FINISHING AND MAINTAINING
WOOD FLOORS

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General Requirements

After laying of a wood floor, four steps may be involved in the completion of the finishing process, namely the sanding of the surface, the application of a filler for certain woods, the application of a stain to unify the color, and the selection and application of the kind of finish to be used. Whether fillers or stains are needed depends on the species of wood used and individual preference.

A careful sanding to provide a smooth surface is essential for a good finish because any irregularities or roughness in the base surface will be magnified by the finish, regardless of the type. The production of a satisfactory surface requires sanding in several steps with progressively finer sandpaper, usually with a machine, unless the area is small. Since the quality of the sanding job determines in large part the quality of the final finish and since the techniques required are exacting, it is generally recommended that the sanding be left to a man who specializes in such work.

A filler is required for woods with large pores, such as oak, walnut, and teak, if a smooth coating without depressions over the pores is desired. Fillers come in either liquid or paste form (the latter to be thinned before application) and either transparent or colored according to the effect desired. Care is required in applying the fillers, otherwise the final finish may appear uneven and smeared.

Stains are sometimes used to obtain a more nearly uniform color pattern when the individual boards vary too much in their natural color. Various stains are available, generally named for the woods they are to imitate. The stain should be of a type that will not raise the grain of the wood, such as an oil-base stain. It should be remembered that stains penetrate wood to a trifling depth only; the protective finish must be carefully

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maintained to prevent wearing through the stained layer, since it is difficult to renew the stain at worn spots in such a way as to match the color of surrounding areas.

The great preference is for a finish that leaves the wood floor as nearly natural in appearance as possible. The transparent finishes now in common use are wood sealer, shellac, varnish, and, less often, lacquer. Linseed and other oils once commonly used have now largely been displaced by wood sealers. All of them can give good service if good materials are properly applied and if the finish is suitably maintained.

Wood sealers, now the most popular and widely used finishes, penetrate the wood just enough to avoid formation of a surface coating of appreciable thickness. Consequently, although more frequent attention may be required than with a coating, traffic areas can generally be patched without going over the entire floor.

Shellac, varnish, and lacquer form a distinct coating over the wood and give a lustrous finish, usually glossy. They are suitable where it is desired to let the floors go as long as possible without attention other than regular sweeping or dry mopping and where it is convenient to go to more trouble when renewal is required. Such transparent coatings wear out in areas of highest traffic and, since it is generally not possible to do a fully satisfactory job of patching the worn areas, the flooring in a whole room or series of rooms must be refinished. In addition, shellac waterspots readily, and lacquer is difficult to apply because it dries too quickly.

Opaque finishes, such as paints or enamels, are seldom used in the interiors of homes. When used, the label should state specifically that they are suitable for wood floors, since many paints are not tough enough or sufficiently abrasion-resistant to be suitable. The same is true of various varnishes.

The durability of floor finishes can be improved by keeping them waxed. Paste waxes generally give the best appearance and durability, particularly if polished by machine. Water-emulsion floor waxes require no polishing—they are merely mopped on the floor and allowed to dry. While commonly used, they give a somewhat less attractive and less durable wax finish than does a machine-polished paste wax.

Best maintenance practice requires at least partial refinishing as soon as the finish wears thin in the traffic areas but before the wood has been left unprotected. Within limits, even the transparent coating finishes can be renewed in spots one or more times. Eventually, however, the old finish must be removed entirely. This is best done by power sanding, but may be done with varnish removers or other materials, the technique depending upon the nature of the original finish.
Finely finished floors should never be scrubbed with water. Sweeping or dry mopping should be adequate for routine cleaning. Water, ink, or other spots may offer some difficulty, but generally, techniques are available for handling them without complete removal and renewal of the finish unless the penetration and extent of the spot are too great.

Sanding

All kinds of finish require the surface of wood flooring to be made smooth by sanding or scraping just before the first coat of finishing material is applied. Just as the finish brings out the full beauty of the wood, it also reveals any defects or roughness left in the surface. Even irregularities that can scarcely be seen before finishing become conspicuous afterward. Unless prefinished, flooring usually has not been sanded by the manufacturer and bears slight ridges left by the planer. Such planer marks may seem unimportant at first but will mar the appearance later on when the finish has been applied. Moreover, if much time passes between the finish sanding and the application of finish, some roughness may develop from raising of the grain of the wood brought about by changing moisture content. Floors therefore should be sanded immediately before finishing is begun—if possible, the day when the first finish coat is to be applied.

Sanding or scraping can, of course, be done by hand, but that is usually far too laborious a method for areas of much size. Nevertheless, some handwork may be necessary if there are places that are inaccessible to power machines. Most floor sanding is done with electrically driven sanding machines. The machine should be well designed, ruggedly built, with its bearings well alined and kept in good condition. A machine with badly worn bearings may do more harm than good. Floor sanding machines can often be rented at retail paint or hardware stores or from concerns that specialize in the renting of power equipment. It should be pointed out, however, that sanding is by far the most exacting step in floor finishing. Nothing can be done later that will make up for defects of a poor sanding job. It is therefore advisable, whenever possible, to have floors sanded by a man who specializes in such work.

Sandpaper acts by gouging fine slivers from the wood surface, leaving behind scratches, the size of which is governed by the size of the grits on the paper. Coarse grits act rapidly, but the scratches they leave are conspicuous, especially if they cross the grain of wood. Fine grits act slowly, but, if fine enough, the scratches left are too small to see. Scratches are least noticeable when they run with the grain of a wood with open texture (large pores) such as oak. Scratches must be especially fine to escape detection on a wood with close texture, such as maple, and must be still finer to remain unnoticed if they cross the grain of the wood.
In sanding a floor, time is saved by starting with coarse sandpaper to remove the grosser roughness and imperfections and to make the floor level as quickly as possible. The scratches left by the coarse grits are then removed by successive sandings, each one with finer sandpaper than the one before, until the scratches left by the last paper are too small to be observable even after finish has been applied.

**Sanding Machines**

Sanding machines are of two types, drum sanders and disk sanders. In drum sanders the sandpaper is mounted on a cylindrical drum that rotates on an axis parallel to the plane of the floor and at right angles to the direction in which the machine is moved. Thus the sandpaper makes its scratches in straight lines in the direction of movement of the machine. In disk sanders the sandpaper is mounted on a disk that rotates in a circle in the plane of the floor. As a disk sander is moved over the floor, the grits make spiral scratches that necessarily cross the grain of the wood. The last sandpaper used with a disk sander therefore may need to be a grade or two finer than is necessary with a drum sander on a floor in which all pieces run in the same direction. A drum sander, however, cannot reach the last few inches of floor nearest the baseboard. Electric edgers, which are small disk sanders, are available for sanding these edges of floor that are not reached by drum sanders.

Provision for varying the speed of rotation of floor sanding machines is useful. If the speed is too great there may be enough heat generated by friction to heat the wood to incipient charring temperatures and thereby produce dark marks called burns, which can be removed only by sanding away more wood than is otherwise necessary. On the other hand, the operator wishes to use the highest speed practicable to get the work done as rapidly as possible. Burns can also be produced if the machine is allowed to stand at one place while the drum or disk is rotating.

**Types of Sandpaper**

Sandpaper, despite the name, is not made with sand. The abrasive grits may be flint, garnet, or emery, which are natural minerals, or the manufactured products aluminum oxide or silicon carbide. The backing may be paper, cloth, or a combination of paper and cloth. Flint is the cheapest, but it wears out most rapidly and is seldom recommended for sanding machines. Garnet and aluminum oxide are most widely used for woodworking. Aluminum oxide is generally preferred for high-speed machines such as floor sanders. A few professional floor men use silicon carbide. Paper backing is satisfactory for floor sanding machines, although combination paper and cloth backing may be desirable for very coarse grits.

Each kind of sandpaper comes in a number of grades, according to the coarseness or fineness of the grits. There are two systems of grading,
by arbitrary numbers that indicate the size of the grits or by the number of meshes per inch in the sieves through which the grits have been passed. The customary grades are indicated in Table 1. The mark "3/0," for example, is a contraction for the older way of writing "000," which in words is referred to as "three ought." When both grit number and mesh number are given, they may be written "3/0(120)" or "3/0-120."

Sandpaper is sold in sheets 9 by 11 inches in size for handwork, in pieces precut to sizes to fit any one of the various models of drum sanders, and in circular disks to fit the disk sanders. In ordering, the make and model of the sanding machine should be specified. Sandpaper is also sold in rolls 50 yards long and of various widths from which the user may cut pieces with a suitable template to fit his sanding machine. There are also "thrift rolls" that are long enough to make 10 pieces for drum sanders.

**Sanding Procedure**

The floor should be swept clean before beginning the sanding. No water should be used. Newly laid hardwood floors should be traversed with the sanding machine at least three times, first with coarse sandpaper of grade No. 2-1/2-30 or No. 2-36, then with medium paper of grade No. 1-50 or No. 1/2-60, and finally with fine paper of grade No. 0-80 or No. 2/0-100. Although acceptable results are sometimes obtained with only two passes, three are generally recommended. For an especially smooth finish, the third pass should be made with No. 0-80 paper, followed by a fourth pass with No. 2/0-100 paper, and even a fifth pass with No. 3/0-120 paper. Another method is to buff the floor with steel wool of No. 1 coarseness after the third pass with No. 0-80 sandpaper. Such buffing can be done by machine, because there are available rolls of steel wool that can be substituted for the drum in drum sanders. Steel wool, however, should not be used on oak floors unprotected by finish, because minute particles of steel left in the wood may later cause iron stains under certain conditions.

Two traverses of the sanding machine usually suffice for softwood floors. The first pass may be made with No. 2-36 sandpaper and the second with No. 1/2-60 sandpaper. Finer grades of sandpaper usually fail to improve the results appreciably.

On strip flooring or other patterns in which all pieces lie with the grain in the same direction, it is possible to operate drum sanders either with or across the grain of the wood at will. It is then helpful to make one of the earlier passes with the coarse or medium sandpaper either across the grain of the wood or at an angle of 45° to the wood grain. Some authorities recommend that the pass across the grain be made with the coarse paper, whereas others prefer to make it with the medium paper. All other passes should be made with the grain of the wood. It is
further helpful to make the two passes that run with the wood grain from opposite directions. Some floor men prefer a disk sander for the last traverse, even when a drum sander is used for the earlier passes.

On parquet or unit block flooring it is necessary to cross the grain of many of the pieces at each traverse. Each pass may well be made in a different direction, say two at right angles to each other and the third at 45° to the first two. Disk sanders necessarily cross the wood grain at each pass. Extra care should be taken to see that each traverse after the first is deep enough to remove all scratches left by the previous pass, and the last pass should be made with No. 2/0-100 or, if necessary, with No. 3/0-120 paper. Disk sanders are sometimes preferred over drum sanders for parquet or unit block floors.

After each pass with a drum sander, an edger should be used for the parts of the floor near the edges that are not reached by the drum sander. Even with a large disk sander, there may be places at the corners where an edger may be used to advantage. If there are places inaccessible even to an edger, such as places near radiator pipes, they must be sanded or scraped by hand.

Before the sanding is considered complete, the floor should be inspected carefully to see that all blemishes have been removed, a smooth surface produced, and all visible scratches removed. Defects can be seen most readily if the floor is viewed against light at a low angle of incidence so that any ridges will cast shadows. Remember that any defects left at this time will show much more prominently after finishing materials have been applied.

When sanding has been completed, the floor should be swept free from dust and may well be wiped with a painters' tack-rag. The walls, windows, and doors also should be dusted to keep dust motes from dropping into wet finishing materials to mar their appearance. Application of finishing materials should begin promptly so that there will be no time for changing moisture conditions to raise the grain of the wood again.

When wood floors have once been finished and the finish has worn out, it is usually expected that the finish can be renewed without sanding the floors again. Sometimes, however, floors become scarred or discolored by accident or abuse or from neglected maintenance to a point where sanding again becomes necessary. The sanding may then begin with very coarse sandpaper, No. 4-16 or No. 3-24, to remove the old finish and blemishes. Two passes should be made, each at 45° to the direction of the wood grain but at 90° to each other. From that point the sanding should proceed in the same way as has already been described for newly laid flooring. Alternatively, the old finish may be removed with a nonaqueous (no water) varnish remover, after which the floor should be sanded as for new flooring.
The usual preference on hardwood floors is for a floor finish that leaves the wood as nearly in its natural color as possible. All finishing materials, however, even though entirely without color themselves, apparently deepen the natural color of wood, for the same reason that wood always appears more richly colored when wet than when dry. Deeply penetrating finishes, such as linseed oil and the "floor oils" that were often used in former times, deepen the wood color more than less penetrating finishes, such as wood sealers, shellac, and lacquers. Of course, if the finishing material itself has considerable color it will add its color to the overall effect.

There is a further enrichment of the color of wood floors with age. Light, even the subdued light inside houses, slowly deepens and browns the very thin superficial layer of the wood into which the light penetrates, producing the patina so much prized on old wood pieces. In addition, light and oxygen gradually act on varnishes and wood sealers to form colored decomposition products. The extent to which wood floors change in color with age from these two processes depends both on the kind of wood and the properties of the finishing materials. Fortunately the color changes are usually of a pleasing nature.

When desired, the color of a hardwood floor may be altered without obscuring the grain of the wood by applying a wood stain of suitable color. Floors laid with wood of the lower grades in which there may be conspicuous variation in natural color may be rendered more nearly uniform in appearance by use of fairly dark stain. The color of wood stains is often indicated by naming them for the wood on which they are to be used or whose color they are to imitate, with further qualification for the shade or character of color. Thus there are light oak, dark oak, walnut, red mahogany, brown mahogany wood stains, and others. The stain should be an oil stain or at least a stain made without water, such as that known as "nongrain-raising" stain. No stain penetrates wood uniformly to more than a trifling depth. For that reason the subsequent protective finish on stained floors must be maintained particularly carefully. If it is not and the surface is allowed to wear away at places of greatest traffic, unstained wood will be revealed to mar the appearance. It is rarely possible to renew the stain at worn spots in such a way as to match the color of the unworn areas. Penetration of stains is especially shallow in very hard woods of close texture such as maple. It may be slightly deeper in birch and beech and still deeper in open-textured hardwoods such as oak, walnut, and teak.

Although stains penetrate somewhat deeper into softwood than into the hardwoods commonly used for flooring, the softwoods do not take stains well. The springwood, which is the softer, lighter colored part of the grain, takes up more stain and becomes more highly colored than the harder, naturally darker colored part of the grain. Thus there is a reversal of the natural color gradations of softwoods that is generally considered unattractive.
Instead of using stain, color may be imparted to wood later on during application of a wood sealer. Suitable oil stain may be mixed with the first coat of sealer, or wood sealers may be purchased that already contain the color.

Filling

Wood fillers may be used on floors made of hardwoods with pores larger than those in birch, namely, oak, walnut, or teak. Filler is useless on softwoods and on hardwoods with small pores such as maple or beech. The pores in birch are large enough to take filler when it is desired to accentuate the grain of the wood by making the pores dark in color but small enough to go without filler if that is not the case.

Filler accomplishes one or both of two purposes. It plugs the voids in the wood surface left by large pores to make the surface smooth and level, and if colored it makes the pores show more prominently. Fillers therefore are two kinds, natural fillers that are transparent and without color, and colored fillers that are opaque and usually dark brown to black in color. Colored fillers are commonly named for the wood on which they are considered especially appropriate, for example, oak, walnut, cherry, or mahogany wood filler. Fillers may come in liquid form, ready for application, or in paste form to be thinned with mineral spirits or turpentine (paint thinners) before application. The directions given by the manufacturer usually should be followed. The paste form is the better for fine work.

Filler is applied best with a 4-inch flat brush. The first strokes should be across the grain of the wood, then a light stroke with the grain. Care should be taken not to cover too large an area at once, because there is further work to be done before the filler has had time to dry. Soon after the initial glossy, "wet" appearance gives way to a dull, "dry" appearance, the excess filler must be wiped off with burlap, excelsior, or other suitable material. Wipe first across the grain of the wood to pack the filler into the pores and then finish with a few lighter strokes with the grain of the wood. Care in wiping should be taken to see that all excess filler is removed, otherwise the finish may appear uneven and smeared. Filler usually should be allowed to dry for 24 hours before further finish is applied, although there are fast-drying fillers for which the manufacturer may indicate that less time is sufficient.

Manufacturers of some wood sealers for floors recommend that the application of filler be deferred until the first coat of sealer has been applied and has dried. Others recommend that the usual practice of filling before sealing be followed. Still others say that filler may be omitted entirely even on hardwoods with large pores when their sealers are used. In general, it is practicable to dispense with filling if the sealer is buffed with steel wool before it has hardened, as is described farther on. But when shellac, varnish, or lacquer is used for the final finish, hardwoods with large pores should always be filled.
The transparent finishes now in common use for floors are shellac, varnish, wood sealer, and, much less frequently, lacquer. In former times floors were often finished with linseed oil or with cheaper floor oils obtained largely from petroleum, but such finishes gradually made wood very dark in color and have now been entirely displaced by wood sealers.

Wood floors can be maintained in good condition with any one of the available floor finishes if good materials are applied properly and if maintenance methods appropriate for each kind of finish and for the degree of wear to which the floor is subjected are used. No type of finish can be said to be superior in all respects, and none will long continue to give good service unless it is suitably maintained. The secret of good floors lies in thorough understanding of the nature and limitations of the particular kind of finish chosen and in carefully following the appropriate maintenance program. Choice of finish should be dictated primarily by the appearance desired and the methods of maintenance that are considered most convenient.

Finish Types

If a highly glossy, lustrous finish is desired, the choice may well be shellac, varnish, or lacquer. Such materials form coatings over the wood surface a few thousandths of an inch thick. Those who prefer a more natural appearance with less gloss and resinous luster may choose the wood sealer finish. With sealers, a thin layer of wood at the surface is saturated with the finishing material, and any excess is wiped or buffed off so that no coating of appreciable thickness is left on the wood surface.

Transparent Coatings.--The coating finishes--shellac, varnish, and lacquer--suit the needs of those who wish to let their floors go as long as possible without attention other than regular sweeping or dry mopping and are willing to go to more trouble when further maintenance finally becomes necessary. When the finish eventually must be renewed, it is usually necessary to refinish the entire room or, if the flooring runs without break from room to room, all flooring on a given story. As a rule, limited areas of a floor receive a preponderance of wear from traffic. The finish wears out in such traffic lanes, while other parts of the floor remain unworn. It is seldom possible to renew coating finishes in the traffic channels alone without having the edges of the patching show. Moreover, after three or four renewals of a coating finish, the areas of little or no traffic acquire an unduly thick layer of finishing material, the older parts of which have darkened with age, and will no longer blend in color with the thinner coatings on the traffic channels. It is then necessary to remove all of the old finish either with varnish remover or by resanding the floors before a new finish of uniform appearance can be applied.

Among the coating finishes, shellac has the merit of drying so rapidly that a floor may be finished or refinished and put back into service overnight. Varnishes, even the quick-drying kinds, require longer
intervals between coats and remain tender for some time, so that the floor should be kept out of service for several days, although with care light service often may be permitted within a day after the last coat has been applied. Landlords and some painters are inclined to prefer shellac finish; the owner-occupant is likely to prefer varnish or sealer finish.

Varnish is more resistant than shellac to water that may be spilled on a floor. Water or even prolonged exposure to high humidity turns shellac white. Good varnish finishes are also tougher and less easily scratched than shellac. Most varnishes gradually darken with age, whereas shellac does not.

Lacquer dries as rapidly as shellac, is as resistant to water as varnish, and seldom darkens with age. The lacquers widely used on furniture or on automobiles are made for application by spray gun rather than by brush. Lacquers made for brushing are more expensive and are still rather difficult to apply evenly on large surfaces such as floors. Moreover, lacquers contain much less nonvolatile material than varnish, so that more coats are required to make a finish comparable in luster to that obtained with varnish. For such reasons, lacquers find much less use than the other finishes for floors.

Opaque Coatings.--Opaque paint or enamel can be used to finish wood floors when it is desired to hide the grain of the wood entirely and perhaps to provide colors that are not satisfactorily attainable in transparent finishes. Hardwood floors inside buildings, however, are seldom painted, because most users prefer to take advantage of the natural beauty of the wood. Softwoods are considered less attractive in appearance. In former times, when softwoods were sometimes used for interior floors of homes for economy, they were often painted. Some commercial buildings still use painted softwood floors. Floors exposed to the weather such as porch floors, however, are predominantly of softwoods and are usually painted. None of the transparent finishes resist weather well enough to last very long out of doors. Good floor paint or enamel proves much more durable.

Sealers

Sealer finishes require more frequent attention, but the maintenance is simple and involves little inconvenience. If all goes well, it is possible to maintain sealer finishes indefinitely without removing old finish. Since no more than enough material to saturate the wood surface is applied, there is no buildup of coating thickness on areas of little wear, and traffic channels can be patched without going over the entire floor. Wood sealer finishes have gained especially wide use for wood floors exposed to unusually heavy traffic such as gymnasiums, schools, stores, offices, and public buildings.

Maintenance of Finishes

It is not possible to set forth specific rules for the frequency of maintenance of floor finishes, because the determining factor is the amount and kind of traffic, which varies greatly. In many homes so much of the flooring is covered by rugs or carpets that there may be no appreciable
wear on the floor finish except perhaps near doors between rooms. Finish wears especially rapidly on bare floors near doors to the exterior where water may be tracked in during wet weather and those entering may have gritty footwear. Foot mats near exterior doors, of course, can be helpful in reducing the wear on floor finishes from such sources. The kind of footwear worn by the occupants and their habits of walking also affect the wear on floor finishes. Soft-soled footwear causes little or no wear unless it is wet or gritty. On the other hand, leather heels nailed in place and used on concrete sidewalks until the nailheads project seriously impair the durability of floor finishes and may even scratch wood badly enough to require resanding the floor. The small heels on women's high-heeled shoes, which concentrate the load on a small area, may be especially damaging.

The durability of floor finishes can be improved by keeping them waxed. In homes, renewal of the wax every 4 to 6 months may suffice, but more frequent renewal may be necessary where traffic is heavier. Well-waxed floors are easier to keep clean by dry mopping. Wax over coating finishes tends to make floors slippery unless the wax layer is kept very thin. Over sealer finishes, wax is usually less slippery. Some floor waxes are made with special ingredients to improve their resistance to slip.

Floor finishes in gymnasiums, school rooms, and commercial or public buildings are subjected to much more severe service, as a rule, than are floors in homes. Accordingly inspection and maintenance must be more regular and more frequent. Some of the makers of floor finishing materials and equipment will train a maintenance man for their customers in the methods of keeping floors in good condition. Sealer finishes applied and maintained adequately with electric buffing machines have proved especially satisfactory for heavy duty floors. Although frequent attention is required, it can be done within a few hours at night or on weekends without interrupting the normal use of the floor. Use of gymnasium floors can usually be restricted to persons in shoes soled with rubber or other nonabrasive footwear. Fast action in such games as basketball produces sharp friction between footwear and floor finish that tends to produce "rubber burns" that mark some finishes more seriously than others. Special sealers for gymnasium floors are made that resist such marring especially well. If rubber burns are not too severe, they can be removed by scrubbing with naphtha or paint thinner.

Application of Final Finish

Varnishes, lacquers, and wood sealers are made for many different uses. Only products made specifically for finishing floors should be used for that purpose. Spar varnish made for surfaces exposed to the weather may be too soft to withstand the abrasion of traffic, and cabinet finishing varnish made for furniture may lack the toughness required for floors.
It is best to use floor varnish that is clearly so labeled by its manufacturer. So-called all-purpose varnish should be used only if the label says specifically that it is suitable for floor finishing. Similar caution applies to lacquers and wood sealers.

Varnish Finish

The floor and room should be clean and as free from dust as possible before varnishing begins. Dust motes falling into wet varnish impair the smoothness and appearance of the finish. The room should be at 70° F. or somewhat warmer, and plenty of fresh air should be provided. Varnish requires oxygen from the air for its drying, and there should be circulation to carry off the fumes of the volatile thinners in the varnish. Damp weather may be objectionable, since varnish dries slowly when the air is very humid. It is well to test the drying power of the varnish a day ahead of time by applying it on a nonabsorbptive surface such as glass, metal, or well-primed wood. Some varnishes lose their ability to dry promptly after long storage on a dealer's shelf. Poorly drying varnish can be exchanged for fresher stock, or its drying properties may be restored by adding about a teaspoonful of paint drier to a quart of varnish.

Varnish is applied with a wide brush. The brush should be cleaned well beforehand. Particles of old varnish or paint left in the brush may work their way into the fresh varnish to mar the finish. Even a new brush may well be washed with soap and water, shaken out, and dried before using it. First spread a brushful of varnish with the grain of the wood, then stroke it across the grain, and finally brush it lightly with the grain again. Then go on to the next area with a fresh brushful. Do not go back to restroke areas that have been covered previously. At least 16 hours should elapse before the next coat of varnish is applied. Three coats will be needed as a rule if the floor was not filled. If filler was applied, two coats of varnish may suffice. After the last coat of varnish, at least 24 hours, better 48 hours, should elapse before traffic is allowed on the floor. Varnish does not acquire its full resistance to wear for several days.

Lacquer Finish

Lacquer is applied much like varnish except that the work must be done more rapidly because lacquer dries so rapidly. The initial spreading, cross brushing, and final stroking must be done very quickly. If lacquer is brushed too long, it will not level out with a smooth surface. Lacquer holds its "wet edge" for a very limited time only. As far as possible, the edges of brush strokes therefore should coincide with the edges of boards in the floor, and the beginning of a second brushful must be joined to the end of the previous one very promptly. With lacquer, an hour or two between coats may be enough. The manufacturer's directions should indicate the required time.
Shellac Finish

Shellac for floors should be purchased in the form of 5-pound cut shellac varnish, that is, 5 pounds of shellac resin in 1 gallon of alcohol. It should be pure shellac varnish, unadulterated with cheaper resins. The bleached shellac, commonly called white shellac, is preferred for its pale color. Orange shellac imparts far too much color. Always test shellac varnish to see that it dries promptly without tackiness before starting to apply it on a floor. When stored too long, white shellac varnish loses its ability to dry hard as a result of chemical reaction between the resin and the alcohol. Shellac should be sold either in glass containers or in metal containers that are lined with lead or other coating to keep the varnish away from iron. Shellac varnish contaminated with iron may produce black stains on woods that contain tannins, such as oak.

The correct thinner for shellac varnish is 188-proof No. 1 denatured alcohol. For application, 5-pound cut shellac varnish should be thinned with 1 quart of alcohol per gallon. It should be applied with a wide brush that will cover 3 boards of strip flooring at a stroke and with long, even strokes, taking care to joint the laps quickly and smoothly. The first coat on bare wood requires 15 to 20 minutes to dry. It should then be rubbed lightly with fine steel wool or sandpaper and the floor swept clean. A second coat should be applied, allowed to dry 2 to 3 hours, and then gone over with steel wool or sandpaper, swept, and a third coat applied. If possible, the floor should not be put back into service until the next morning, but if necessary, it may be walked on carefully in about 3 hours after finishing. If wax is to be used, it should not be applied less than 8 hours after the last coat of shellac. Paste wax is suitable, but water-emulsion wax should be avoided because water may turn shellac white.

Floor Sealer

Manufacturers' directions for applying floor sealer vary widely and in some cases are very inadequate. In general, floor sealers may be brushed on with a wide brush or mopped on with a squeegee or lamb's wool applicator, working first across the grain of the wood and then smoothing out in the direction of the grain. After an interval of 15 minutes to an hour, according to the characteristics of the sealer, the excess is wiped off with clean rags or a rubber squeegee. For best results, the floor should then be buffed with No. 2 steel wool, although the buffing may be omitted by those who are willing to sacrifice something in appearance and service to save the labor of buffing. (On oak floors, presence of the sealer makes it unlikely that any particles of steel wool will become embedded in the surface as previously mentioned for bare floors.)

If possible, the buffing should be done by a rugged power-driven machine designed for buffing with steel wool. The next best procedure is
buffing with pads of steel wool attached to the bottom of a sanding machine. Buffing may be done by hand if no machine is available. One application of sealer may suffice if it is made very carefully, but a second application is generally recommended for floors that have just been sanded. The floor should be swept clean before making the second application.

A correct interval of time between application of sealer and buffing is very important. If the interval is too short, the sealer may still be too fluid to buff properly. If it is too long, the excess sealer "gums" the steel wool badly, is removed from the floor with difficulty, and where not removed becomes blackened with detritus from the steel wool. If the manufacturer of the sealer does not specify the correct interval of time clearly, the user should determine it for himself by trial on samples of flooring or in some inconspicuous places where imperfect results will not prove too disappointing. Once the user has learned how to work successfully with one brand of sealer he will do well to stick to it, since he might have to learn the technique all over again with another brand.

Floor sealers are now offered by a number of manufacturers of floor finishing materials and equipment, who are usually able to give precise and reliable instructions for the proper application and maintenance of their products. Sealers are also sold by most of the larger paint and varnish manufacturers, although the preference of their dealers is usually for floor varnishes.

Waxing Floors

Waxing of floors is done to best advantage with paste floor wax and an electric polishing machine designed for the purpose. For best appearance and durability there is no satisfactory substitute for the polishing machine; polishing by hand is far too laborious for the modern household and too expensive for the business building. The paste wax is mopped on the floor, allowed to stand until the volatile thinner evaporates, which may take 15 to 30 minutes, and the floor is then polished with the machine. The most modern type of floor waxing machine applies the wax and polishes in the same operation. For those who wish to get along without a polishing machine and are willing to accept a somewhat less attractive and less durable wax finish, there are water-emulsion floor waxes that are merely mopped on the floor and allowed to dry.

Floor Paint or Floor Enamel

Paint or enamel for use on wood floors should be made especially for such use. The wear of traffic requires paint that is hard enough to withstand abrasion and yet tough enough to withstand impact. Paints or enamels made for other purposes may not have such properties in sufficient
degree. The manufacturer's label should say clearly that the product is intended for use on wood floors. Paints made for concrete floors may serve also for wood, but there is no assurance that they will unless it is so stated. For porch floors exposed to the weather it should also be stated clearly that the paint or enamel is suitable for exterior use.

On new floors or floors that have just been sanded, at least two coats of floor paint or enamel are necessary. The first coat should be thinned moderately with paint thinner in accordance with the manufacturer's directions. Subsequent coats usually should be applied unthinned. Each coat should stand at least 16 hours for drying before the next coat is applied or before the floor is opened to traffic. Porch floors should be painted in warm, dry weather.

It is generally necessary to repaint the entire floor when the coating becomes worn through at the traffic channels. Freshly applied paint, even from the same lot as the original paint, does not present the same appearance as the older paint. After a few repaintings, the coating tends to become too thick on the areas of least wear and then the coating may begin to crack and scale at the thick places. To postpone such condition as long as possible it is a good plan to apply a first coat of new paint in the worn parts of the traffic channels only and then to apply a single finish coat over the entire floor, brushing it out as thin as practicable on the areas that receive little wear. Once the coating begins to crack and scale badly, it becomes necessary to remove all of the old coatings by sanding or with paint remover so that the painting can be started over again with a coating of even thickness.

Cracks in Floors

When floors are laid originally with insufficient regard for control of moisture content, they may present a problem of cracks or gaps between boards by the time refinishing is in order. There is no satisfactory way of eliminating such cracks short of taking up the floor and relaying it. There is a seasonal movement of the cracks, whereby they open wider in winter when the wood reaches a minimum moisture content and become narrower in summer when the wood is more moist. If the cracks are filled with a soft putty or crack filler in winter, some of the filler may be squeezed out during the following summer to be tracked over the floor. If a hard filler is used, the wood may be further compressed during the summer. In either case the cracks will open again during the next winter and may become worse than they were before the filler was applied. Filler applied in the summer will be insufficient to fill the gaps when they become wider again in the winter. On the whole, the best course when cracks develop seems to be to learn to put up with them unless they are bad enough to justify relaying the floor.
Wide cracks, of course, tend to collect dust and dirt. If they become completely filled with foreign matter, the cracks may no longer be able to come and go with seasonal change in moisture in the wood. As a result the cracks may become wider, just as though they had been filled with a hard filler. Regular use of a vacuum cleaner in the course of normal house cleaning should serve to keep the cracks open. If necessary, compacted dirt may be pried loose with a blunt instrument. For much the same reason, floors with wide cracks into which some finishing material is bound to flow when refinishing are refinished to best advantage in the late summer season when the cracks are at their narrowest. When oak floors with wide cracks are buffed with steel wool in refinishing, the floors may well be gone over with a vacuum cleaner a few days later to remove any particles of steel wool from the cracks.

**Refinishing Floors**

Best maintenance requires at least partial refinishing as soon as the finish wears thin in the traffic channels but before the wood has been left unprotected there. If the floor has been waxed it is necessary to remove the wax before new finish is applied because wax interferes with the drying and adhesion of new finish. Most of the wax should be scrubbed off with rags kept moistened with turpentine or other paint thinner. The rest of the wax should be washed off with soap and warm water, doing the work as rapidly as possible so that the water will have too little time to reach the wood or to turn a shellac coating white. After the surface has dried again new finish may be applied.

With wood sealer finish no more may be necessary than to mop fresh sealer on the worn areas of the traffic channels, wipe up any excess, and buff the surface as had already been described for the last coat on new floors. With the coating finishes, varnish, lacquer, or shellac, two coats may be advisable on the worn areas but would be altogether too much on the areas of little wear. It may therefore be practicable to apply a first coat in the worn areas only, ending all brush strokes at joints between boards, and then to apply a second coat over the entire floor.

After varnish, lacquer, or shellac finish has been renewed several times it may no longer be possible to refinish the worn areas to match the appearance of the unworn areas where too much old finish discolored by age remains. It is then time to remove the old finish entirely.

**Removal of Old Finish**

The best way to remove old finish is by power sanding, which is necessary in any case if the wood has become badly scuffed or marred. But there
is a limit to the number of times a floor may be sanded because each sanding removes a substantial amount of wood as sander dust. Other methods of removing old finish therefore may be needed at times.

Floors Originally Finished with Oil.--An old linseed oil finish, since it is embedded in the wood, may cause some difficulty. If a steel-wool buffing machine is available, an attempt should first be made to clean the floor sufficiently merely by buffing with No. 3 steel wool. If this is not feasible or proves ineffective, a chemical treatment will be necessary. Mild alkalies change oil and many sealers or varnishes into soap that can be scrubbed off with water. The alkali used may be a water solution of trisodium phosphate, washing soda, or a commercial cleanser. Lye is inadvisable because it is strong enough to discolor some woods or even to swell and soften them. Since alkaline solutions are hard on the hands, rubber gloves should be worn while using them.

In applying the alkali, flush a small area of the floor at a time and allow to stand for a few minutes, then scrub with a stiff brush or No. 1 steel wool. Next flush with clean water and scrub to remove the soap that has been formed, and finally remove all the water possible by mopping and let the floor dry thoroughly. If the floor turns gray in color as a result of the action of the alkali and water, it may be necessary to bleach it with a saturated solution of oxalic acid in water (oxalic acid is poisonous and must be handled with care). Rinse off the oxalic acid thoroughly with clean water, mop, and let the floor dry completely. Any raised grain or roughening of the surface of the boards should be smoothed with sandpaper or steel wool before new finish is applied.

Floors Originally Finished with Varnish or Lacquer.--Old varnish or lacquer can be removed with liquid varnish remover. The remover should be one of the kinds made with organic liquids and should contain no water. The directions for using the liquid remover should be followed closely.

If the first coat of the original varnish was thinned too much and penetrated into the wood too far, some of it may still remain embedded in the wood. It will not interfere with the new finish except for the darker color it produces. If the color is unacceptable it may be possible to remove the embedded varnish by the treatment with alkali described for floors originally finished with oil.

Floors Originally Finished with Shellac.--Old shellac finish can be removed by scouring the floor with No. 3 steel wool and denatured alcohol diluted half and half with water. If the floor boards are level and are not warped or cupped, the scouring can be done to advantage with a floor-polishing machine fitted with a wire brush to which a pad of the No. 3 steel wool is attached. After the scouring, the floor should be rinsed with a minimum amount of clean water and allowed to dry thoroughly before refinishing with shellac.
When white spots have developed in shellac finish from accidental contact with water they may often be taken out by rubbing lightly with a soft cloth moistened with denatured alcohol diluted half and half with water. The alcohol, however, must be used with care to avoid cutting the shellac coating.

**Floor Maintenance**

Wood floors with fine finishes should never be scrubbed with water or unnecessarily brought in contact with water except in connection with refinishing old floors as already described. Sweeping or dry mopping should be all that is necessary for routine cleaning. A soft cotton floor mop kept barely dampened with a mixture of 3 parts of kerosene and 1 part of paraffin oil is excellent for dry mopping. Commercial preparations are available for the purpose also. When the mop becomes dirty it should be washed in hot water and soap, dried, and again dampened with the mixture of kerosene and paraffin oil. Exceptional patches of dirt that cannot be removed in this way, or rubber burns from friction between rubber footwear and floor, may be removed by rubbing lightly with fine steel wool moistened with turpentine or paint thinner.

Badly soiled spots, such as gray spots where water or pets' urine has been allowed to stand on the floor for a time, may offer difficulty. Where the finish is a floor sealer the stained area can be sanded by hand, patched with fresh sealer, and buffed with a pad of steel wool. Similar patching with varnish, lacquer, or shellac may not blend perfectly with the rest of the floor but will usually prove much less objectionable than the stain. Where the water stain has penetrated the wood too deeply to be removed by hand sanding, it is necessary to remove the finish by sanding and then to bleach the wood with oxalic acid as described for floors originally finished with oil. Stains from some writing inks also can be bleached with oxalic acid or with other commercial wood bleaches such as alkaline hydrogen peroxide bleaches. Stains from vegetable oils or greases usually will yield to the treatment with alkali described for old oil finishes but petroleum oils or greases that become embedded in the wood may resist all practicable treatments except that of sanding off all of the stained wood.

Varnish coatings and other finishes are not effective in preventing long-term moisture changes such as occur seasonally. They do, however, retard the entrance and exit of water and thus may be expected to moderate the effects of short-term changes, such as water spillage or short periods of extremely high humidity. It is desirable, therefore, to refinish worn areas as promptly as possible to reduce the possibility of excessive swelling, and perhaps buckling, from short-term effects such as those mentioned.
Floor squeaks are caused by relative movement of the tongue of one flooring strip in the groove of its neighbor. Such movement may occur for any one of a number of reasons. For example, if the floor joists are somewhat small for the span, they may deflect sufficiently to permit movement in the flooring. Similarly, if sleepers are not held down tightly to a concrete slab, or come loose in service, enough movement may be possible to cause squeaks. Poorly manufactured flooring in which the tongues are undersize and thus do not fit tightly in the grooves may also lead to squeaks. Warped flooring or subflooring may permit the boards to rock under traffic; this is unlikely to be a factor with hollow-back flooring. An unusual case, but one which might occur occasionally, is one where the joists change direction in adjoining rooms while the flooring direction is constant. In such a case, the flooring in one room would be parallel to the joists and deflection of the subfloor might permit sufficient movement to cause squeaks. Finally, and perhaps most commonly, squeaks may result from inadequate nailing.

Obviously, then, the best method of eliminating flooring squeaks is to install well-made flooring on a sound floor system, taking particular care in installation, especially with the nailing. If, however, squeaks do occur in a finished floor, there are a number of steps which may be taken.

The first step is to determine what is causing the movement so that proper steps may be taken for correction. Regardless of cause, one expedient is to lubricate the tongue with mineral oil introduced into the opening between adjacent boards. The oil must be used sparingly; too much may result in stains in the flooring.

A fairly common and effective procedure is to drive a nail through the face of the flooring into the subfloor—preferably also into a joist. The nail should be driven near the tongue edge of the flooring strip, then set and the hole filled.

Where flooring is warped and the under surface of the floor is exposed, screws through the subfloor and into the finish floor will be effective in reducing movement. Where this can be done, it will be somewhat less objectionable than face nailing from the standpoint of appearance.

In cases when the flooring strips run parallel to the joists, as described earlier, little can be done if there is a finished ceiling below the floor. Where it is open, however, as in a garage or basement, solid blocking may be fitted between and nailed to the joists and snugly fitted against the subfloor. The blocking needs to be at sufficiently close intervals to provide support for the subfloor and finish floor. Adequate nailing to the joists is necessary in order that the blocking will maintain its position.
<table>
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<tr>
<th>Type</th>
<th>Garnet Silicon carbide</th>
<th>Flint paper</th>
<th>Emery cloth</th>
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