

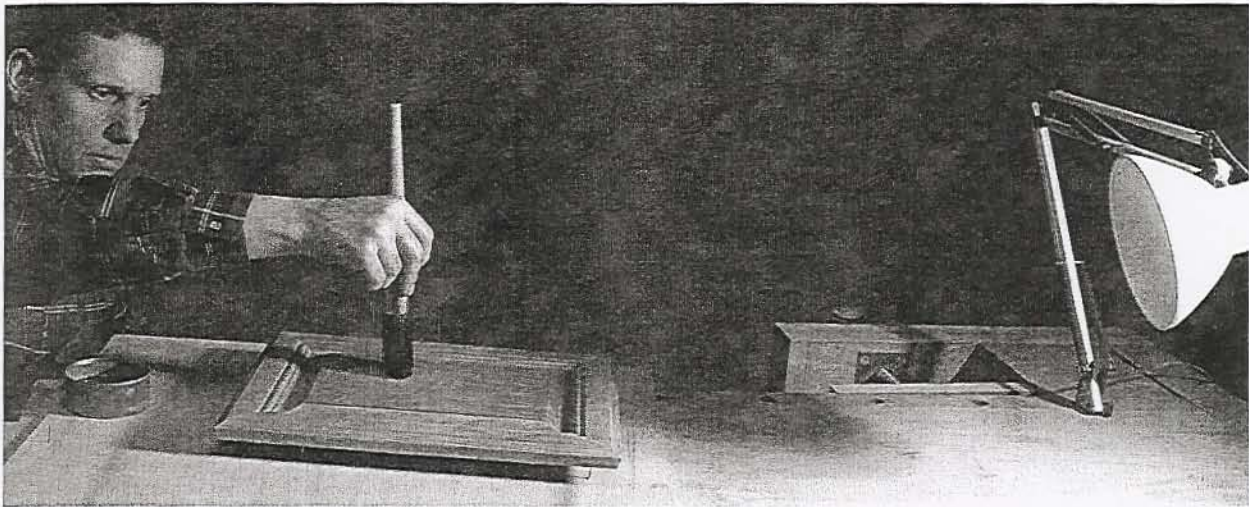
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Getting Started

Finishing begins well before you pick up a can of stain or a brush. Everything you do from initial design to final assembly affects the outcome of the finish. For example, how well you lay out and dimension stock determines how easy it is to sand it. How well you glue up a dovetailed drawer affects the staining and finishing. Equally important is the environment in which you apply the finish.

The Right Environment

When a finish fails, it's natural to blame the finish or your own application skills. But many finishes fail simply because they are applied in an unsuitable environment. Finishes are complex chemical products that react differently to extremes of temperature and humidity. Inability to dry, "blushing," and "bleeding" are all attributable to extreme weather conditions and improper ventilation (see the Glossary at the back of the book for definition of finishing terms). Lighting is another easily overlooked area; improper lighting makes it difficult to detect missed glue spots, small dents, or uneven finish application, and makes accurate color matching nearly impossible. Dust is yet another problem, especially with slow-drying finishes like varnish.



A backlight positioned directly behind the surface you're working on is a great help when brushing on a finish.

A big step in controlling the quality of finishes, then, is to maintain a suitable environment in which they are applied. There are several simple and effective steps that can be taken to maintain temperature, increase ventilation, remove vapors and dust, and improve lighting. An added benefit is that not only will your finishes improve, but you'll also be much healthier for it.

TEMPERATURE

All finishes are sensitive to application in extremes of temperature. Not only is the cure time affected, but application also becomes difficult, if not impossible, in extreme situations. With most finishes, heat is not as big a problem as cold, as long as it's dry heat. Most finishes cure more rapidly in high heat, but, unless you live in the desert, higher temperatures usually mean higher humidity, which poses a problem that we'll cover shortly (see p. 4).

Cold can have a variety of effects, depending on the finishing material. Cold finishes are harder to apply and do not flow out and level properly if brushed. They cure very slowly, if at all, when the air is below 60°F. Oil-based reactive finishes (those that dry by reacting with oxygen in the air, such as varnish and linseed oil) take longer to cure in cold conditions and at low enough temperatures refuse to cure at all. Solvent-release finishes like lacquer and shellac aren't as fussy in cure time in extremes of temperature but won't flow out properly if applied by brush below 65°F. Water-based finishes are the most finicky in cold weather, and problems are likely at temperatures below 65°F. The ideal air temperature for applying finishes is 70°F to 80°F. The finish and the object being

finished should also be maintained within this range. In short, don't use cold finishes and don't put finishes on cold wood.

You can use heaters to warm cold workshop areas, but there are a couple of important things to bear in mind. If you use a wood-burning stove or other open-flame heating, your finishing options are limited and the area in which you work should be as far away from the source of heat as possible. The greatest risk is from the buildup of flammable vapors, which could possibly ignite when a heater kicks on. When working in a small basement room, open the doors and provide adequate ventilation when using flammable materials.

RELATIVE HUMIDITY

Relative humidity (RH) is defined as the amount of moisture in the air compared to the amount of moisture it is capable of holding. It is expressed as a percentage, and its effects on finishes are problematic when it is very high. Oil-based reactive products are generally not affected by high RH, but cure time can be increased. Solvent-release finishes fare much worse. In 90% RH and above, shellac and lacquer may turn white, or "blush," after application. Blushing can be remedied by adding a retarder to slow down the evaporation, but it's usually better to wait until the RH drops. Water-based finishes have problems in RH above 80%. The most noticeable problem is slow dry time, given that these finishes contain water as the carrier. When the air is already holding a lot of moisture, it won't want to take on any more. In extreme cases (above 95% RH), the coalescing solvent evaporates before the water does; as a result, the finish will not form a smooth, contiguous film.

Because temperature and relative humidity are so critical to proper finishing, it's a good idea to invest in a thermometer/hygrometer. An inexpensive digital model is available from Radio Shack (catalog #63-867).

LIGHTING

Lighting is not as critical to a quality finish as temperature and relative humidity, but an effort should be made to provide as good a light source as possible. Proper lighting is necessary to show defects in sanded surfaces. Good lighting also helps you see whether you've applied finish evenly, particularly when brushing. In most cases, the optimum lighting is ambient (indirect) natural daylight from windows and skylights, but for some operations you need backlighting. A gooseneck lamp clamped to a bench usually suffices (see the photo on p. 3).

If you work in an area without windows, the type of artificial lighting you choose is very important. Incandescent (regular light-bulb) lighting is not a good choice for finishing if you do any color matching because it makes colors appear redder (warmer) than they really are. Incandescent lights also produce bright spots. Fluorescent lights are a better choice because the light is produced by a large tube, which does not throw harsh shadows and results in more even lighting. Purchase neutral lamps with a color temperature of 4,200 Kelvin. Although they are more expensive, these lamps have the best overall color rendition and simulate natural daylight best.

DUST

Dust is the inevitable by-product of woodworking operations; you create it every time you cut, rout, sand, or drill. Finishes and dust do not mix, but there are several things you can do to alleviate dust problems in the finish. If space allows, set up a separate room for finishing. If you have to finish in the same room as you do your surface preparation, wait a day or so (at least overnight) after sanding. Either way, use source dust collectors on all machines, particularly on sanding equipment. The fine dust created by these machines will infiltrate everywhere. Varnishes are the most susceptible to dust. Apply varnish at the end of the day, so that you won't be walking around the shop kicking up dust. In some situations, the best solution is to use fast-drying finishes that don't give dust a chance to settle. These finishes include shellac, solvent lacquer, and water-based lacquer, which dry to the touch in a matter of minutes.

Don't become so obsessed with dust that you tear out your hair every time a speck lands in the middle of your freshly brushed varnish. The best-looking finishes are rubbed out—a process that levels the dried finish and removes small imperfections like dust. (Rubbing out is discussed at length in Chapter 6.)

Personal Safety

Finishing products are made up of complex chemical products. Many of these contain organic solvents that are flammable, irritating to lungs and skin, and harmful or poisonous if swallowed. In short, they are bad for you, and you need to take appropriate precautions to protect yourself. You also need to protect yourself from fine wood dust created during the sanding process and from noise generated by high-pitched sanders and vacuums.

SOLVENTS

Almost all the products used as finishing materials contain organic solvents. These solvents are divided into groups; the most common in finishing are hydrocarbons (mineral spirits), chlorinated hydrocarbons (methylene chloride), alcohols (methanol, ethanol), glycol ethers (coalescing solvents used in water-based finishes), esters (lacquer solvents), and ketones (acetone, lacquer thinner).

All solvents differ in degrees of hazard (for example, ethanol is far less toxic than methanol), but all enter the body through either the lungs or the skin. For best respiratory protection, work in a well-ventilated room (see p. 7). When applying finish to a large area or working in close proximity to solvent-laden varnishes and lacquers, wear an organic-vapor cartridge-style respirator for added protection. These respirators must fit correctly to be effective. I recommend that you buy a respirator from one of the major safety-supply companies (such as Mine Safety Appliance Co., P.O. Box 426, Pittsburgh, PA 15230; 800-672-2222). These companies have staff experienced in selling the correct-style mask and cartridge for your needs and also carry test kits to determine correct fit. Change your respirator's cartridges and prefilters on a regular basis—don't wait until you smell solvent through the filters.

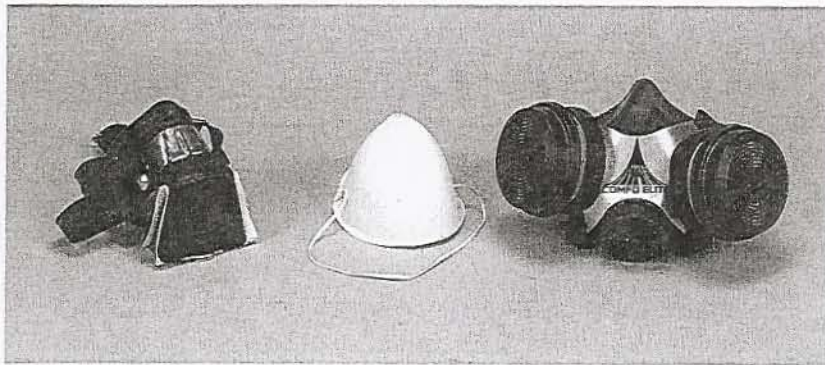
Gloves are recommended when handling any solvent; even the relatively nontoxic solvents like ethanol can dry out the skin. Wear "chemical-splash" goggles for eye protection and an apron to protect against spills. Use common sense when working with any finishing product. If something makes you sneeze, cough, or feel dizzy, stop what you're doing and get some fresh air. It should go without saying that you should always read the handling and safety warnings on the products you use.

WOOD DUST

The hazards of wood dust are clearly established. Breathing fine wood dust such as that created by sanding is an irritant to the lungs. Fine airborne dust stays suspended in the air, while heavier dust particles fall to the floor. When machining and sanding wood and composite wood products like plywood and particleboard, use a dust collector at the source and wear a dust mask rated for fine particulates.

NOISE

Noise is measured by a decibel rating, and, at certain levels, hearing protection is advised. Sanding machines, canister vacuums, and dust collectors create the most harmful noise, and appropriate



The quarter-mask respirator on the left is designed for use with fine particulates, while the “nuisance” mask in the center will block only large particulates. An organic-vapor respirator (right) is recommended when working with solvent-laden varnishes and lacquers.

hearing protection should be worn when using them. I find earmuff-type protectors the most comfortable, but other styles are available that provide just as good protection.

Workshop Safety

The area most often neglected in controlling the safe use of finishing products is the finishing room itself. Most finishing products can be used safely without risk of fire and explosion only if proper handling, storage, and disposal of these products are followed.

Flammable and hazardous finishing materials should always be stored in a metal cabinet (see the photo at right). If shop design permits, I recommend venting the cabinet at the top and ducting it outside to prevent the buildup of solvent vapors within the cabinet.

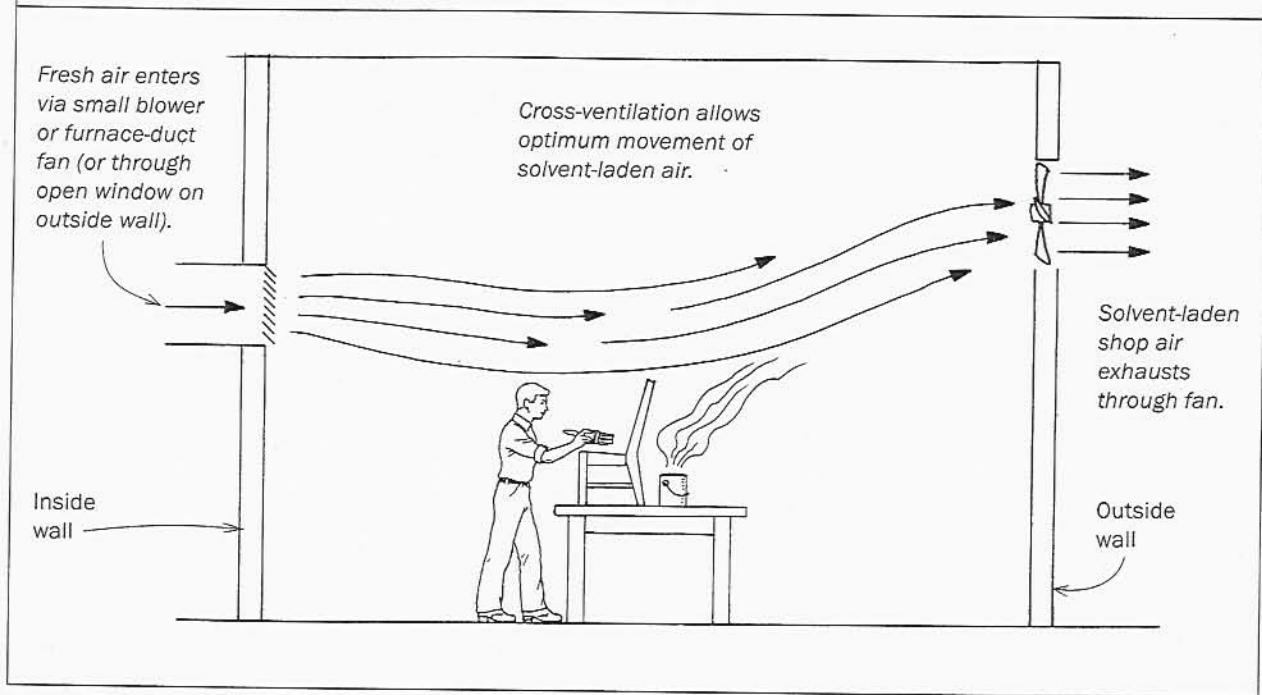
Proper ventilation removes solvent-laden air from the shop and is necessary for proper drying of finishing materials. Cross-ventilation—an influx of fresh air and an exhaust of shop air—provides the best protection for the woodworker and reduces the buildup of hazardous vapors (see the drawing on p. 8). Applying finishes by hand (rather than by sprayer) greatly reduces any potentially dangerous buildup of vapors, but a window exhaust fan is still a good idea. Keep a door open to bring in fresh air. A fan can be placed so that it blows air toward an open door, but keep it from blowing directly over a wet finish, which could cause flowout and leveling problems.

Most small shops do not generate enough hazardous material to be regulated, so proper disposal is the responsibility of the user. Never pour finishing materials down the drain. Set them outside where the solvents (even water-based) can evaporate, and then dispose of the dry resin as you would any garbage. If you are



For safety, finishing materials should be stored in a metal cabinet.

CROSS-VENTILATION



To reduce the risk of fire, store oily rags in a specially designed disposal pail.

concerned about putting the dried material in the garbage, call your municipal waste-treatment facility for advice.

Many finishing items can be recycled for other finishing tasks. Rags used for light cleaning and rubbing out can be cleaned and used for removing glaze and cleaning stripping residue. Thinners used for cleaning can be used to clean off stripped furniture. Oily rags pose a very hazardous problem and must be disposed of properly. Oil-soaked rags can combust spontaneously and start a fire. The risk of fire is greatest when the rags are balled up and thrown in with other combustible items such as wood and paper. The chemical reaction that causes the oil to cure produces enough heat to start a fire. To reduce the risk of fire, dispose of rags in a specially designed container (available from industrial safety suppliers). Empty the container at the end of the day, run the rags under cold water, and then dispose of them. Alternatively, soak rags in water, then drape them over the side of a metal trash can to dry.

Every shop should have at least one fire-extinguisher. Check with your supplier for the type rated for extinguishing organic solvents.

Finishing Tools

When a finish doesn't turn out right, it's often because the wrong finishing tool was used. You don't need sophisticated tools to apply finishes by hand, but you do need to know which applicator to use. The three basic types of finishing tools are brushes, cloth pads, and applicator pads.

BRUSHES

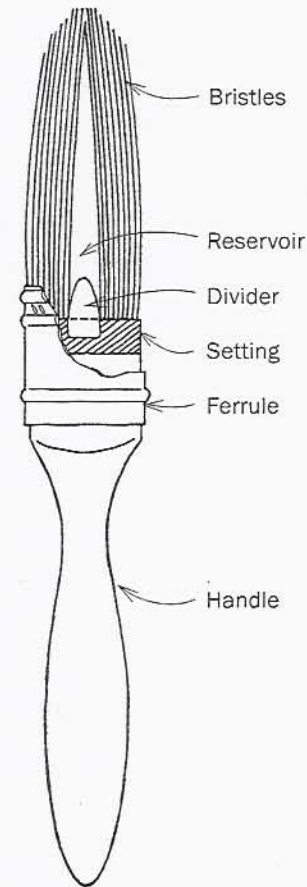
Brushes are the most common finishing tool, available in hundreds of different styles that vary in shape, size, bristle, and cost. Choosing the right brush is as important as choosing the right finish (see the sidebar on p. 14).

Brush construction All brushes have the same basic components: bristles, setting, divider, ferrule, and handle (see the drawing at right). The *bristles*, which can be either natural hair or synthetic filament, take up, hold, and release the finish to the work when brushing. The *setting* is a glue, usually epoxy, that holds the butt end of the bristles in place. *Dividers* are wooden plugs placed into the setting that create a reservoir and determine the shape of the brush. One or two dividers are used depending on the thickness of the brush. Dividers are omitted in artist's brushes and some specialty brushes. A *ferrule* is a metal band in which the setting is anchored and attached to the handle. The *handle*, which is usually a hardwood like beech, determines the comfort of a brush; it can be "beaver-tailed" for good balance and less fatigue, or long and thin for precise control.

A well-made brush with quality components is an indispensable tool and a pleasure to use. Of all the components, none is more critical for finishing performance than the bristle. Bristle technically refers to a specific type of animal hair, but in brush manufacture it is a generic term. Bristle is subdivided into two main classes: natural hair and synthetic filament.

Natural-hair brushes Natural-hair brushes are further subdivided into two categories, soft fur and hog bristle. Soft fur comes from animals like weasels, mink, badgers, and oxen. Soft-fur brushes are typically artist's brushes and some of the specialty brushes. Hog bristle is the hair from hogs and is commonly used in painting and finishing brushes. Many times, two or more hair types are mixed to produce brushes with specific performance characteristics.

ANATOMY OF A BRUSH



The best bristle comes from Chinese hogs and is either white or black in color. *Hog bristle* has two distinct advantages over other types of hair. It is naturally tapered toward the tip and has flags or split ends at the tip. The taper gives bristle resilience and spring; the flags allow heavier loading of finish material at the tip.

Sable is the best natural hair for artist's brushes because it forms a fine sharp point when wet. Kolinsky sable from the mink is the best; other sables are made from weasels.

Camel is actually a misnomer since the hair is not from camels but from the tails of European squirrels. Camel-hair brushes are often used for lettering and detail work.

Ox hair, taken from behind the ears of oxen, is silky and durable. Ox-hair brushes are used extensively in sign painting.

Badger, a very soft and resilient hair, is regarded as one of the best hairs for flowing on finishes like oil varnishes and lacquer. It does not have the body of hog bristle, so it is usually combined with other hairs such as bristle or skunk.

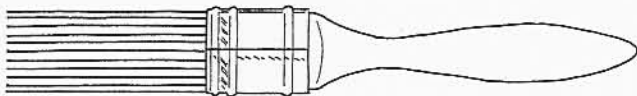
Fitch is a somewhat confusing term because it applies both to a type of hair and to a specific brush. American fitch is from a skunk, whereas European fitch is from a gray or black weasel. Fitch brushes are made from skunk, badger, or bristle, or from a combination of these three hairs.

Synthetic-filament brushes The distinct advantage of synthetic filament over natural hair is that synthetic filament absorbs only 7% of its weight in water. Natural hair absorbs 100% of its weight, causing it to become floppy and soft in water-based finishes. Modern machinery is now able to duplicate the flags on synthetic filaments so that synthetics are the best choice for water-based products. Chinex is the most recent filament developed and is excellent for all water-based paints and finishes. Taklon is a generic term for artist's brushes made from tapered nylon; these are excellent brushes for applying shellac and lacquer. Because of their rectangular chisel edge, Taklon brushes are useful where precise control is needed.

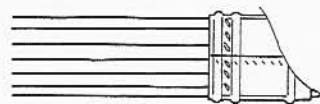
Bristle configuration The different brush profiles are shown in the drawing on the facing page. Natural and synthetic brushes are available in flat trim, rectangular chisel, and oval chisel. The bristle can be blunt end (or "square cut"), flagged, or tapered. Flat-trim brushes are usually square cut; they are useful in exterior painting because the blunt tip of the bristle can work the paint into the

BRUSH PROFILES AND BRISTLE TYPES

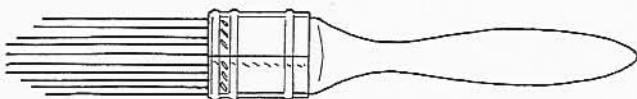
Flat



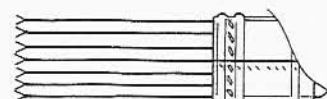
Blunt end



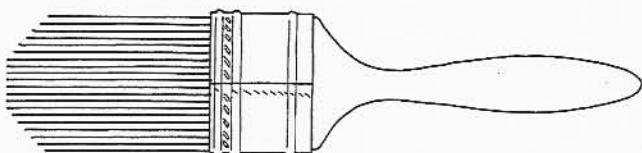
Rectangular chisel



Flagged



Oval chisel



Tapered



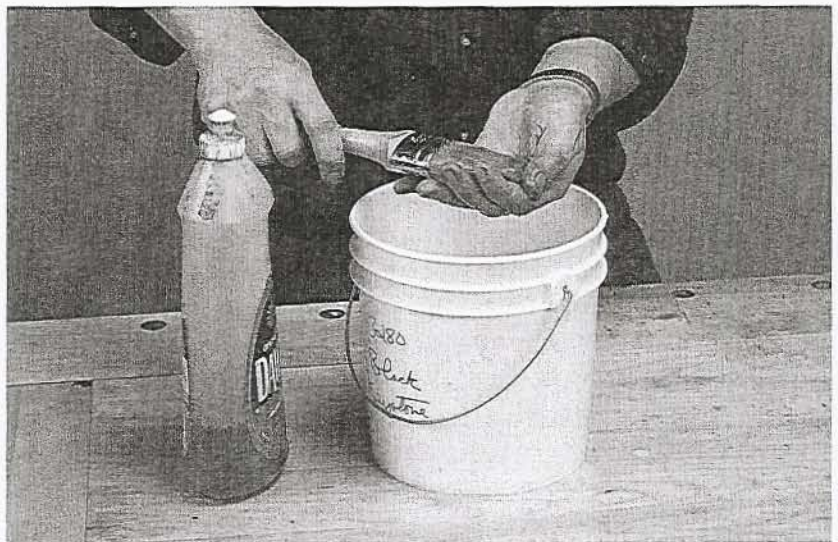
crevices of the wood. The chisel edge on rectangular and oval brushes is preferred for its ability to “cut in,” or draw a straight even line. The bristle on these brushes is either flagged or very fine, which makes them the best brushes for all finishing work, whether you’re finishing a flat top or a complex edge. Tapered bristles are found on synthetic-filament artist brushes; the fine ends leave less noticeable brush marks than the thicker filament found on blunt-end bristles.

Caring for a brush A brush that is properly cared for should improve with use. Before using a brush, tap the bristles against a table or your palm to dislodge any debris or loose bristle. Then dip the brush in the thinner for the material you’re using. Use alcohol for shellac, mineral spirits for oil-based products, and water for water-based products. Dipping the brush in thinner makes it much easier to clean when you’re through. Remove excess thinner by wrapping the bristles in a rag, and then dip the brush into the finish.

When you're ready to clean the brush, brush the excess finish on some newspaper and dip the brush into the appropriate thinner. Scrape the brush across the lip of a metal can to remove excess thinner. Apply a liberal amount of dishwashing detergent to the brush, and then lather the bristles with water by swirling the brush around in your cupped palm (see the photos below and at left on the facing page). Bend the bristles back to force finish out of the base near the ferrule, and then rinse with plenty of water. Repeat until the bristles no longer feel slimy. Next twirl the brush between the palms of your hands to spin out excess water. To keep the bristles shaped, comb them with a brush comb, and then wrap the brush in a paper towel or clean rag and lay it flat to dry (see the photo at right on the facing page).

Artist's brushes should be cleaned with soap and water as explained above, but after rinsing with water, dry the brush with a paper towel and then dip the tip into a 1-lb. cut shellac solution (see p. 72). Form the hairs or filament back into a fine point or chisel edge with your fingers and set the brush aside to dry. The

Cleaning a Brush



1. After rinsing the brush in the appropriate thinner, pour a generous amount of dishwashing detergent over the bristles.

shellac sizes the brush and keeps the brush profile sharp. Soak the brush for a few minutes in alcohol before using.

If a brush has hardened finish in the bristles, soak it for several hours in an NMP (n-methyl 2-pyrrolidone) based stripper like Citristrip or Woodfinisher's Pride. Don't use a methylene-chloride-based stripper—it will destroy the stiffness of the bristle. Scrub the base of the bristles near the ferrule with a stiff wire brush to remove any softened finish, and then clean the brush as explained previously.

CLOTHS

For applying wipe-on, wipe-off finishes and stains, almost any absorbent cloth can be used as long as it's lint-free and clean. Old clothes and diapers will work, provided they have been washed first and dried to remove lint. Paper towels are fine. For applying shellac and varnishes that are not wiped off completely, it's a good idea to use cloths with special weaves; these cloths will be dealt with in later chapters. If you use a lot of rags, consider purchasing them in bulk



2. Work the soap into the bristles by scrubbing them into the palm of your hand.



3. Once the brush is clean, wrap the bristles in a paper towel or clean rag and lay the brush flat to dry.

Buying a Brush

A good-quality brush always performs better than a cheap one. When buying a brush, there are several features to look for. On chisel-tip brushes, check for flags on all the bristles, which indicate that the bristles are hand-cut. Rather than forming a chisel edge from bristles of various lengths, cheap brushes will have the chisel cut into the tip after the brush is made. These brushes can be identified by the lack of flags on the bristles.

Check for firmness of the bristle setting by tapping the brush against your hand. None of the bristles should fall out. Bend the bristles back and forth—they should feel springy. If you can pull the bristles far enough apart, check for an oversized divider. Manufacturers will sometimes

use a large divider to give an illusion of fullness to the brush. The ferrule should be nickel-plated or stainless steel and should be firmly attached to the handle. Handles should feel balanced and comfortable in your hand. They can be finished or unfinished; unfinished handles are always used on brushes used in water-based products.

A basic brush inventory for finishing should include the following:

Shellac The fitch and the oval bristle are the best brushes for flowing on shellac. For quick application of shellac in thin coats, the 1½-in. Taklon works best.

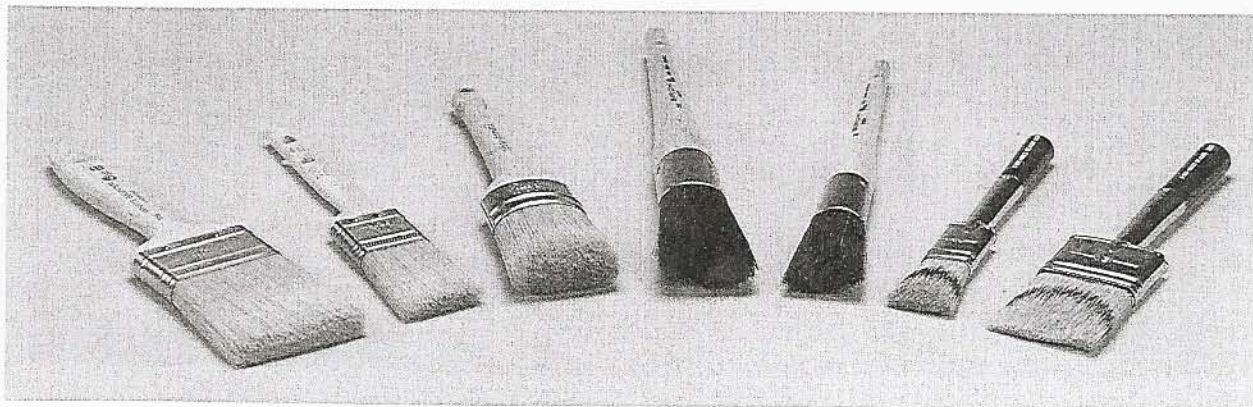
Oils and oil-based varnishes An oval bristle with a chisel edge is my favorite, followed by the

fitch brushes. A less expensive 100% white China bristle with a rectangular chisel edge also performs well. You'll need a 2-in. brush for finishing large surfaces and a 1-in. brush for cutting in.

Solvent lacquer Fitch and oval bristle brushes are recommended.

Water-based products Use only synthetic-bristle brushes—Chinex, Taklon, and Tynex are best. Flagged bristles work well for most products, but use a tapered synthetic bristle for products that tend to foam.

Touchups and repairs 100% red sable brushes are the only ones I recommend. At least two sizes, a #1 (for fine detail work) and a #4 (for larger areas), are needed.



Among the author's favorite brushes for finishing are, from left to right, two rectangular China bristle brushes, three oval chisel bristle brushes, and two chisel-cut fitch brushes.

from an industrial supplier. Look in the Business-to-Business Yellow Pages under "Wiping Cloths." Recommendations for various finishing operations are listed below.

Staining: Any absorbent cloth or paper towels.

Grain filling: Upholsterer's grade of burlap.

Shellac: Lint-free, open-weave "trace cloth" or padding cloth, surgical gauze.

French polishing: Traditionally, wool inside and linen for the outside of the pad. Absorbent cotton and muslin can be substituted.

Wipe-on varnish and oils: Lint-free, clean cotton cloth like diapers, T-shirt material, or padding cloth.

Waxing and polishing: Clean, bleached-cotton T-shirt type material. Cheesecloth or surgical gauze is good for buffing.

APPLICATOR PADS

Applicator pads are very good at dispensing water-based stains and finishes quickly over a large area. They are less prone to foaming, a common problem when brushing water-based finishes, and can hold a great deal of finish before they need to be recharged. For finishing floors and large tables, they are the best choice. Just like paint-roller pads, applicator pads are available in various naps. Use the shortest nap you can find.

The downside of pads is that they work well only once or twice. They are hard to clean thoroughly, so I usually end up throwing them away after one session. I'm not fond of throwaway tools in principle, but they are fairly inexpensive to replace.



Cloths and pads used for finishing operations include (clockwise from left) burlap, T-shirt material, surgical gauze, an applicator pad, two types of muslin (one dyed, one bleached), and cheesecloth.