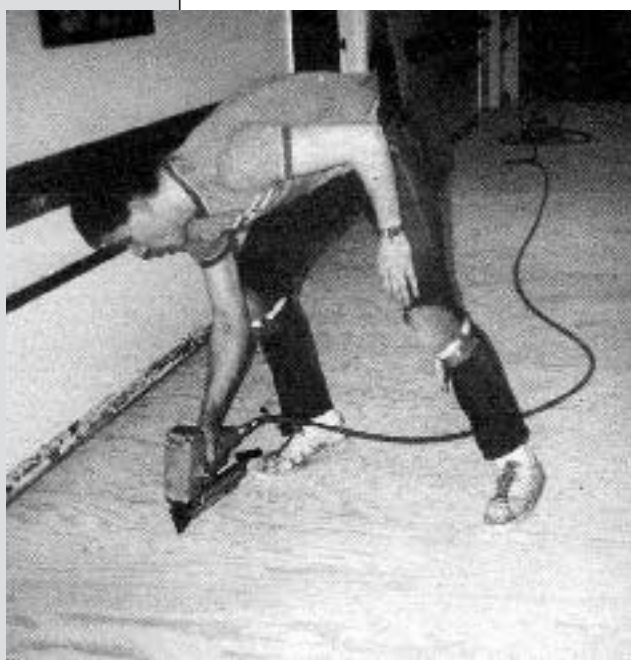
Underlayments For Resilient Flooring

Resilient flooring needs the right underlayment installed the right way

by Paul Fisette



APA

Plywood is a good underlayment choice for resilient flooring. The right grade of plywood has a fully sanded face and no large voids in the inner plies.

Installing floor underlayment is routine for most builders: order thin particleboard or plywood and fasten it to the subfloor. But careful selection and fussy workmanship become more critical when the finish surface will be vinyl tiles or sheet goods. Resilient flooring is thin and subsurface irregularities are readily transmitted through thin vinyl. Nail-pops, swollen wood fibers, and deformed joints are the villains of the resilient underworld.

Subfloor versus Underlayment

The terms "subfloor" and "underlayment" are often used interchangeably around the job site, but there is a world of difference between the two. A subfloor is a structural layer intended to provide support. It serves as the working platform and takes the abuse during construction. CDX plywood or oriented-strand board (OSB) are the most common subflooring materials.

Underlayment, on the other hand, is installed over a subfloor to create a smooth, durable surface to support the finish flooring. Underlayment should be installed just before the finish floor to avoid surface damage. Hardboard, particleboard, self-leveling concrete, plywood, and at least one OSB product offer the smooth, hard surface required for thin resilient flooring.

Some hybrid systems combine subflooring and underlayment functions in one layer, most notably American Plywood Association's (APA) Sturd-I-Floor.

Resilient flooring demands a lot of any underlayment. The underlayment must be very hard, smooth, dimensionally stable, and stiff. But few of the commonly used underlayment materials can live up to all these tasks in all situations.

Hardboard

Hardboard provides a thin, hard, smooth surface and, despite an increasing acceptance of newer materials, it is still a common choice for underlayment among remodelers. In fact, the Resilient Floor Covering Institute (RFCI), a Rockville, Md., association representing seven of the largest resilient flooring manufacturers, recommends hardboard as one of only two acceptable underlayments for resilient flooring (the other choice is an appropriately graded plywood).

The product the RFCI recommends, however—a 0.215-inch, Class 4, service-grade hardboard—is hard to get at the lumberyard. Few manufacturers make it any longer, so many builders may be using the wrong kind of hardboard underlayment. And, in spite of the RFCI's recommendation, many resilient flooring manufacturers flat out do not allow any hardboard under their fully adhered floors. They cite its inadequate uniformity, poor dimensional stability and variable surface porosity as reasons for avoiding its use. Other manufactures allow hardboard underlayment only for perimeter-bonded systems.

Hardboard is formed by densely packing wood fibers with heat and pressure. Because the material is dense and smooth, it affords great impact resistance which is needed in underlayment. Unfortunately, the tightly packed fibers also make it unsuitable in moist environments.

Product standards allow a 1/4-inch service-grade hardboard to swell as much as 30% (.075 inch) when subjected to a 24-hour soak test. By comparison, 1/2-inch particleboard is allowed to swell 12% (.063 inch). There is no product standard specifying allowable swell for plywood, but since the veneers are peeled from logs in a rotary fashion the thickness swelling of plywood mimics radial swelling of solid wood: about 2% to 4%. Since swollen panels can create unsightly bumps in the surface of the resilient flooring, hardboard should not be used in bathrooms where it might be exposed to high humidity and overflow from toilets and bathtubs.

Nailing can create problems with hardboard, too. When you drive a nail into a piece of lumber, the wood fibers around the nail are compressed into voids within the board. But because hardboard is very dense, when you drive a nail into it, the detached fibers will either be forced beneath the panel, causing a bump, or the fibers will mushroom out of the top near the nail head. These irregularities are easily telegraphed through thin resilient flooring. To prevent this, you need to use thin shank nails and pre-drill nail holes.

If you choose hardboard underlayment, the panels should be stood on their edges and spread around the room for 48 hours prior to application. This will give the panels a chance to adjust to ambient conditions. When installing the sheets, follow the nailing schedule shown in Table 1 and the placement specifications shown in Figure 1.

Table 1: Recommended Underlayment Thicknesses and Nailing Schedule

Underlayment	Subfloor	Underlayment Thickness	Fastener (should be positioned 1/2 in. from panel edges)	Nail Spacing (in.) along panel edges	Nail Spacing (in.) within field both directions
plywood	plywood (1/2 in. and thicker)	1/4 in.	1 1/4 in. (3d) underlayment nails	3	6
plywood	plywood (1/2 in. and thicker)	3/8 to 1/2 in.	1 1/4 in. (3d) underlayment nails	6	8
plywood	plywood (1/2 in. and thicker)	5/8 in. to 3/4 in.	1 1/2 in. (4d) underlayment nails	6	8
plywood	plywood (1/2 in. and thicker)	1/4 in.	18 g staples x 3/16 in. x 7/8 in.	3	6
plywood	plywood (1/2 in. and thicker)	3/8 in. and thicker	16 g staples x 3/8	3	6
plywood	boards up to 4 in. wide	1/4 in.	1 1/4 in. (3d) underlayment nails	3	6
plywood	boards 4 in. and wider	3/8 in.	1 1/4 in. (3d) underlayment nails	6	8
particle-board	plywood (5/8 in. and thicker)	less than 3/8 in.	1 1/2 in. (4d) underlayment nails	3	6
particle-board	plywood (5/8 in. and thicker)	3/8 in. to 5/8 in.	2 in. (6d) underlayment nails	6	10
particle-board	plywood (5/8 in. and thicker)	1/4 in.	18 g staples x 3/16 in. x 7/8 in.	3	6
particle-board	plywood (5/8 in. and thicker)	3/8 in.	16 g staples x 3/8 in. x 1 1/8 in.	3	6
particle-board	plywood (5/8 in. and thicker)	1/2 in. to 5/8 in.	16 g staples x 3/8 in. x 1 5/8 in.	3	6
particle-board	boards less than 8 in. wide	same as for 5/8 in. plywood subfloor	16 g staples x 3/8 in. x 1 5/8 in.	3	6
hardboard	all of the above subfloors	0.215 in.	1 1/4 in. (3d) underlayment nails	3	6
OSB	plywood or boards, at least 5/8 in. thick	1/4 in.	1 1/2 in. (4d) underlayment nails	4	6

Particleboard

Particleboard is smooth, knot-free, and hard. It has no core voids and has great impact resistance. Because of this, many builders feel that particleboard is pretty darn hard to beat. In fact, about 1/2 billion square feet is installed each year as underlayment under resilient and non-resilient flooring. So why doesn't the RFCI recommend its use for fully adhered sheet vinyl or tile floors?

Thickness edge-swelling is the number-one complaint when it comes to particleboard installed under resilient flooring. Particleboard will take on moisture at its edge first, creating ridges in the finish flooring. Like hardboard, particleboard should be excluded as an underlayment option for bathrooms. And if vinyl tiles are chosen over sheet goods, particleboard should be excluded because the many seams in the tile floor could expose the underlayment to too much water.

Some sheet vinyl installers report another common problem with particleboard: during the "pull-back" operation, wood particles tear from the surface of particleboard. Normally adhesive is spread directly onto the underlayment except at the point where two adjacent vinyl sheets will meet, leaving a "dry zone." Once the flooring is positioned on the adhesive, the edges between adjacent sheets are "pulled-back" so that adhesive can be spread under the seam. At this point, wood particles are often pulled from the board, creating an irregular surface and a poor bond.

Rich Margosian, general manager with National Particleboard Association (NPA) claims, "The biggest problems are usually related to installation." Examples of this include laying the floor before the structure is enclosed or over unventilated crawlspaces without a vapor barrier. Once the particleboard gets wet or is installed over a wet subfloor it's a loosing battle. Improper on-site storage is another common problem, according to Margosian. Particle board should be stored flat in a dry location. Panels should remain off-site until they are needed—this should be long after the concrete and plaster have dried.

If particleboard is used, a glue-nail fastening system will produce the best results. White carpenters glue, not subfloor adhesive, is recommended by the NPA. Spread the glue onto the subfloor using a paint roller and then nail down

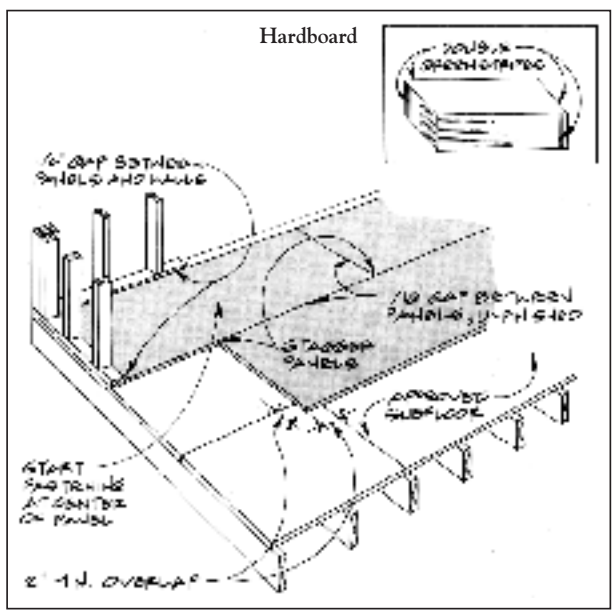


Figure 1. *The only hardboard underlayment approved by resilient floor manufacturers is a Class 4, service-grade panel. This grade is indicated by a double green stripe near the corners of a stack of panels (inset). To install, start nailing at the center of panels and work toward the edges. Leave a 1/16-inch gap at all joints.*

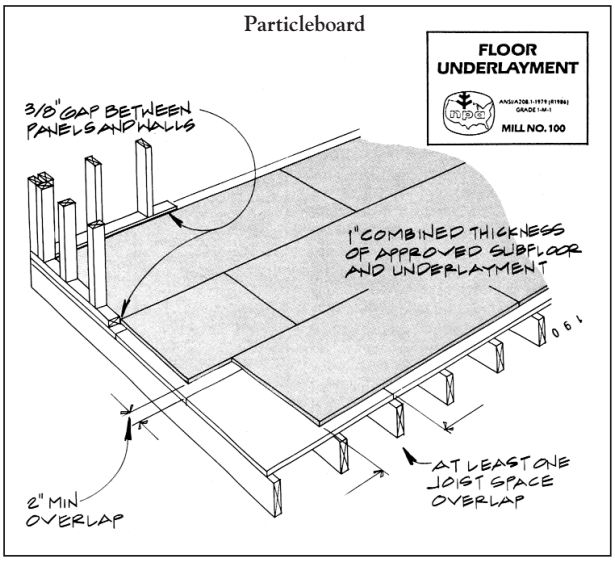


Figure 2. *Particleboard underlayment should carry the National Particleboard Association grade stamp (inset) on the face of the panels, and the combined thickness of the subfloor and underlayment should be one inch. Also be sure to protect the installed underlayment from moisture.*

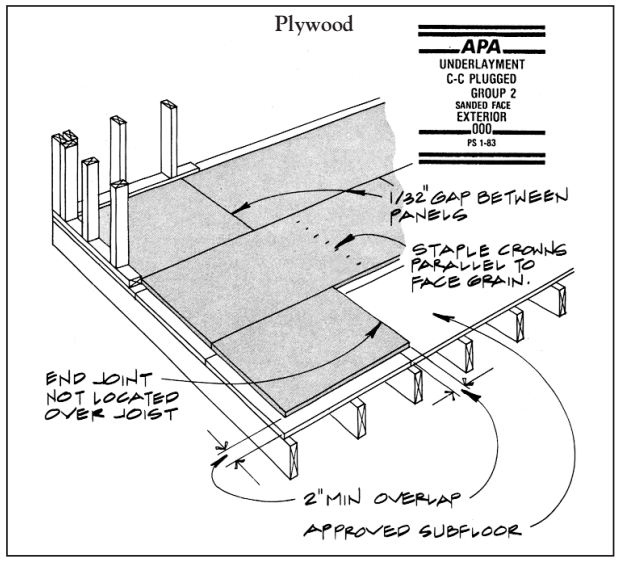


Figure 4. *Plywood underlayment should be laid perpendicular to the floor joists. Space end joints 1/32 inch apart and don't locate them over joists.*

the panels. Standard placement procedures are shown in Figure 2.

OSB

While there are over a dozen APA-approved oriented strand board (OSB) subfloor and sheathing panels, there is no approved OSB underlayment. Only one manufacturer, Weyerhauser, seems to be seeking APA approval for their 1/4-inch OSB underlayment, *Structurwood*. And it seems that a mere procedural technicality blocks the endorsement. The APA has not yet developed a standard for non-plywood underlayment, but hopes to have one in place by the end of the year.

Several of the large resilient flooring manufacturers have tested and approved Structurwood for use under fully adhered and perimeter-bonded floors. But perhaps it has been Weyerhauser's marketing savvy that has earned the product's widespread acceptance in the field. Weyerhauser installed and monitored test floors for four years before selling the first sheet of Structurwood. And since bringing it to market, the company has assumed responsibility for the performance of its product with a one-year warranty: They promise to pay for the repair or replacement of the damaged floor including underlayment, adhesive, floor covering, and labor—providing the product was professionally installed and handled in strict accordance with the installation guide (see Figure 3).

Surface smoothness can be a problem with OSB underlayment because strands lying next to each other may shrink and swell differently, causing an irregular surface that will telegraph through thin resilient flooring. Weyerhauser claims to have licked such problems with a proprietary stabilizing and conditioning process. They insist Structurwood uses a different surfacing process and greater fiber density so the panels remain smooth.

APA Plywood

Plywood gets a clean bill-of-health from virtually everyone. As one builder put it, "I ask for premium-grade plywood underlayment. I want a fully sanded face and a plugged second ply. Why should I screw around?" Tried-and-true is appealing in an environment where everyone wants to blame the other guy for problems that might arise. All resilient flooring manufacturers approve the use of appropriately graded APA plywood under all types of resilient flooring, provided it is installed correctly (see Figure 4).

All APA approved underlayments are classified as either Exposure 1 or Exterior. Exposure 1 will survive limited exposure to the elements like those experienced during a construction project. Exterior indicates the use of an exterior phenolic resin. These panels can withstand repeated exposure to moisture and are the best choice for bathroom floors.

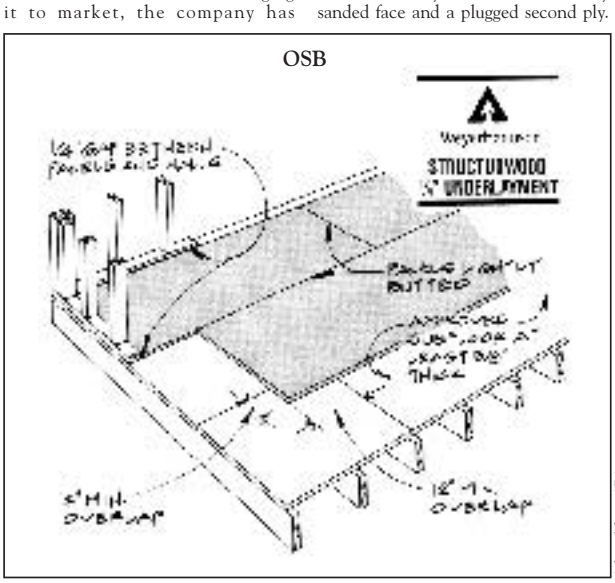
Approved underlayments for resilient flooring can be identified by a grade stamp which says either "underlayment" or "plugged crossbands" (see Table 2). The APA insists that underlayment plywood have a *fully* sanded face. PTS (plugged and touch-sanded) plywood is only sanded in spots, so it is not as desirable. In addition, the crossbands (the inner plys between the face and back veneers) must have plugged knot holes and voids, or knot holes limited to one inch. This specification is meant to eliminate the possibility of a concentrated load, such as a high heel, from puncturing both the finish floor and the face veneer.

Lauan Plywood

Quarter-inch lauan plywood is commonly used as an underlayment and it meets with fair success. All resilient floor manufacturers allow its use under at least some resilient floor applications and some manufacturers even recommend it as an underlayment for all applications. Lauan owes its popularity to a solid track record and wide-spread availability. Lauan plywood should be installed following the guidelines issued for 1/4 inch APA plywood.

Still, builders should be wary of lauan. Lauan is made under a wall-panel specification of the International Hardwood Products Association (IHPA). No one accounts for its performance as an underlayment.

The most common problem with lauan as an underlayment arises from



Adapted from APA

Figure 3. *Weyerhauser's "Structurwood" is the only OSB underlayment approved by resilient flooring manufacturers. The 1/4-inch panels should be laid over an approved subfloor that is at least 5/8 inch thick. Look for the stamp (inset).*

Table 2: Recommended Plywood Grades for Underlayment

GRADE	EXPOSURE DURABILITY CLASSIFICATION	LOOK FOR THESE SPECIAL NOTATIONS IN PANEL TRADEMARK
APA Underlayment	Exposure 1	Sanded Face
APA C-C Plugged APA Underlayment C-C Plugged	Exterior	Sanded Face
APA A-C	Exterior	Plugged Crossbands Under Face
APA B-C	Exterior	Plugged Crossbands Under Face
APA A-D	Exposure 1	Plugged Crossbands Under Face
APA B-D	Exposure 1	Plugged Crossbands Under Face
APA Underlayment A-C APA Underlayment B-C	Exterior	Sanded Face

not specifying the correct type of material. There are two types of lauan: Type 1, with an exterior glue, and Type 2, with a water-resistant glue. Only Type 1 should be used under resilient flooring to prevent delamination of the plys from moisture, especially when using a water-based filler. The "type" is stamped on the very edge of the panel, usually on the 4-foot edge. But you will have to look closely since the panels are only 5.2 mm or 5.5 mm thick (1/4 inch = 6.35 mm). The panels are metric because they are imported.

Three face-grades are available — BB, CC, and OVL (overlay). Knot holes 3/4 inches in diameter are permitted in the face of the worst grade (OVL) if they are puttied. But take note: The putty might stain or react with the finish floor. Problems with yellowed vinyl have arisen in the past over puttied patches in domestic plywood panels. The APA claims these problems were related to only one patching compound which is no longer used in APA-approved underlayment. But in luaun plywood, which is not designed to serve as an underlayment, similar problems could arise. It is ironic that many resilient flooring manufacturers endorse lauan, even though no manufacturing specifications support its use as an underlayment.

Don't Fill Nail Holes

Whatever underlayment you use, all gouges, gaps, and chipped and sunken edges must be filled with a patching compound and sanded flat. Most resilient floor manufacturers specify a portland cement-based compound mixed with latex. Other fillers that are readily available but less effective include plaster compounds like calcium sulfate, plaster-of-Paris or gypsum mixed with a latex binder. With the exception of hardboard, all the joints between panels must be filled and leveled, too. *But don't fill nail holes.*The American Plywood Association, the National Particleboard Association, and the American Hardboard Association all agree that underlayment nails should not be set and filled. The reason: If a nail works loose, it can force the patching compound up and form a small bump in the finish floor. Instead they recommend driving the nail heads *just* below the surface of the plywood and leaving the holes unfilled. Obviously it's going to be tough to drive the nails just right every time. In the case of a grossly overdriven nail or deep rosette in the underlayment surface, the associations suggest it should be filled. This leaves a lot to the discretion of the builder.

Self-Leveling Concrete

One of the newest players in the underlayment game is self-leveling concrete. Self-leveling underlayments are an option for builders and remodelers working with out-of-level or bumpy subfloors (see Figure 5). These products are cementitious blends that are either gypsum-based or portland cement-based (see Product Information at end of article).

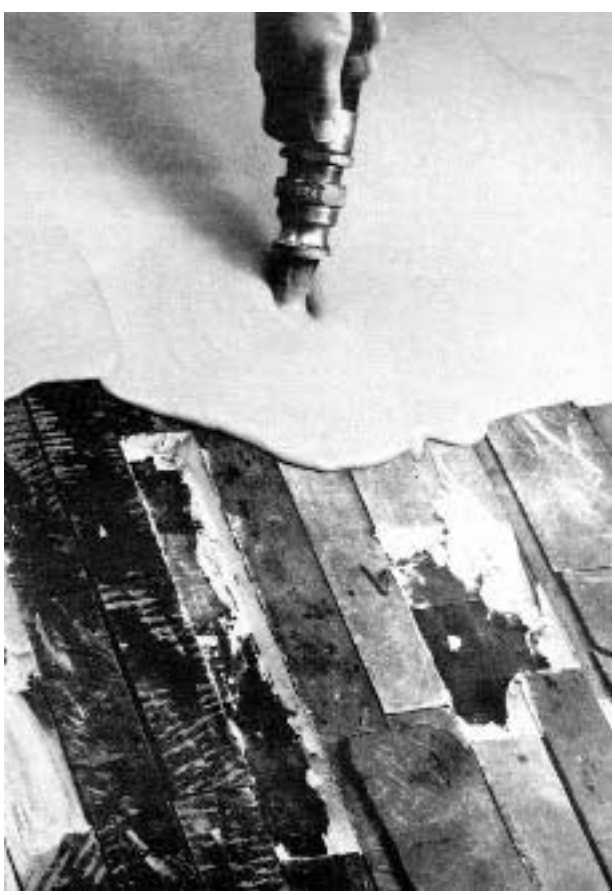


Figure 5. *Self-leveling concrete underlayment is a good choice for renovating bumpy, out-of-level, or damaged floors.*

Gypsum-based materials can be pumped to depths ranging from 3/4 inch to 3 inches. Portland-based materials are poured at much thinner 1/8-inch to 1-inch depths. Portland-based materials are harder and more water-resistant than gypsum-based products. Typically the gypsum-based materials are less expensive but must be installed by licensed applicators. Both types of underlayments are lightweight so floor framing does not usually have to be strengthened.

Self-leveling underlayments cure to form a smooth, seamless surface that is ideal for resilient flooring. Moreover, they are inorganic, non-combustible materials that do not produce smoke or fuel a fire. In fact, they restrict the spread of fire and carry a one-hour fire rating. They also create good sound barriers by filling voids and cracks in the subfloor and beneath the wallboard and adding mass. Some manufacturers even claim that their products help control insect penetration and air infiltration. So finally, we have a product that resilient flooring manufacturers have to embrace—right? Not exactly. Several flooring manufacturers claim that they have had problems with self-leveling underlayments.

A technician in Tarkett's technical services department indicated that mold and mildew are associated with the use of these products. Tarkett also thinks that some gypsum-based products are not hard enough to support concentrated loads. They recommend a minimum density of 100 pounds per cubic foot (pcf), whereas many cementitious products are only rated at about 85 pcf. As a result, Tarkett does not recommend these products as underlayments for resilient flooring.

Congoleum's technical services representative, Bob Dempsey, also cautions against the use of light-weight or gypsum-base concrete as underlayments for resilient flooring. He has received complaints blaming cementitious underlayments for denting easily and damaging the flooring. Dempsey does not think the problems are inherent to the underlayment material, but rather a result of poor job-site control. Adequate drying time is critical so that moisture, which can soften the concrete and stain the vinyl, will not become trapped beneath the floor covering. Congoleum does not approve or disapprove of its use. Armstrong takes a similar stance, passing all liability on to the underlayment manufacturer or installer if it is used.

Patrick Giles, quality assurance manager for Gyp-Crete Corporation, says, "The number-one problem associated with our product with regard to resilient flooring is that floor-goods mechanics do not run a moisture test before installing the vinyl flooring." In good climate conditions, it takes Gyp-Crete five to seven days to completely dry. After five days, Giles recommends that you tightly tape a 2x2 foot piece of polyethylene to the floor and leave it for 48 hours. If condensation collects on the underside of the poly, the underlayment needs to dry more.

Specifying and installing underlayment for resilient flooring seems like a game of dodge-the-bullet. Everyone wants to pass the buck. The safest course to follow is one paved by common sense. Know what you are asking your materials to do and understand how you materials will perform. And, oh yes—make sure you follow the manufacturer's recommendations so you won't get the buck passed to you if a problem does arise. ■

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For More Information

Trade Associations:

American Hardboard Association
520 North Hicks Road
Palatine, IL 60067
708/934-8800

American Plywood Association
P.O. Box 11700
Tacoma, WA 98411
206/565-6600

Hardwood Plywood Manufacturers Association
P.O. Box 2789
Reston, VA 22090
703/435-2900

International Hardwood Products Association
P.O. Box 1308
Alexandria, VA 22313
703/836-6696

National Particleboard Association
18928 Premiere Court
Gaithersburg, MD 20879
301/670-0604

Resilient Floor Covering Institute
966 Hungerford Drive, Suite 12-B
Rockville, MD 20850
301/240-8580

Product Information:

Cementitious Underlayments:

Ardex, Inc.
630 Stoops Ferry Road
Coroapolis, PA 15108
412/264-4240

Gyp-Crete Corp.
P.O. Box 253
Hamel, MN 55340
612/478-6072

Hacker Industries
1501 Westcliffe
Newport Beach, CA 92660
714/645-8891

Quikrete
1790 Century Circle
Atlanta, GA 30345
404/634-9100

Thoro System Products
7800 N.W. 38th St.
Miami, FL 33166
305/592 2081

Structurwood:

Weyerhauser Company
2000 Frontis Plaza Blvd., Suite 101
Winston Salem, N.C. 27103
919/768-5533