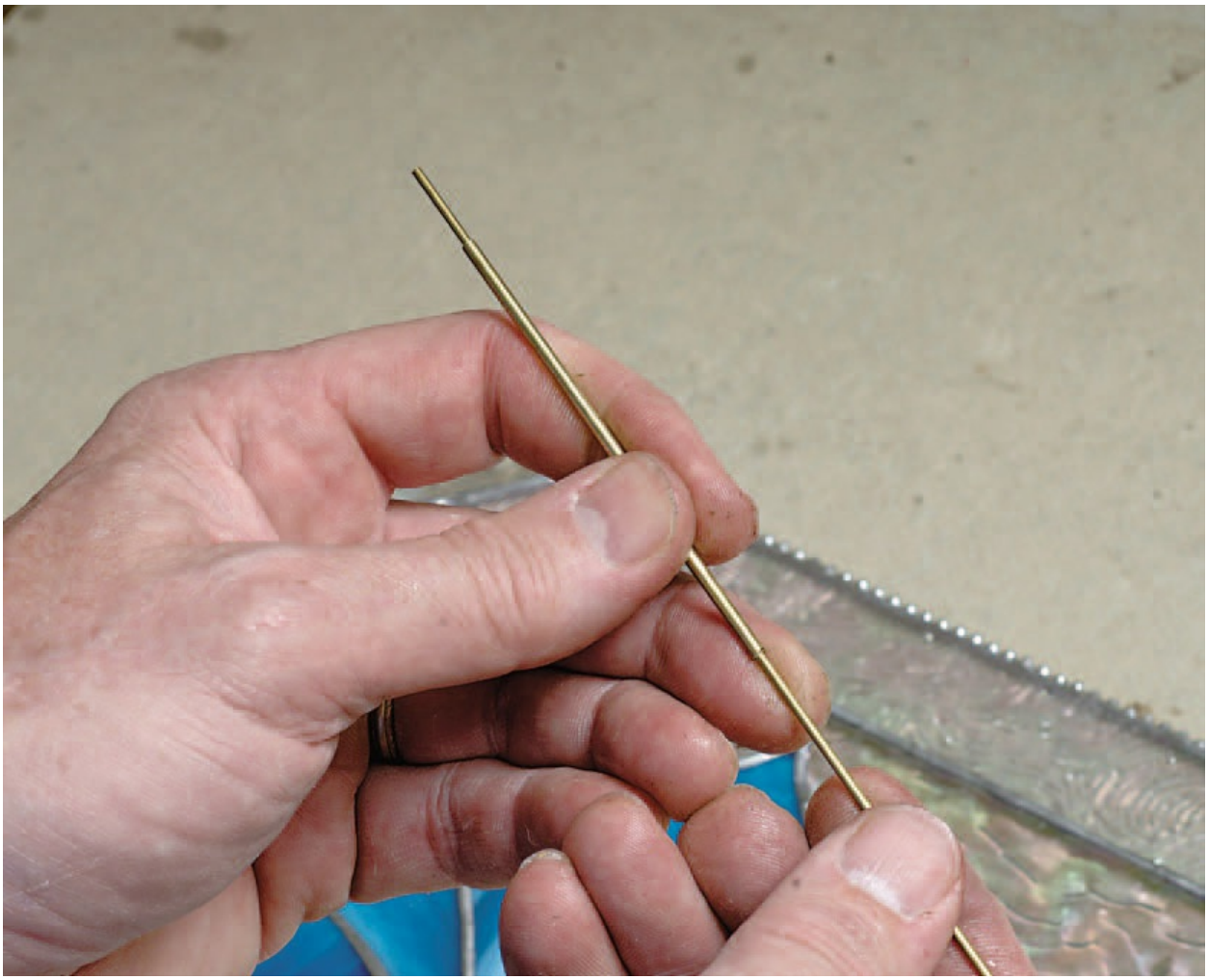
73. Next, score the tube with the knife. To do this, lay the tube flat on your work surface and press the sharp edge of the blade on the mark. Pull it toward you. Do this two or three times to make an indention.

74. Snap the tube in two. It should break cleanly where you scored it.

75. Mark, score, and break off a second piece of larger tube the exact same length.

76. Next, insert a length of the smaller tube inside one of the cut pieces of larger tube.

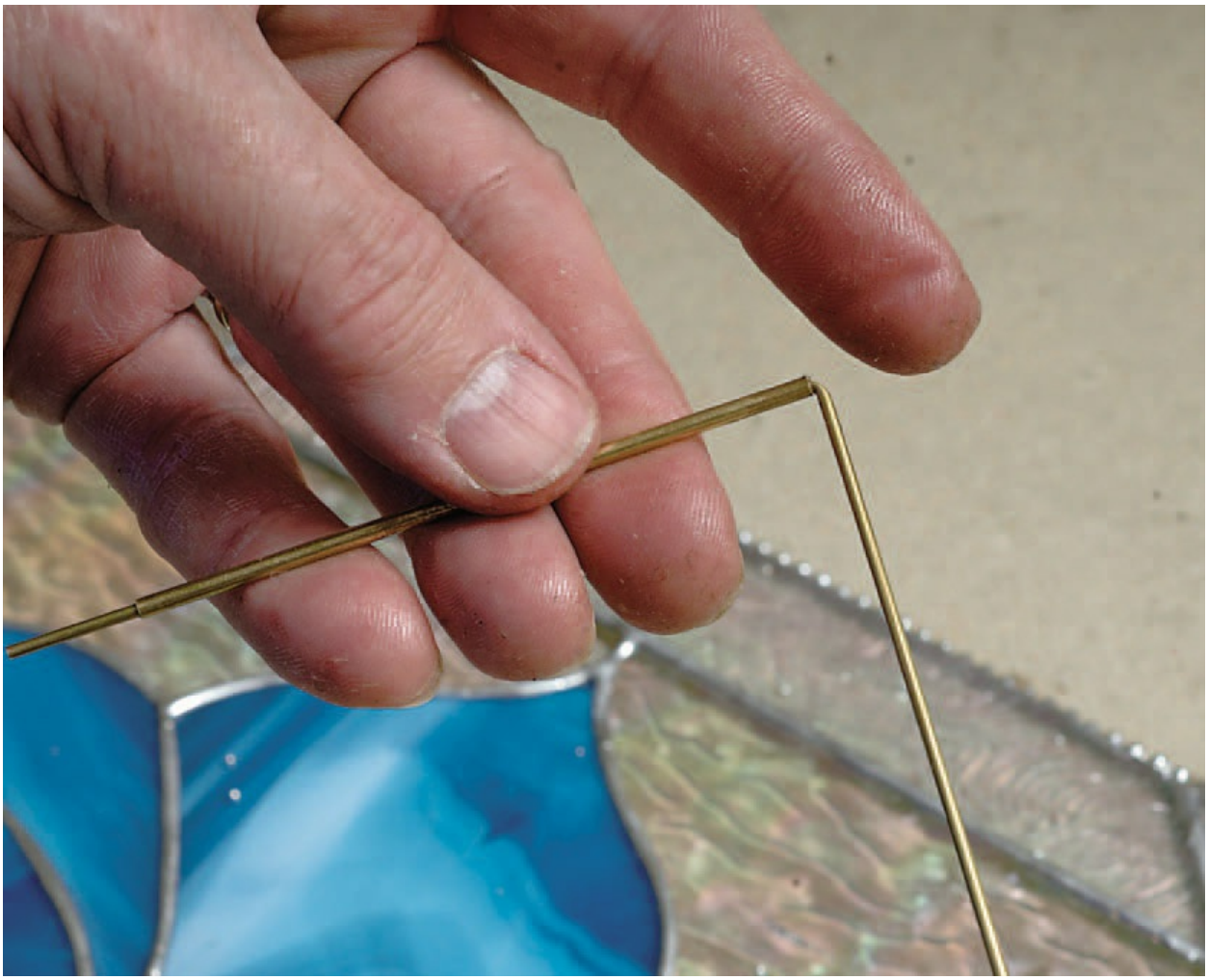
77. Push it through so it sticks out the other end, about ½inch.



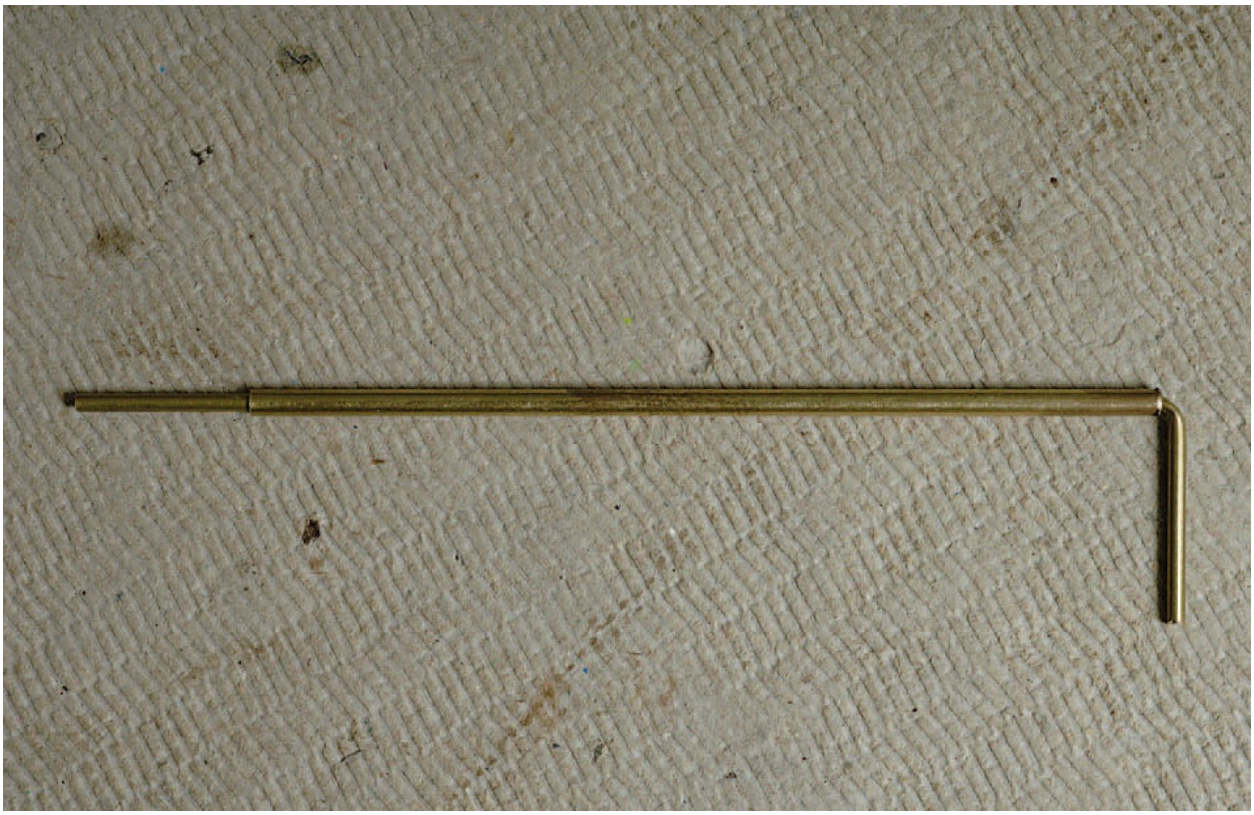
78. Hold this ½ -inch length between your fingers; with your other hand, use needle-nose pliers to grip the long end of the smaller tube just beyond the edge of the larger tube.

79. Turn the wrist of the hand that's holding the pliers to bend the smaller tube.

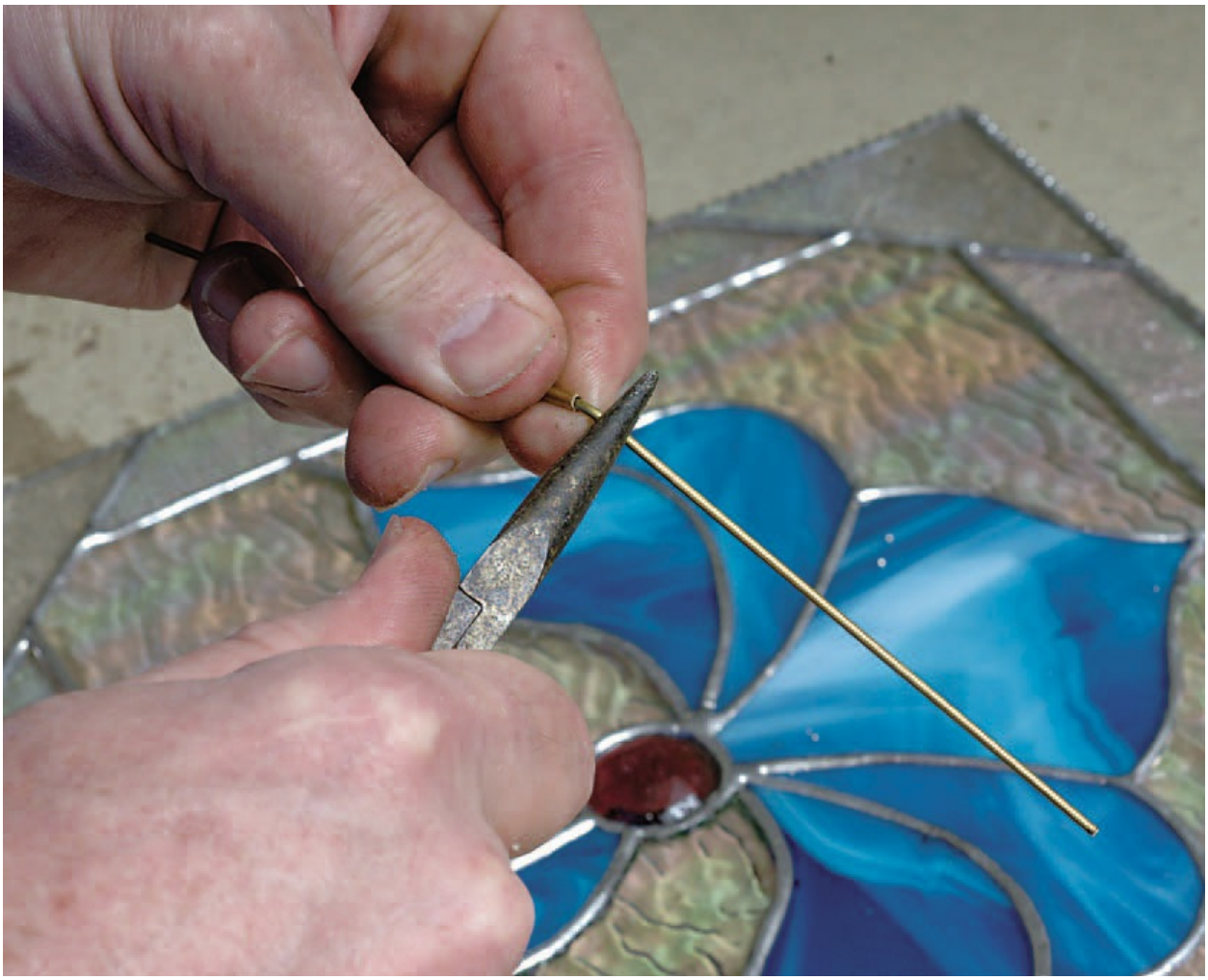
80. Stop when you've made a 45-degree angle (if you bend it further, there's a good chance it will snap).



81. Mark, score, and break off the smaller tube so that ¾ inch extends beyond the bend, as shown. Notice that ½ inch of small tube still extends straight out of the other end of the large tube.



82. Make a second hinge the same way you made the first.

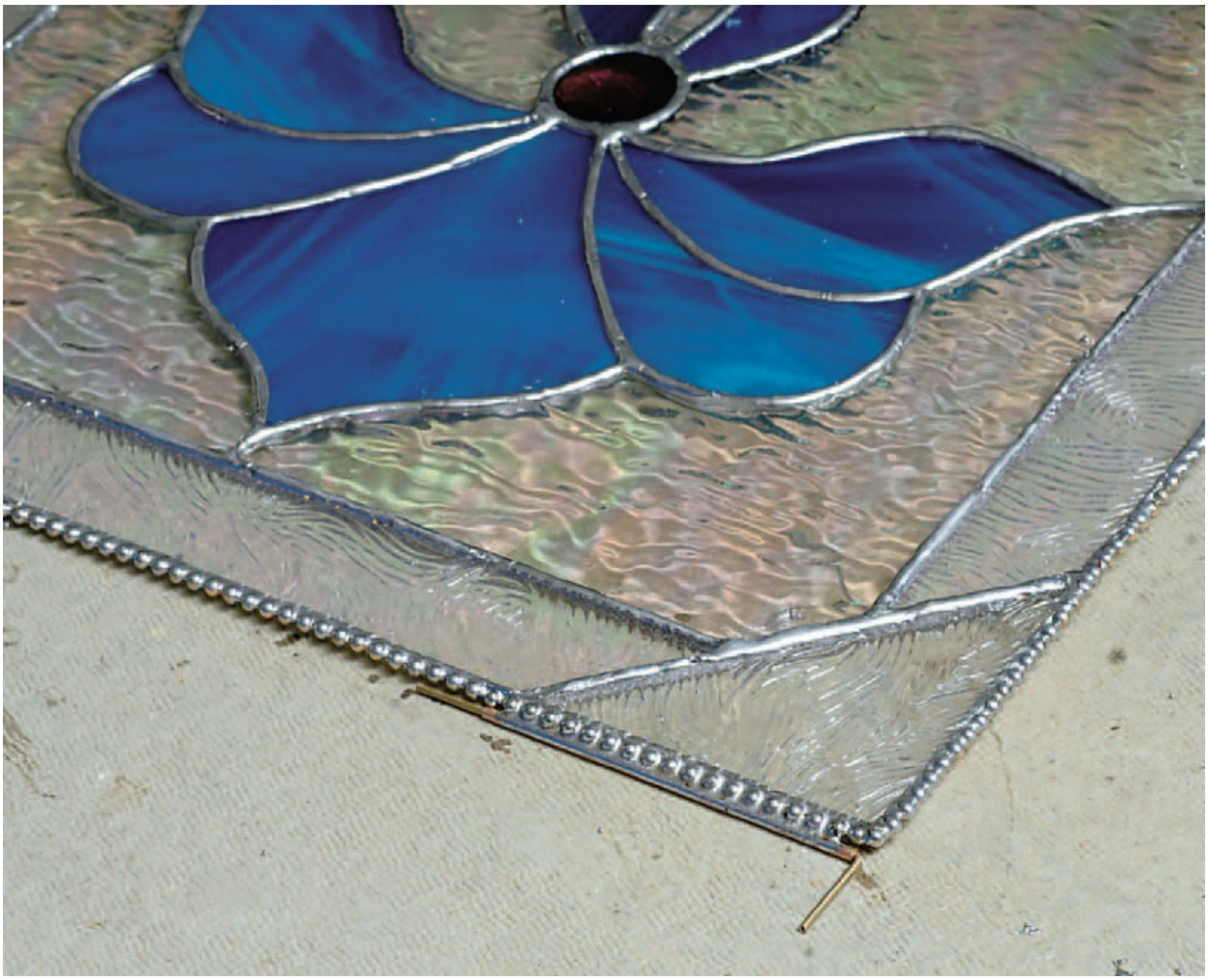


83. These tube arrangements will form the lid's two hinges. You will solder the larger tubes to the back edge of the lid near the corners.

84. Lay one large tube alongside the lid edge so it stops 3/16 inch from the lid's end and then flux the tube.

85. Tack solder the tube to the lid at each end, keeping the solder a few millimeters away from the very ends of the tube—you don't want to solder the large and small tubes together.

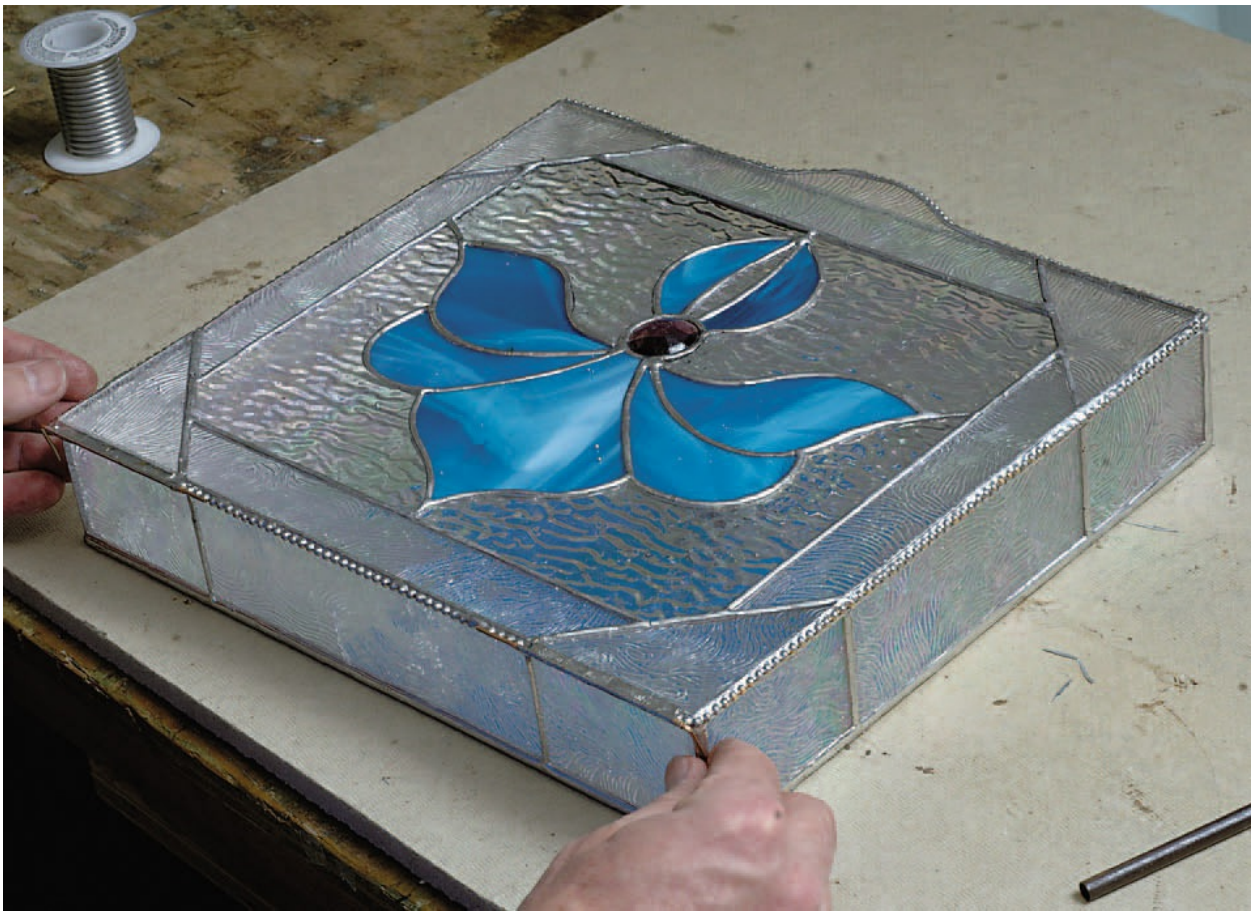
86. Solder the seam between the two tacked spots.



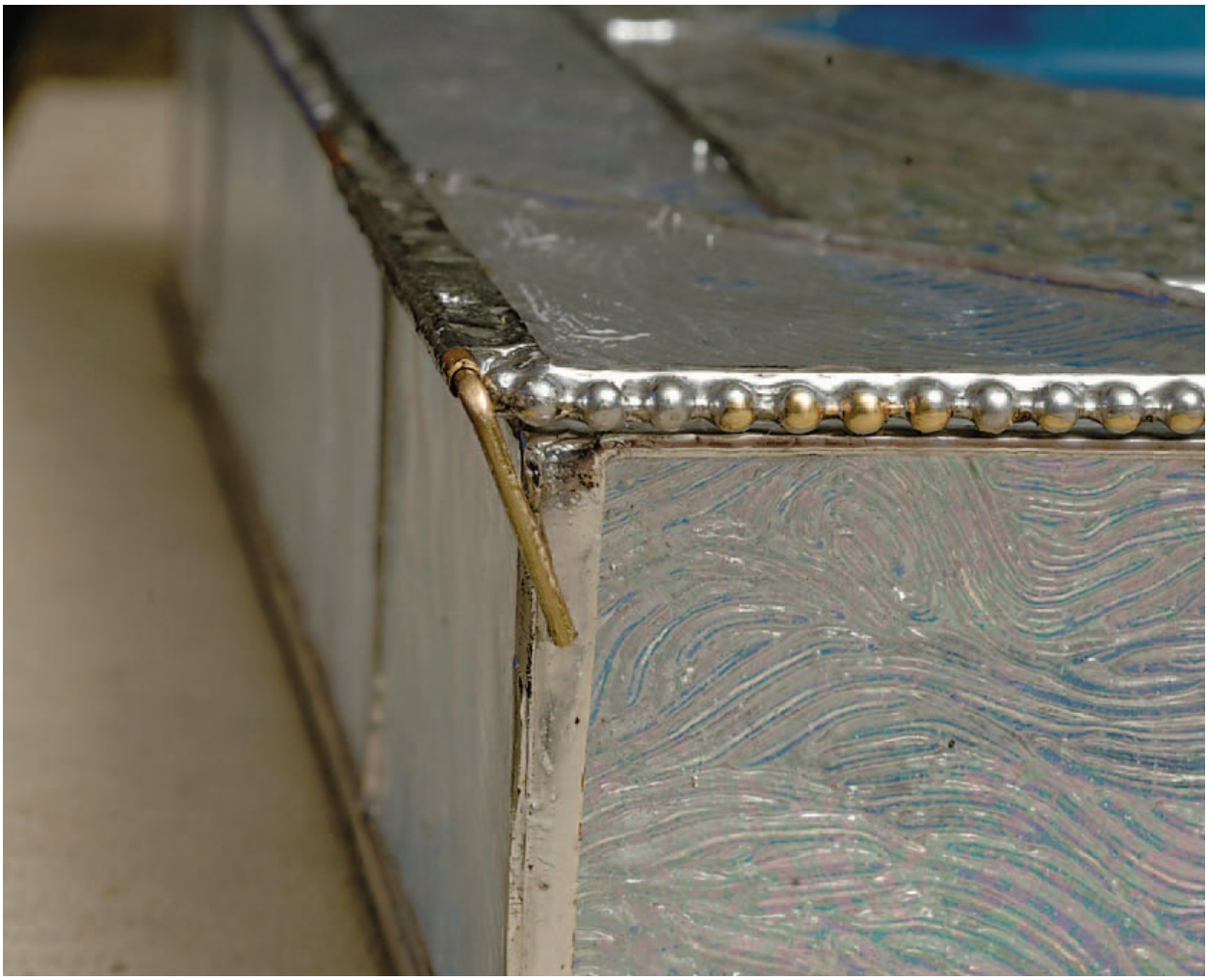
87. After you've soldered the tube, make sure the smaller tube still turns within it.

88. Attach the second hinge at the other side of the lid the same way.

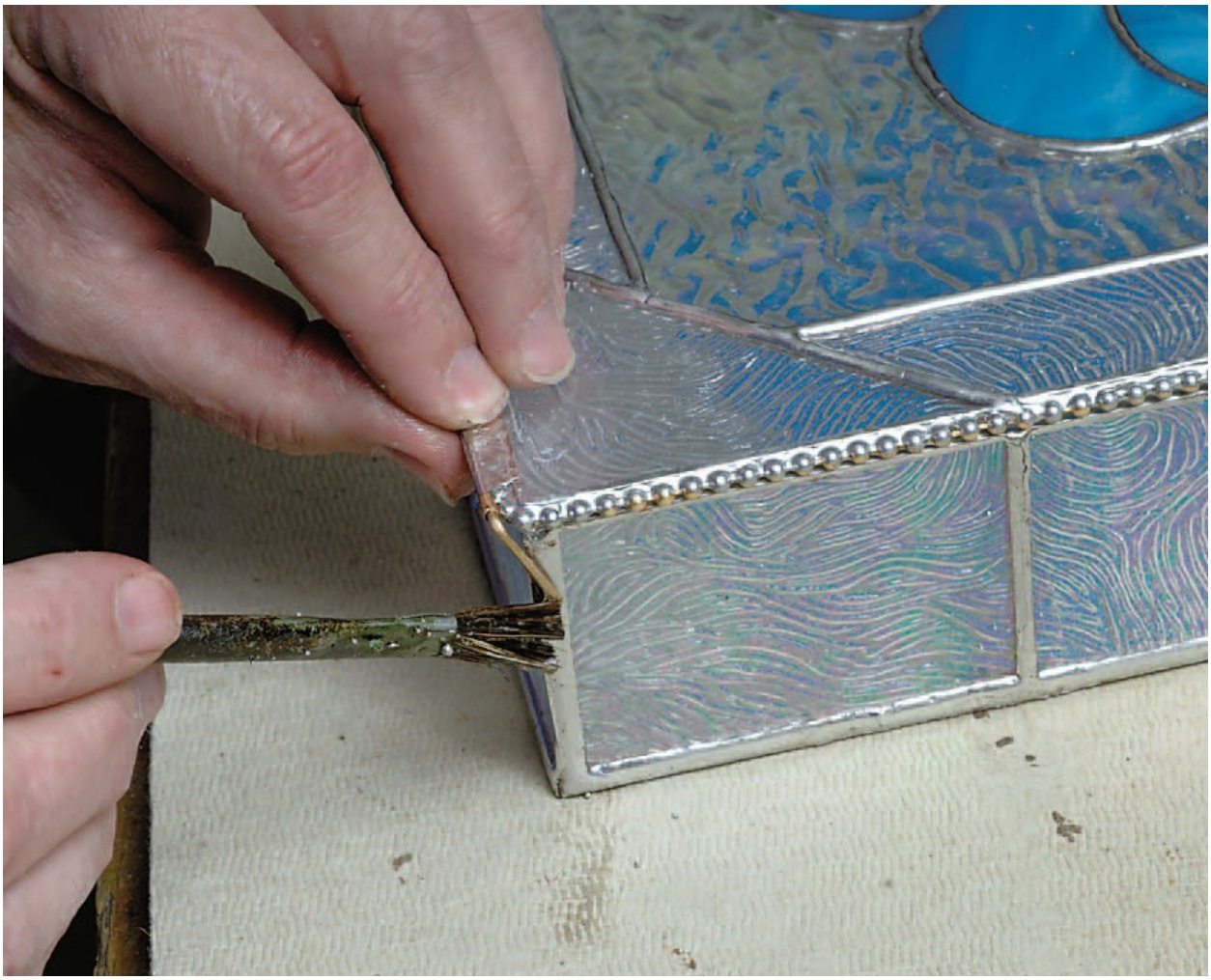
89. When the hinges are attached to the lid, lay it on top of the box to make sure that everything aligns.



90. Use your fingers to turn the bent part of the small tubes downward so they touch the box's corner seam, as shown. The tube should angle toward the front somewhat— this will allow the lid to open and close properly.

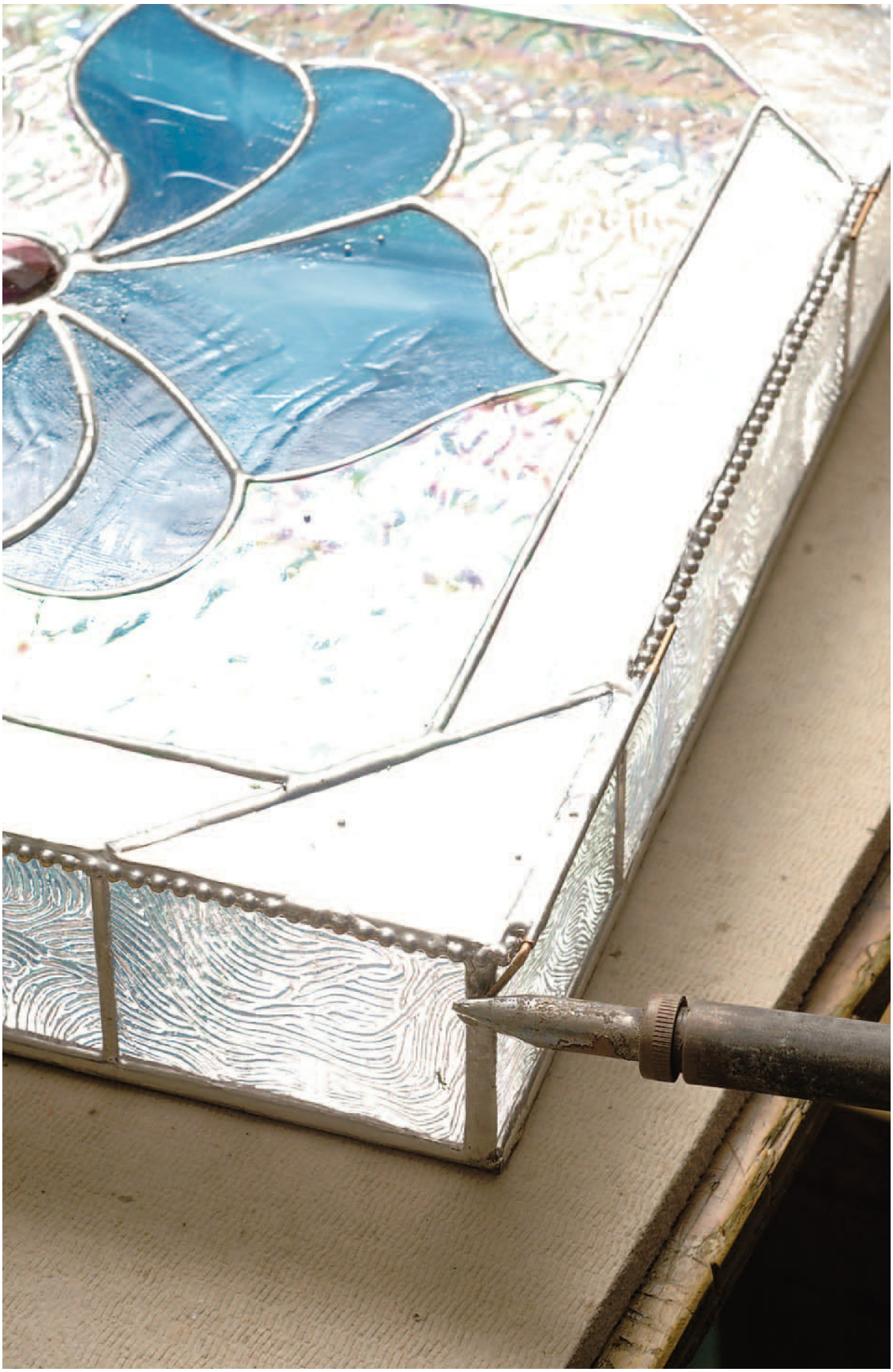


91. Flux the bent tube.

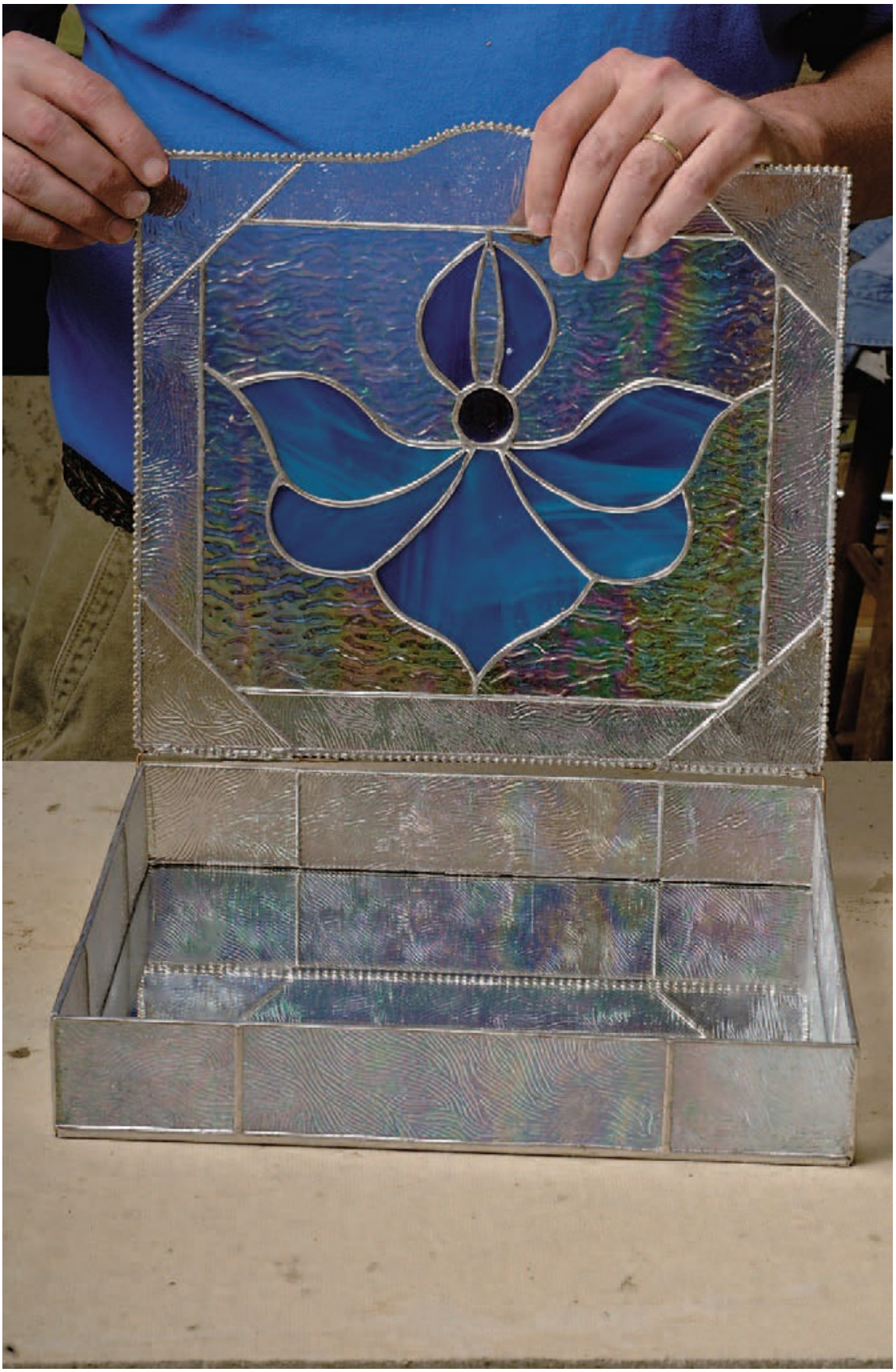


92. Tack solder it to the seam.

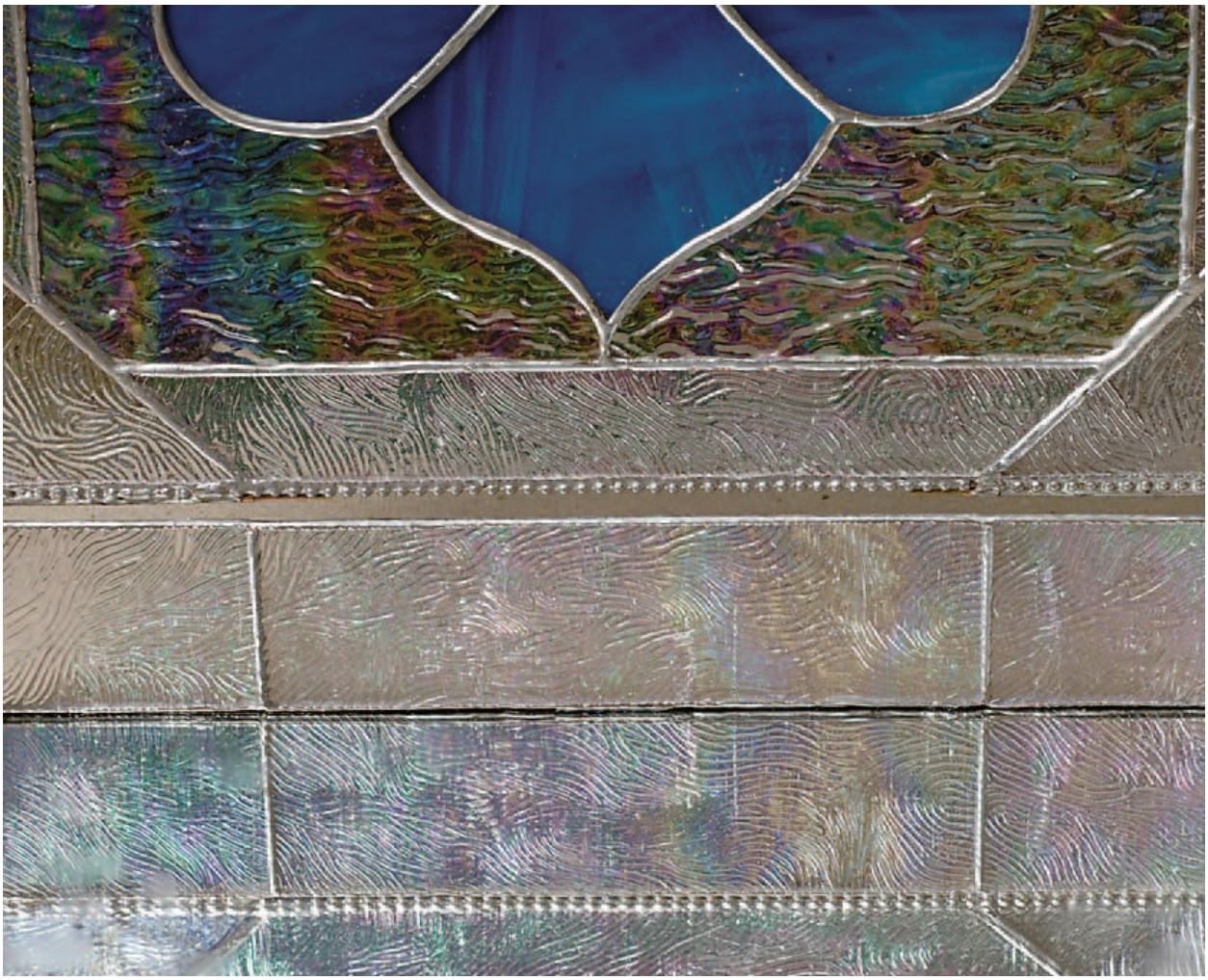
93. Do the same to the other hinge.



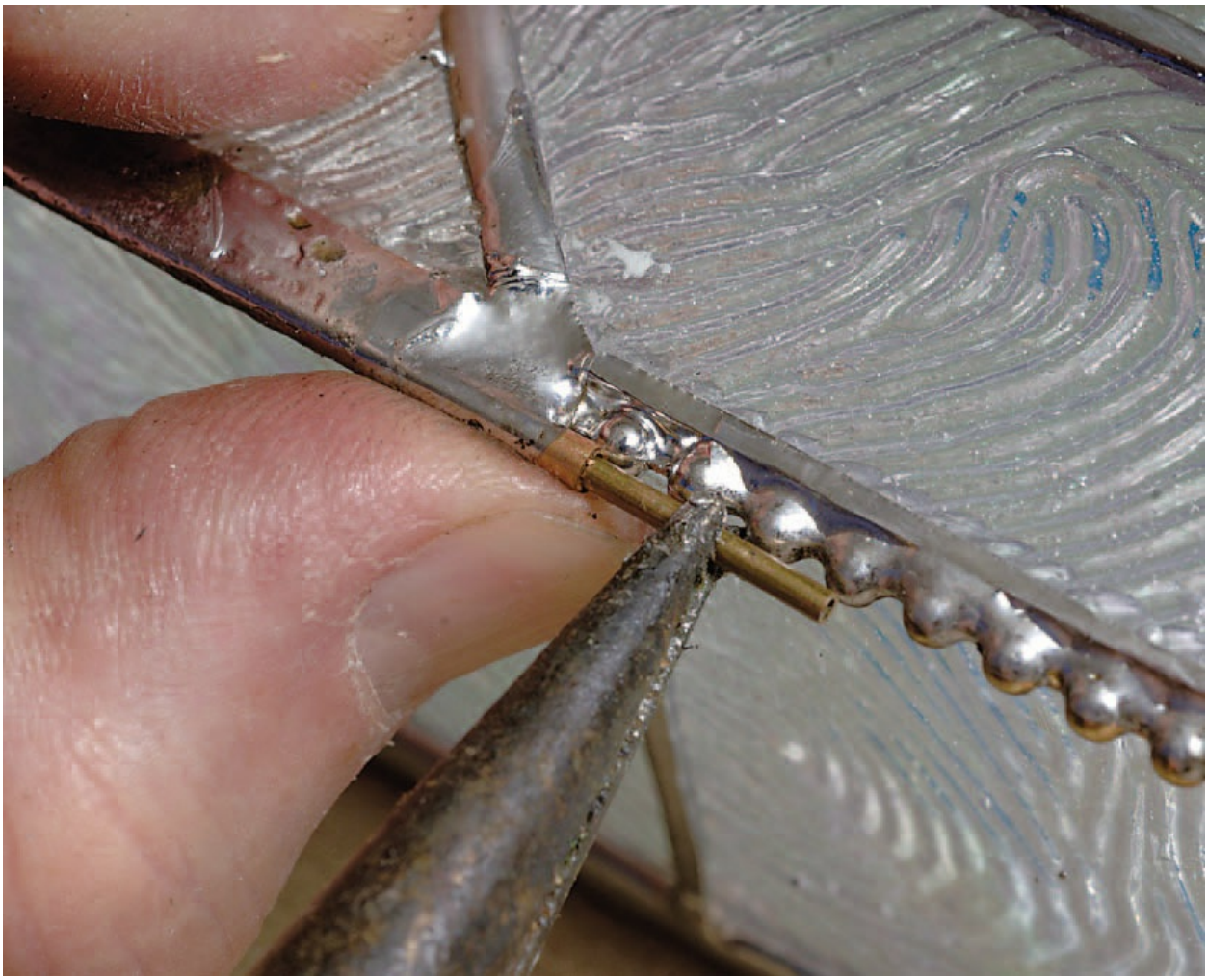
94. The lid should open and close easily.

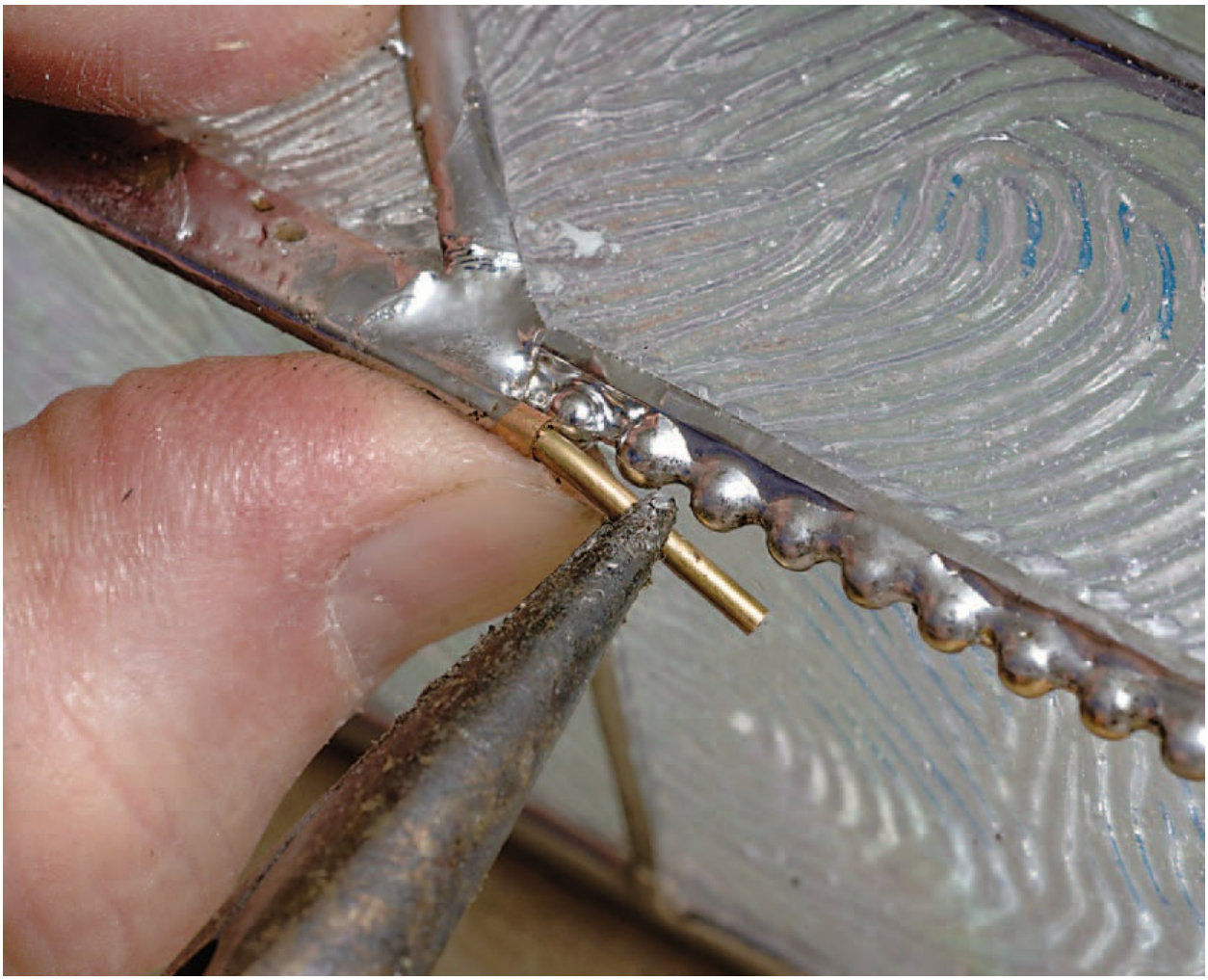


95. The angled hinge tube creates a gap between the back of the box and the back edge of the lid.

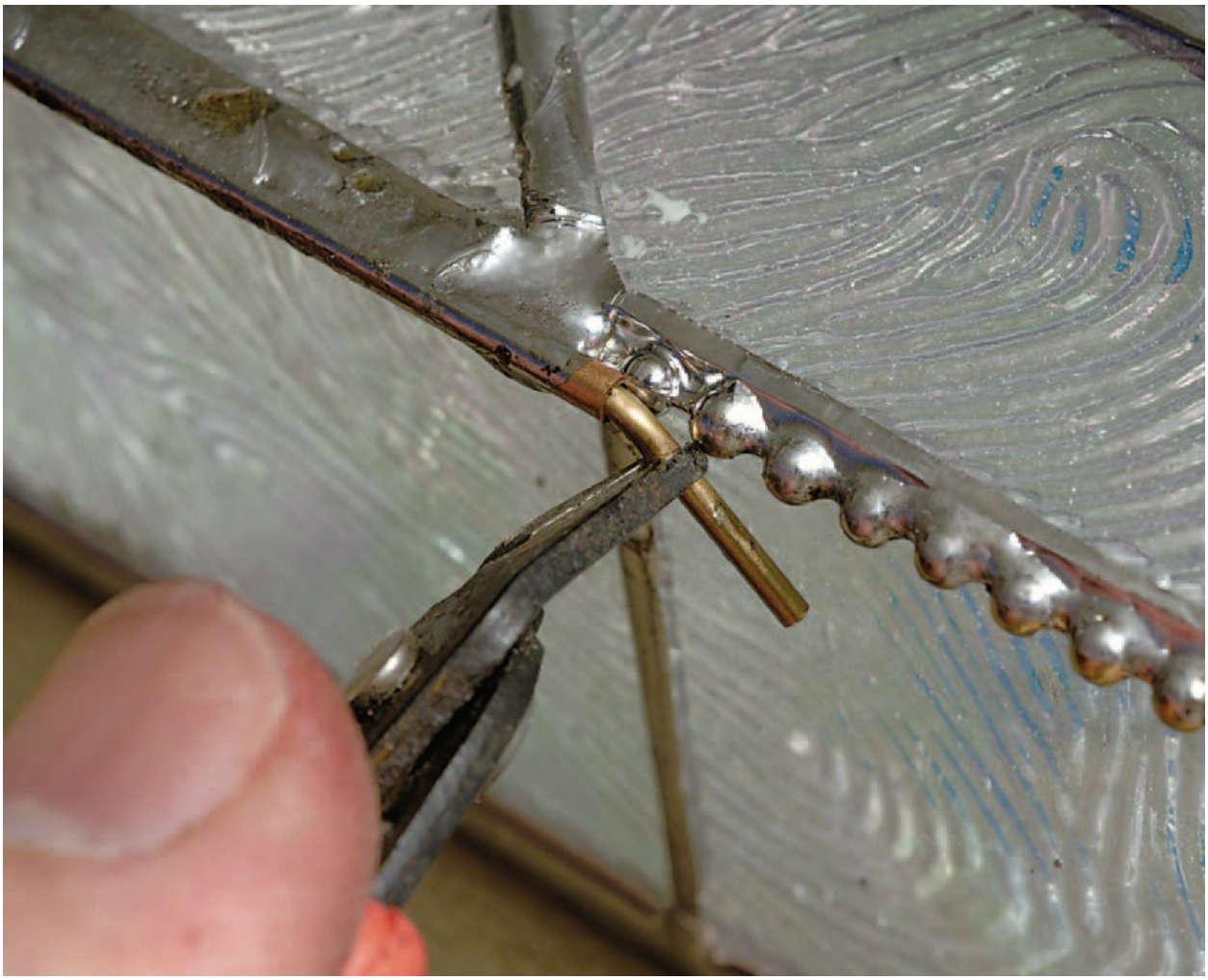


96. On the back of the box, use needle-nose pliers to grip the straight length of small tube that extends beyond the large tube and bend it downward to about a 30-degree angle.





97. Snip off the tube, leaving about ⅛ inch of bent tube sticking out. This will be enough to hold the tubes in place.



98. Bend and trim the other small tube the same way.

Premade legs will be attached to the four corners of the base of the box. These legs are made of brass and are usually sold individually. Tinning the legs will make them match the silver of the box's seams.

99. To tin the legs, first brush them with flux, covering both sides.

100. Then, hold one leg with pliers and get a hunk of solder on the hot iron.

101. Allow the solder to flow over the surface of the leg.

102. Do both sides.

103. Cover each leg completely and then set them aside.

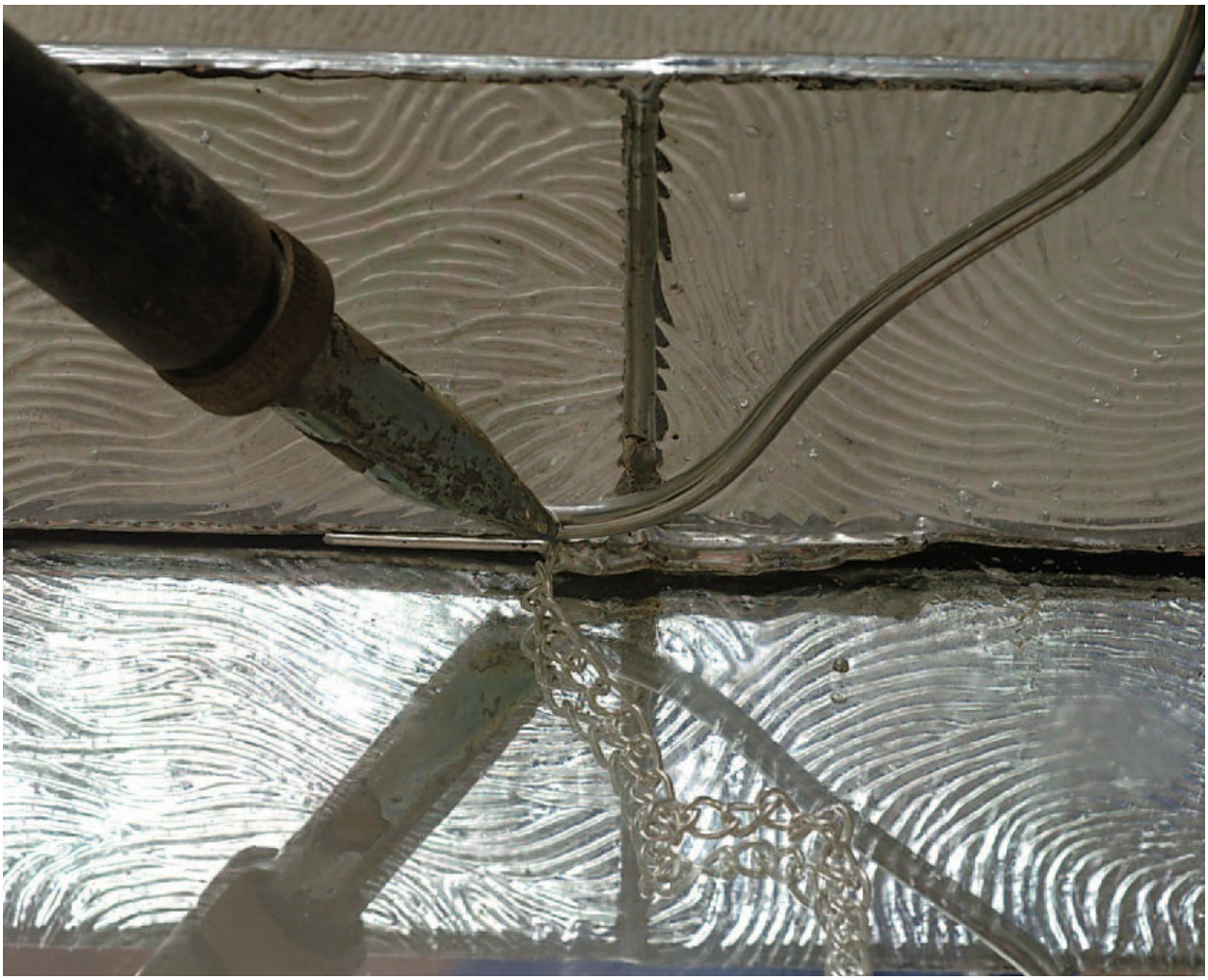
104. To keep the box lid from opening all the way, you will attach a silver chain to it with a thin silver bar (you could also use a tinned copper tube). Thread the bar through the second to last link in the chain, as shown.

105. Flux the threaded link.

106. Tack solder the chain and bar together.

107. Place the bar and chain inside the box so the bar lies along the right-hand side of the base, as shown; the threaded link should align with the side seam nearest the front of the box.

108. Tack solder the threaded link to the seam.



109. Solder the length of the bar to the bottom seam.

110. The chain should hold the lid open at an angle slightly greater than 90 degrees. Open the lid to the proper position and note where the chain hits a seam that will keep the lid in that position. The spot should be about a third of the way down from the top.

111. Trim the chain at the spot where it touches the seam.

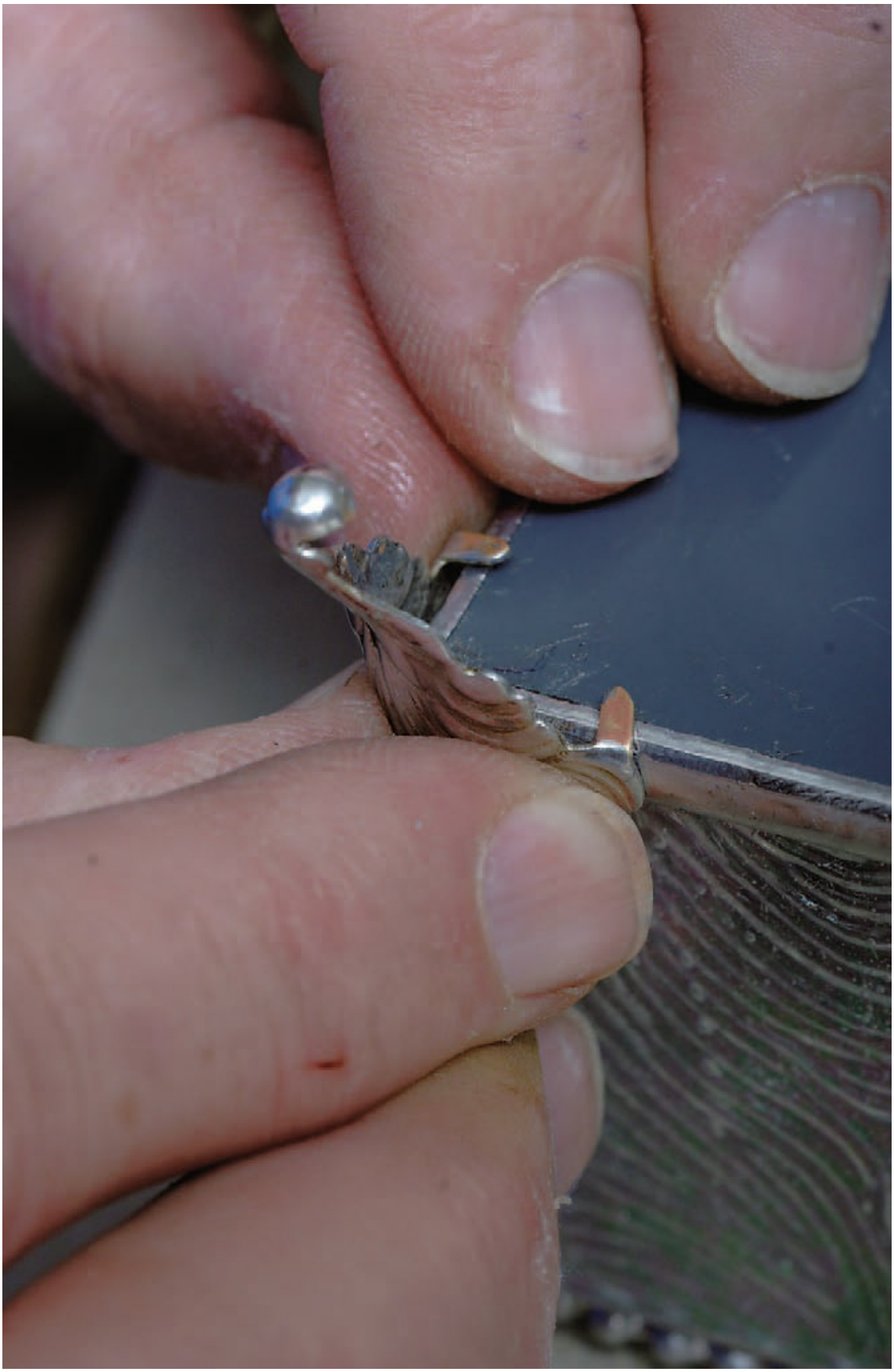
112. Lay the box on the back of its lid, propping the rest of the box up with a foam block. Flux the spot on the seam where the chain touches the lid.

113. Solder the end of the chain in place.

114. Make sure the chain is firmly embedded in solder.

115. If you’ve attached it correctly, the chain should hold the lid open.

116. Shut the lid and turn the box over. Fit one of the tinned legs onto the bottom’s corner, as shown.



117. Flux the seam between the leg and the box.

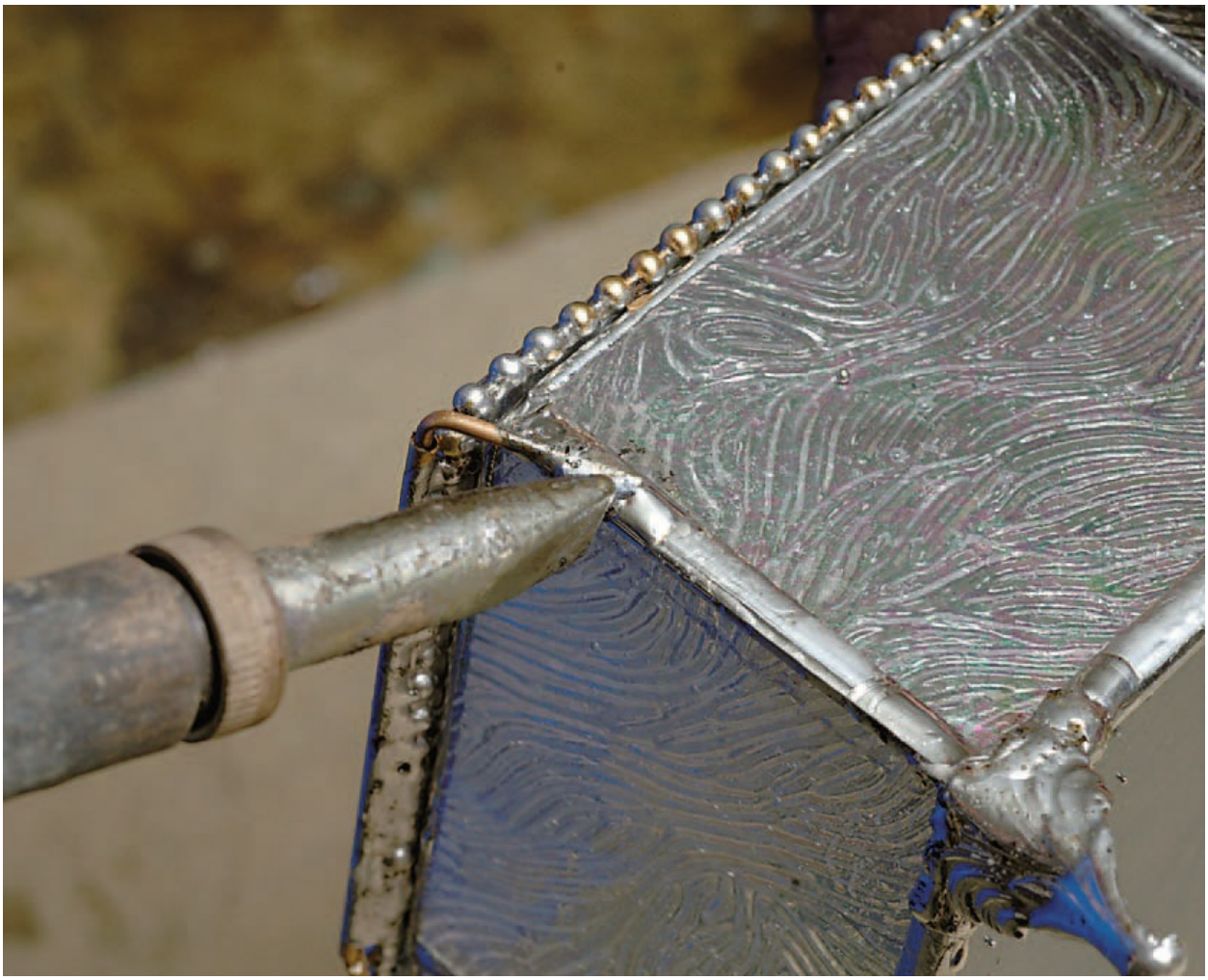
118. Solder the leg in place by soldering the sides of the leg first.

119. Then solder the top of the front of the leg.

120. Then the top of the back of the leg.

121. Attach the other three legs the same way.

122. Finish soldering the hinge's joints, making certain they still work after you're done.



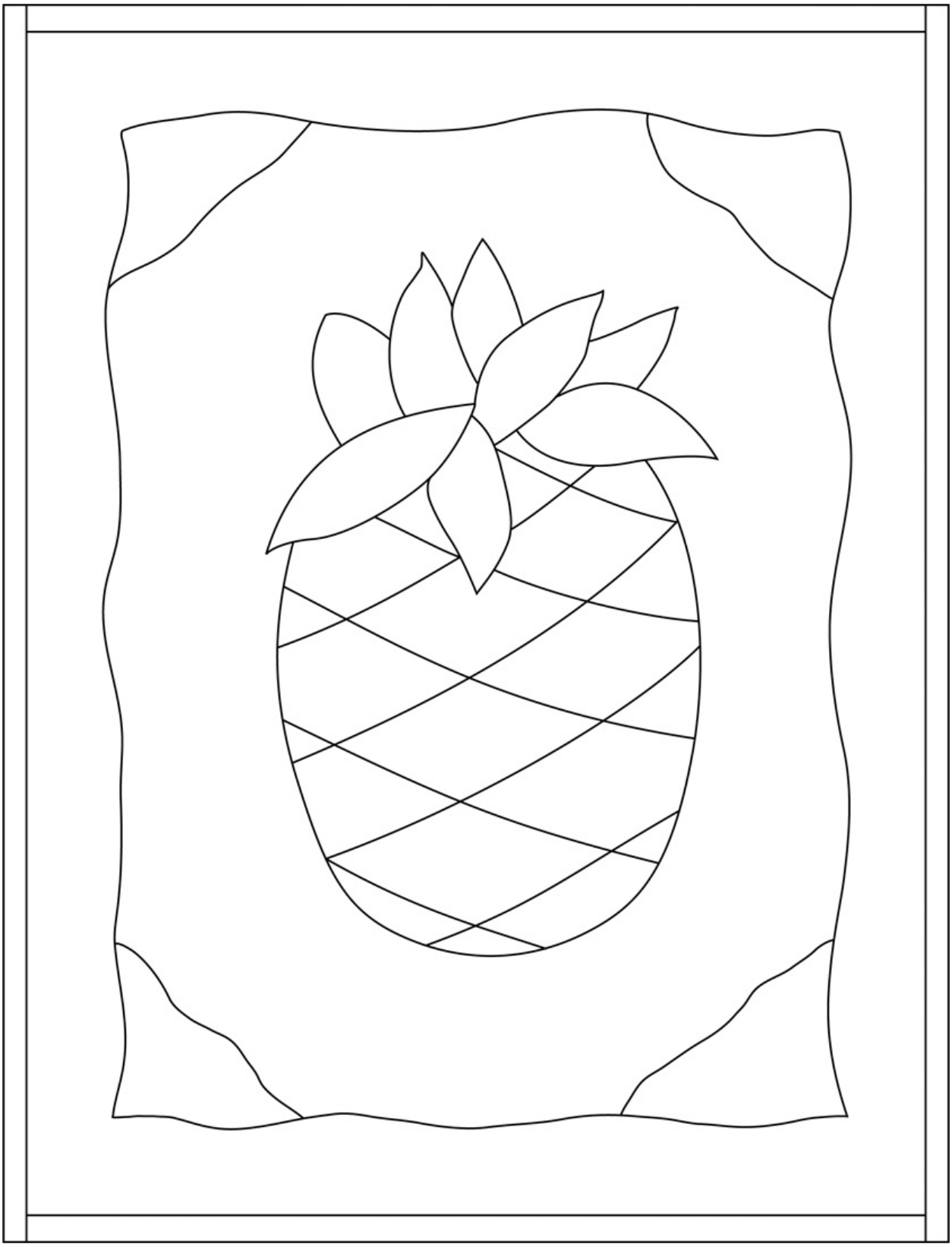
The finished box.

7

Stained Glass Mosaic

Using stained glass to make mosaics allows you to create all kinds of projects: decorative wall hangings, table or bar tops, kitchen or bathroom backsplashes, picture frames—any number of useful items. The base of this mosaic is a piece of plywood, which could be cut to any shape you wish. Waterproof glue and ready-tomix grout are essential materials, as

is a selection of stained glass that looks interesting even if no light shines through it. A final finish protects your work of art.



Enlarge 150%

Materials and Equipment

ENAMEL PAINT

Used to cover the ungrouted edges of the base.

MOSAIC CUTTERS

The wheel-shaped blades of this tool cut stained glass cleanly and precisely. Tile nippers, which are used to cut ceramic tile, tend to crush

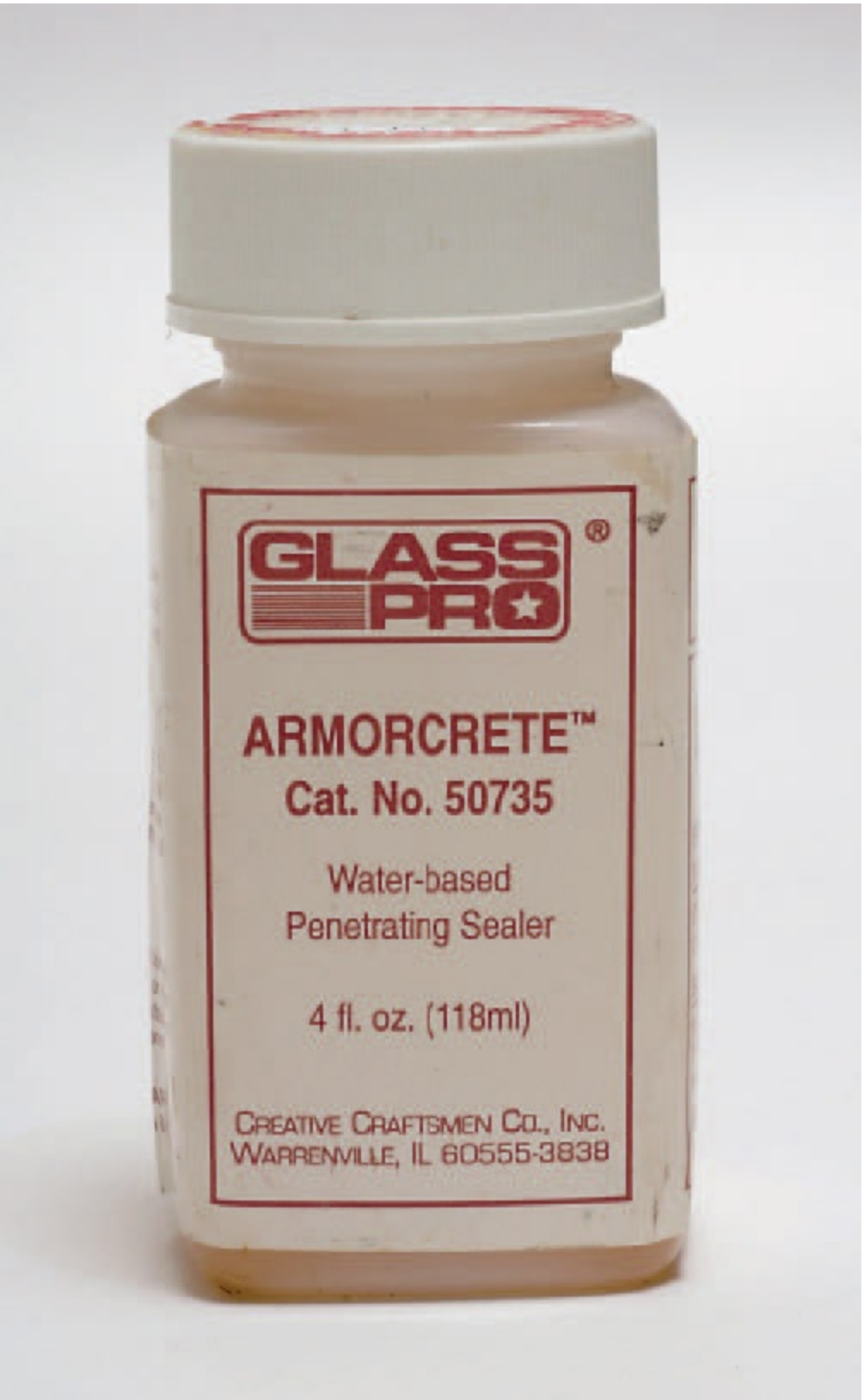
glass and shouldn’t be used for stained glass projects. Approximate cost: $18.

PENETRATING SEALER

A final coat of sealer will protect your finished mosaic.

GROUT

Grout comes in powdered form and in a variety of colors. In general, darker-colored grout looks best with stained glass. Approximate cost: $5 for a 2-pound container.


GLASS PRO®
ARMORCRETE™
Cat. No. 50735
Water-based
Penetrating Sealer
4 fl. oz. (118ml)
CREATIVE CRAFTSMEN CO., INC.
WARRENVILLE, IL 60555-3838

GROUT SPREADER

A flexible plastic grout spreader pushes grout into grooves as it is dragged across the surface of a mosaic.

WATERPROOF GLUE

Any durable waterproof glue that bonds glass and wood will work. Approximate cost: $5–$10.


Universal Space Age Adhesive
WELDBOND®
MORE
Than Great
Glue!
Glues: WOOD • TILE • GLASS
& Much More!
Seals: ALL POROUS SURFACES
Bonding Agent: For CONCRETE & PLASTER
BONDS MOST ANYTHING!

A ¾-inch plywood board, sawtooth picture hanger, hammer, carbon paper, pencil, ruler, small paint brushes, sponge, and old towel are also needed for this project.

Stained Glass Mosaic

An 18-inch-long, 13 ⅝-inch-wide, ¾-inch-thick plywood board forms the base of this piece. The thick plywood will not warp when it gets wet from the grout and is great for indoor items. (If you plan to keep your mosaic outside, it's best to use concrete backing board, which is readily available at home improvement centers.) The edges and corners of the board were rounded down and sanded with a handheld sander, which gives the finished piece a nicer appearance.

A sawtooth picture hanger attached to the back of the board will allow the mosaic to be hung on a wall. Hangers like this usually come with small nails.

1. Attach the hanger first—you won't be able to hammer on the back of the board after you affix the glass and grout. To attach the hanger, first measure the top edge of the back of the board and make a mark at the halfway point, as shown.

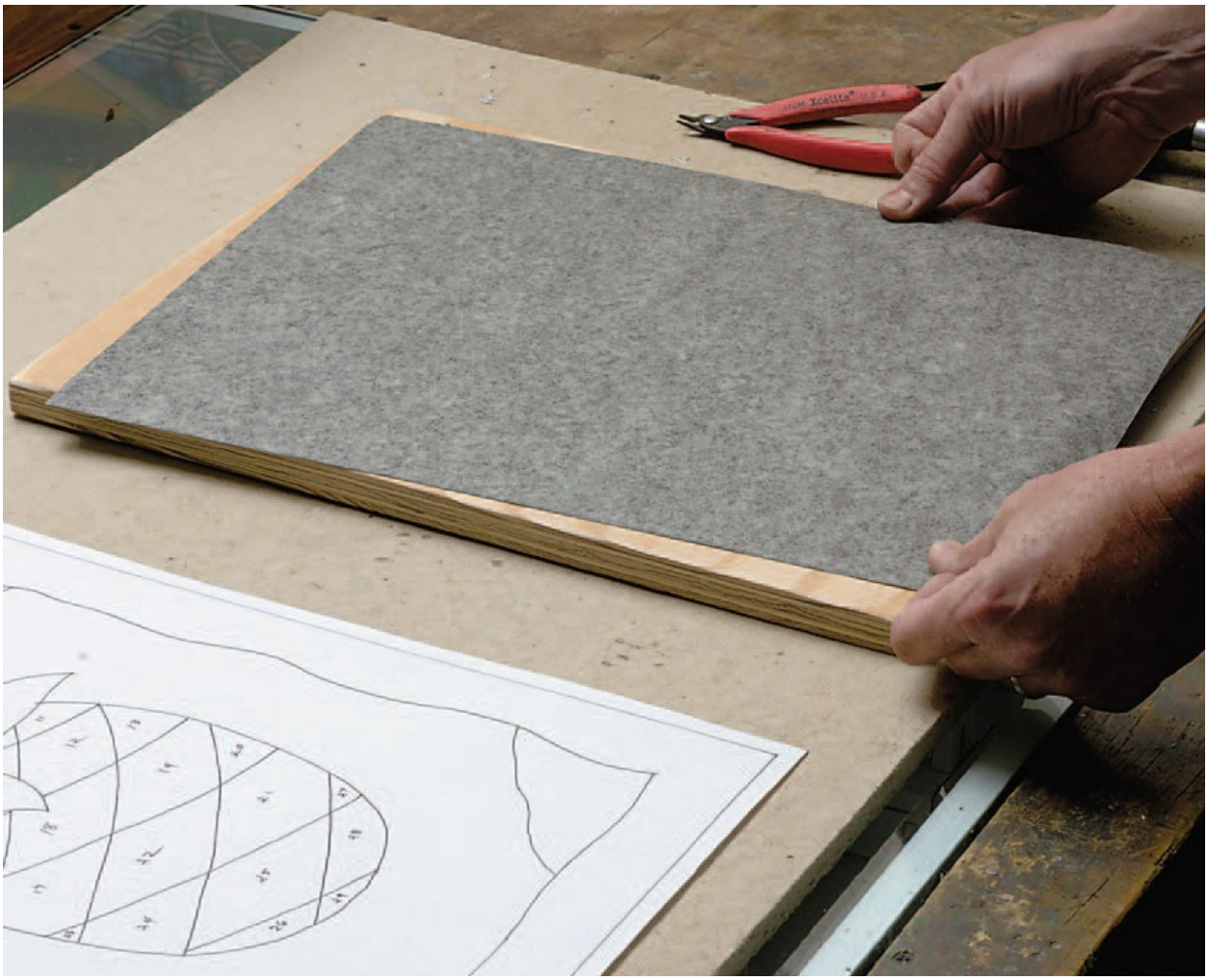
2. Measure down 1 inch from the top edge and make another mark at the halfway point.

3. Place the hanger so the second mark is lined up with the middle groove, as shown.

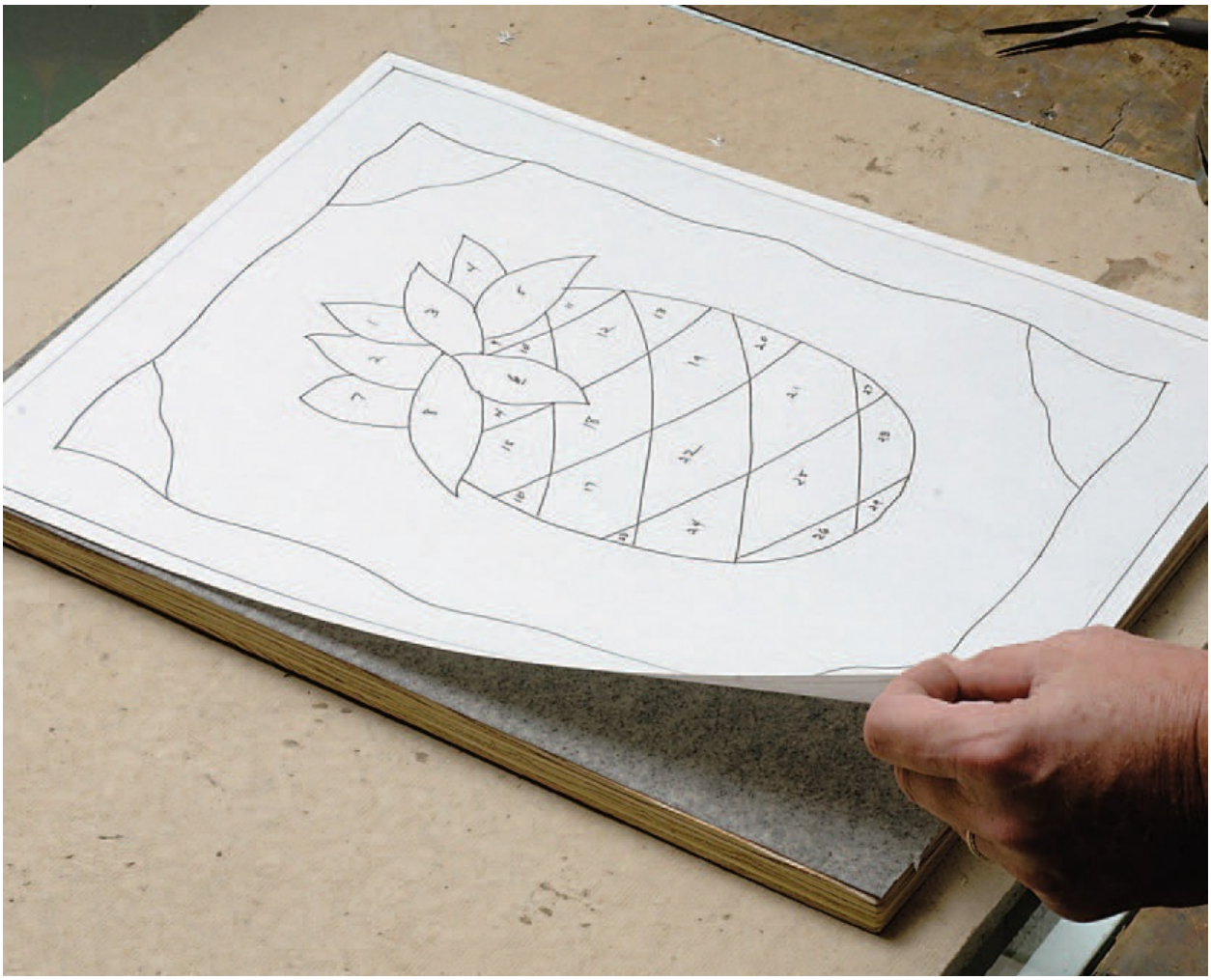
4. Fasten the hanger to the board using the nails. Holding a nail in place with needle-nose pliers as you hammer it makes the process easier.

5. The attached hanger should be parallel to the edge of the board.

6. Flip the board over and lay a sheet of carbon paper on top of it. It's easiest if the carbon sheet is cut to the same size as the board. The darker side of the paper should be facing the board.

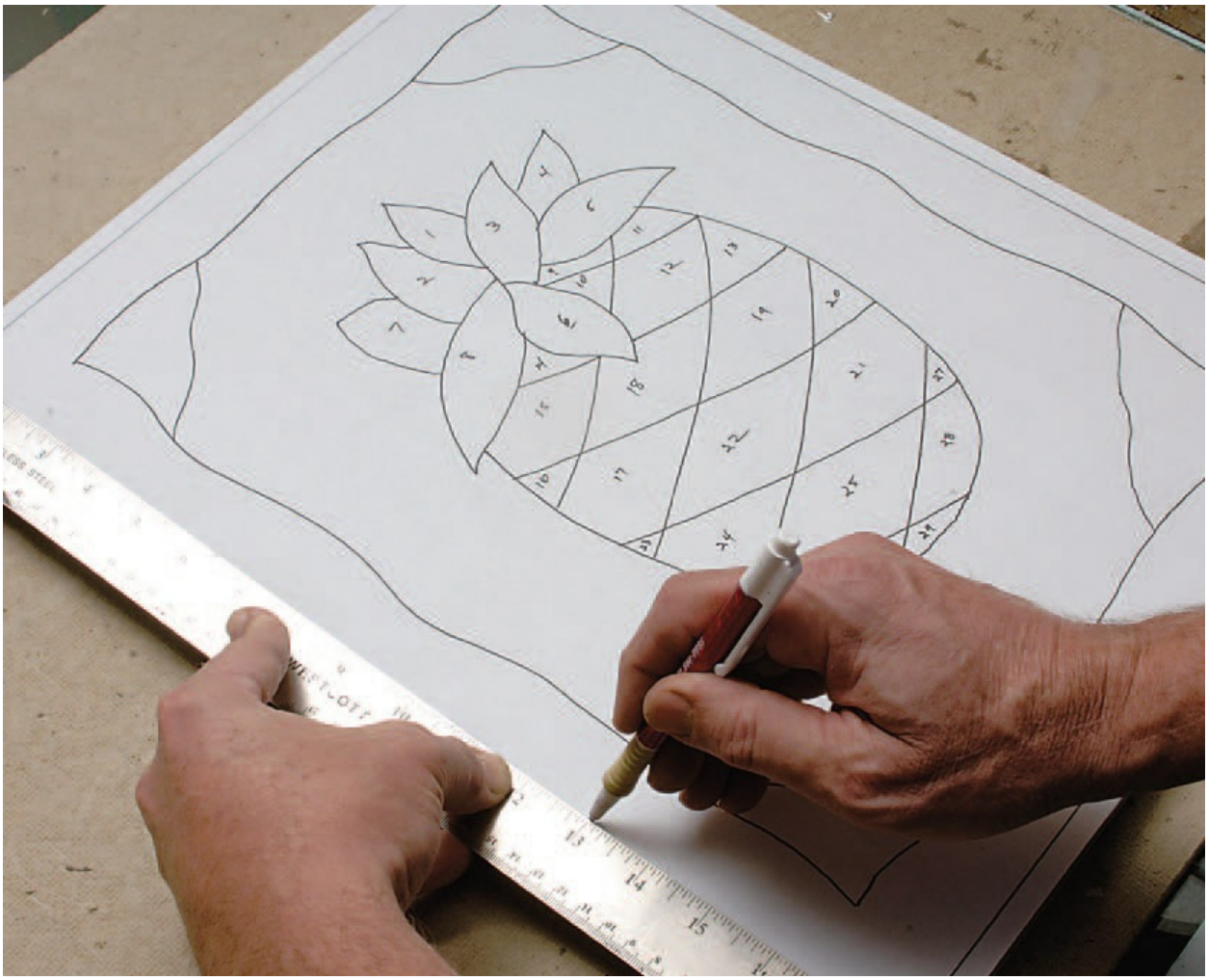


7. Number each piece on the pattern and cut it to the same size as the board. Lay it on top of the carbon paper and align both sheets with the board's edges.

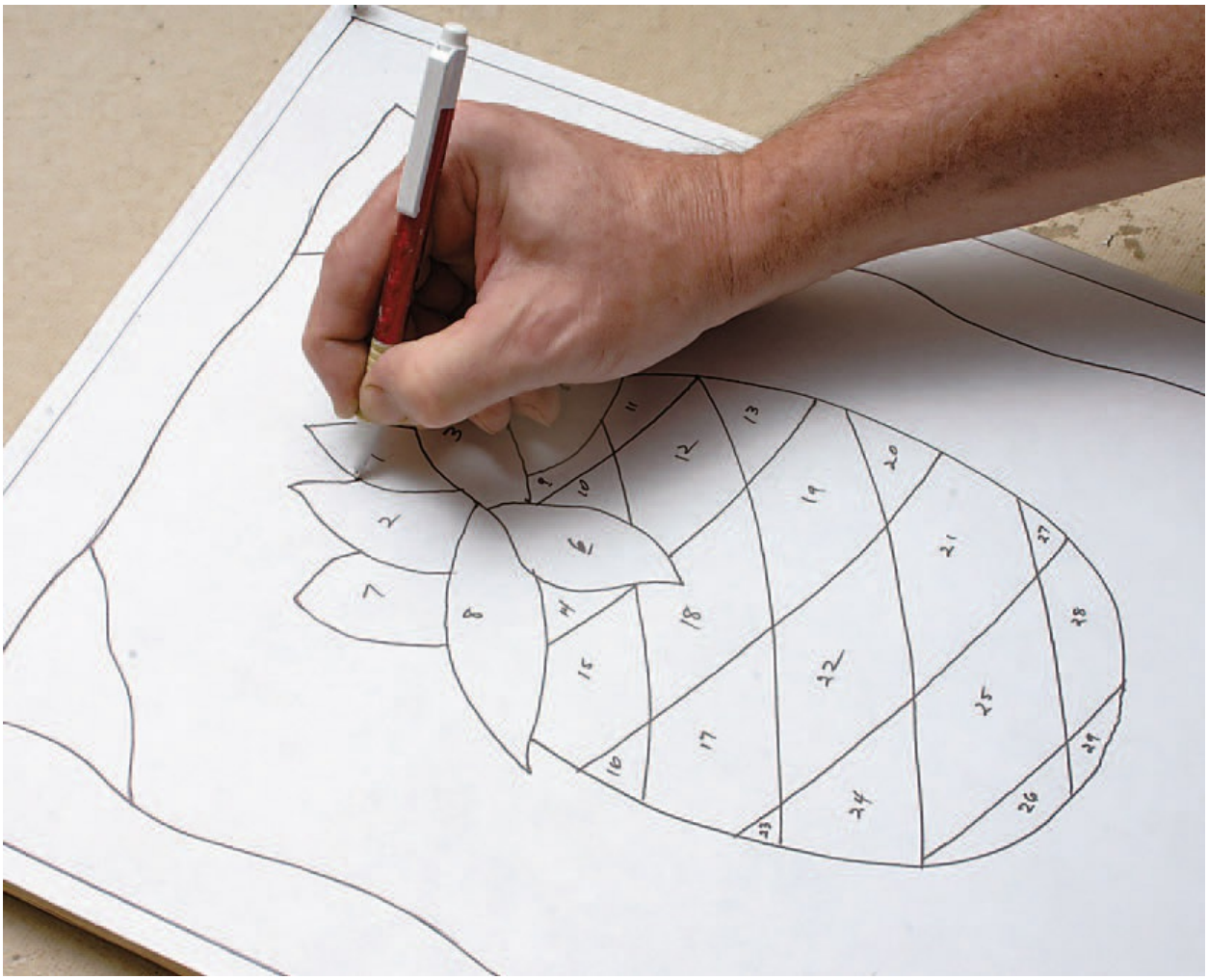


8. Tack the sheets to the board with push pins in each corner. Don’t worry about the resulting holes: They’ll eventually be covered with glass or grout.

9. Use a pencil or ballpoint pen to trace over the entire pattern (a softer felt-tip pen won't work very well). You can use a ruler to help you draw the straight lines.



10. Draw the curved lines free-hand. Press firmly enough so the carbon paper will leave a mark but not so hard that you tear the pattern.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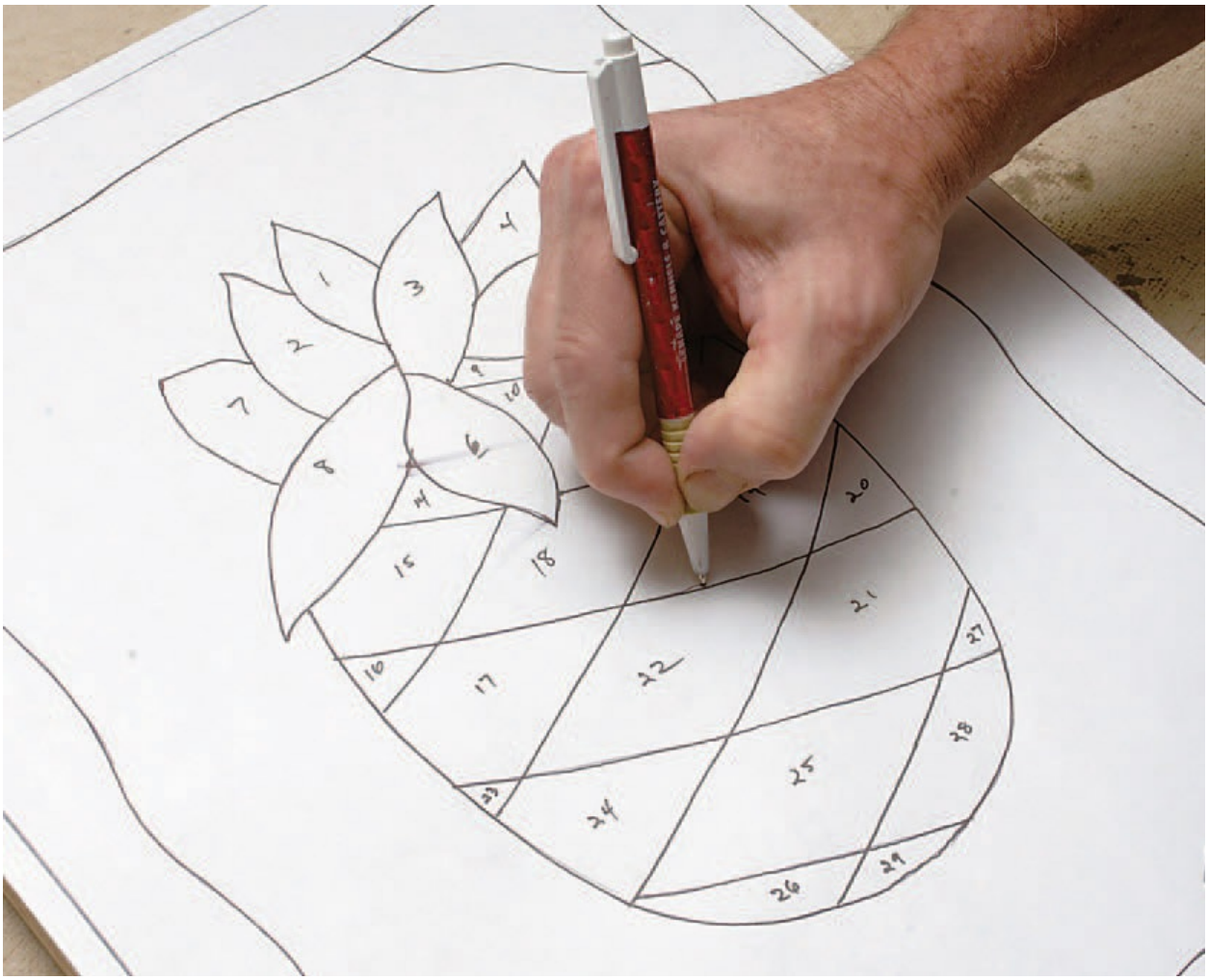
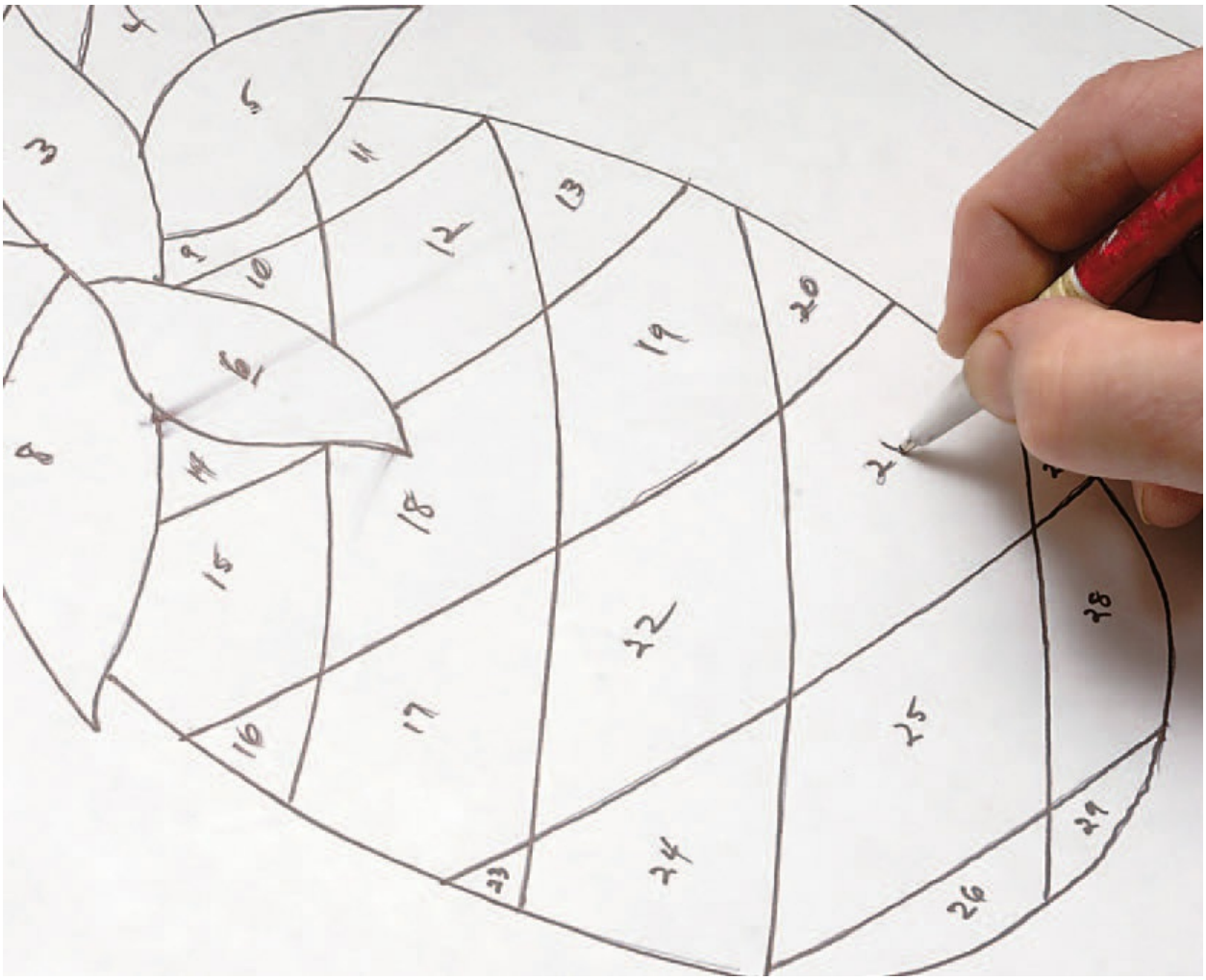


11. Trace over the numbers, too.

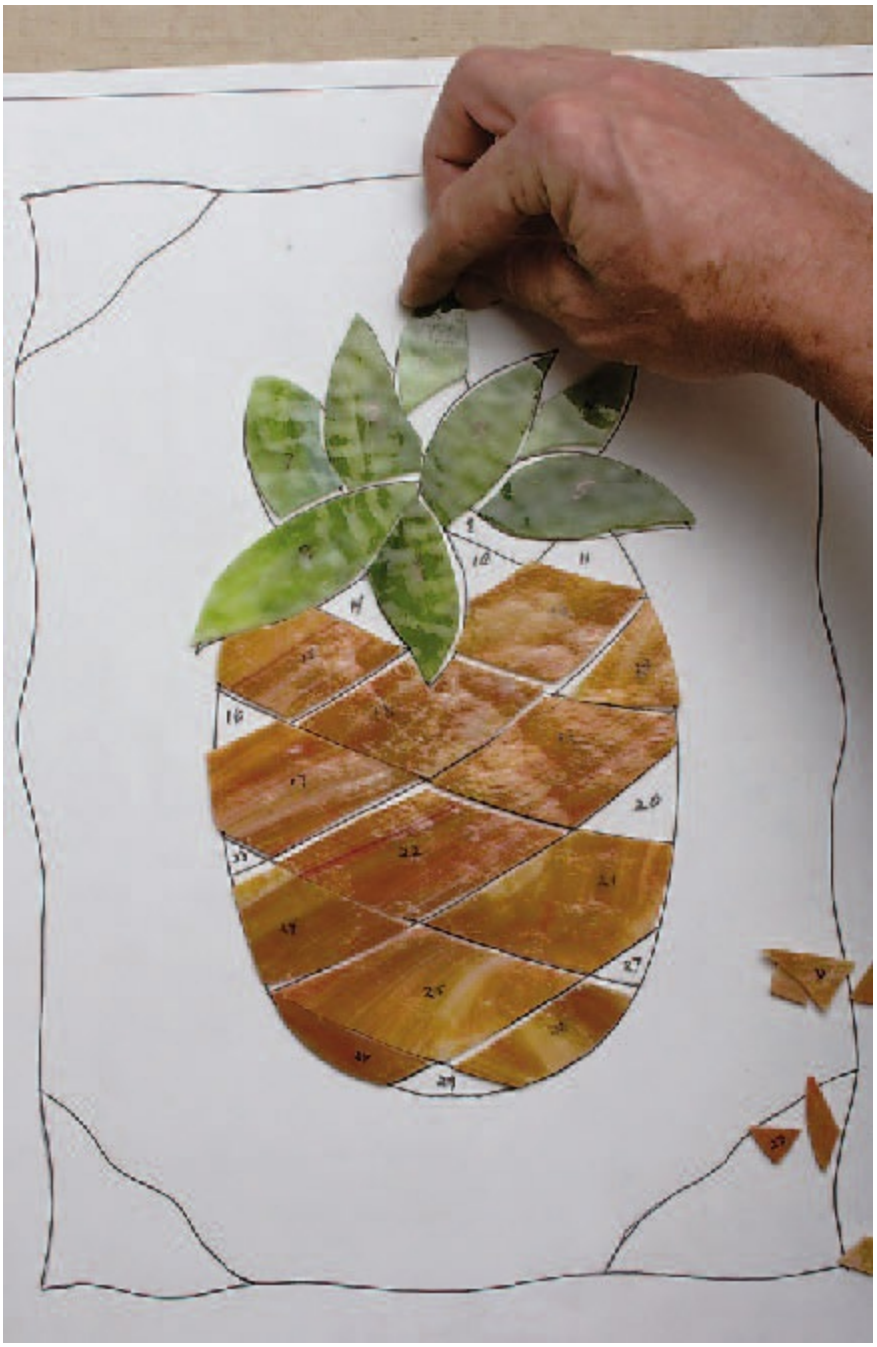


12. When you're finished, remove the pattern and carbon paper.

13. The entire pattern should be transferred to the board.

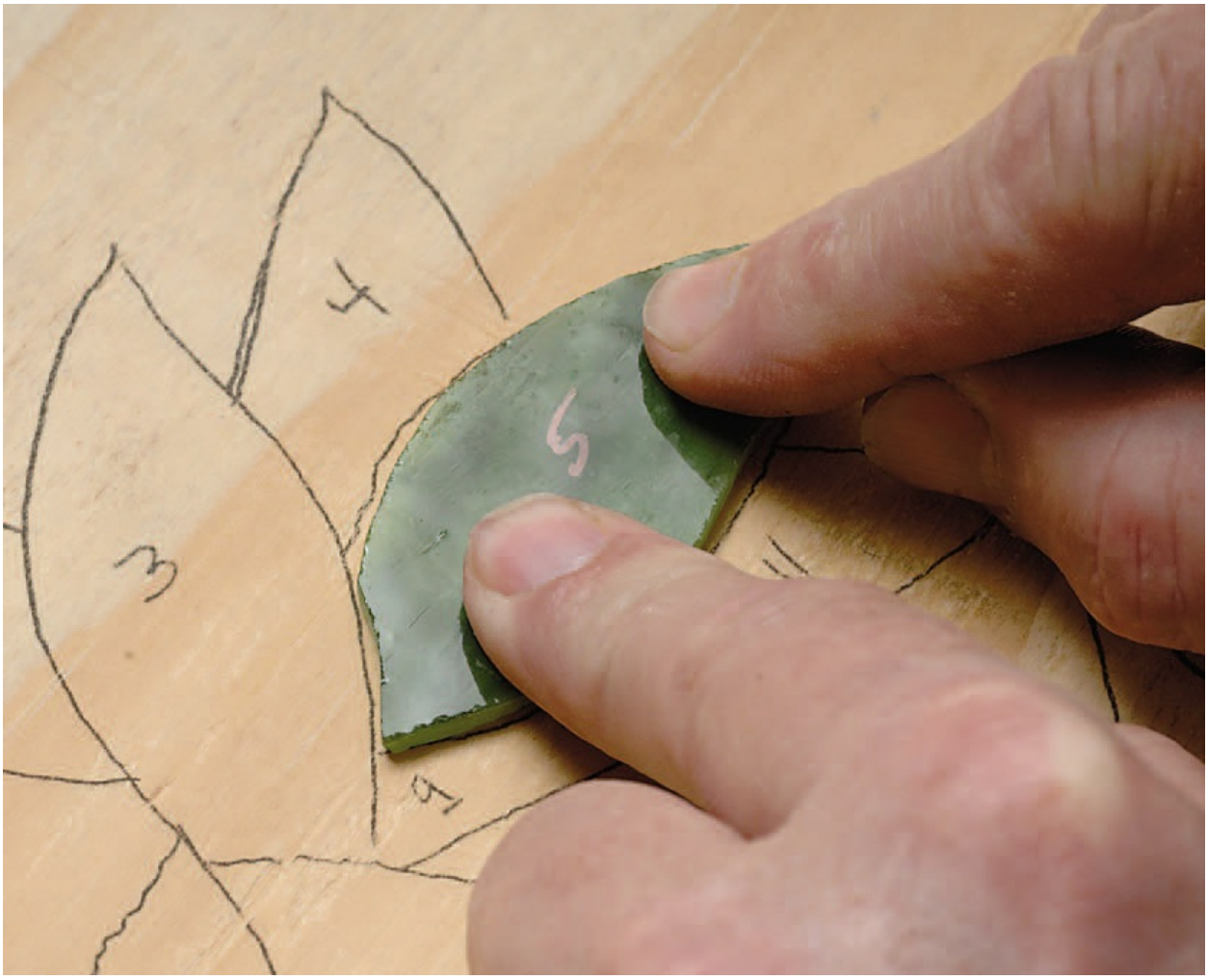
You might want to make a copy of the pattern so that when you cut one up to create templates for the glass pieces you still have an uncut pattern to help you lay out the design.

14. It’s a good idea to assemble the numbered mosaic pieces on the pattern so you have all the pieces in order before you begin gluing them to the board.

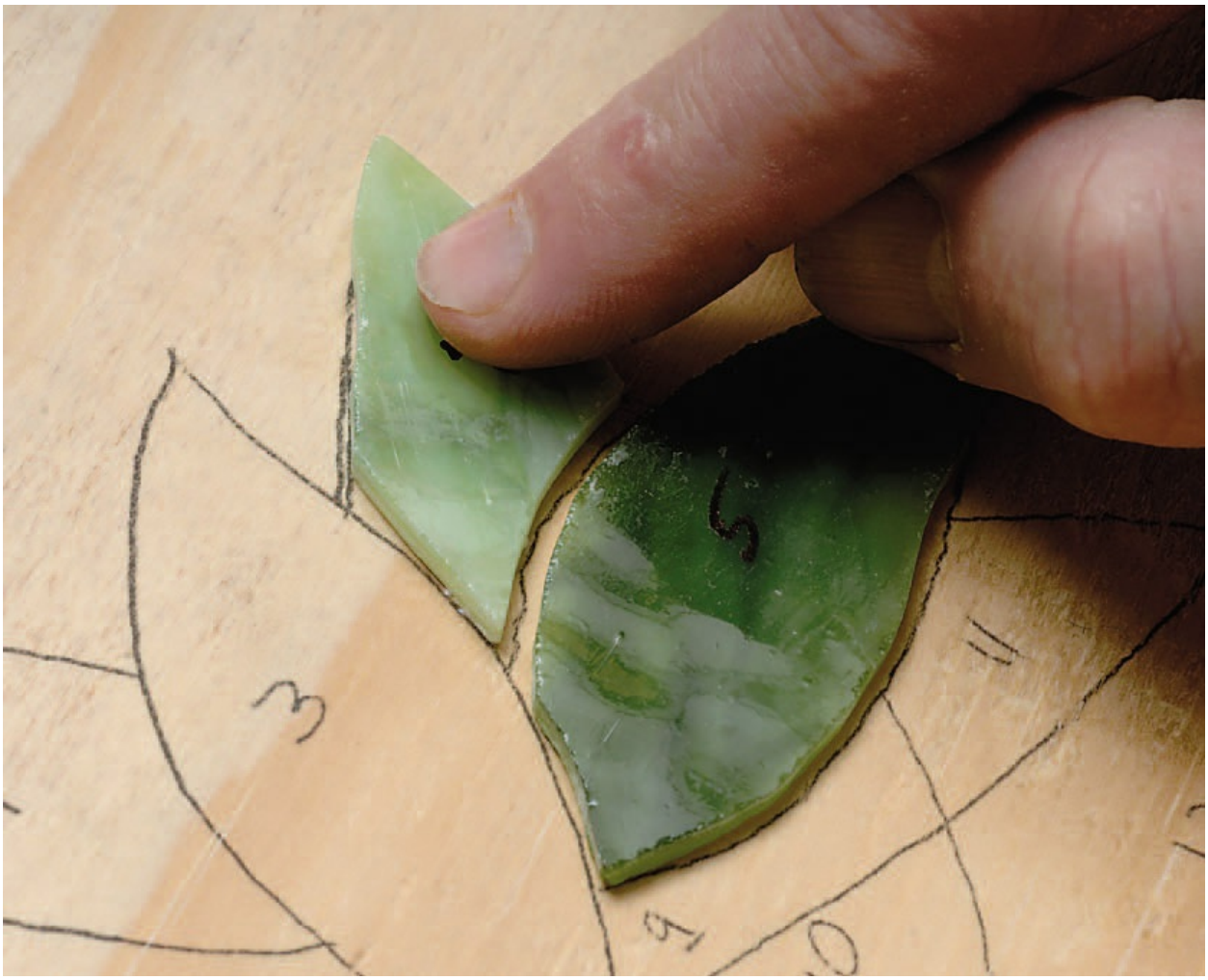


15. Apply glue to the back of one of the numbered glass pieces. Cover most of the glass surface with a thin layer of glue.

16. Place the piece on the correct spot on the board and press it into place.



17. Glue and place the rest of the glass pieces. As you work, try to keep all the edges of all the pieces separated by a ⅛-inch gap.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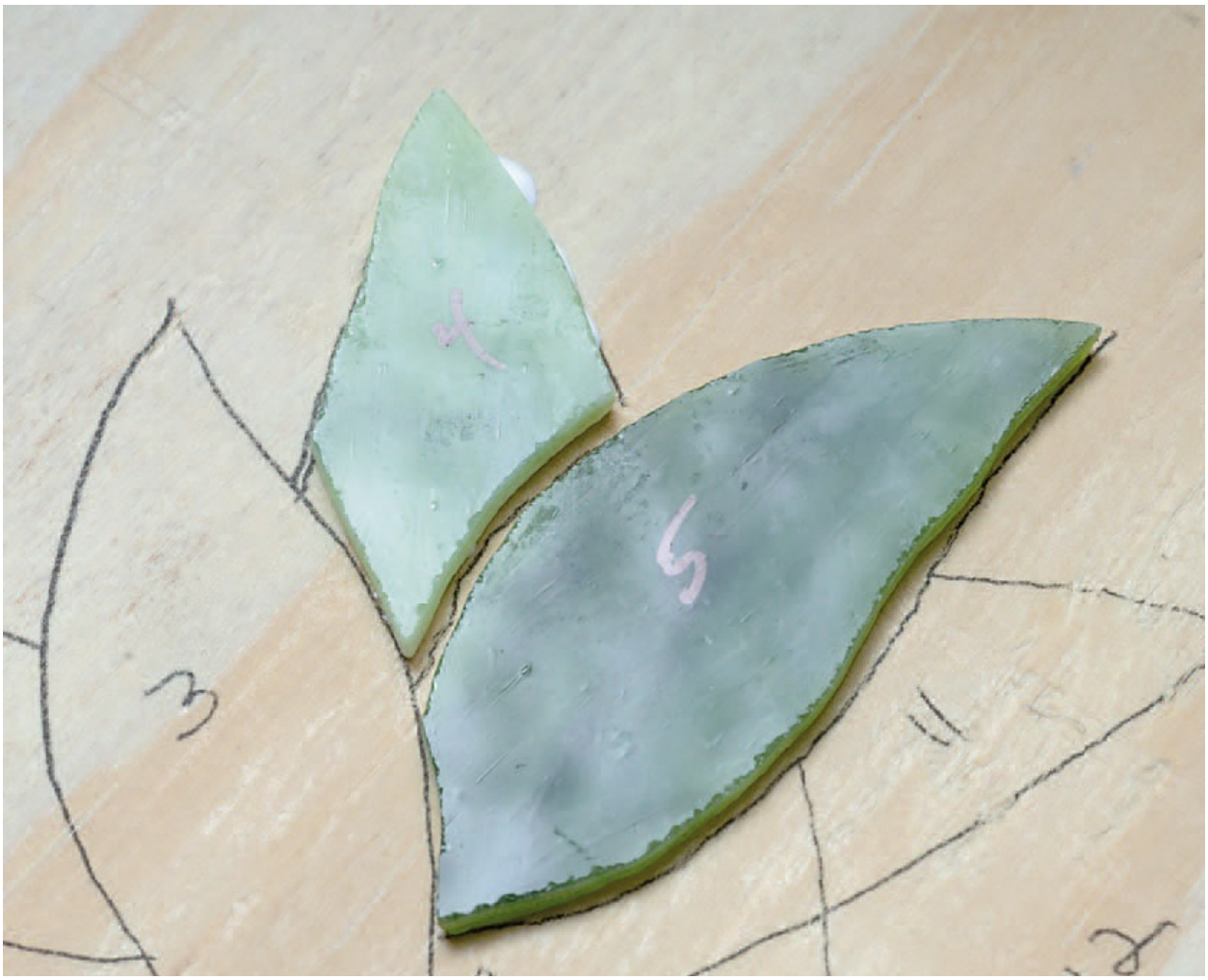
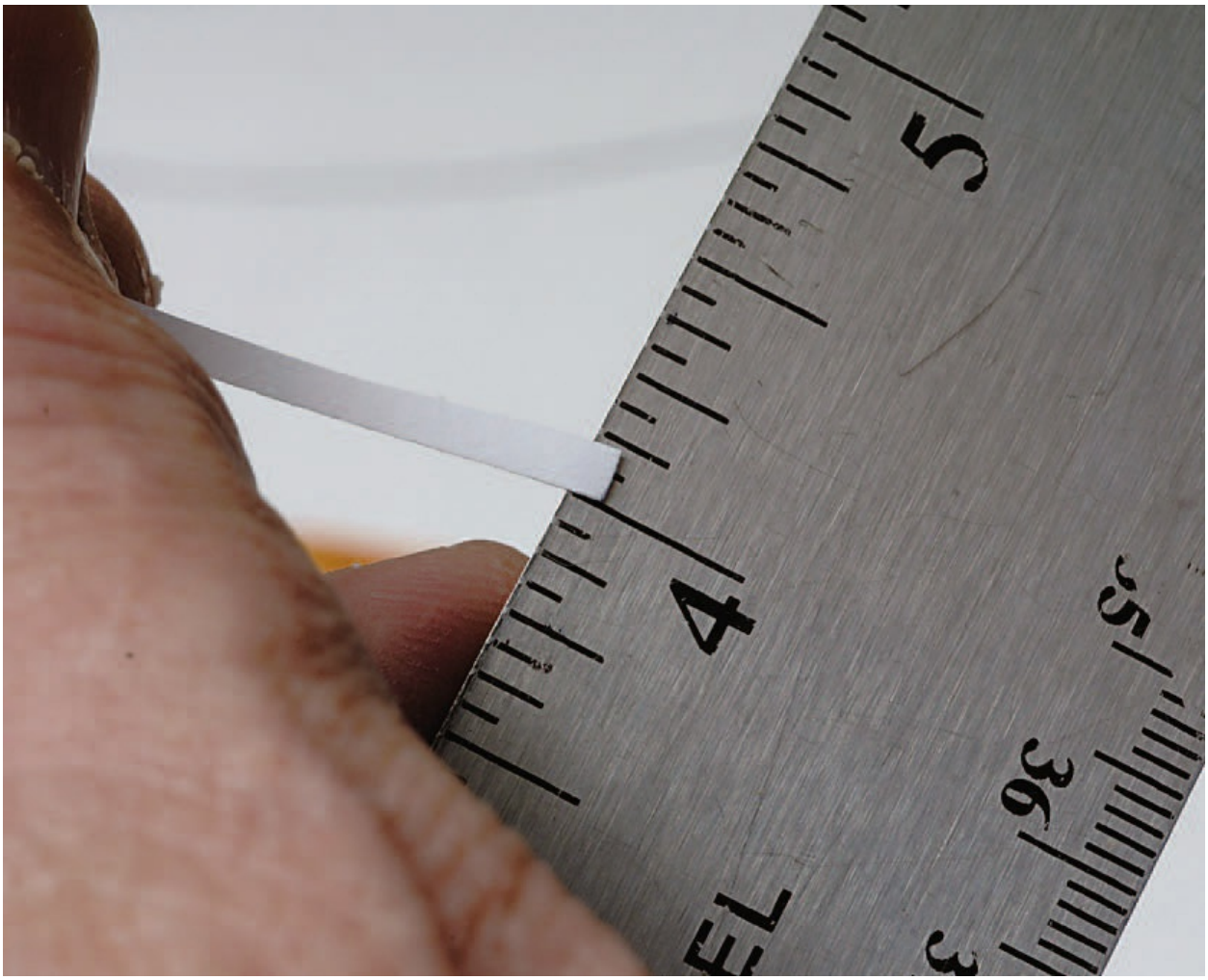
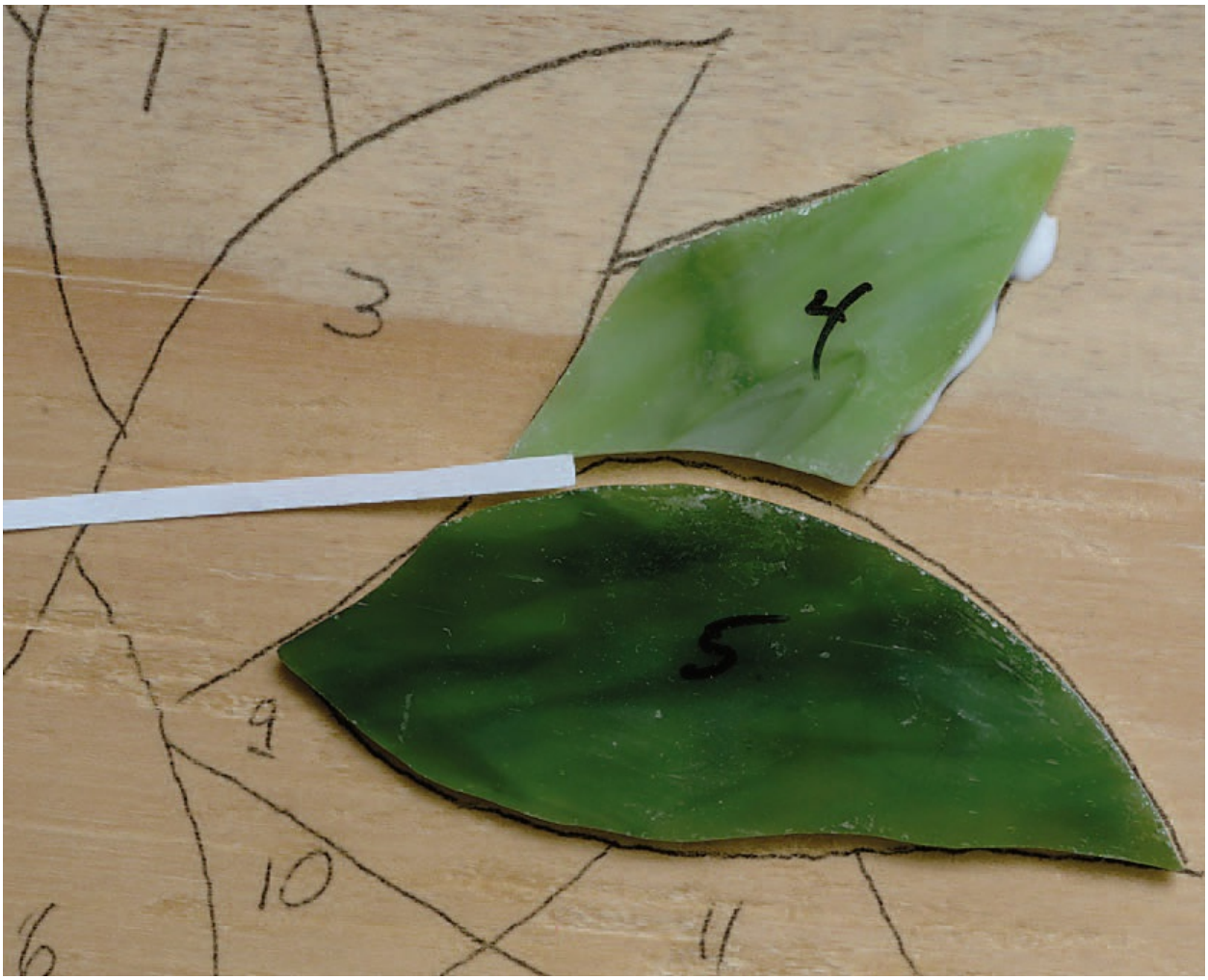


18. It’s helpful to cut a strip of scrap paper ⅛ inch wide and use it to check that the pieces are separated by approximately the same width.





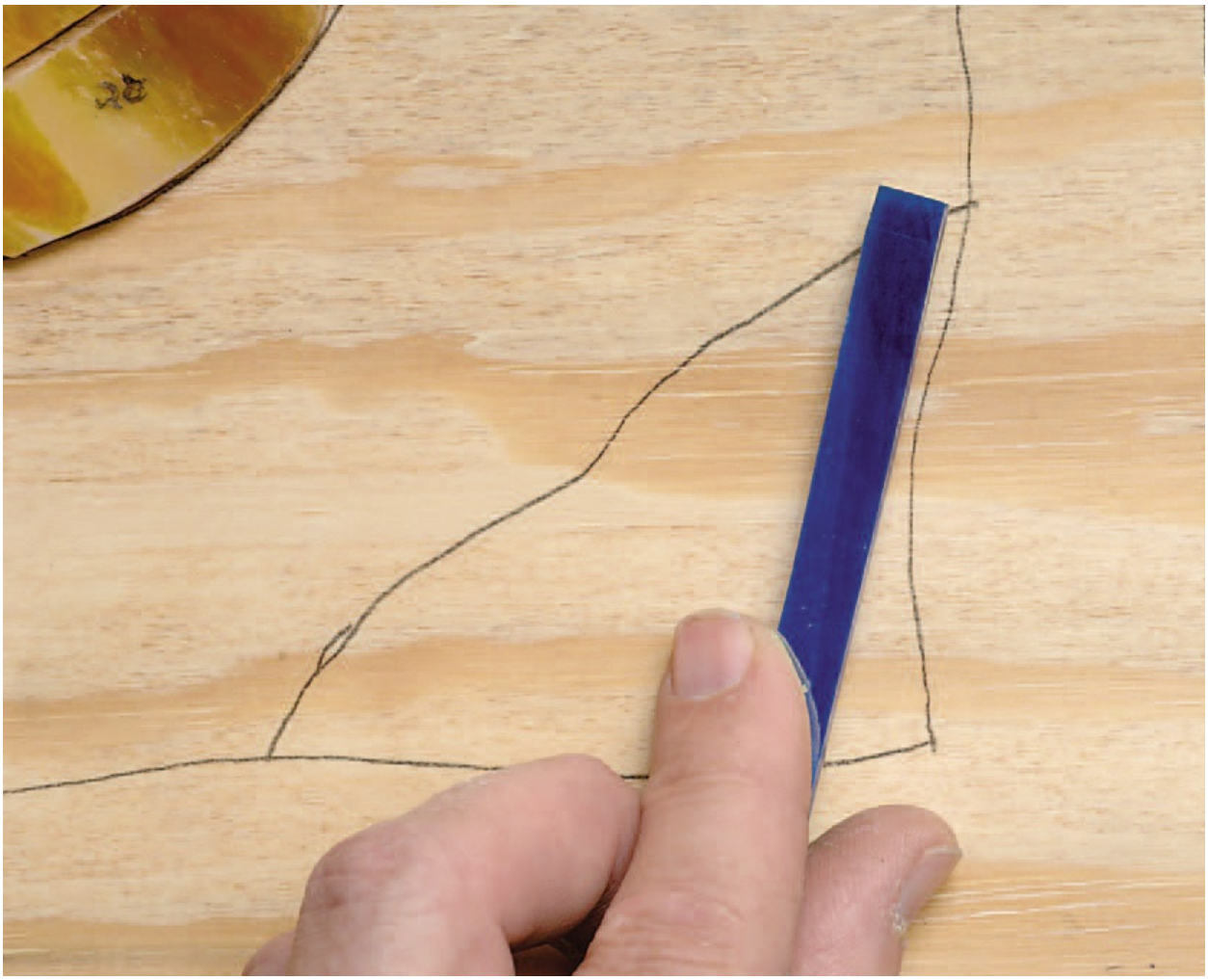
19. Glue the pieces down one by one, being careful to place them in their correct positions.

20. Because of variations in the surface of glass, some of the pieces might not lay completely flat; they might wobble a little. If they do, add some extra glue to the piece so it forms a bond to the board.

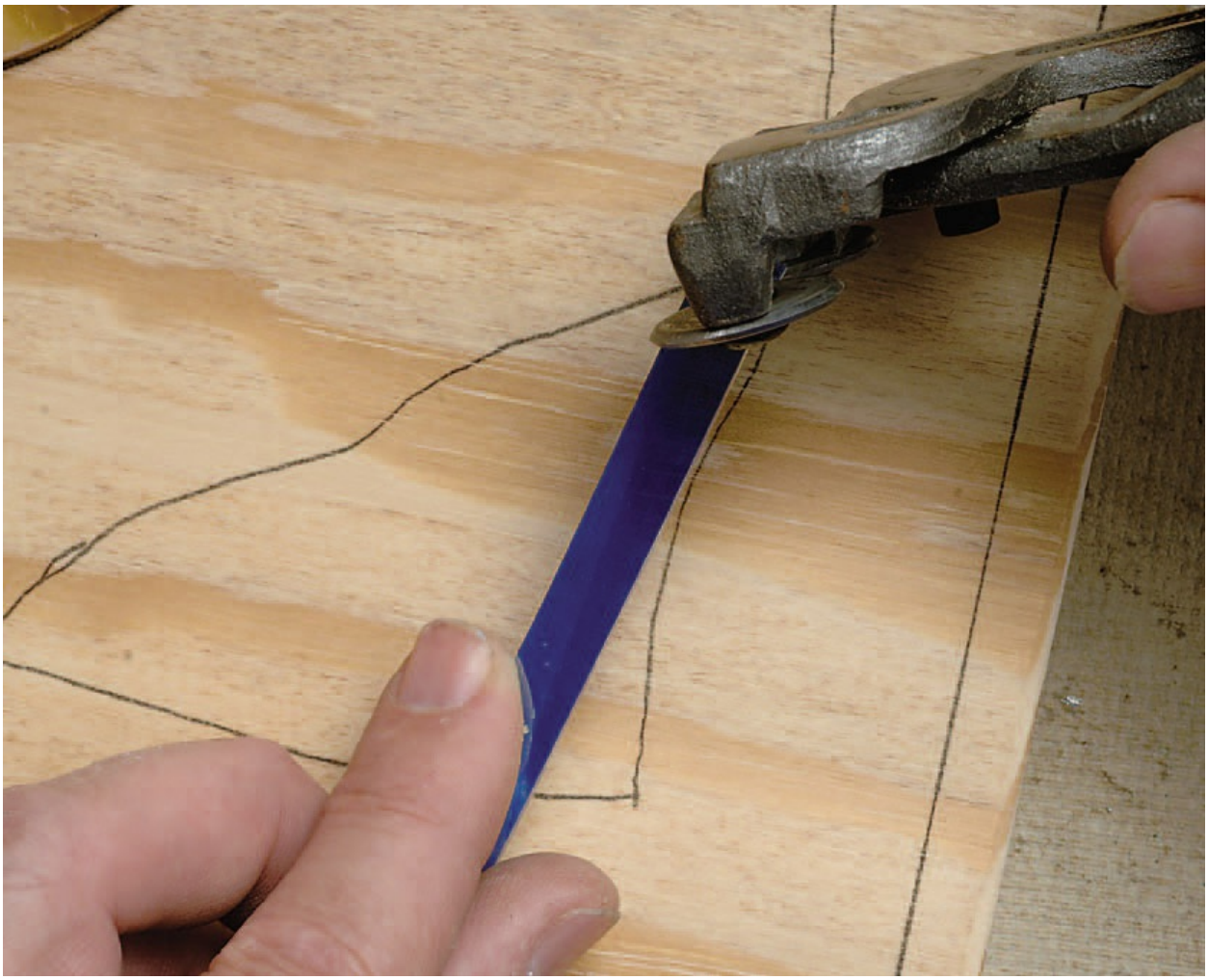
21. After the numbered design is complete, the next step is to cut the glass for the border and surrounding area.

A variety of complementary glass styles are used for these sections of the mosaic. Because light won’t shine through the glass on the finished piece, glass styles with reflective or textured surfaces work best for mosaics. The glass is first cut into strips using the jig system so it’s easier to handle and trim them to final size.

22. Fill in the colored corners of the design first. They contain blue glass cut into angled shapes each around 5/16 inch long. To cut these pieces, lay a strip of blue glass along the outermost edge of a corner and note how the glass needs to be trimmed to match the pattern's outline.

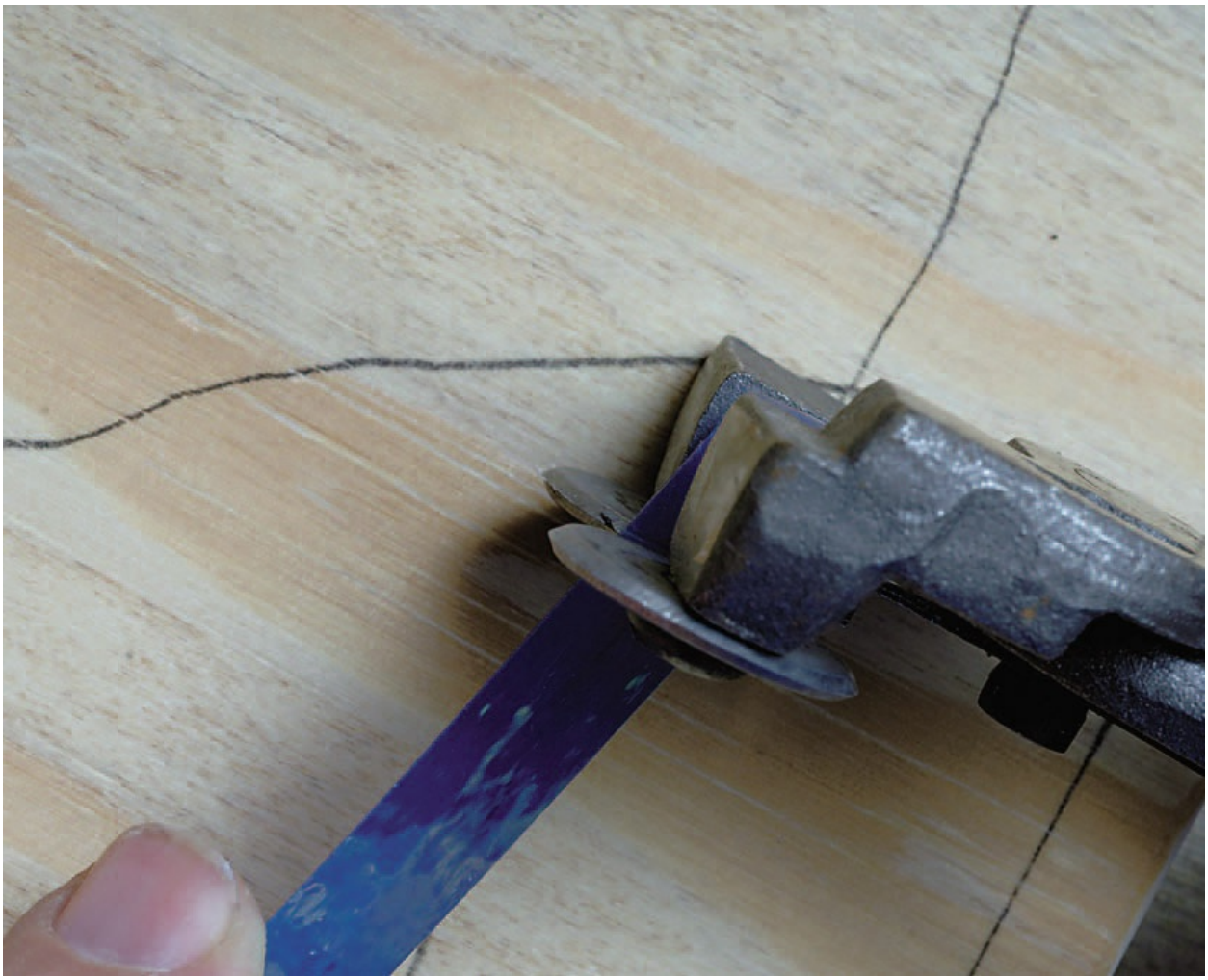


23. Use mosaic cutters to trim the corner of the glass at an angle, as shown.

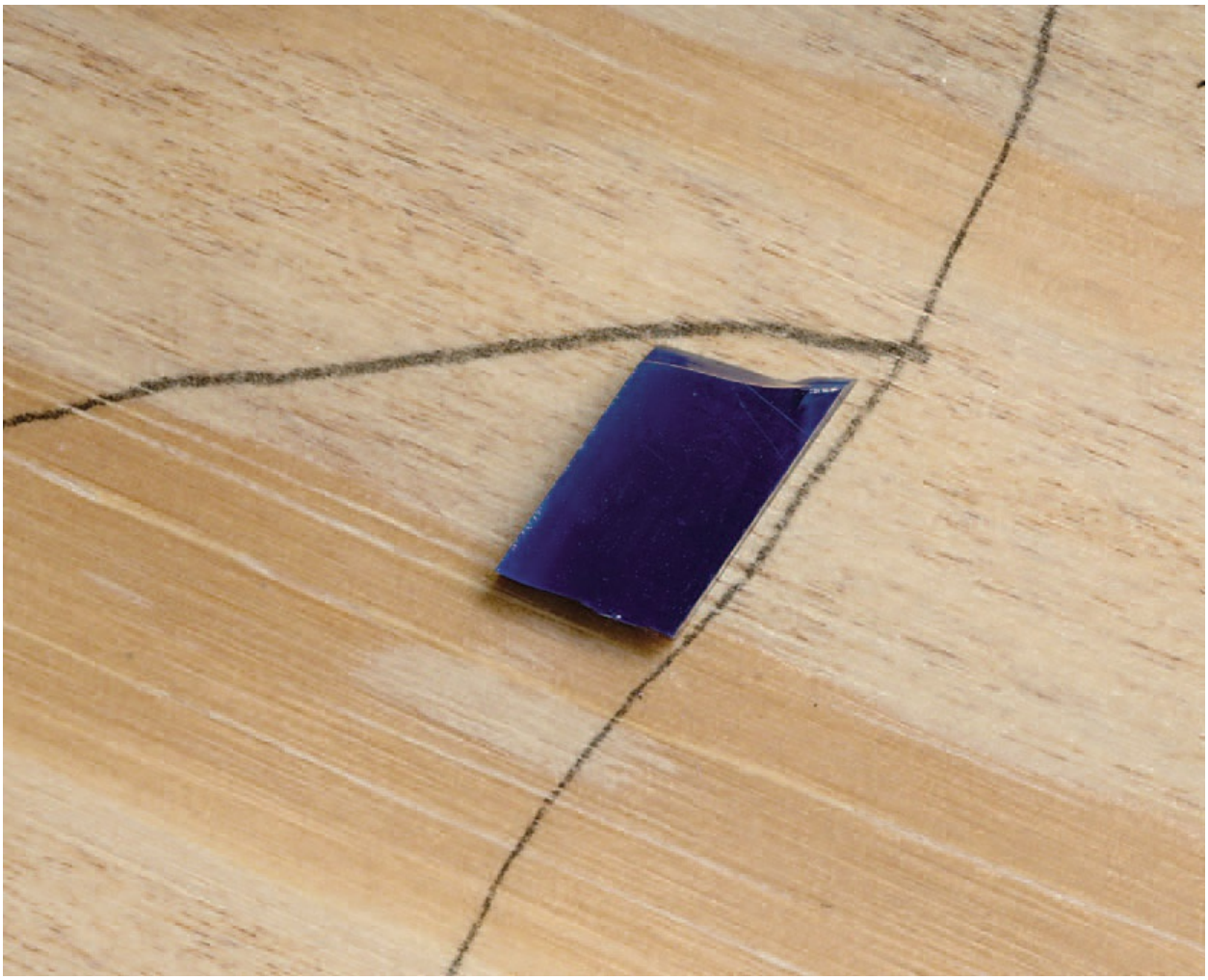


24. Notice how the trimmed piece matches the pattern line. It doesn't have to be exact, of course; all the glass pieces will be separated by a gap that will be filled in with grout.

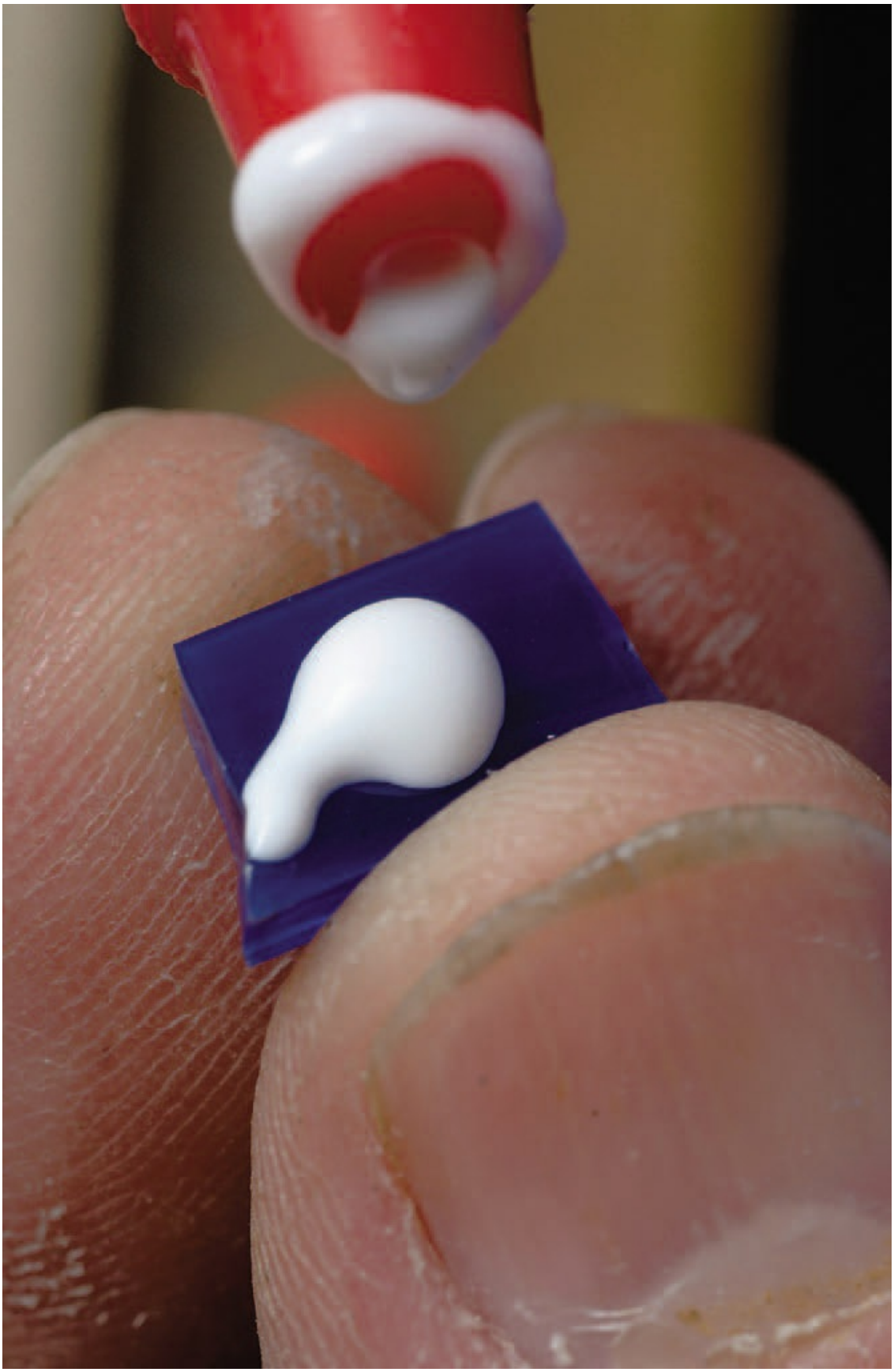
25. If you're satisfied with the first cut, make a second cut—this one straight across—as shown.



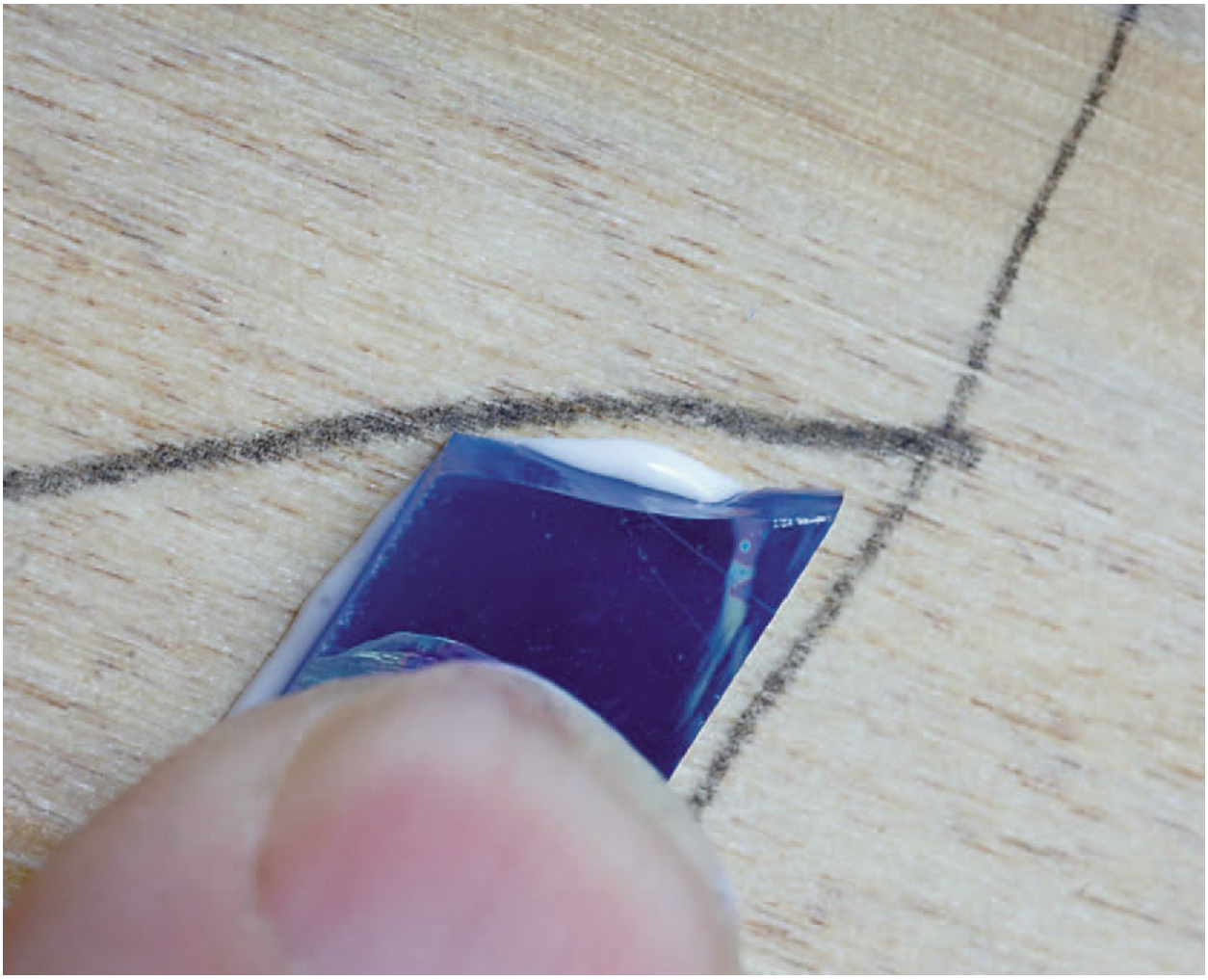
26. Test fit the piece on the board.



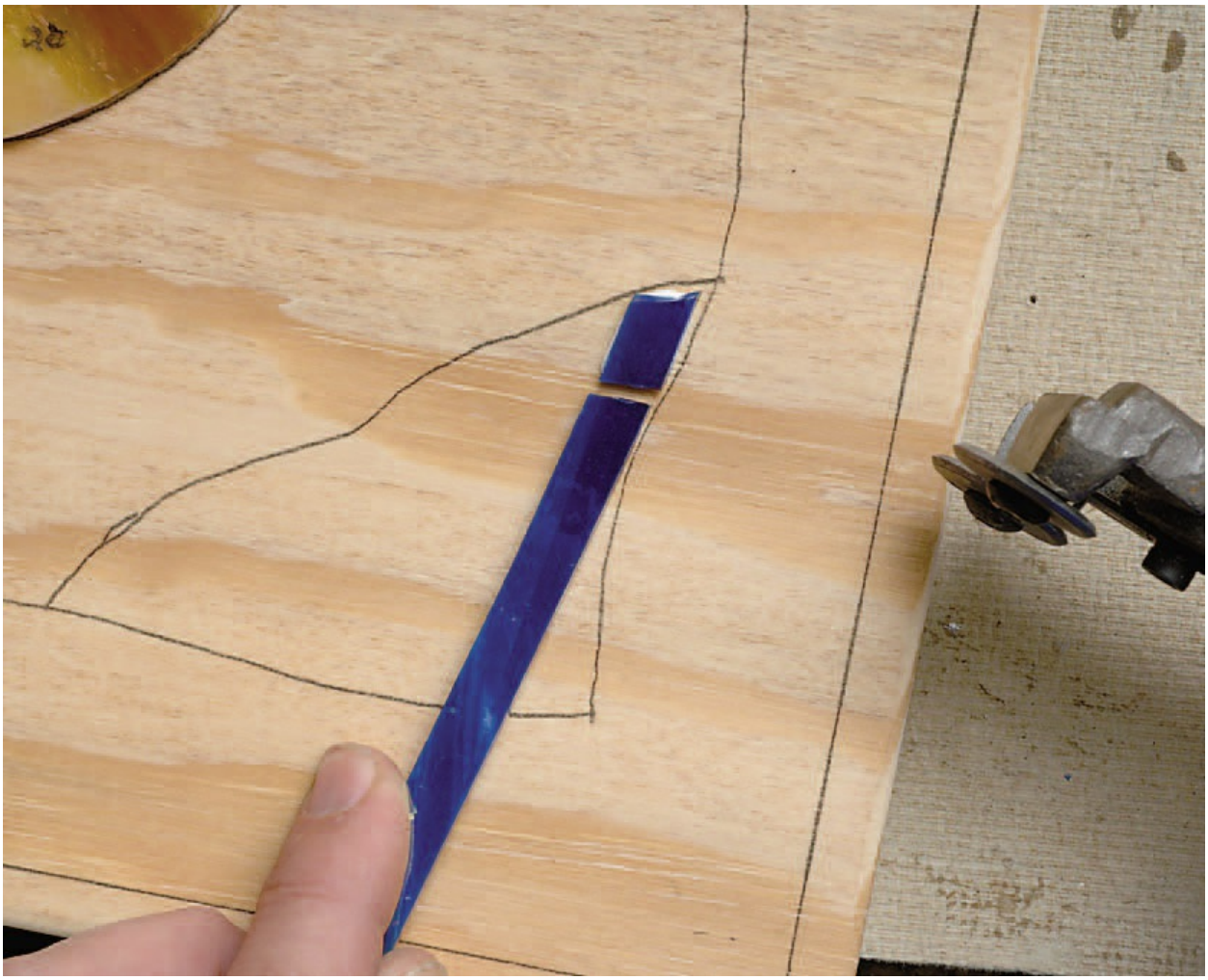
27. If it looks good to you, apply glue to the back of the piece.



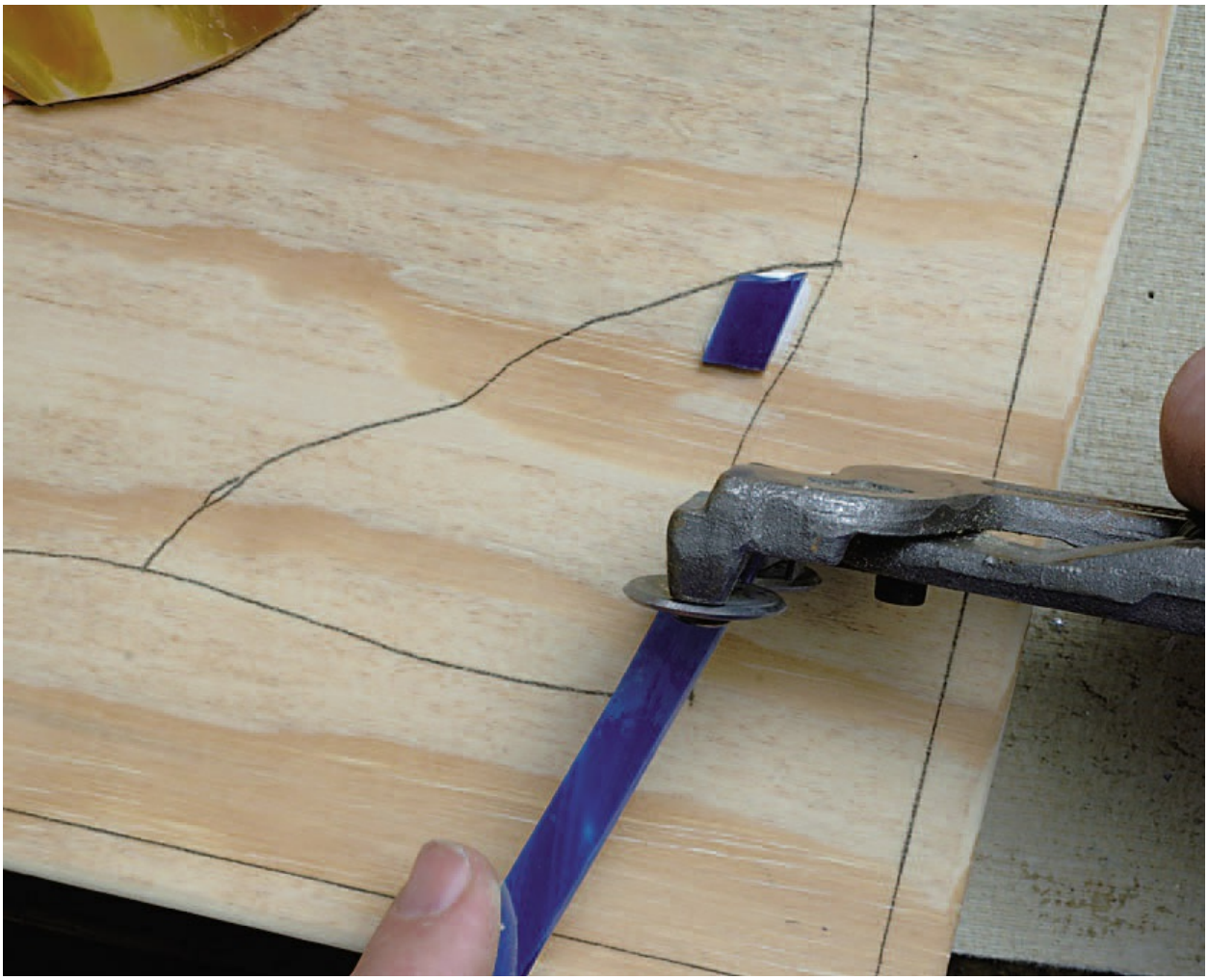
28. Press it into place.

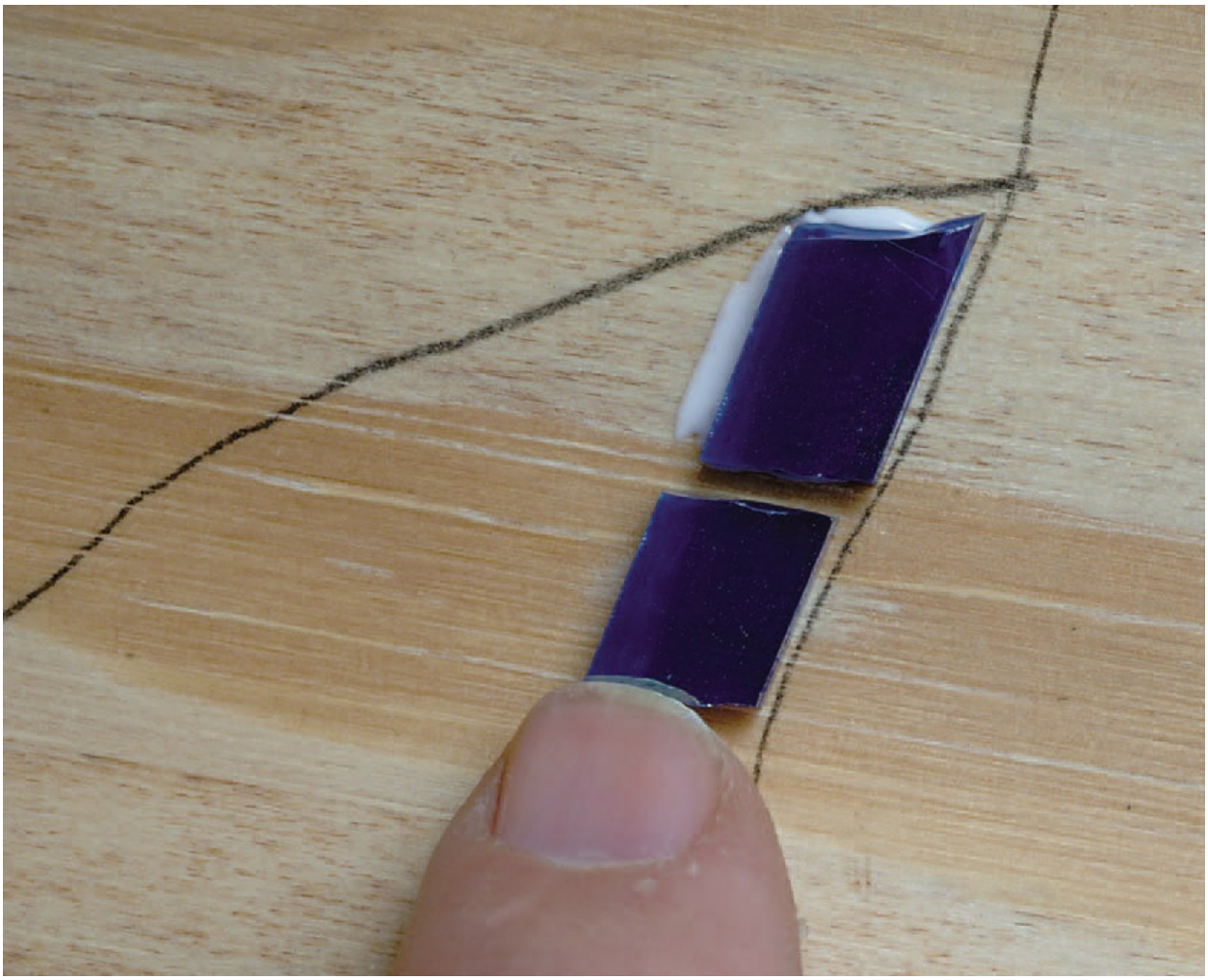


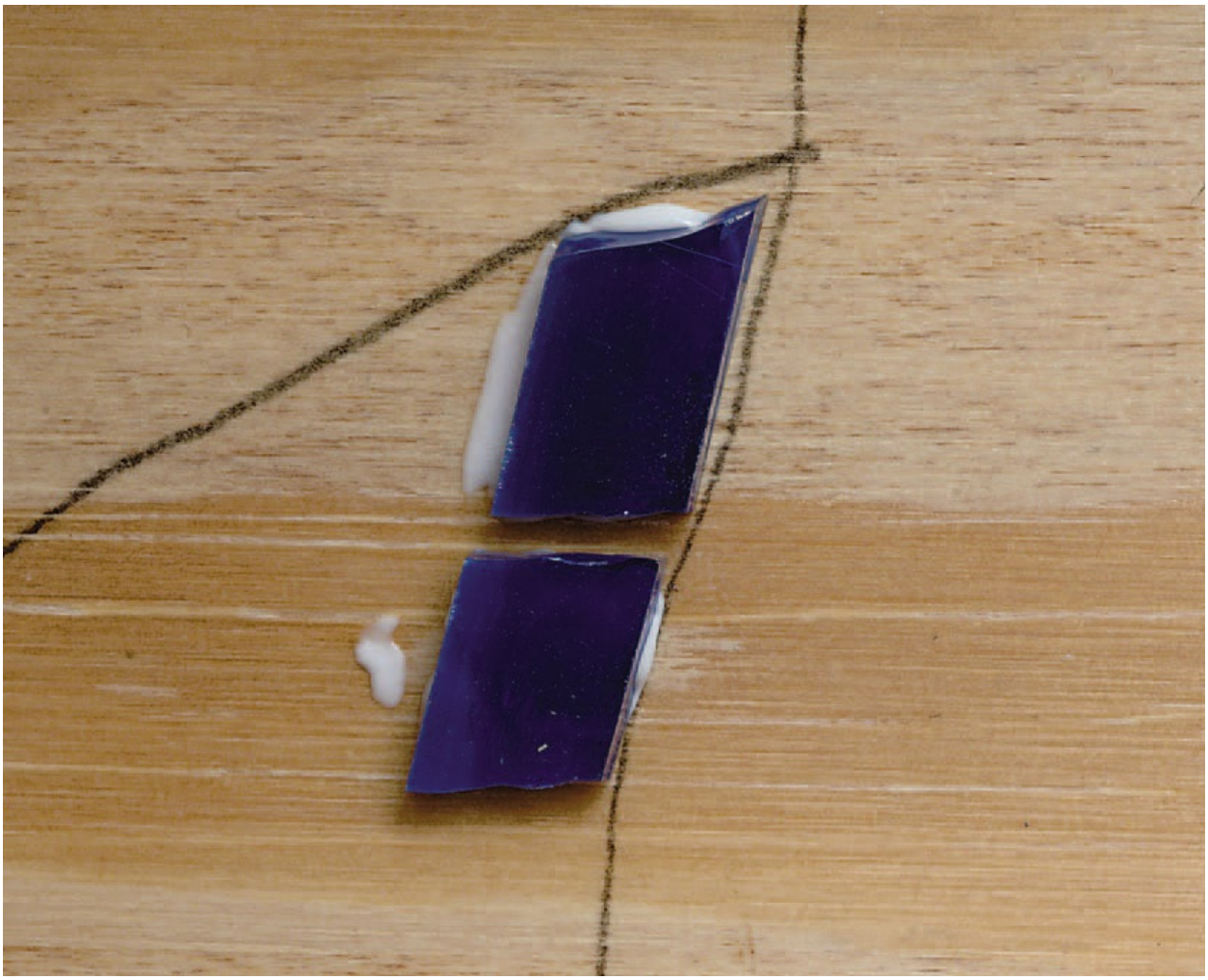
29. Lay the strip down to see how to cut the second piece. On the finished mosaic, the corner section consists of rectangular shapes about 5/16 inch wide.



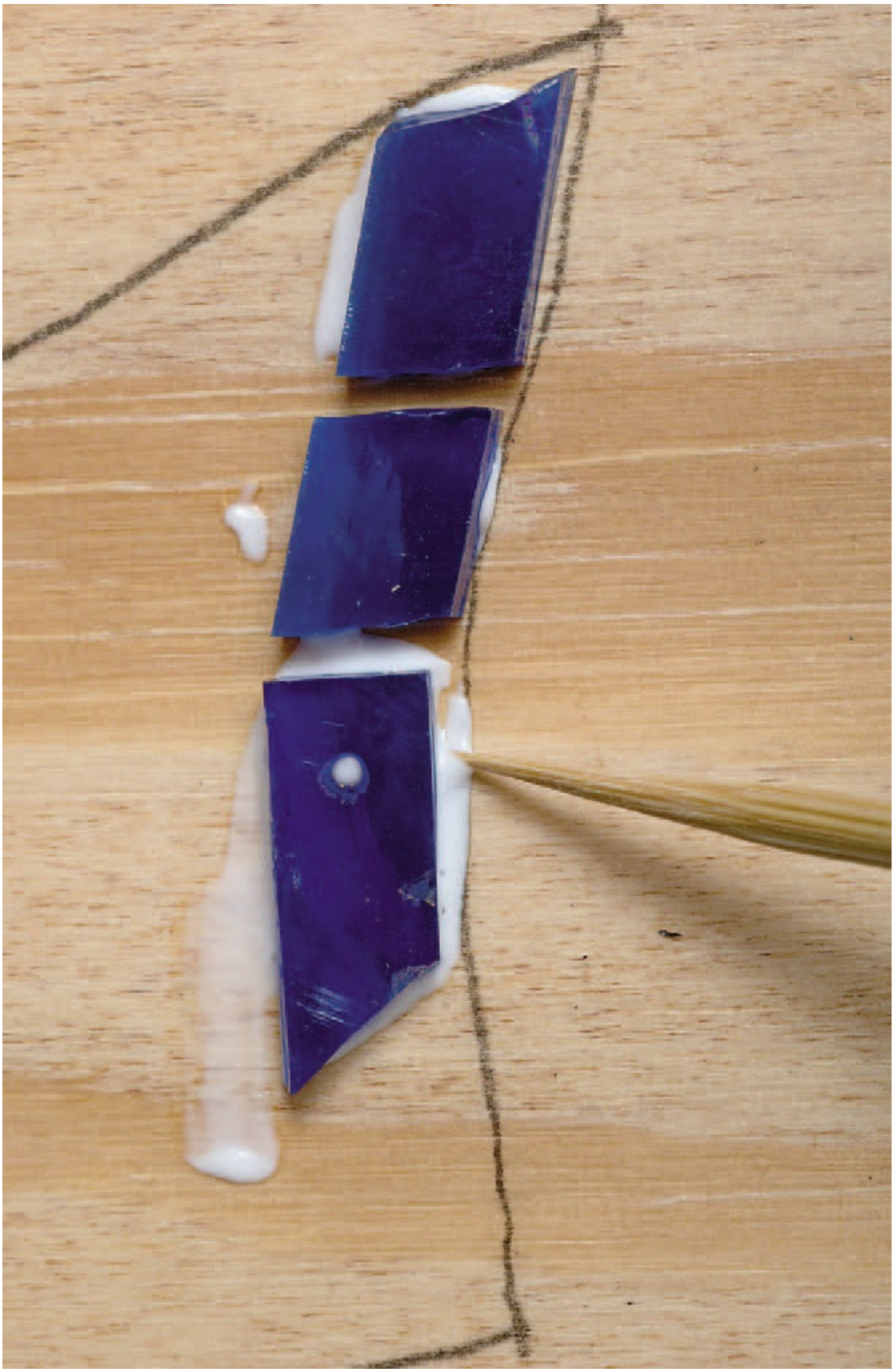
30. Cut the piece, glue it, and press it into place. Be sure to leave a ⅛ -inch gap between it and the first piece.



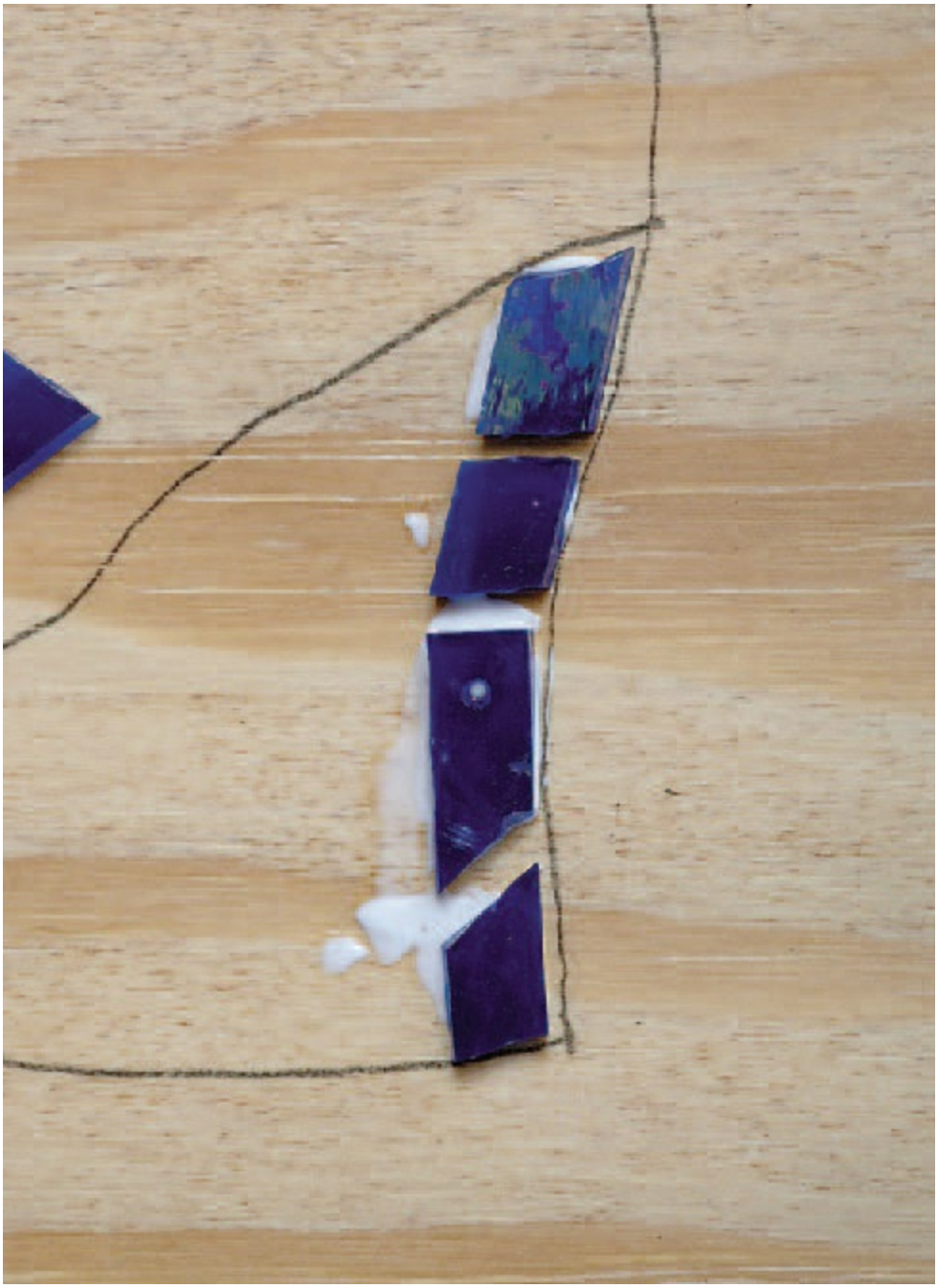




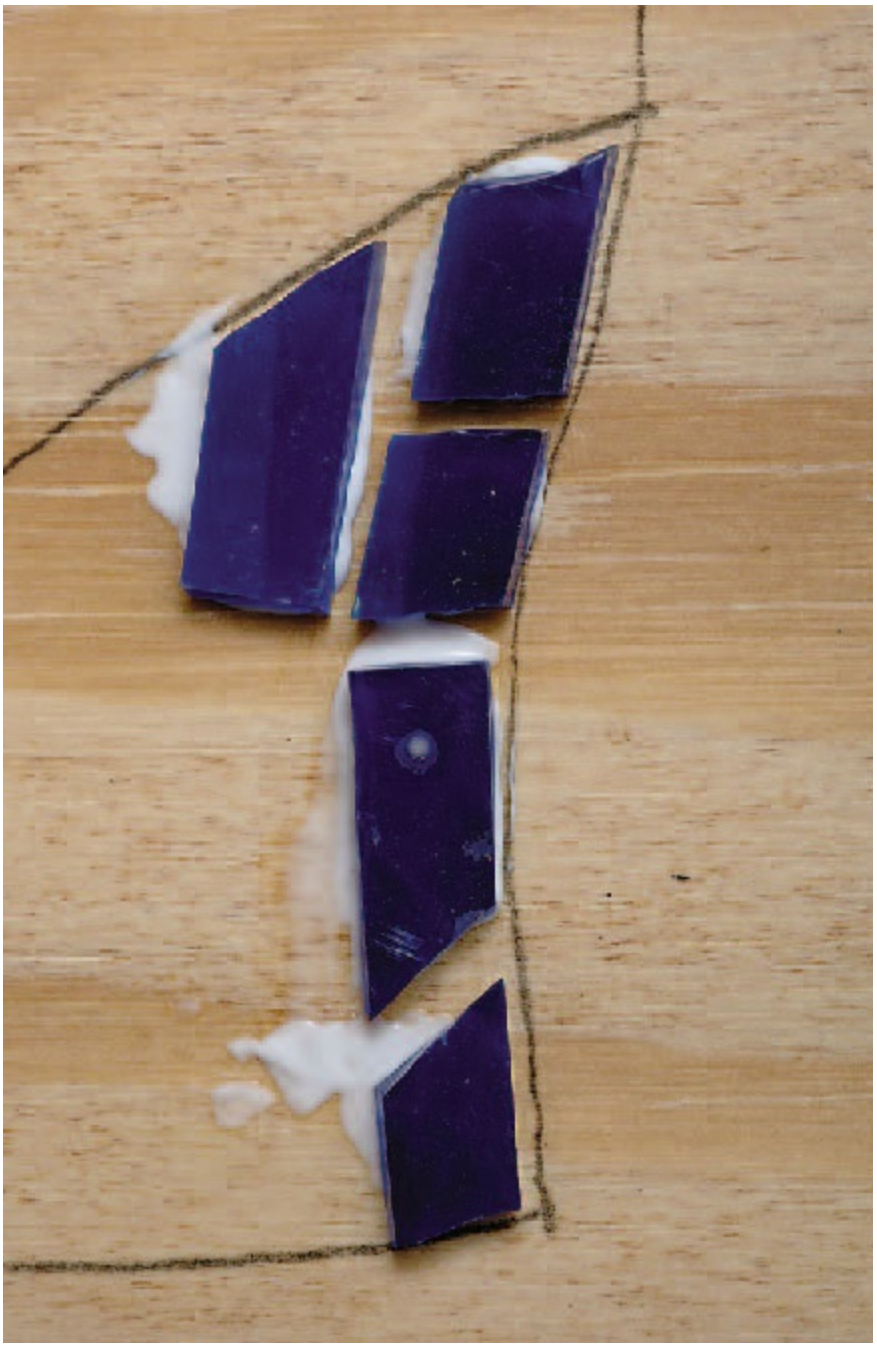
31. Cut a third piece to continue this row. Here, we've angled the second cut on the third piece slightly to vary the shape a bit.



32. The first cut on the fourth piece matches the angled third piece.

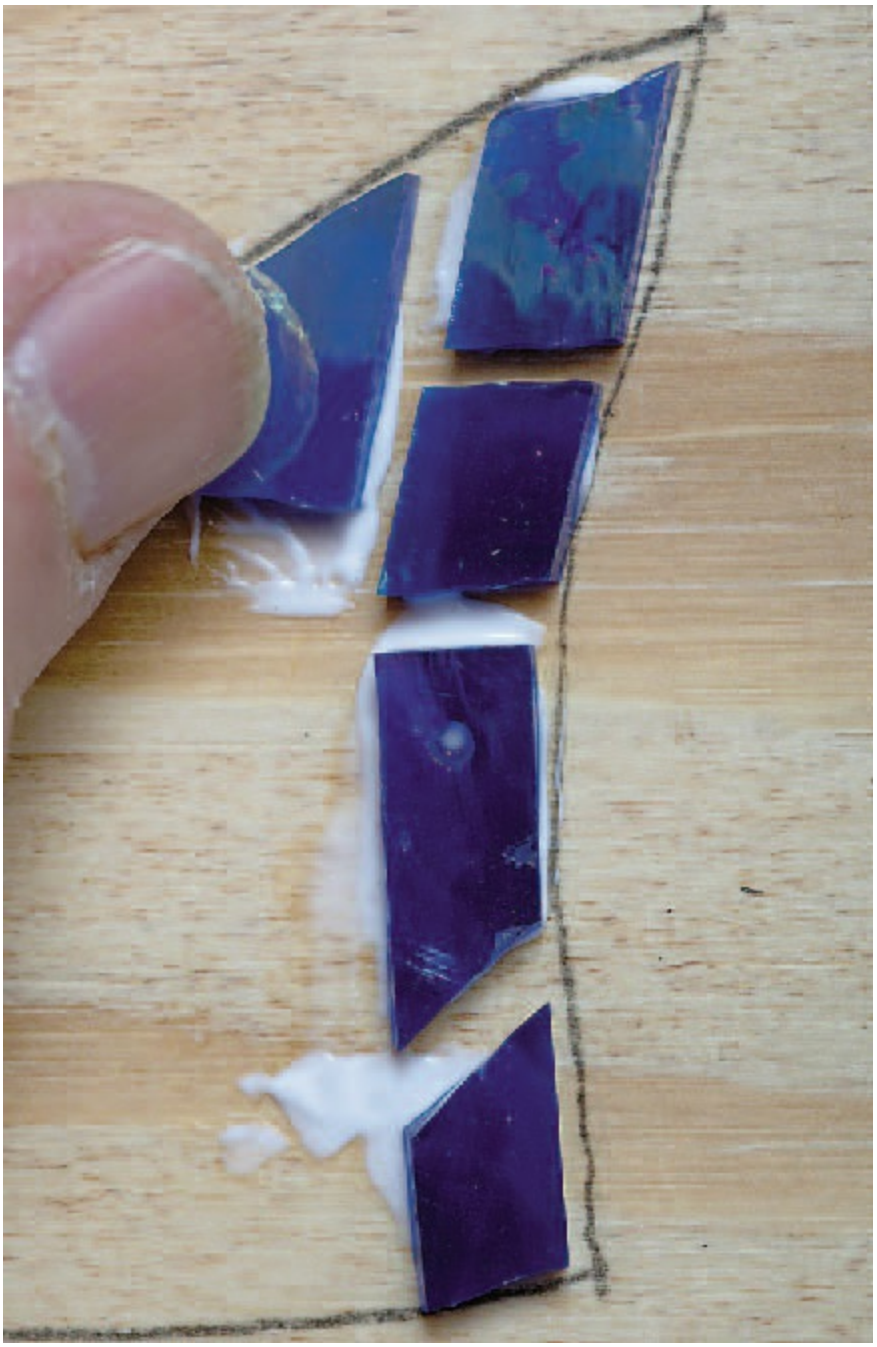


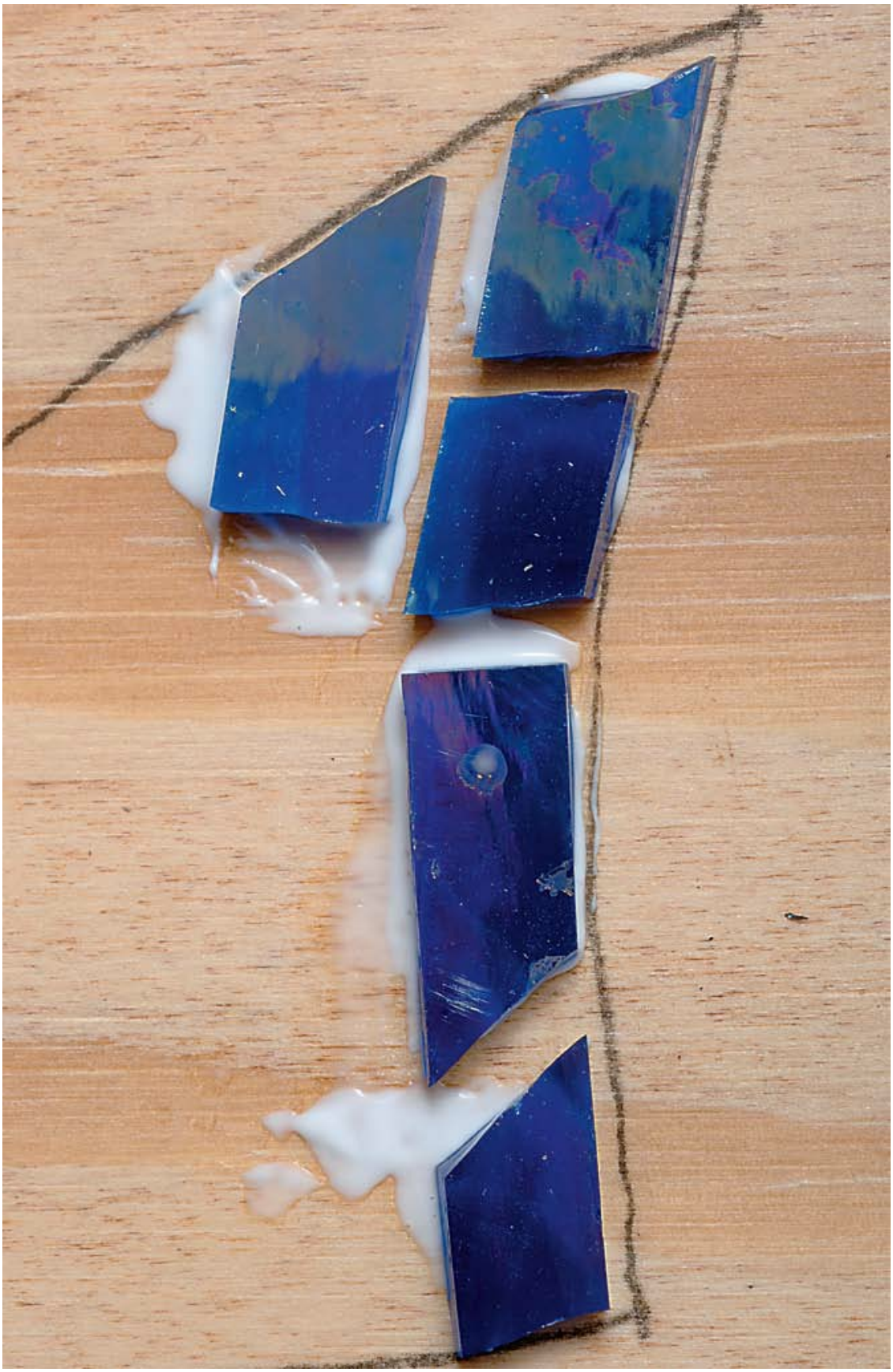
33. Cut the rest of the pieces one by one to fill in the pattern.



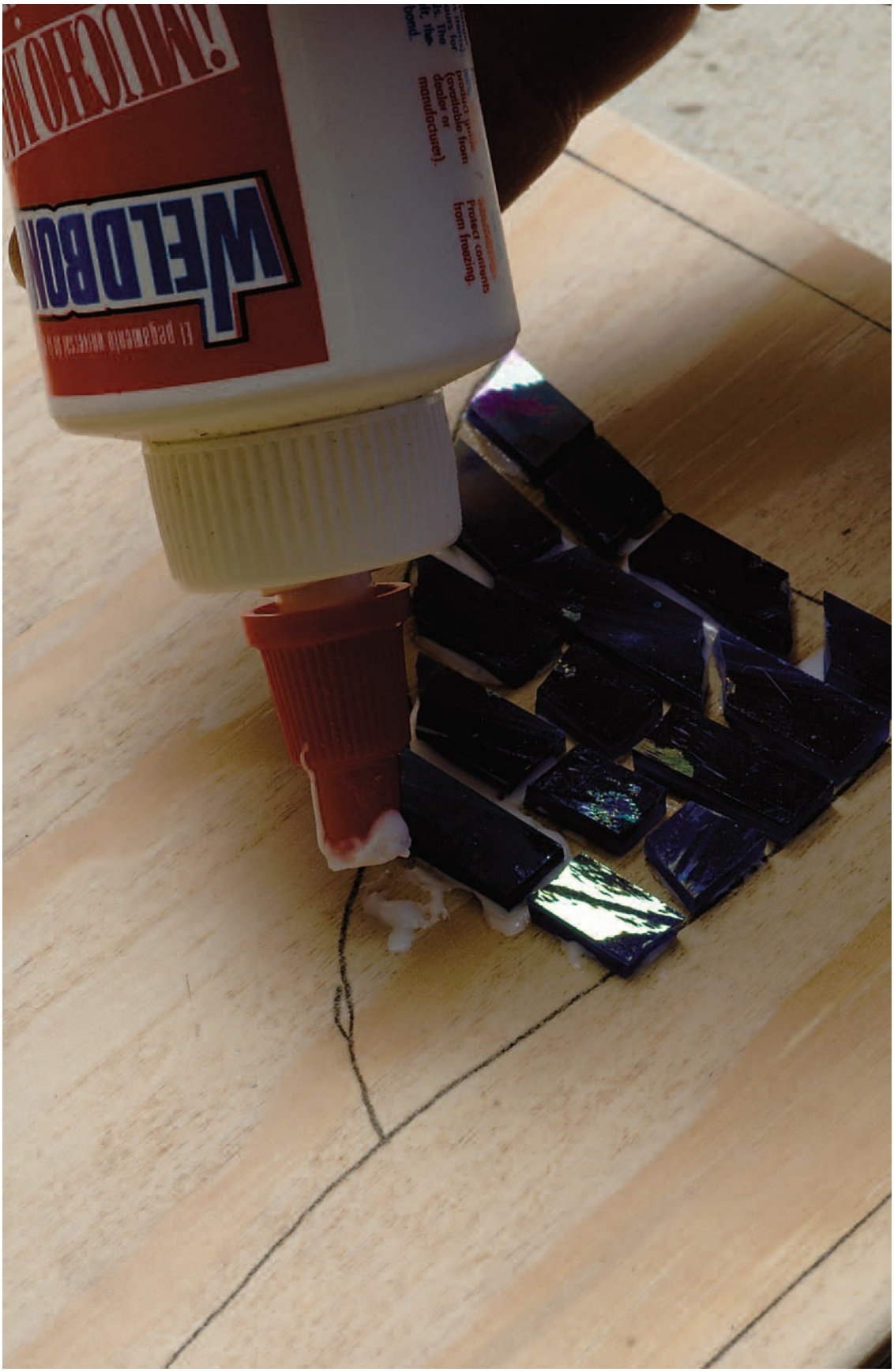
34. Notice how the piece that starts the second row ends at the same spot as a piece in the first row.

35. To stagger the gaps, this piece was removed and retrimmed to make it a bit shorter so it ends in the middle of the piece alongside it, eliminating what would have been a long line of grout.

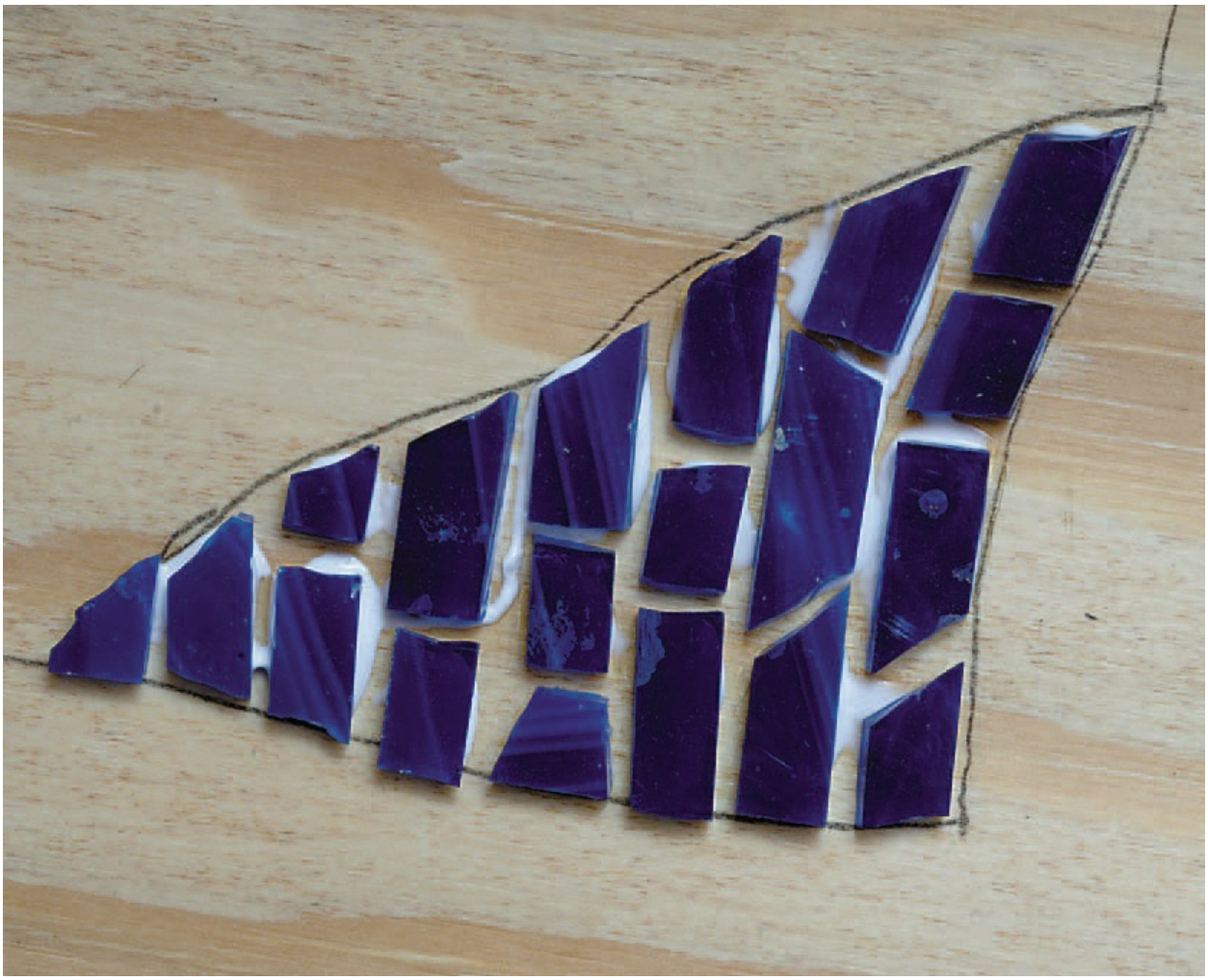




36. As you fill in the corner, it might be easier to apply a thin layer of glue to the board itself instead of to the backs of the pieces.

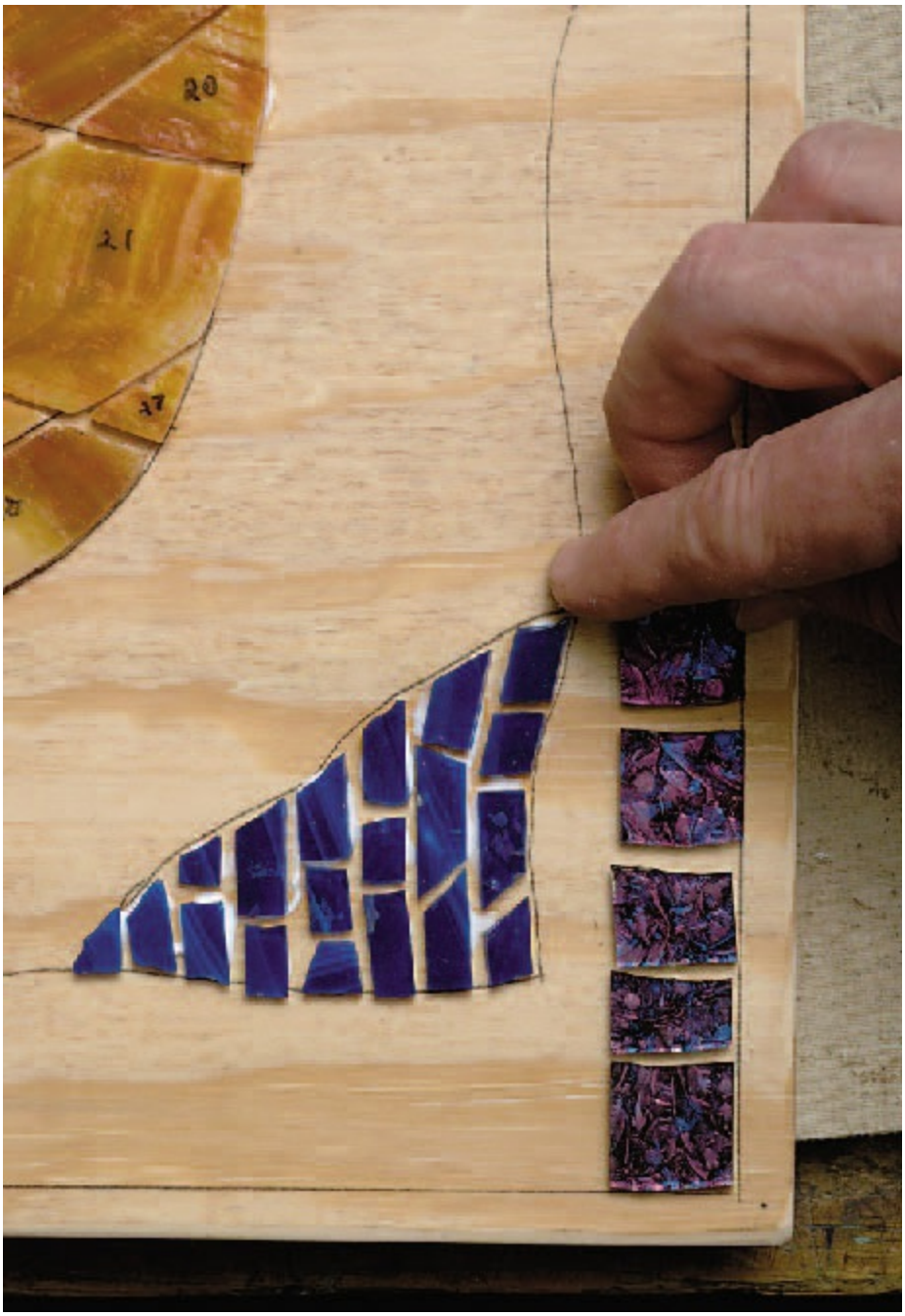

WELDBOND
Product Warnings
Protect contents from freezing.
Product Details
(available from dealer or manufacture).

37. The finished corner fits within the pattern lines. A consistently wide gap was left between all of the pieces, and all the gaps are staggered. Do the other three corners the same way.



Textured purple glass cut into ⅞-inch-wide squares was used to make the border.

38. Glue these pieces into place, starting with the outermost row.



39. As you cut and place pieces to form the inner row, you might have to do a little trimming to make everything fit the way you want it. Remember to keep a ⅛-inch gap between all the pieces.

Triangular pieces of textured milky glass about ⅝inch wide were used to fill in the background.

40. They were cut from strips using mosaic cutters.

41 It’s a good idea to start at a corner and work outward.

42. If you're pleased with the results, there's no wrong way to do it.

43. After you've glued on all the glass, let the glue dry completely before you apply the grout. Check the glue's instructions for the drying time.

Grout comes in powder form and must be mixed with water before use. In general, the ratio of grout to water should be three to one. To avoid wasting grout, start out with slightly less water than you think you'll need. It's less wasteful to add water than it is to add grout and create more "paste" than you'll need.

44. For this mosaic, use about 1 cup of grout to start.


1467

45. Add a little less than ⅓ cup of water.


1467

46. Mix well with a paint stirrer or piece of scrap wood.

47. The grout mixture is ready to apply when it resembles brownie mix. It should be spreadable but should stick to the stirrer instead of dripping off. If it’s too thick or still contains dry grout, add a bit more water. If it’s too thin and drippy, add more grout.

48. Plop a dollop of the mixture onto the mosaic.

49. Use a plastic spreader to spread the grout around.

50. Keep adding more and spreading it out until all the grooves are filled.

51. To spread properly, hold the spreader at a slight angle, as shown.

52. Drag the edge evenly across the mosaic's surface so the grout fills in every groove.

53. To grout the edges of the piece, hold the spreader at a slight angle to one edge and pull the grout mixture to the edge of the piece and then a little beyond.

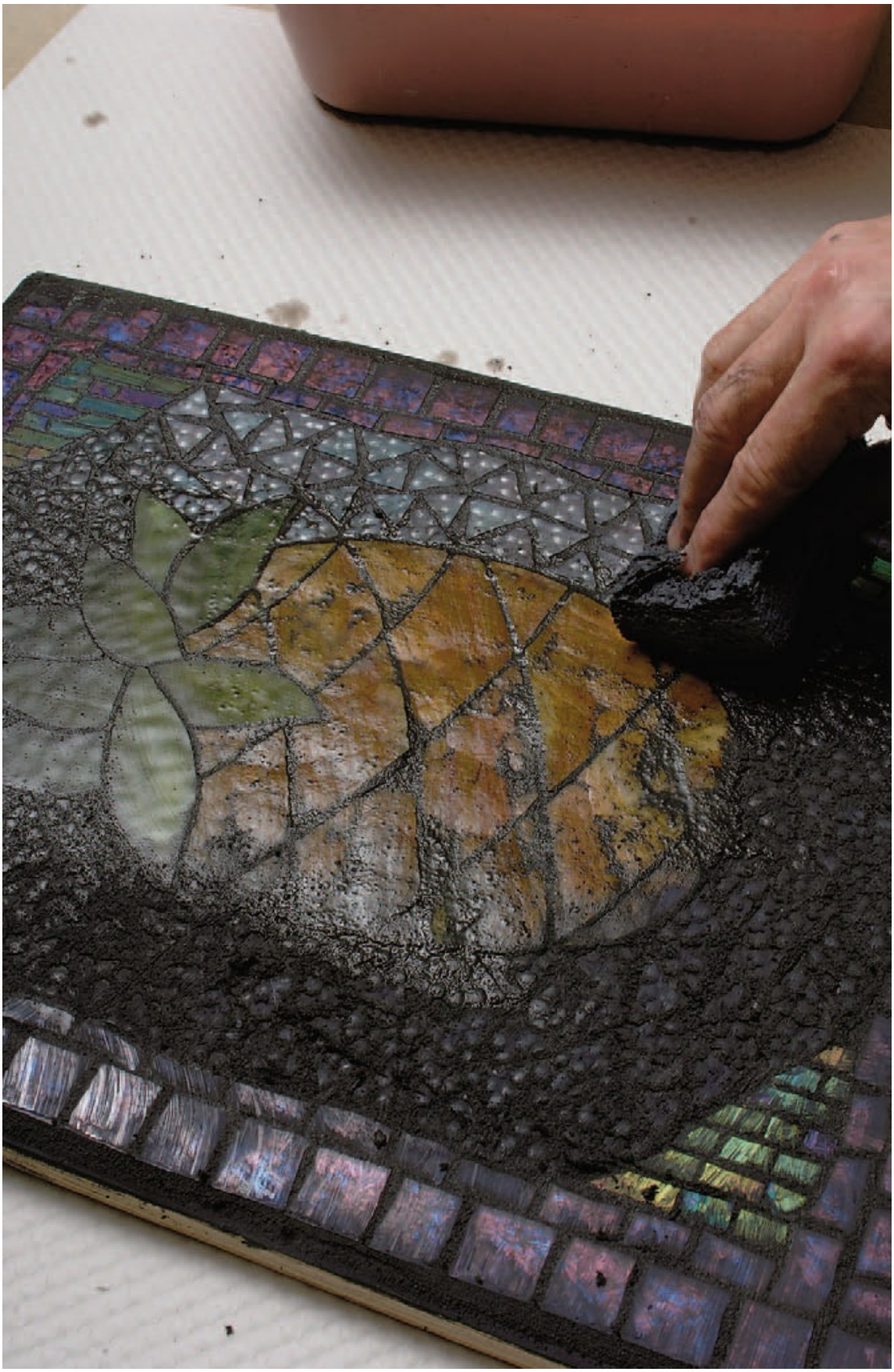
54. Hold the spreader at an angle as shown and drag a corner along the edge. This should create an even “slope” from the glass to the edge.

55. When you're finished spreading the grout, the design will probably be all but obscured.

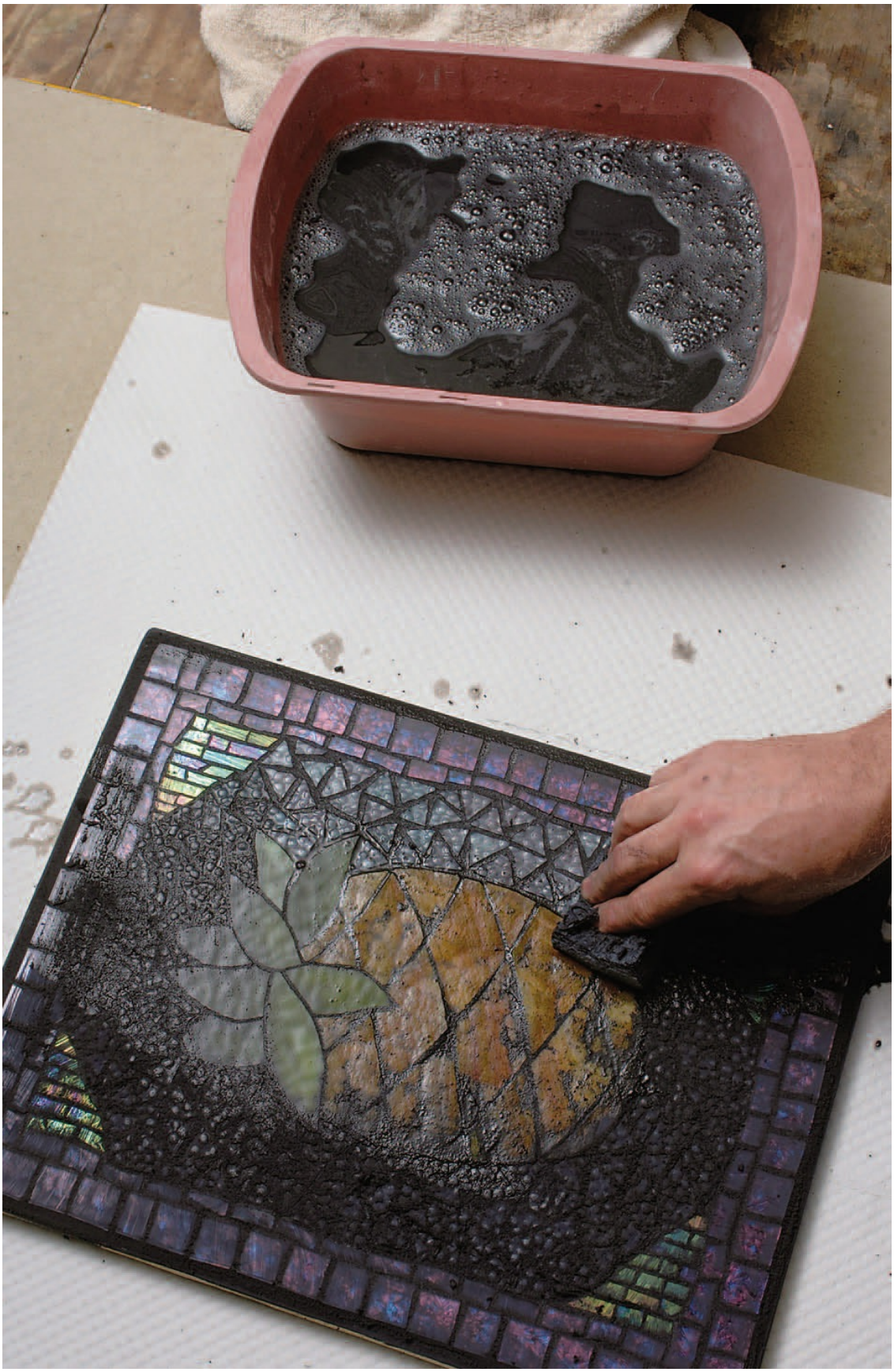
56. After about 30 minutes, the grout will harden enough so that you can remove it from the glass with a damp sponge. Don’t do this step right after application or you’ll pull the grout out of the grooves.

57. Rub the surface of the piece with the sponge, wiping hardest on the glass.

58. The goal is to wipe away all the grout from the surface of the glass, leaving the rest of the grout in place.



59. Rinse the sponge and wring it out regularly as you work.



60. After you've removed as much grout from the glass as you can with the sponge, use a dry towel to clean away the rest.

61. Occasionally, a bit of grout will stick in a pit in the glass. Use the tip of a knife to pick it out.

62. The grout will take at least 12 hours to dry thoroughly. When it does, you can paint the edges of the board (and the back, if you wish).Matte black enamel paint is used here to match the color of the grout.

63. As the final step, apply a coat of penetrating sealer to the entire piece.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ARMORCRETE™
Cat. No. 50735
Water-based
Penetrating Sealer
4 fl. oz. (118ml)

The finished mosaic.

Once you know how to create stained glass mosaics, you can apply the technique to all kinds of projects. This large mosiac was created to hang over an outdoor bar. It features a design from Aanraku Stained Glass of San Mateo, California.

This decorative garden “bird house” includes four sides and two roof pieces that feature different mosaic patterns.

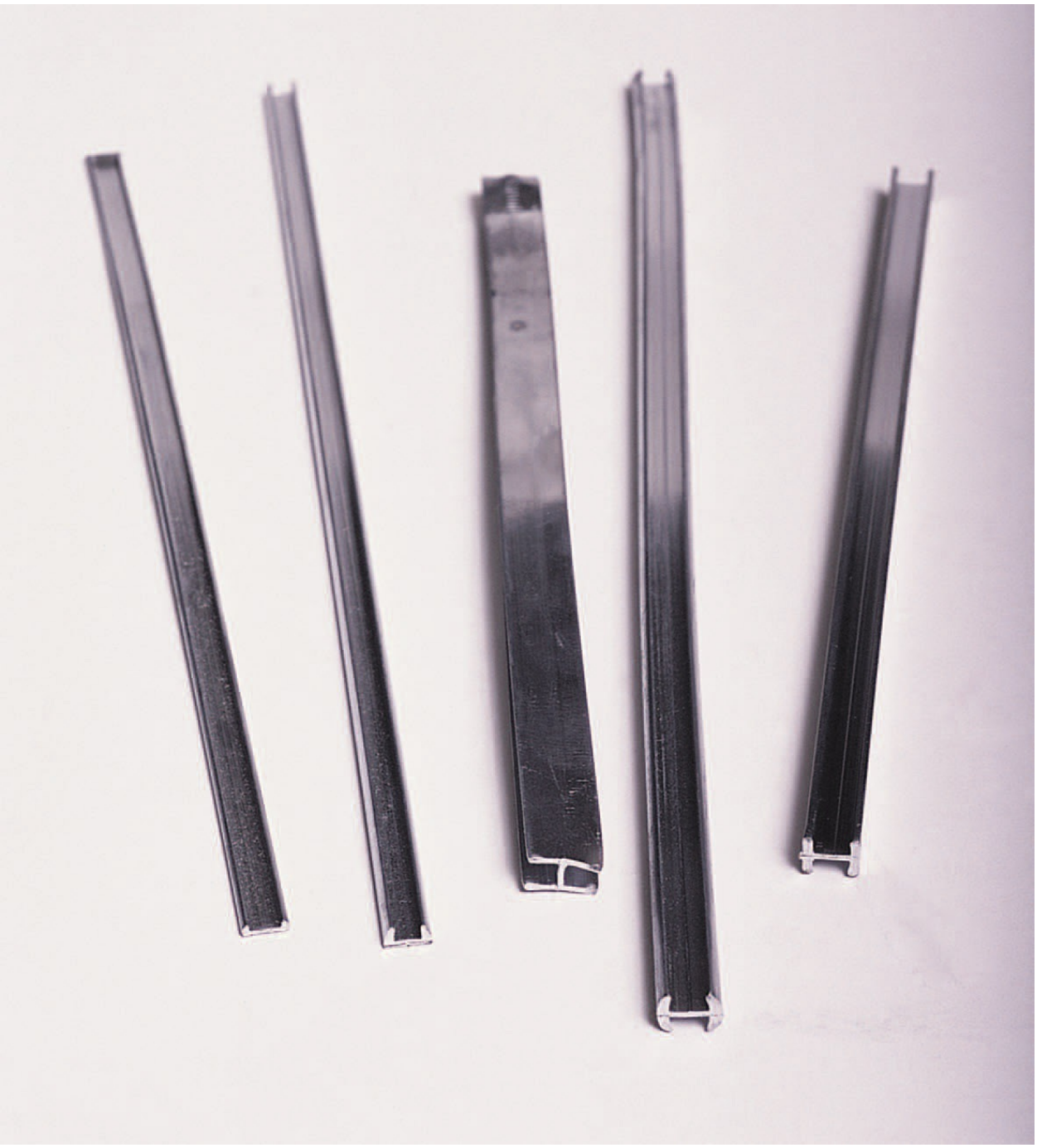
8

Framing and Finishing a Large Panel

Designing and creating this large panel requires only basic techniques, but to frame it securely and finish it is more of a challenge. Because

zinc is stronger than lead, zinc cames are used to frame the piece, along with hooks made of copper wire. Two different types of patinas are used to darken the metal—one for zinc, one for the solder of the interior seams. A final coat of finishing compound completes the project.

Materials and Equipment



ZINC CAMES

Long strips of zinc, usually sold in 4- or 6-foot-long sections, make up the frame of this large stained glass panel. A central channel holds the glass and provides the metal surface for soldering. The U-shaped cames used here hold a single piece of glass along an outside edge. (Cames that are H-

shaped hold pieces of glass along a shared edge.) Approximate cost: $3 for a 6-foot-long strip.

HORSESHOE NAILS

Long narrow nails that are flat on one side, making them perfect for holding a project together and in place. Usually sold in packs of a dozen or so.

HACK SAW

Cuts came strips cleanly. Approximate cost: $10.


NOVACAN
BLACK
PATINA
FOR ZINC
WARNING
MAY BE FATAL IF
SWALLOWED
READ CAUTION ON BACK
237 ml
8 fl. oz.
NOVACAN
BLACK
PATINA
FOR SOLDER
POISON CAUSES
BURNS • VAPOR
READ CAREFULLY CAUTIONARY
INFORMATION ON SIDE PANEL
237 ml
8 fl. oz.

PATINAS

Patinas are chemicals that darken the metal they come in contact with. Some are for use only on solder; others are used only on zinc.

Small sponges, rubber gloves, 16-gauge copper wire, steel wool, and a sheet of absorbent paper as large as the panel are also needed for this project.

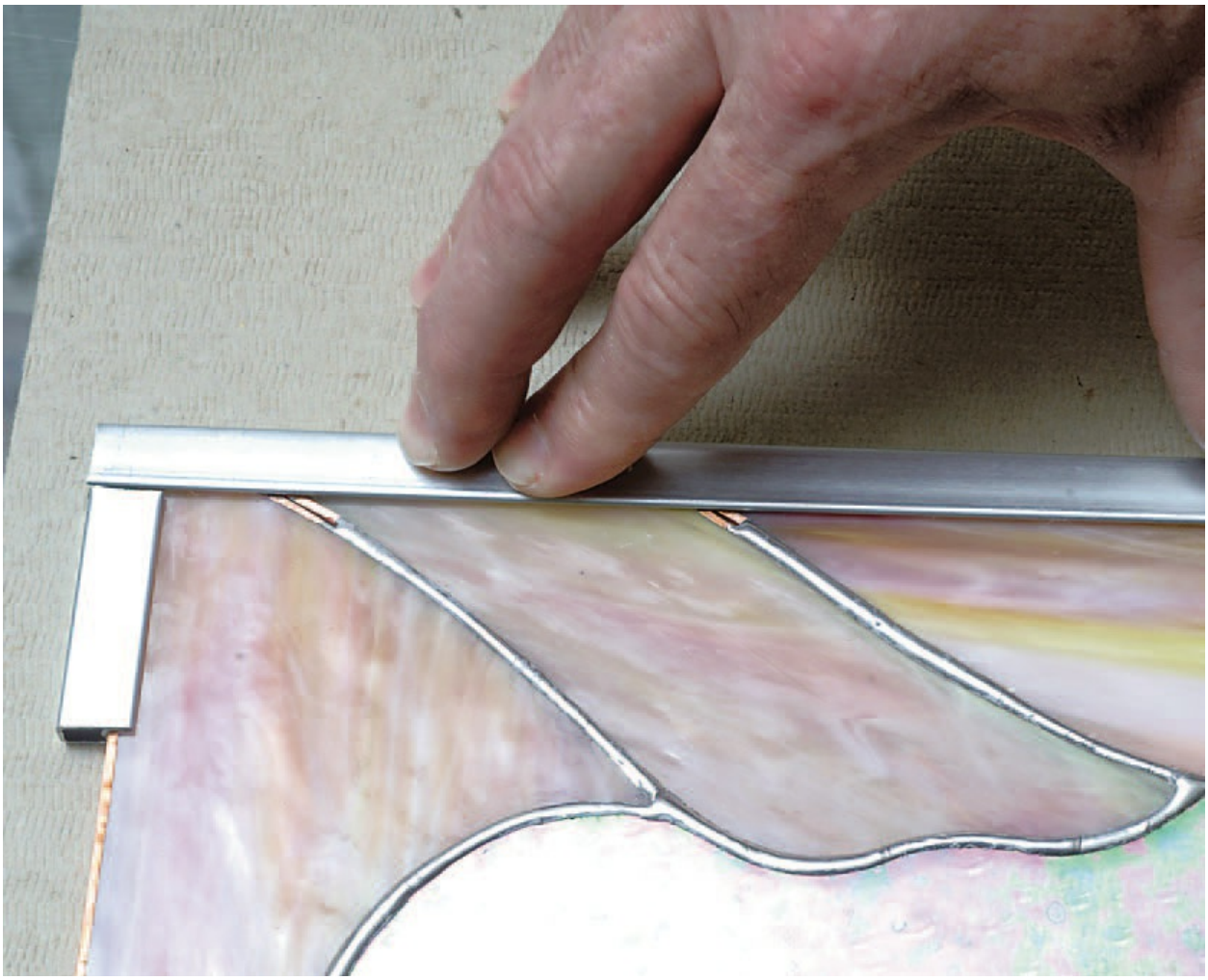
Framing and Finishing a Large Panel

Zinc cames with slots on one side are used for the frame. Zinc is generally stronger than lead and will work to support this heavy piece. Two came scraps a few inches long will help you determine how long the sides of the frame should be.

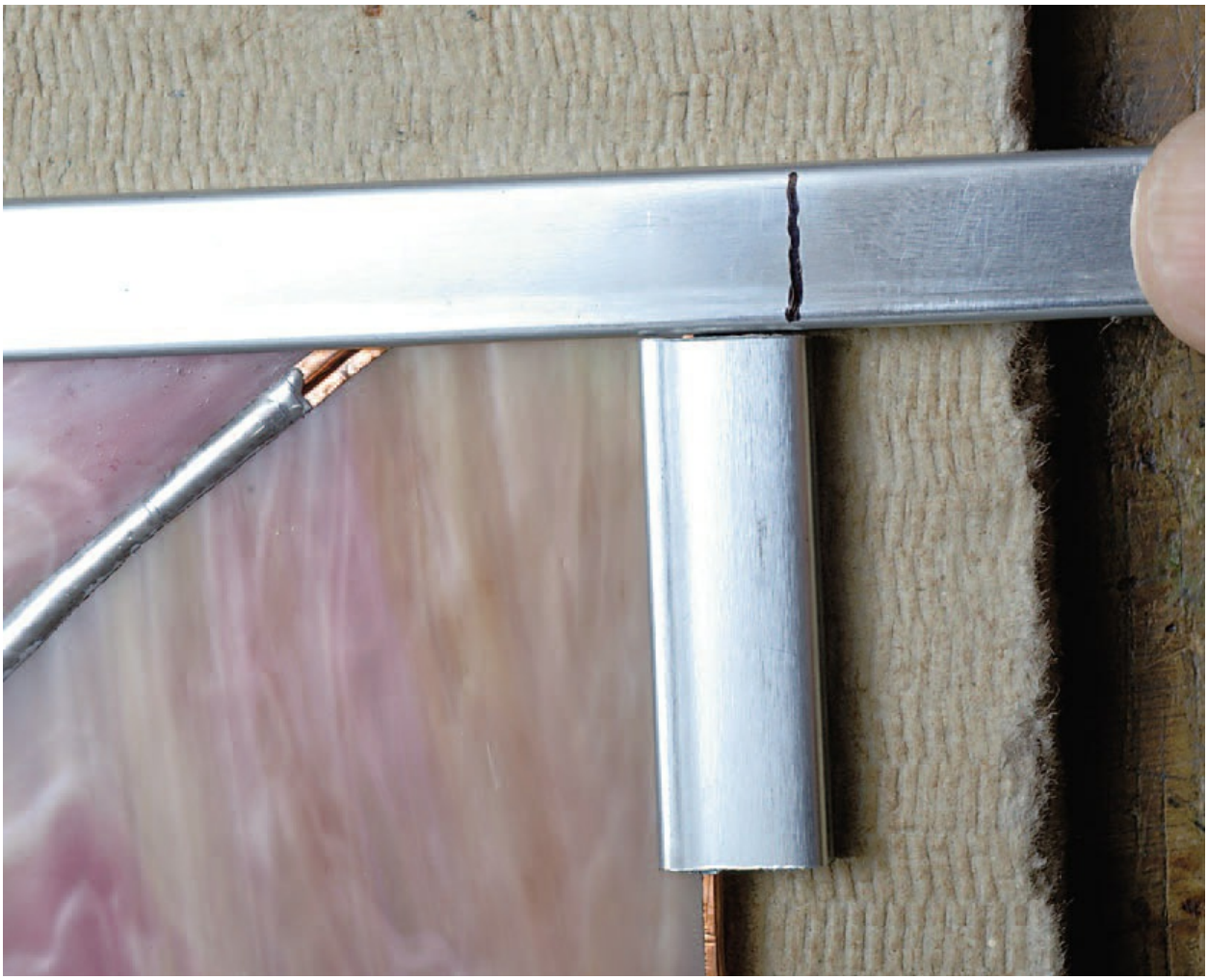
1. Slip one came scrap on the side of the panel near the top, as shown.

2. Slip the other came on the opposite side.

3. Slip the full came strip on the top of the panel, lining up one end with the side of the came scrap. Notice that the came on the panel top should extend over the end of the scrap piece.



4. Use a marker to draw a line on the other end of the top came in line with the end of that scrap piece.



5. To cut it, put the long piece of came in a lead vise.

6. Cut the came at the mark using a hack saw.

7. Use the same method to determine the exact length of the cames that will be placed on the bottom and two sides of the panel. After you've cut all the pieces, slip them on the panel.

8. Use horseshoe nails to hold the panel with its came framing in place.

9. The rubber side of the mallet works well to tap the came in place if need be.

10. When everything is in place, flux the spot where the came strips meet.

11. Flux every spot where the lead solder touches the frame.

12. Solder each of these spots.

13. Be sure that the frame is soldered together completely.

14. When one side is finished, turn the panel over to flux and solder the other side. Be careful when flipping a heavy piece like this—don't grab it by the sides to turn it over. The panel's own weight could cause the center to sag and break.

15. To turn it over properly, slide the panel to end of the work surface until half is hanging over the edge.

16. Tilt the panel downward, keeping the center of the panel supported by the edge of the work surface.

17. Gently set the panel on the floor.

18. Use both hands to turn it around.

19. Place the soldered side toward the work surface.

20. Gently lift it upward, as shown, until the center of the panel is against the edge of the work surface.

21. Tilt the panel down onto the surface.

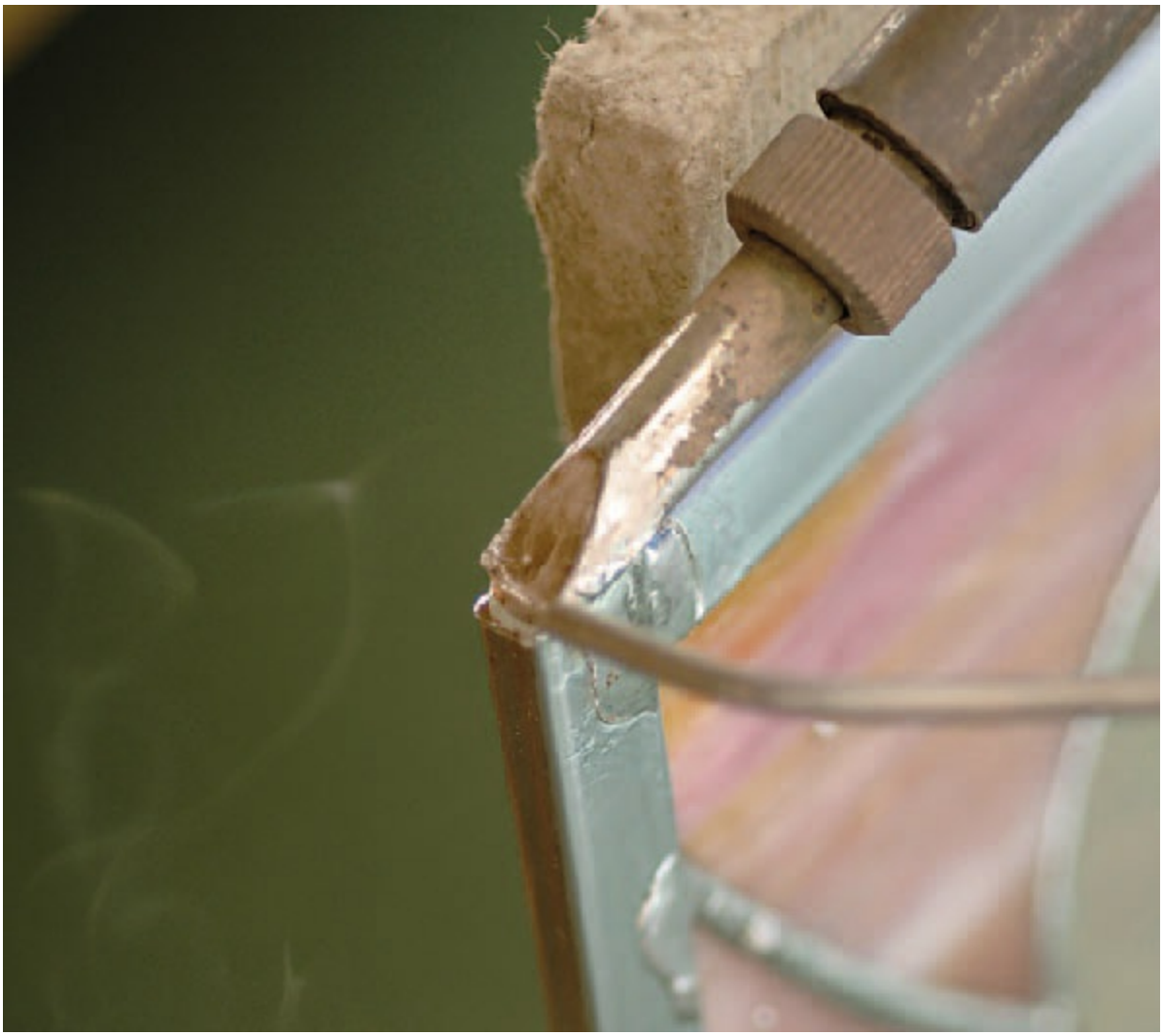
22. Slide the panel into place.

23. You can now solder the back of the panel.

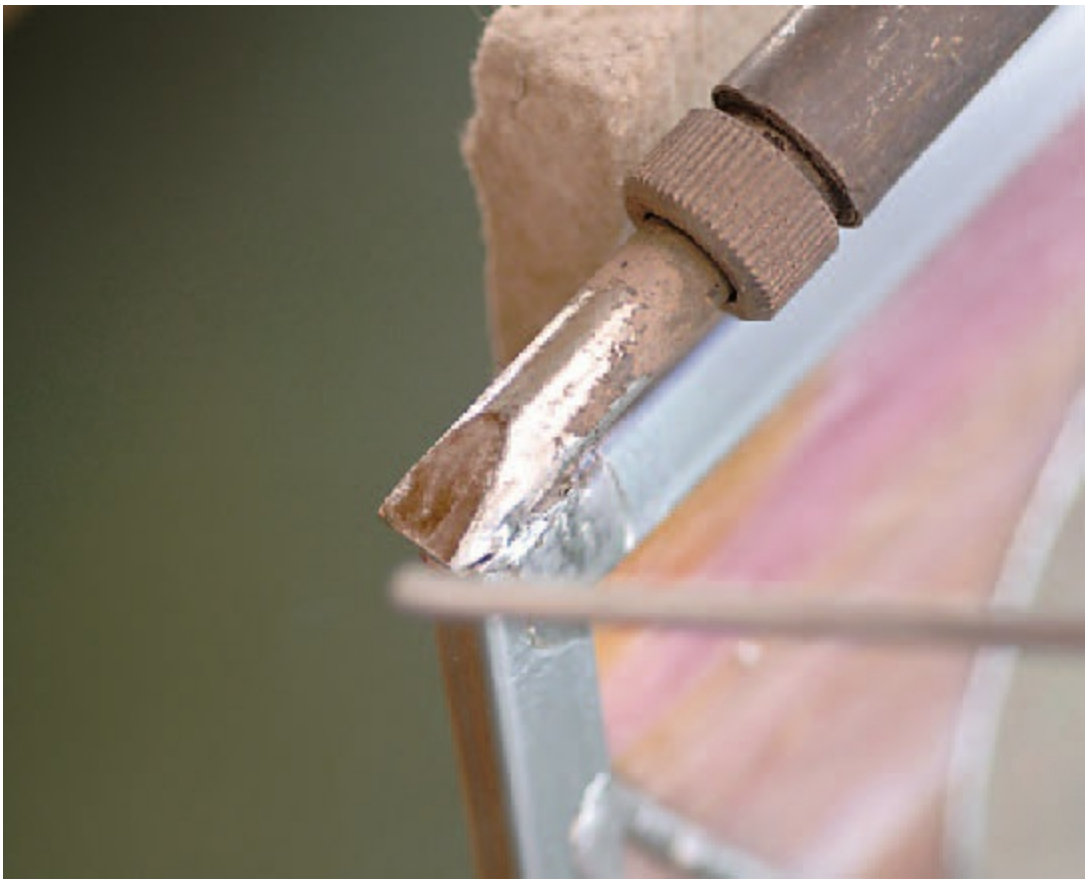
24. A final bit of soldering is needed to close the gaps left at the corners.

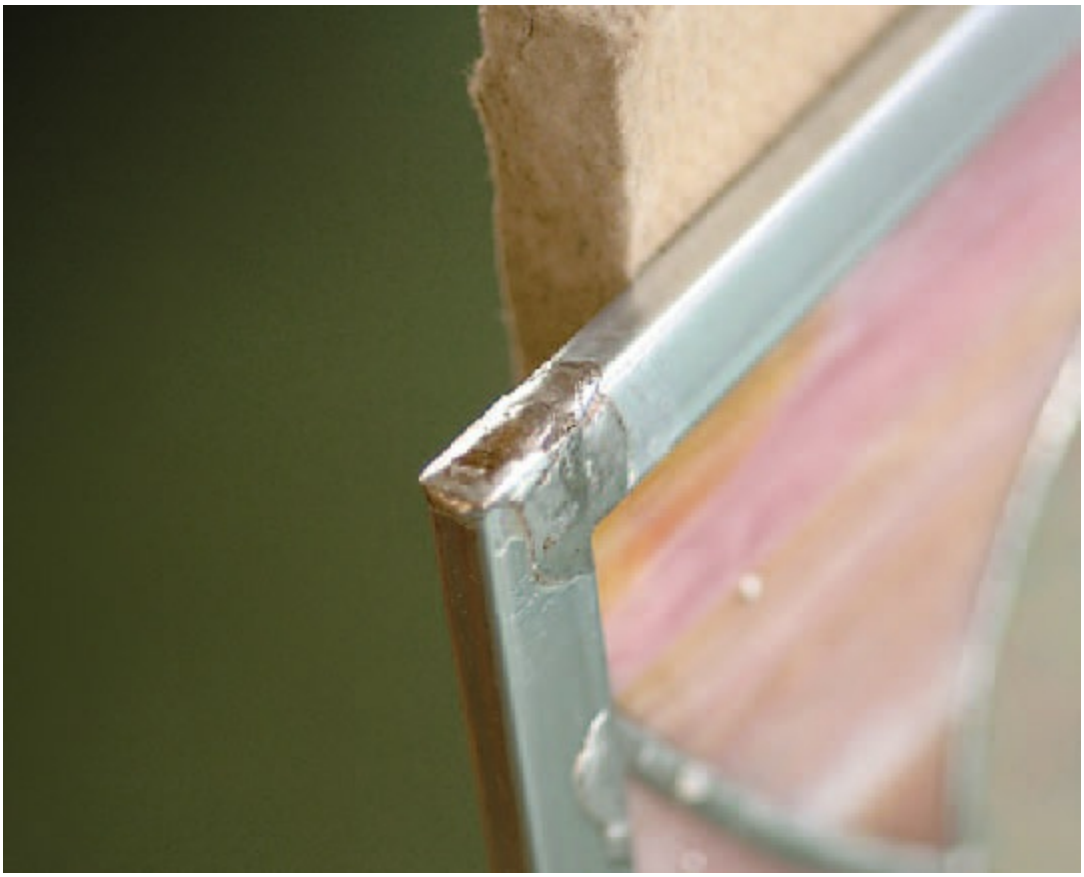
25. Flux these spots.

26. Make one pass with the iron to partially fill up the hole.



27. Then make another pass to fill it completely.

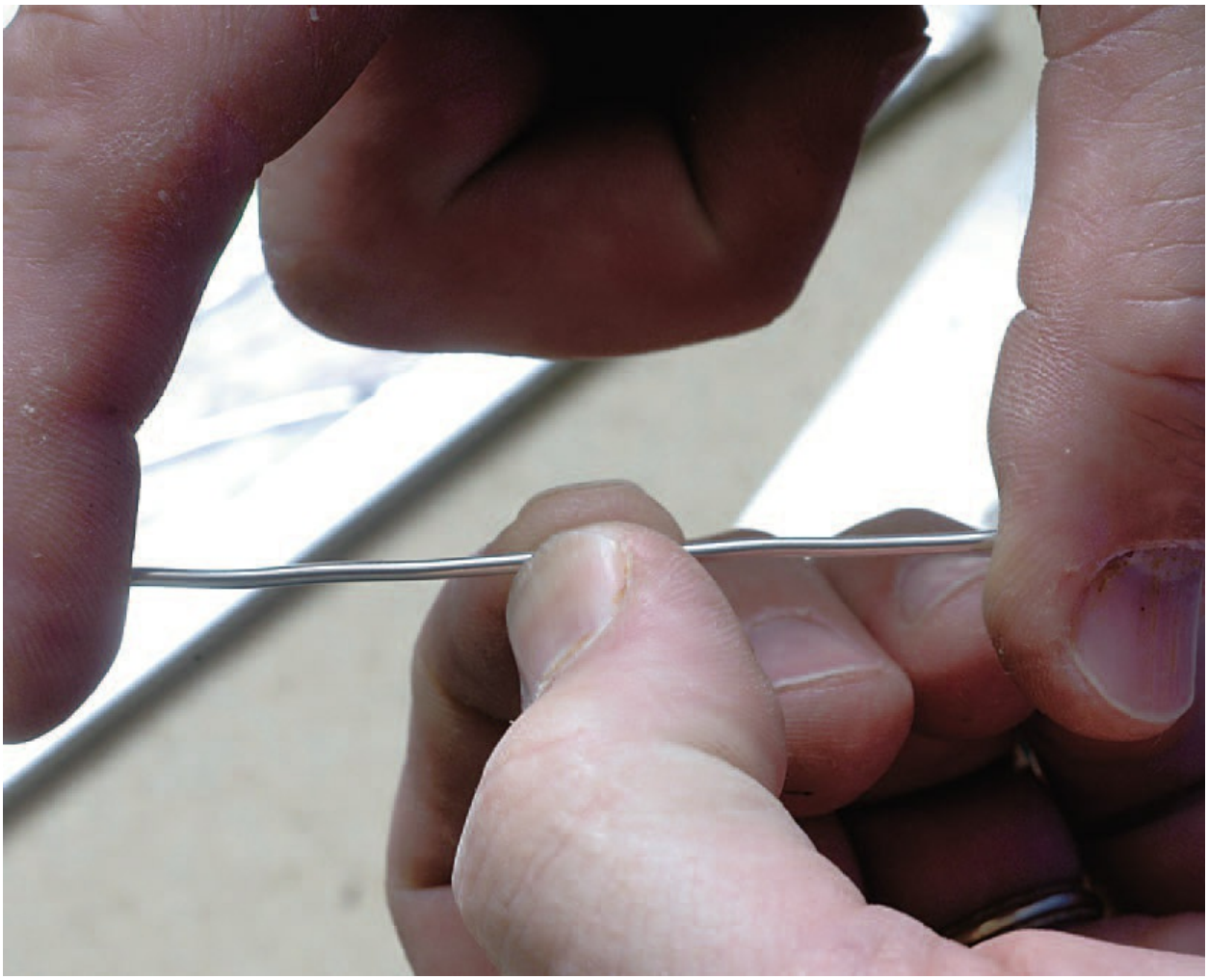




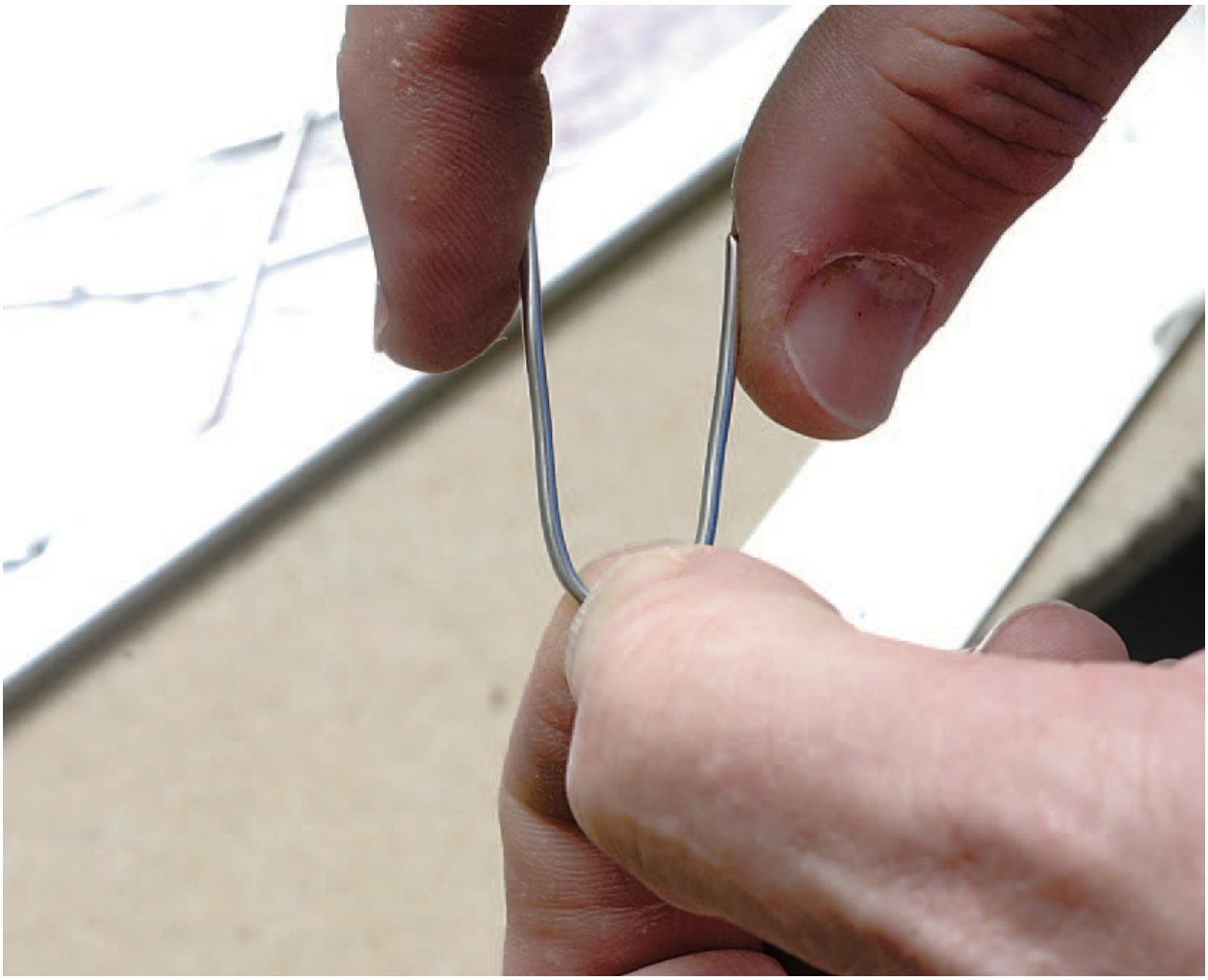
28. The corners should be covered with solder and sturdy.

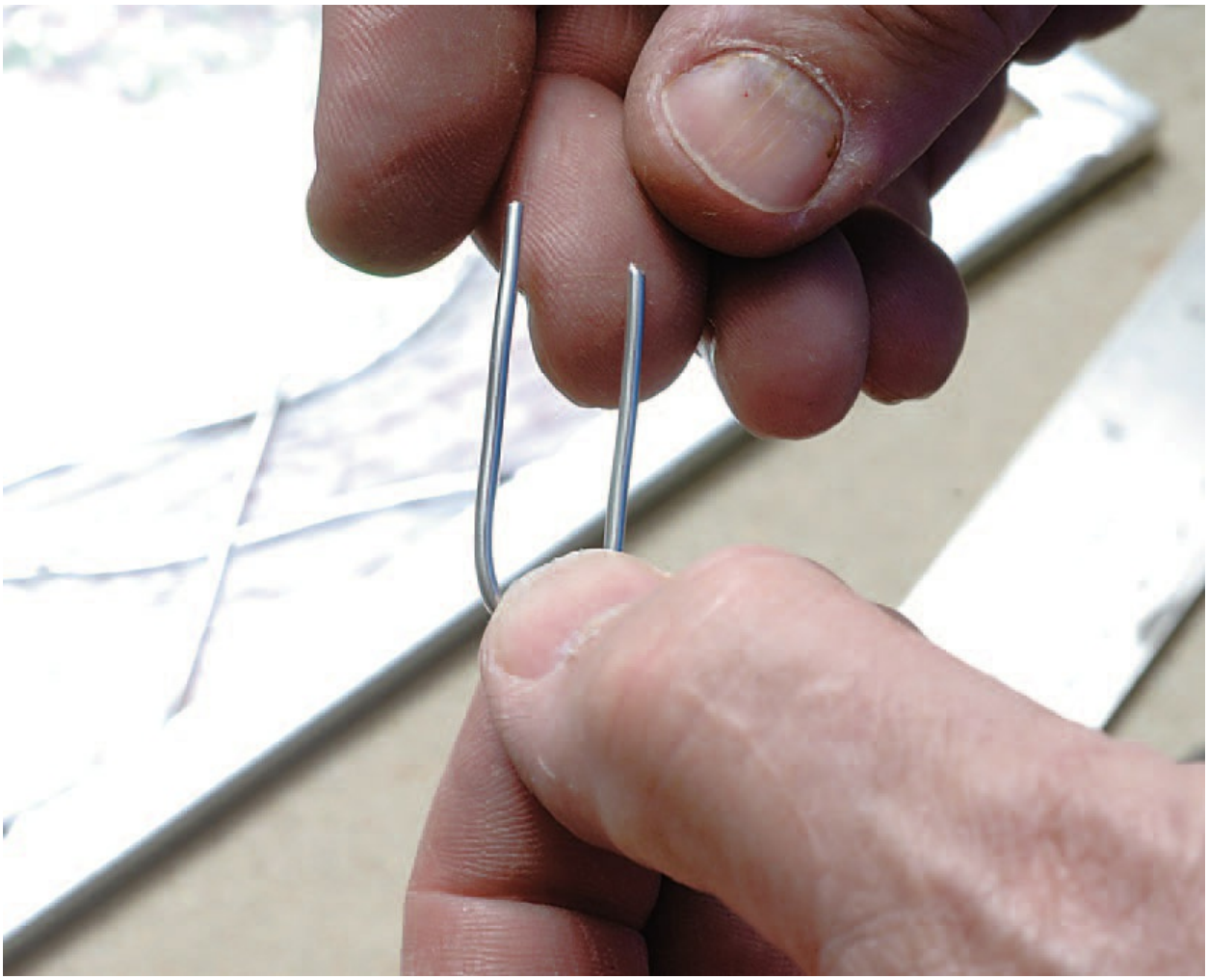
29. Simple hangers will be attached to each side of the top of the frame. These hangers are made of two pieces of 16-gauge wire, each 3 inches long.

30. Position the 3-inch wire between your thumb and index finger.



31. Pinch the wire into a U shape, making sure each side of the U is the same length.



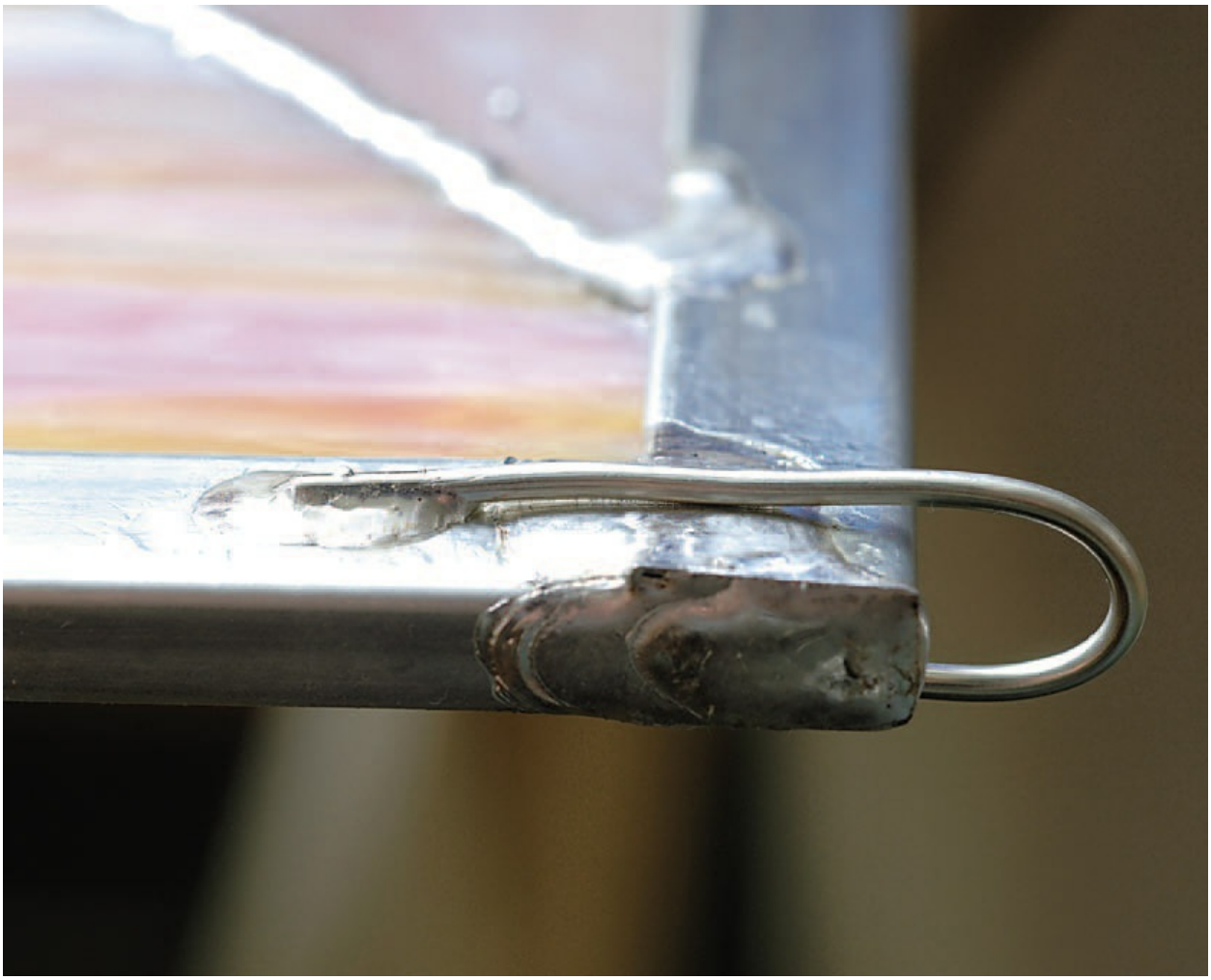


32. Slide the bent wire on the top of the frame so the arms extend down the middle of the frame's side piece.

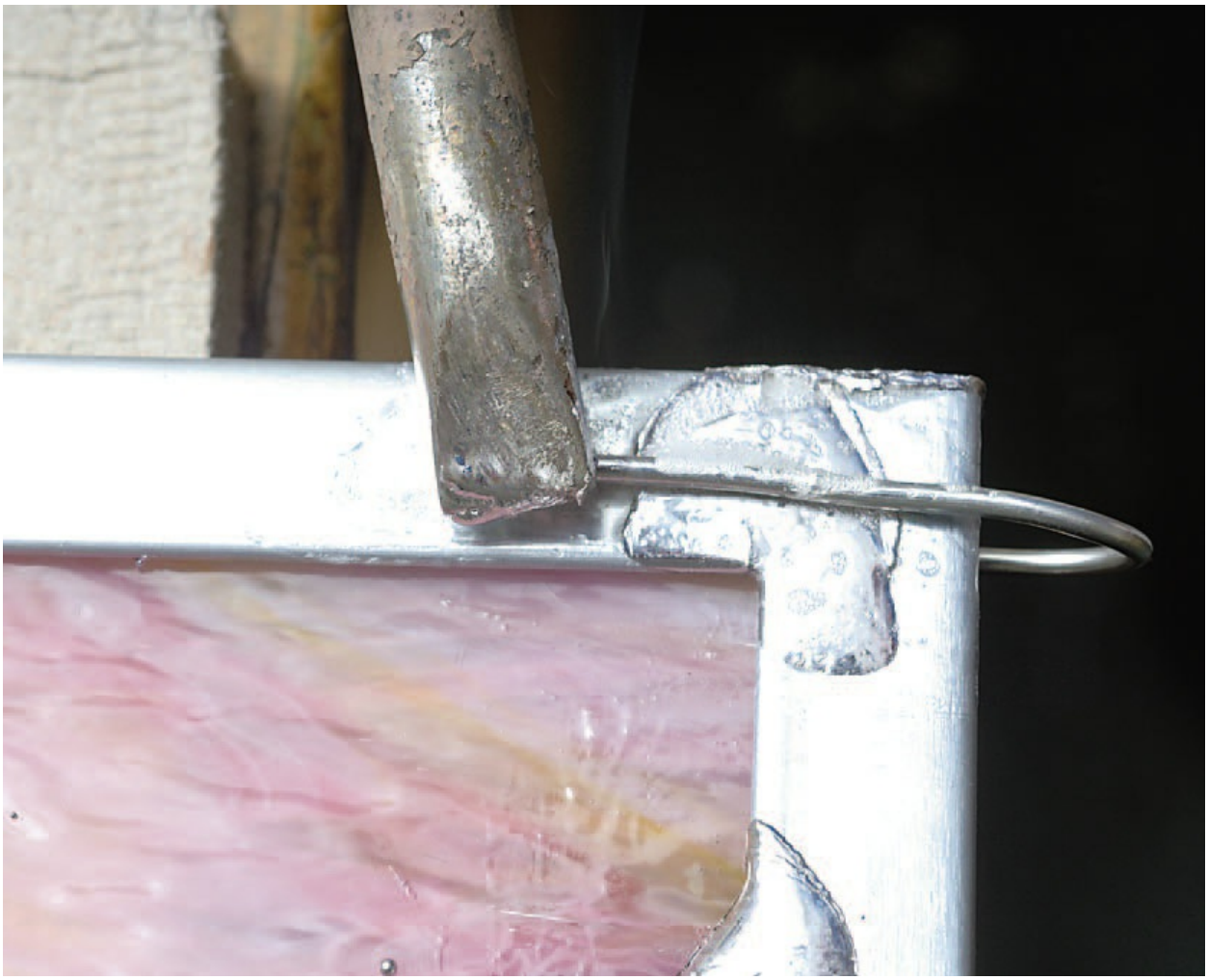
33. Adjust the wire so that ⅜ inch of the U extends beyond the edge of the top piece.

34. Flux the arm of the U.

35. Solder it into place.



36. Solder both the front and back of the U so it holds firmly, then use the same procedure to add a hanger to the other end of the frame, making sure that the U extends ⅜inch beyond the top (otherwise the panel will hang crookedly).



37. The next step is to apply a patina to all the metal. Scrub the zinc clean with a piece of fine steel wool.

38. Set the panel on a piece of absorbent paper (newspaper works well too). Put on a pair of rubber gloves.

39. Wet a sponge with patina that's specially formulated to use on zinc.

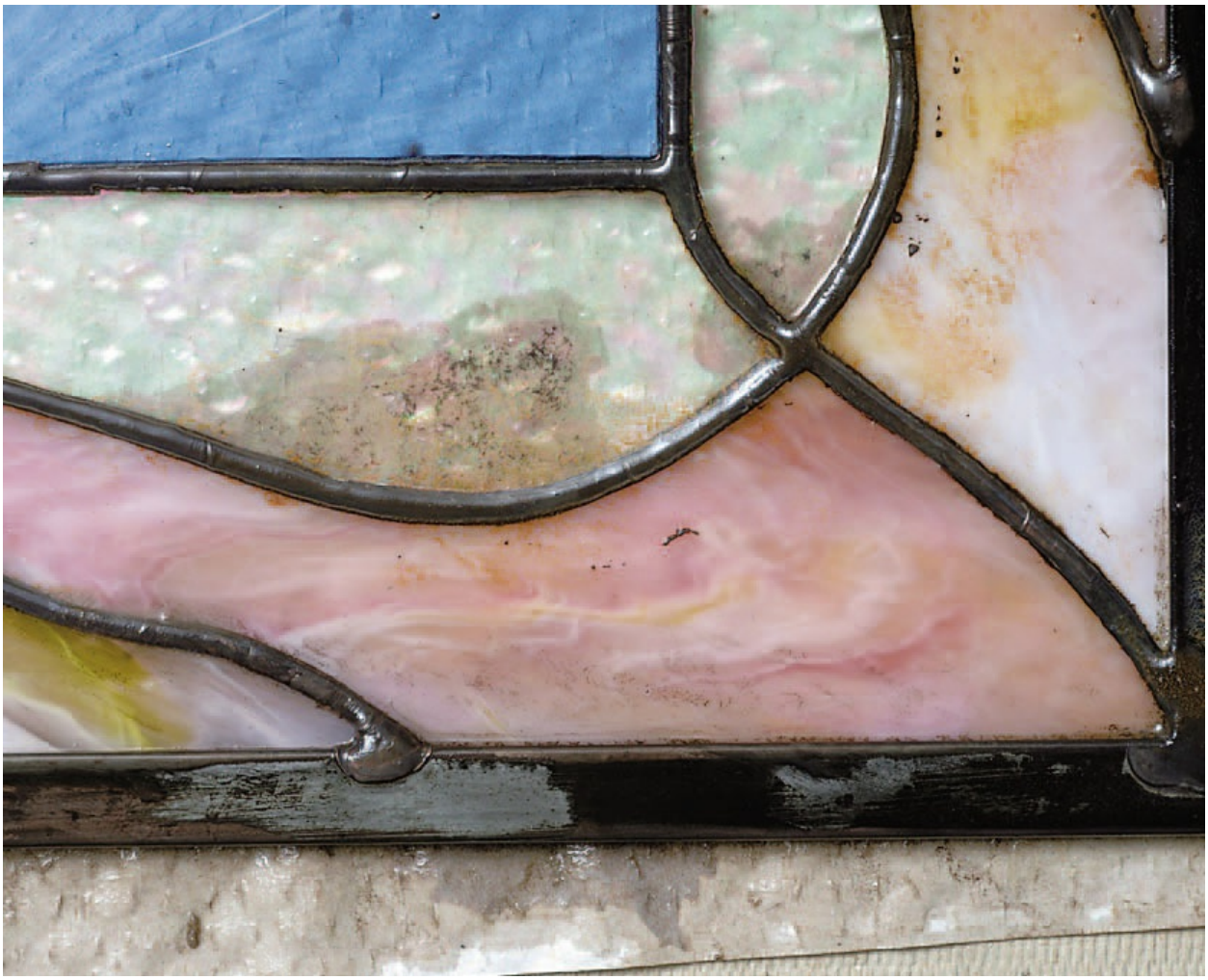
40. Apply the patina to turn the zinc black.

41. Apply to both sides of the panel.

42. Switch sponges and patinas— one formulated for solder is used to blacken the lead solder in the panel's interior.

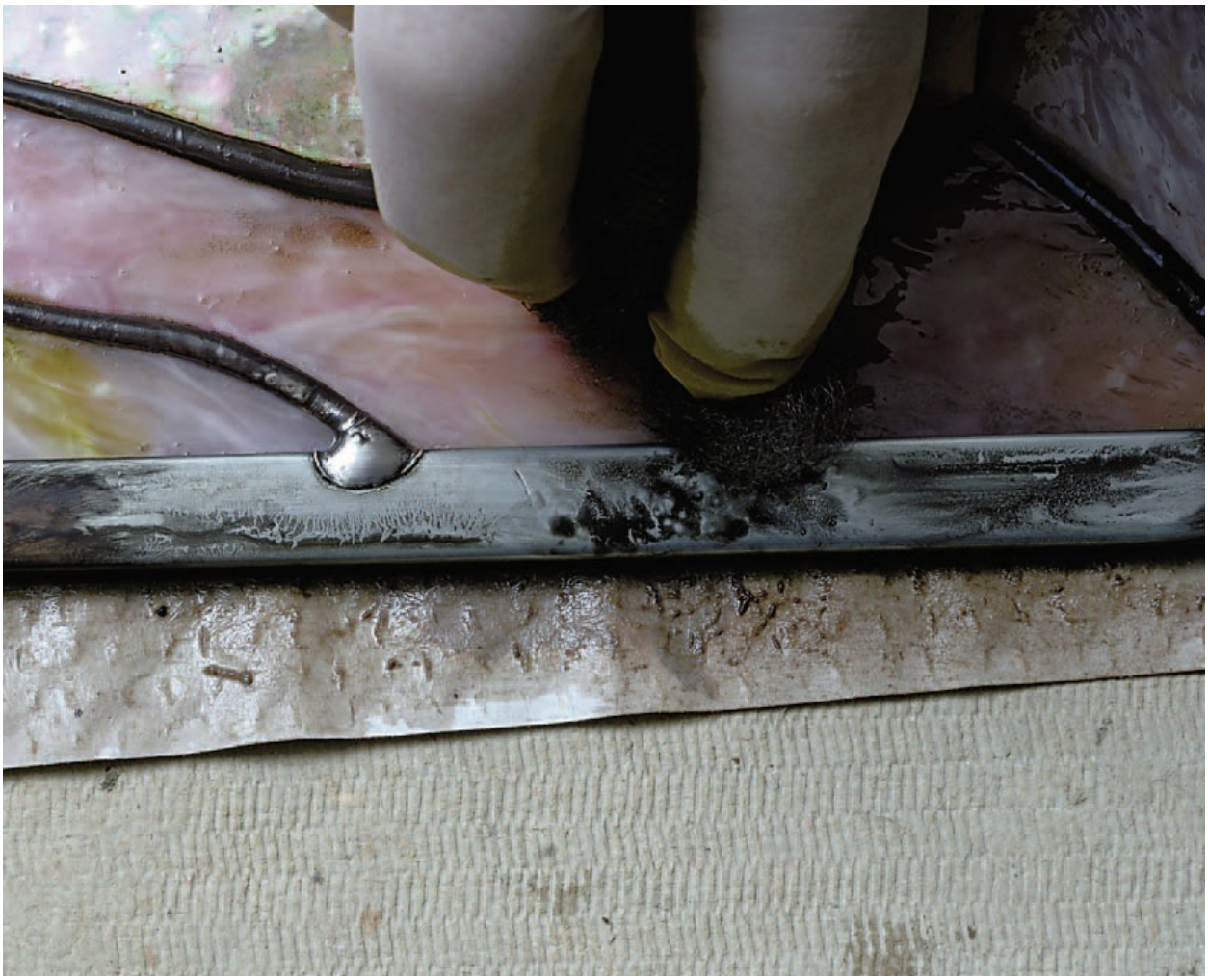
43. Apply carefully, keeping the lead patina off the zinc as much as possible.

44. If the two patinas do mix, you might notice that the zinc patina starts to break up and get splotchy.

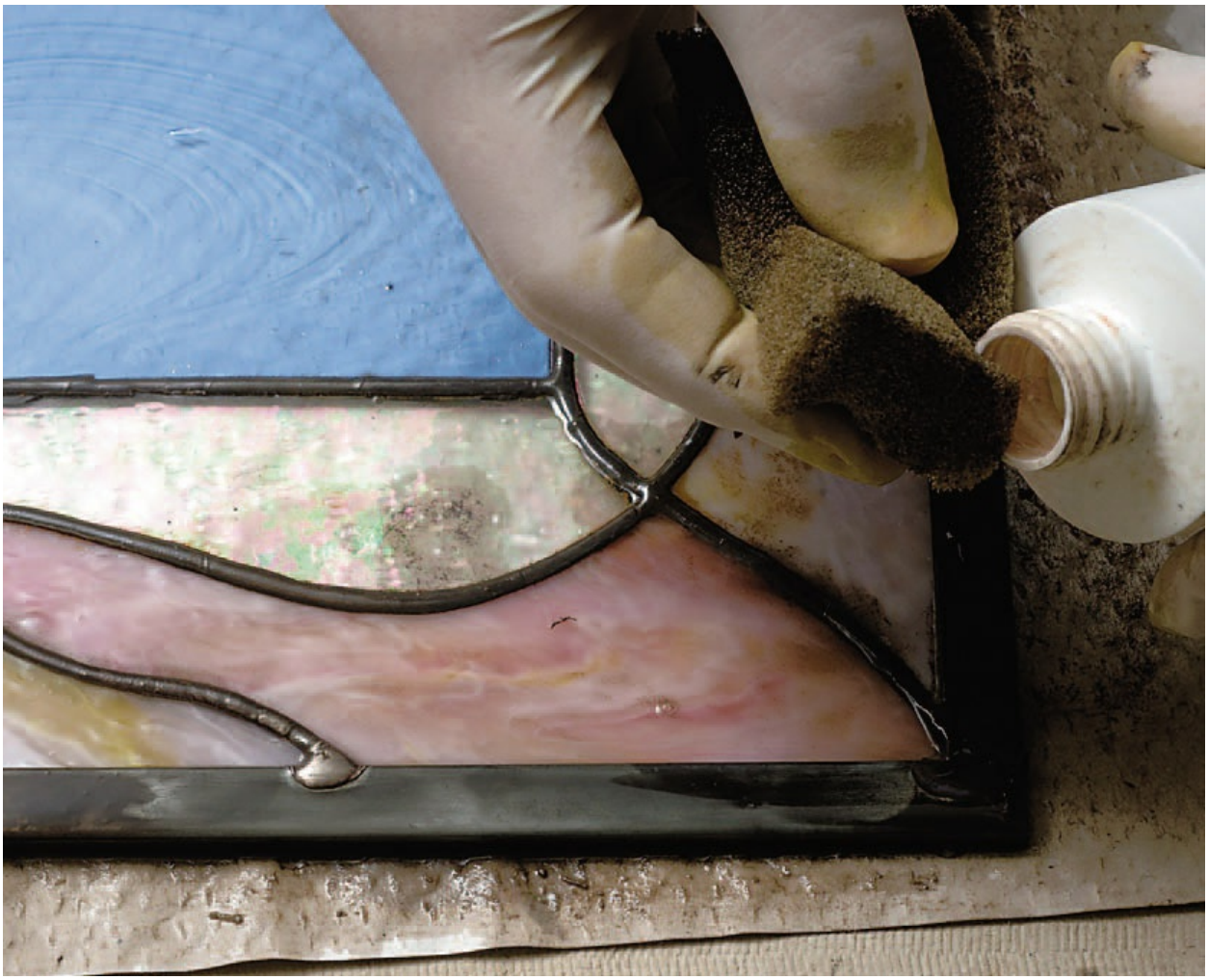


45. If that happens, scrub the

46. . . . until it is clean.

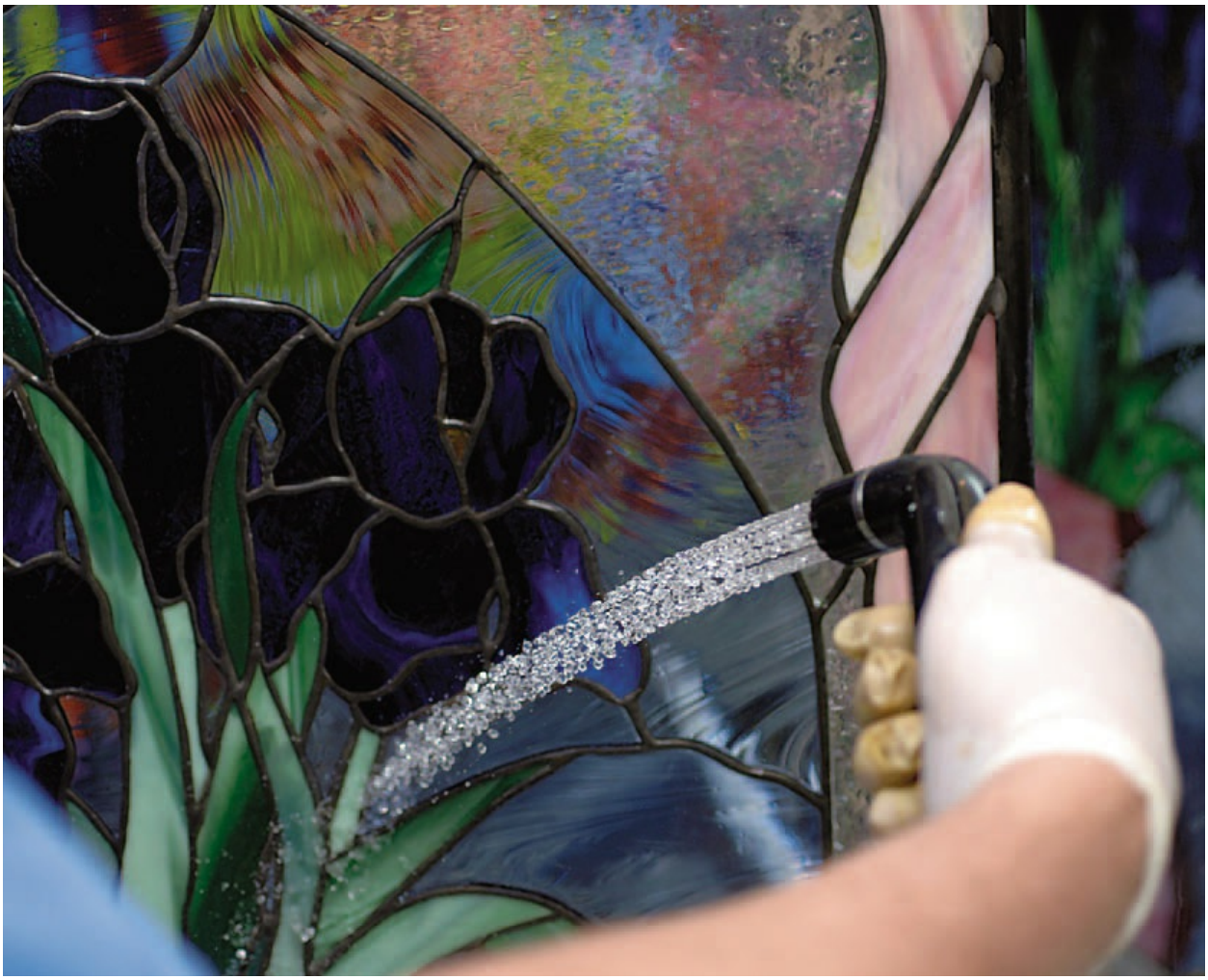


47. Then reapply zinc patina.



48. If you cleared the old patinas away thoroughly, the new patina should darken the zinc smoothly.

49. The next step is to wash the piece completely with water to neutralize the patinas' chemicals.



50. Dry the panel with an old towel.

51. Apply a finishing compound. 51.

52. And wipe it until the glass shines.

With chains linked through the panel’s hangers, the finished piece is ready to hang.

Resources

BOOKS ABOUT STAINED GLASS MAKING

The following titles contain information, projects, and ideas useful to beginners looking to advance their skills.

Bier, Barry. *The Art of Stained Glass Made Easy.* London: New Holland, 1999.

Larson, Alicia. *Stained Glass Secrets.* Aspen, CO: Crystal Images, 1996.

Rich, Chris, with Martha Mitchell and Rachel Ward. *Stained Glass Basics.* New York: Sterling Publishing, 1996.

Wrigley, Lynette. *Stained Glass: Stylish Designs and Practical Projects to Make in a Weekend.* New York: Sterling Publishing, 1999.

RESOURCES ON THE INTERNET

www.rainbowvisionsg.com

Web site of Rainbow Vision Stained Glass in Harrisburg, PA, owned by expert and consultant Michael Johnston. Contains nice information about all things stained glass, and equipment and materials can be purchased from the company. Numerous stained glass workshops are held regularly as well.

www.artglassassociation.com

Web site of the Art Glass Association, an international nonprofit group dedicated to the art of stained glass making.

www.inlandcraft.com

Web site of the Inland Craft Products Company, which carries glass grinders and some other equipment used in stained glass making. Also includes a handy state-by-state locator of stained glass retailers.

www.mortonglass.com

Web site of the company that manufactures the Morton system for stained glass cutting. Site also includes plenty of other information about the craft.

www.spectrumglass.com

Web site for the Spectrum Glass Company, a Washington-based manufacturer of specialty sheet glass for use in hobby-craft, fine arts, architecture, lighting, and other applications. Site includes free stained glass patterns that can be downloaded, as well as listings for retailers who sell Spectrum glass.

www.stainedglass.org

Web site of the Stained Glass Association of America. Features an incredible amount of information about the craft, such as its history, profiles of artisans, and details about techniques. Also included is material about lead safety issues as they pertain to stained glass making.

www.stainedglassretailers.com

Web site of Retailers of Art Glass and Supplies (RAGS), a nonprofit organization of owners of retail stores selling stained glass supplies around the world. Includes good information about the craft, as well as listings of nearest suppliers.