

PROTECTING AND FINISHING LOG BUILDINGS

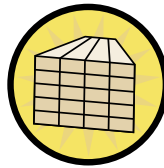
A Wood Protection Fact Sheet



Unique Timber Corp. / EDG Architects / Brian Lloyd Photography



Nicola Logworks Limited / Sortun-VOS Architects



Log builders can ensure a long life for their products by taking a few basic steps to protect the wood. Careful consideration in log selection, log storage, architectural design, construction and finishing will ensure that the owners will enjoy minimal maintenance and beautiful log structures that last a lifetime.

Log Selection

Start on the right foot by using good quality logs without signs of decay. Be aware that if decay fungus is present in the sapwood, it may continue to grow, causing damage during the seasoning process. Large logs may have butt rot in the center of the tree, which usually does not develop further and may not be a problem. On the other hand, fresh decay should be avoided; it is often indicated by white cottony growths. However, it may be difficult to tell the difference. If in doubt, consult with an expert or have the logs graded by an agency such as Log Homes Council or Timber Product Inspection using rules developed specifically for log construction. Don't confuse bluestain with decay. The bluestain fungus merely leaves behind an insignificant discoloration, while a decay fungus causes rot damage.

Logs from standing dead trees may be appealing to use because they are pre-seasoned, but be aware these logs can harbor woodborers. Although generally harmless, the beetles can be a nuisance to homeowners. It's difficult to tell if a log contains borers, but one possible sign is their noise – “sawyer” beetles can sometimes be heard inside the log. Kiln-drying or fumigating the logs will kill the beetles and any decay fungi present.

Because the exterior logs in log buildings are exposed to the weather and thus at risk of decay, choosing a durable tree species adds a level of protection. Western redcedar and yellow cypress are two species with durable heartwood. Douglas fir and larches (such as tamarack and western larch) have moderately durable heartwood. However, the sapwood of these species has no natural durability, just as with most other North American tree species. So any log



structure, no matter what species is used, needs to be designed so that the logs are protected from excessive water. Otherwise, the logs should be treated with preservative.

Many builders prefer to harvest logs in late fall or winter to reduce fungal and insect problems. In the winter, the sapwood has low levels of nutrients (sugars and starches), which would otherwise encourage fungal growth. Also, bark beetles are dormant in winter. Some builders feel that an additional advantage to winter felling is the possibility of less checking, due to a belief that the initial moisture content (MC) of the tree is lower in winter than in summer and there is less difference in MC from heartwood to sapwood. Actually, the tree's MC is lower in the summer due to heavy demand by the needles for water. But this has no relevance, as checking only occurs when parts of the log get below the fiber saturation point (FSP), and the live tree's MC is far above FSP in all seasons. However, one wintertime factor can have a beneficial effect on checking. Slower evaporation in cold winter weather can reduce the drying stresses inside the log, which can reduce checking.



West Coast Log Homes

Protected yard storage

One manufacturer's approach to safe storage of logs in a wet climate includes protection from rain, ground moisture and ultraviolet exposure.



Unique Timber Corp., Brian Lloyd Photography

A super-heated steam vacuum (SSV) kiln

Kiln-drying is effective at killing insects or fungi already in the log. In addition, dry logs are less likely to grow mold or sapstain fungi during storage and transit.

Protection in the yard

Once a tree is cut, its natural defense mechanisms no longer work, and it is vulnerable to attack by insects and fungi whose role in nature is to recycle dead wood. The best way to protect a log surface from mold, insects and other biological trouble is to help the surface layer to dry as fast as possible, without causing extensive checking. In very dry climates it can also help to keep the bark fully intact until the logs are needed for construction, in order to reduce checking. An alternative possibility for protecting freshly felled green logs in storage is to keep the surfaces fully saturated by continually spraying the logs with water. The disadvantage of this method is that the logs will take longer to dry when they are peeled.

Kiln-drying is the fastest way to dry wood, and super-heated steam vacuum kiln technology is the most effective method for logs. Appropriate kiln drying has the additional advantage of "setting" the pitch in resinous species and preventing pitch bleed from the

logs. The kiln heat also kills any fungus or insects already residing in the log. However, too much heat too quickly can cause excessive log checking due to the creation of too steep a moisture gradient within the log.

Air-drying is more common, but slower; mold, stain and decay can develop while the logs are drying. Protect the logs from water while they are seasoning and awaiting construction. Stacking the logs off the ground and out of contact with each other will facilitate airflow around the logs and help them dry faster. It is strongly recommended that some kind of overhead protection be provided (without restricting air flow), especially in rainy climates. Chemical protection may be effective in minimizing biological growths or discolorations – see the section on log treatments.

When to peel a log for best protection is a difficult judgment call. Intact bark offers some protection. But bark encourages beetle attack and inhibits drying,

so leaving the bark on for some time is perhaps only best in dry climates. Peeling the bark right away helps the log dry faster, eliminates existing beetle infestation and prevents new attack, and, depending on the debarking method, removes the nutritious cambium layer just under the bark. If debarking is done only using a peeling spud, most of the cambium layer is still attached to the wood. In that case, pressure-washing right after debarking will remove the cambium. This will reduce mold growth on the surface of the logs during seasoning or after re-wetting during storage. The downside of early peeling is that logs may become weathered if exposed to sun and may need to be cleaned or re-dressed prior to finishing.

If logs in storage are at risk for mold growth, they should be treated with a sapstain control product approved for use on logs - see the section on log treatment. If logs start to discolor from mold, they can be pressure-washed. As the logs dry down during seasoning, they will be less likely to support mold growth.



Unique Timber Corp.

Protection during pre-assembly

This manufacturer uses a covered and well-ventilated space for pre-assembly. A roofed work area is a good idea in general, but is particularly appropriate for protecting the kiln-dried logs being used here.

Protection in transit to the construction site

Logs are typically tightly packed for transportation and may be in transit for some time. These factors present risks for log degradation. Any excessive moisture in the packages combined with a lack of airflow can lead to fungal growth, particularly mold. Even if the logs are dry, moisture can develop in a package due to condensation of water vapor, or leaks in the package or container.

In general, dry logs fare well if they are sheltered from rain and splash – either well-sealed in a container or covered

with an effective tarp on an open deck transport truck. Chemical protection before transportation is generally helpful for all other cases – see the section on log treatments. It's important to treat the entire log, paying particular attention to lateral grooves, corner notches and end grain.

In order to protect the logs from dirt or iron stain, some log home exporters use plastic liners when shipping by container. Some builders also find dried logs stay cleaner during shipping if they are first given a base coat of finish.



Moose Mountain Log Homes Inc.

Protection by design

Proper design is essential for a long-lived log structure. A badly-designed log building will be at risk of leaks, which can lead to damage to the structure or to furnishings. Best practice tips are found in several design guides – see the list of resources on the back page. Here are some key recommendations:

- A good roof **overhang** is critical for protecting the logs and the finish. Keep all wood within the roof drip-line – in fact, the larger the roof overhang, the better. This is particularly important at the gable ends, where the height of the end wall can be substantial. Log ends extending beyond the roof line may look attractive but aren't protected – this is an invitation for decay. Don't forget to provide gutters and downspouts to minimize splash.
- Covered **porches** work like overhangs to protect the walls. These can be especially helpful on the side(s) most subjected to wind-blown rain.



Nicola Logworks Limited/Nicola Logworks Design

Use overhangs

A simple wrap-around covered porch provides good wall protection.



Whitevalley Log Homes/Jean Steinbrecher Architects

Doing it right

These logs are well-protected from rain, splash and ground moisture.

- Properly designed and installed sill log **flashing** around perimeter foundations and at the connection between the framed gable-end wall and the plate log will prevent water penetration. Flashing around chimneys and vertical vent pipes protruding through the roof must accommodate for settling in order to prevent water leaks. Be aware that the roof supported by log walls can drop several inches as the logs settle, while the chimney will remain at the same height.
- Logs should be **tight-fitting**, or the gaps should be sealed with chinking. Lateral grooves and notches should be self-draining. The insulation between logs should be protected from water with a good sealing system at the long groove, the corners, and the checks running through the wall. In situations where a wall is likely to face heavy wind-driven rain, the use of water-absorptive insulation between logs should be avoided, as it can hold water in the groove. An alternative solution, such as a compressible non-absorptive gasket between the logs, is preferable in these cases.
- With seasoned logs, **place existing checks facedown** if possible, so water won't pool in the crack. **Protect upward facing checks** that develop in risky locations (such as the bottom few logs in a wall with insufficient roof overhang) by regular chemical treatment – see the maintenance and repair section for advice on protecting checks. If building with green logs, kerfing each log will relieve radial stresses and thus may reduce the number of checks that will develop on the exposed surface of the wall. Also, application of sealant to the end grain, particularly in very dry climates, can reduce the end checking by slowing the rate of drying. Fewer checks mean less maintenance and potential problems for the

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homeowner. However, homeowners should be aware that checking is a natural process in logs and normally causes no problem for the structure.

- Proper design to **accommodate shrinkage in all the details** is important for preventing gaps.
- Untreated logs must **never be in direct contact** with the soil, or with masonry or concrete, as these materials absorb water and can transfer excessive moisture to the logs. Untreated logs should also be kept at least 12 inches (300 mm) away from the finished (after landscaping) ground surface to avoid rain-splash. Preservative treatment of sill logs (typically boron rods or a topical borate solution) is a good idea. An alternative possibility is to set the sill log onto a pressure-treated sill plate. In restoration cases where an existing sill log is unavoidably in contact with a masonry or concrete

foundation, or with the ground, on-site treatment of the sill log (or replacement of the log with a pressure-treated log) is essential.

- Log homes are heavy, so they need special design attention at the **foundation** or they may settle off-vertical, which can lead to gaps and leaks. The foundation should sit on stable ground. Areas with permafrost need extra precautions – see the Alaska guide in the list at the end.
- Grading and landscaping should **drain water away from the house** and shouldn't restrict airflow. Trim back overhanging tree branches and avoid planting anything too close to the house. Properly designed landscaping will help to protect the log structure from the sun's ultraviolet (UV) rays while maintaining adequate airflow around the building to keep the logs dry. When installing garden

sprinklers, placement is important so that the log walls aren't sprayed.

- If shipping the building to a **termite zone**, consult with local design experts on termite prevention. Western redcedar and especially yellow cypress are two species with some resistance to termites in the heartwood, however, any untreated wood may be at risk of termite degradation. Be sure termite shields are designed into the foundation details. See the termite section of <http://www.durablewood.com>.
- Reduce the potential for problematic **condensation**. Follow local best practice design guides regarding attic ventilation (full ridge venting), crawl space or basement ventilation, mechanical ventilation, pipe insulation, and the use of vapor barriers in insulated framed walls, and around windows and doors.



Brian Lloyd, International Log Builders' Association

A design for durability

Another well-designed home, this one includes a good roof overhang, kiln-dried logs, base flashing with a drip edge, and well-fitted logs. To be even more cautious, the ends of the uppermost logs would have been set in further from the edges of the overhang. As built, these logs are good candidates for borate pre-treatment or borate rods. Gutters and downspouts would also help protect the walls.

A design at risk

Some features of this home may cause durability problems, including (not all are visible in the photo): an inadequate roof overhang, lack of base flashing, a non-self-draining roof post/roof beam notch, and poorly-fitted logs.



Brian Lloyd, International Log Builders' Association

Finishing new log structures

Exposed outdoor wood can be left unfinished and allowed to naturally weather, but appearance and protection are better when a finish is applied. Note that finishes are a complement to, not a replacement for, good design, construction and maintenance. When applying finishes, always follow manufacturer instructions and appropriately protect yourself and the surroundings. When selecting finishes, make sure they are compatible with any other log treatments previously used or that will be used in the future, including chinking and caulking.

Good surface preparation is critical before applying a finish to any wood product. Logs should be clean and dry, however, some finishes are more tolerant of higher moisture content in wood than others. Surface stains such as chainsaw oil, boot and pencil marks, and dirt should be removed with detergent or chemical cleaning, pressure-washing, brushing, sanding or shallow planing. Light roughening of the outside face of the logs (for example, by light sanding or buffing with nylon power brushes or non-woven pads) will give a fresh surface

to the wood. This will increase the amount of finish taken up by the log and will give a longer life to the finish, especially if the logs were peeled by pressure-washing.

Wood finishes are classified as either **penetrating products** (absorbed by the wood, as with stains, and usually oil-based) or **film-formers** (a coating for the wood, like paint, and often water-based). For most log buildings, a natural look with easy maintenance is desirable - in general penetrating products preserve the natural look and allow



Sansin Corp.

A finish doing its job

This water-repellent, pigmented, penetrating finish is performing well. Note the beads of water.

for easy maintenance. There are many high-quality finish products specifically intended for log structures.

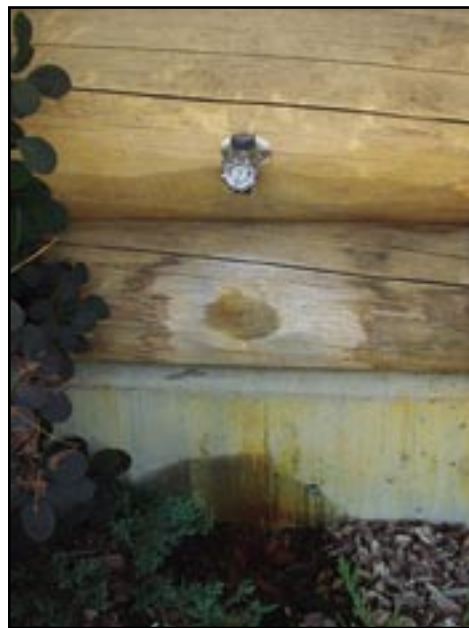
Water repellents are clear, penetrating exterior finishes used alone or, with some types, as a pre-treatment for paint. These products reduce water penetration into the wood. Water repellents and other finishes may contain a preservative to protect the finish against mold. This is not equivalent to using preservative-treated wood, but high-quality, well-maintained products will offer surface protection for the wood.

Semi-transparent penetrating stains are water repellents with a light pigment added for better protection from UV. This type of exterior finish is a popular choice for log buildings, allowing the wood's texture and some of its natural color to show, while still providing good protection from sun and water. Although the initial service life of penetrating stains typically is much less than paints, they are often easier to maintain; the only surface preparation required is cleaning. Penetrating stains are also vapor permeable, thus they allow any moisture in the logs to dry. Weathered wood requires much more finish than unweathered wood as it will absorb more of the product, but with a penetrating stain this generally gives the finish more durability.

Several penetrating **oil finishes** are available for exterior use, usually based on boiled linseed oil or tung



Sansin Corp.



Dalibor Houdek

A semi-transparent stain for natural-looking protection

A log home corner six years after application of a penetrating pigmented stain. A high quality stain on logs that are well-protected from excessive rain and sun can hold up well for several years. Ideally, the owner would have applied a maintenance coat during the fifth year or earlier, prior to fading.

Design, maintenance and finishes all work together to protect the logs. The placement of this faucet and lack of attention to a leak are problematic. Water is splashing on and pooling under the sill log, which can lead to rot. In addition, a well-maintained water repellent would help prevent the water stain.



Robèrt Savignac, International Log Builders' Association.



Robèrt Savignac, International Log Builders' Association.

Film finish on a log building

The famous Chateau Montebello in Québec, the largest log building in the world, is suffering from layer upon layer of peeling paint and some log decay. Film finishes require proper surface preparation before application and re-application, and the logs should be dry. If these requirements can't be met, then a penetrating finish – or no finish – should be chosen instead. Also note the problematic direct contact between the sill log and the masonry foundation.

oil and containing a material preservative to avoid mold growth in the can. These natural oils are a food source for fungi.

The exterior film-forming products, **paints** and “**solid color stains**,” are long-lasting, but are not often used on log homes as they hide the look of the wood and require substantial effort to re-finish when they degrade. The performance of all film-forming finishes is very dependent on proper surface preparation and on moisture in the wood. For example, bubbles and peeling of the film are the result of water vapor in the wood getting trapped behind the film. Film-formers also retard drying. Finish adhesion and performance of film-formers is best when the wood has not been allowed to weather; even a few days of exposure to sunlight has a detrimental effect. If painting weathered wood, no matter how slight the weathering, sand or otherwise re-dress the logs immediately before finishing. This will give better film adhesion and will reduce premature flaking. **Do not use** clear films for exterior finishing. They have almost no UV resistance and will degrade quickly outdoors, creating a significant maintenance problem.

On the **inside**, almost any finish will work well, as these surfaces are sheltered from the weather and UV. All film-formers can be used, including **clear films** such as acrylic latex or polyurethane varnish, so long as the logs are dry. **Penetrating oils, stains,**

and waxes are also used indoors. Be aware that some oils may attract dust to the log surface. Note also that wax-based finishes may inhibit the adhesion of chinking or caulking later. Ensure the interior log surface is smooth to provide for easy cleaning. If rags don't tear on knots and rough places, cleaning generally occurs more often.

Both exterior and interior finishes can be applied to logs by brushing or spraying, paying special attention to the log ends. The end grain is the most vulnerable to decay and therefore warrants special attention. Apply as many coats as needed to the end grain until the fibers will take no more finish; use a brush and work from the bottom up, then repeat. Back brushing is recommended, even with spray application, to ensure all crevices are well penetrated by the finish.

If the building was made from green logs, advise the occupants to keep the heating low in the first year. The logs will dry significantly during the first heating season. Slowing down the rate of drying helps prevent excessive log checking on the interior, and helps prevent damage to finishes and chinking adhesion.

Note that there has been little research performed on the durability of finishes on log homes. The information supplied here is based on exposure tests of sawn lumber and gathered experience of log homes in service.

Chemical wood cleaners

Log building owners should be provided with advice on the best cleaning approach for the log species and finishes used. In many cases, just water, or water plus detergent, will work (with or without pressure-washing). For stubborn discolorations, consider using cleaners that also have some bleaching action. Household bleach or one of the prepared wood cleaners, usually based on either oxalic acid or sodium percarbonate, can be used. Cleaners should be tested on a small area first to make sure they do not cause undesirable color changes. If not thoroughly rinsed off, all cleaners can leave residue that may interfere with finishing. Note also that strong bleach can damage wood fibers on the log surface and can cause the logs to turn yellow or to make them gray faster, if not completely rinsed off.

Wood cleaners have varying degrees of toxicity, thus it is absolutely critical to use them with care. Workplace safety requirements such as signage and proper protection must be met and are addressed by WHMIS regulations in Canada and by OSHA in the US. Also protect nearby plants, as some cleaners can damage them. The manufacturer will supply details on dilution, application and rinsing method with each product.

Some manufacturers and design guides will additionally recommend professional pressure-washing, with care applied so as not to damage the wood fibers. Any remaining surface stains can be sanded or buffed off. More aggressive cleaning and stripping methods, chemical and non-chemical (i.e. dry), are available professionally.

While cleaners can remove surface stains associated with fungus, be aware that they have no residual activity in preventing fungus from growing.

Annual maintenance

It's a good idea to supply a maintenance manual with a log building. This manual should include a record of finishes used on the building. Following are some useful tips for the maintenance and refinishing of log structures.

Log structures must be regularly maintained to minimize the risk of appearance degradation or decay. Annual cleaning is probably the most important single task to perform and is best done on a dry day. Wash the outside of the structure with a cleaning agent, completing one wall before moving to the next. Pressure-washing is often not necessary. However, if professionally advised, it should be done by an experienced person. Inexperienced users of pressure-washing equipment may cause significant damage to the log surfaces, finish coatings and chinking.

Remember the objective is to clean the logs, not to strip off the finish. Use a garden hose to wash the log exterior, working from the top down. After this initial removal of surface dust, spider webs and debris, apply a cleaning solution with a fairly soft bristle scrub brush. Never use steel wool or wire brushes as these will leave behind small iron particles, which may result in dark marks known as ironstain. Scrub the log surface with similar motions and pressure as if cleaning a car. Then rinse well with water, but be mindful of any potential for wetting

the interior walls. If rinsing is done with high pressure, the water could be forced between the logs into the interior. If the water appears on the interior wall, dry it immediately to avoid water stains.

This "up close and personal" annual cleaning routine is a good way to keep an eye on the status of the logs and the finish, and to remove all remaining organic debris like pollen and dirt. Pay particular attention for any signs of insect activity, such as holes or wood dust, and signs of rot, mold, or other discoloration problems on the logs.

Apply a borate preservative to upward facing checks and other vulnerable spots according to the manufacturer's recommended schedule for re-application. If there are any signs of decay detected during the annual maintenance routine, consult with a specialist and take appropriate action to fix the problem areas promptly.

There may be very rare occasions where sealing upward-facing checks with a caulking or chinking compound is advised, for example, to prevent excessive air infiltration caused by checks running through the joints. However the practice of caulking all checks should be generally avoided as it is likely to increase long-term maintenance. This is because caulking needs to be frequently re-applied, as checks will seasonally open or close

to a small extent, stressing the seal. In addition, caulking can trap moisture in vulnerable checks.

During the annual cleaning process, make note of areas that need chinking, repair, or refinishing. Once the cleaning has been accomplished and the logs have dried, any chinking failures will need to be repaired. Allow sufficient curing time before proceeding to the next step.

Interior walls are subjected to different influences such as smoke, dust, grime, etc. Clean these walls as if they were furniture.

As with all construction, fix any leaks or deterioration problems promptly. If moisture, mold or decay are present without any obvious leaks, the problem may be due to condensation. This can happen when warm air encounters a cold surface and there is inadequate ventilation to dry the resulting moisture. House, attic and crawl space ventilation systems need to be operated as appropriate for the climate and the building's design.

Clear the gutters. Maintain ground and landscaping so water runs away from house and plants aren't touching the walls. Keep a clear view of the bottom logs.

Document all procedures and products used to maintain the log building, for future reference.



Restoration: David Rogers, Logs & Timbers.
Photo: Deborah Mendenhall, copyright 2001.

Before and after restoration

This restoration of a historic 1937 building required extensive repairs and refinishing. It's far better and easier to maintain a building in the first place than to face an expensive restoration later. The log rot would have been prevented by borate rods, if they were available at the time the rot started.



Restoration: David Rogers, Logs & Timbers. Photo: Deborah Mendenhall, copyright 2001.

Refinishing

Once the wall is clean and dry, it can be refinished if required. Frequency of re-application depends on the type and quality of the product and the degree of exposure to the elements, especially the sun. The supplier of the finish will have a recommended refinishing schedule. It is not necessary to refinish all sides of the structure at the same time. Depending on the location, it's likely that one or two sides will be quite sheltered from sun and rain and may rarely need refinishing — although note that these sides should still be annually cleaned and inspected. Refinishing only the sides that need it helps keep the costs and labor down, which may help encourage owners to do this maintenance in a timely manner. **It's important not to wait too long before refinishing.** If the logs no longer bead water, or there

are signs of discoloration or pigment fading, it's time to refinish.

It's simplest to always stay with the same type of finish, as finishes can normally be re-applied over themselves. Consult with a product supplier if a change in finish is desired, for example, to remove paint and use a penetrating stain instead. In cases like this, the previous finish must be completely removed and the end result may still not be fully satisfactory. Applying the process to a small test area is recommended.

Penetrating stains and water repellents are easiest to refinish as they only require a good cleaning before a new application. Generally, these finishes should be reapplied every 1-5 years.

If refinishing a film-former such as paint or varnish, it is essential that loose finish material be removed and surfaces be sanded; sometimes, blasting with various media, heat removers, chemicals or other stripping methods are required. The book on exterior finishes, listed at the end, has detailed tips on refinishing.

Remember to mask all areas to be protected from finishes, such as windows, doors, shrubs, siding, walkways, etc. This is particularly important when the finish is to be sprayed.

Nuisances for wood

Mold (sometimes inaccurately called mildew – see sidebar), bluestain, sapstain and rot are all caused by different types of **fungus** that can grow on wood.

Mold is unsightly, but doesn't harm the wood and is relatively easy to remove from logs that get moldy during seasoning. Mold inside an occupied house indicates a moisture problem and may be a health concern for those with allergies to molds. The mold is more likely to be associated with wet carpets, wet wallboard, or wet ceiling tiles than with logs.

Log **bluestain** is often seen in beetle-killed wood. The wood is sound, although the residual stain is permanent. Only the strongest bleaches can partially decolorize this stain and then only from the surface. Because the fungus that created the bluestain is usually dead by the time a log building is erected, there is usually no associated surface "fuzz" as with mold.

Various other types of surface staining fungus can grow on freshly cut lumber or logs held in damp conditions. They have a whisker-like sporadic black surface growth. This is not mold and presents no health risk, but is sometimes confused with mold. Like mold, surface stainers don't usually grow in bright light conditions, because the humidity is too low. This growth on lumber sold green is commonly controlled at sawmills with anti-sapstain fungicides. Drying will also stop growth of staining fungi. Surface stain and mold growth can alter the response of wood to finishes and so should be cleaned off prior to finishing.

A more common staining problem on exposed wood that gets wet is often called "in-service bluestain" or simply "mildew," though technically it is a black yeast. This is an irregular black disfigurement with little or no surface fuzz associated. It can be prevented by finishes which contain an effective biocide (mildewcide). Such finishes require federal registration, but unfortunately few are registered in Canada. The fungus causing this stain is generally water-carried, resulting in vertical black streaks. When these black yeast cells germinate, they can penetrate paint or varnish films and cause them

to peel. Unlike bluestain fungi, these black yeast fungi are more persistent because they can withstand ultraviolet light exposure and low moisture. Fortunately, the stain is only on the surface.

A different group of fungi is damaging to wood – **decay fungi** can invade and rot wood when excessive moisture is present for extended periods. Decay fungi are controlled with good storage and design practices, or with wood preservative treatment.

Insects that can eat logs or make their homes in wood are of special



Canadian Building Restoration Products Inc.

The upper log is discolored by "in-service bluestain" caused by black yeast fungi growing on a linseed oil finish that contained inadequate biocide. This phenomenon is very common on exposed wood. The lower log has been cleaned with oxalic acid prior to refinishing.

interest to log home builders and owners. Large borers such as longhorn (sawyer) or metallic (flathead) beetles infest standing dead trees and can produce chewing noises and sawdust for years, possibly alarming owners. They rarely cause structural damage but may surprise the occupants when they eventually emerge into the finished home, leaving significant exit holes. Ambrosia beetles or pinhole borers are sometimes visible in logs that have been stored green with the bark on. These beetles are particularly abundant in Pacific coastal forest areas. Small piles of white dust on stored logs are evidence of their presence. Internally they leave an irregular pattern of pinholes with a grey/black lining of bluestain fungus. The damage is aesthetic, not structural. Bark beetles might also be occasionally encountered. While these are usually removed along with the bark, and will not infect dry wood, the tunnels they make under the bark are sometimes partially visible as etchings on the log surface.

Fortunately, few insects attack debarked logs during and after seasoning. Of these, powderpost beetles are the most destructive. The name comes from the habit of reducing sound wood to a very fine powder, often kicked out of small exit holes when the tiny adult beetles emerge. One family of powderpost beetles, the anobiids, prefers damp wood and thus is more common in coastal areas or in situations where wood is allowed to remain damp. A similar group prefers seasoned hardwood. Information on other wood pests such as termites and carpenter ants can be found in a number of the

references listed at the end. Borate treatments are effective at preventing attack from wood-eating insects.

Sunlight, its **ultraviolet (UV)** component especially, is hard on wood and on finishes. UV causes some wood discoloration and surface damage, makes it more difficult for wood to initially hold a finish, damages the bond between wood and finish, and causes damage to the finish itself. The pigments in finishes help protect wood from UV damage. In clear finishes, transparent UV absorbers are often incorporated.

Lichens, moss and algae can grow on damp logs but are primarily just an appearance problem. They grow on the surface and do not degrade the wood. However, moss in particular can harbor moisture, which promotes rot.

Exterior wood is exposed to repeated **wetting** and drying cycles, which causes the wood to alternately swell and contract, stressing film-forming finishes. Excessive water can also enable the growth of fungi or insects. In log structures, water is controlled by a good roof, good access to air for drying the logs after wetting, and a regularly-maintained finish.

Other discolorations, such as stains from wood tannins and extractives, and iron stain, are harmless for wood. Avoid in-service ironstain by using stainless steel, hot-dipped galvanized or other heavy-duty coated fasteners in locations expected to occasionally get wet. If metal is cut or ground during building re-assembly, all iron filings must be carefully cleaned up immediately.

What is mildew?

Although many people use the word to describe surface growth of fungus, mildew is a non-specific term with little scientific meaning. Scientifically speaking, only a few species of fungi, associated with plant diseases and typically white or gray in color and looking downy or powdery on leaf surfaces, are correctly called mildews. However, the popular usage of the term is as a general equivalent word for dark stains caused by mold, staining fungi and the black yeast fungi. In the finishes industry, biocides that control molds and black yeasts are usually called mildewcides.

Log treatments

The organisms that discolor or harm wood can be controlled with **fungicides** (antimicrobial pesticides). Use of these chemicals is regulated in most counties. In Canada the regulatory body is the Pest Management Regulatory Agency (PMRA), and in the US pesticides are regulated by the Environmental Protection Agency (EPA). Any product identifying itself as a wood preservative or as a product that prevents mold and mildew must be registered with the appropriate agency. Stringent labeling requirements include identification of permitted applications. Log builders are advised to select products specifically intended for logs. Always read labels and follow instructions closely.

A variety of treatments to control stain and mold fungi are registered for use on green lumber in sawmills. Some of the labels also specify treatment of logs. Log building components may require treatment to prevent mold and stain during seasoning or shipment, so these sapstain control products can be used if the label instructions are followed. Unfortunately the label may require special application techniques not readily available to the log builder.

In sawmills, sapstain control products are usually sprayed on lumber, but can be applied by dipping as well. On logs they would be most effective when ap-



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plied immediately after debarking. As with all pesticides, adequate personal protective equipment is required. It is important as well that care be taken not to contaminate the surrounding environment with chemicals, nor to allow any wood waste such as bark to be inadvertently treated. Newly treated wood should be protected from rain. Safe storage and signage practices must be followed.

PMRA will be evaluating the use of anti-sapstains in the log building industry. Search the PMRA pesticide labels on line for registration updates (see "for more information" section). In the US the information can be obtained from EPA. Some inorganic borate wood treatments are registered for brush or simple spray application. However borate products, which are available for logs, are weak against mold and stain at normal use levels.

A fungicide is being sprayed onto these logs during pre-assembly. Depending on the climate and season, fungicide may need to be applied several times between peeling and shipping. It's critical that anyone applying these treatments is using the right equipment, is properly trained, is wearing the right personal protection, and has carefully read the product label.

If logs are expected to be at risk for rot (sill logs, exterior log posts, or any log heavily exposed to weather are candidates), pre-treatment with a **wood preservative** is ideal. Copper azole (CA) and amine copper quat (ACQ) are replacing the traditional chromated copper arsenate (CCA) for residential applications. However, these preservatives generally change the color of the wood and therefore are often not desirable for log structures. **Borate** is colorless and thus generally preferred. Its use is appropriate as long as the treated logs won't be subject to substantial water flow, as this preservative can eventually wash out. For best performance, logs are pressure-treated by professional treaters, or treated with borate using a dip/diffusion process, which can be done by log building manufacturers; this is not yet a common practice due to strict regulations.

Borate treatment is effective at protecting logs against decay and insects. The preservative is applied before finishing the logs, either during the manufacturing stage or during construction. Logs can be sprayed or brushed with topical water-based or water/glycol-based disodium octaborate. The glycol should aid penetration into dry wood, and the additional viscosity makes it easier to retain enough borate on the smooth log surface. For very large logs, multiple applications, or a drill and injection with the formulation, might be needed to give adequate preservative loading. After treatment, it is best to cover the logs and allow the borate to penetrate for a week or so. The covering also retards drying of the borate solution, which can leave a preservative residue on the surface if it dries too fast. In those cases, the residue is easily removed with a damp rag or light sanding. Glycol-based formulations can affect the top sealant if the finishing is done too soon after the borate treatment. Try testing a small area, as a slight color change may occur.

Also useful for log homes are fused borate rods and borate paste. The rods are inserted into pre-drilled holes in parts of logs that are anticipated to get wet. When the wood reaches adequate moisture content, the rods slowly dissolve and the preservative diffuses through the wet part of the log. Borate rods and borate-glycol mixtures can also be useful for log restoration and



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Placing a borate rod

This rod is being inserted into the bottom of what will be an exterior post for a new log structure. This type of rod is dark; others are white. Neither one will be visible, as the rod is entirely inserted and the hole filled with a plug.

maintenance, if a moisture problem cannot be addressed through other measures.

Regarding beetles that may be resident in logs, note that heat treatment or fumigation may become a requirement in the future for logs shipped to some countries, because pests carried by wood materials are under increasing scrutiny by quarantine inspectors.

Log builders frequently also use bleaches, brighteners and cleaners, all of which are intended to improve the appearance of wood. Because their purpose is not to protect against pests, these products are not subject to PMRA pesticide regulations. However, workplace safety requirements do apply – see the section on wood cleaners.



Mark Fritch Log Homes



Canadian Building Restoration Products Inc.



Forintek is Canada's wood products research institute. Established as a private, not-for-profit corporation in 1979, Forintek is an amalgamation of two former public laboratories whose history dates back to 1913. To this day, Forintek continues to provide leading-edge technical support to the solid wood products industry. As part of its broad program, Forintek is a major North American supplier of information on treatment technologies and durability performance of wood. For more information, visit <http://www.forintek.ca>.

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Pest Management Regulatory Agency – Pesticide labels web site. <http://www.eddenet.pmr-arla.gc.ca/4.0/4.01.asp> Pesticide labels clearly indicate allowable uses for each product. Labels for current registered pesticides can be found on this Health Canada web site. For example, to find all products registered for use on logs, click the search button. Then under search full contents in E-labels, type log and click submit. A table of matching products will appear. Click on any of the registration numbers to read the full text of the label. Alternatively, search for other criteria such as active ingredient. For example, under search field, select active ingredient and under criteria type in borate. Then click the registration numbers to see which of these borate products are approved for logs. Pesticides must be registered before they can be legally used, and users must follow all instructions on the label.

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