WOOD FINISHING:
Blistering, Peeling, and Cracking of House Paints from Moisture

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When too much water gets into paint or into wood beneath the paint, the paint may blister or peel. Understanding the causes of these failures will help homeowners to diagnose the particular problem and take corrective measures.

Blistering

Moisture blisters should not be confused with temperature blisters or glossy-back blisters. Their causes and cures are not the same. Moisture blisters usually contain water when they form, or do so soon afterward; temperature blisters do not. Temperature blisters usually occur within 1 or 2 days after painting with dark-colored paint on cool days in the fall, and are usually in only the last coat of paint. Glossy-back blisters, as their name implies, have a glossy material on their backs; moisture blisters do not. Glossy-back blisters usually involve several layers of old paint.
Moisture blistering usually includes all of the paint down to the wood surface and indicates that the wood behind the paint is excessively wet. Moisture blistering usually occurs in early spring and will occur first on only specific areas in heated buildings. These are areas that enclose rooms with a high relative humidity in the winter time or are areas wet because of ice dams and plugged gutters.

After moisture blisters appear, they dry out and collapse. If the blisters are small, they may disappear completely. If they are fairly large, they may leave a rough spot on the surface. If the blistering is severe, the paint may peel.

Moisture blistering is more likely in new, thin coatings of oil-base paint containing zinc oxide pigment than in old, thick ones. Older and thicker coatings are usually too rigid to swell enough to form blisters; instead, they are more prone to crack and peel after excessive wetting.

Peeling and Cracking

Peeling is a common type of water damage to paint and does not usually involve the formation of distinct blisters. Failure occurs in both heated and unheated buildings on siding areas where rain and dew commonly wet the paint. Such failures are associated with porous, flat, oil-alkyd and latex paint systems which hold water on the surface and so provide ample time for water penetration into the layers of paint. Peeling can occur at the wood interface or at some weak bond between layers of paint.

Cracking failure, followed by peeling at the ends of boards and the lower portion of horizontal siding, also indicates the adverse effect of rain and dew penetrating through paint or through cracks in paint. Such failures will occur on all sides of houses and also on unheated buildings.

On the other hand, peeling failure at localized areas, such as gable ends of heated buildings, indicates the moisture is coming from within the building.

Sources of Harmful Moisture

Moisture that works its way behind or through the paint film to cause blistering and peeling can come from several sources. Water might be getting in from the outside, or going out from the inside of the house.
Outside Water Going In

Rain and dew account for tremendous volumes of water which come in contact with painted surfaces. If the outer layers of paint are flat, porous systems, they will adsorb large quantities of water which can gradually penetrate down into the paint coating. During weathering, cracks also gradually develop in paint, particularly over joints and at the edges and ends of boards on the side walls of a building. Water can pass through these cracks, soak into the paint or wood, and produce paint peeling. Leaks in the roof, or the formation of ice dams on the roof, also allow outside water (melted snow) to enter the side walls and damage the paint.

Inside Water Going Out

Water from inside of a building can attack paint on the outside by soaking through the wood. This water can come from such faulty conditions as leaks in plumbing, overflow of sinks and bathtubs, or shower spray on a bathroom wall that is not properly sealed. Or it may result strictly from conditions of high humidity.

Water in the form of water vapor (humidity) inside the building is a source of many gallons of water daily. This moisture in the winter time is attracted toward the cold surfaces of the outer walls. If the outer walls have no vapor barrier or a poor one, the water vapor passes into the walls and condenses to liquid in the sheathing and siding. In very cold weather, it may condense into frost and later be melted by the warm spring sun. The condensed water vapor soaks into the siding and wets the paint. This problem is called cold-weather condensation and is a common cause of paint blistering.

Interior water vapor also can penetrate through the ceiling to condense on the gable ends and roof boards. If the attic space is not adequately vented, this moisture can cause paint failure on gable ends and other side walls when the water runs down the rafters and roof boards to the outer walls of the building.

Too high a humidity inside the building aggravates the cold-weather condensation problem. Frequent condensation on the windows during cold weather indicates that the humidity inside the building is too high.

The typical home has many sources of water vapor contributing to high humidity. Cooking, dishwashing, laundering, bathing, and normal respiration (by an average family of four) can contribute as much as 3 gallons of water per day to the humidity. Other sources are humidifiers and unvented gas heaters and clothes dryers. Crawl spaces, too, contribute moisture that works up into the home and out through the walls.
Finding the Source of Damage-Causing Moisture

The first step in solving a house-paint moisture blistering or peeling problem is to determine the source of the water that is doing the damage.

Outside Water Clues

The following situations are typical of cracking and peeling problems caused by moisture from outside the structure (rain and dew):

1. It can occur on both unheated and heated buildings.
2. It occurs only on surfaces that can be wetted by rain and dew.
3. It will be most pronounced at edges and ends of boards and where water is held on the surface.
4. It occurs after rain or heavy dew and is associated with a brown discoloration.
5. It occurs below roof valleys and corners where rain runoff from the roof wets the side wall of the house excessively.
6. It occurs below horizontal roof edges and roof valleys where ice dams developed during winter months. Ice dams form when melting snow on the roof refreezes at the roof edge and gutter, dams up the water which penetrates in under the shingles and through the roof boards, and finally runs down into the side wall and behind the siding.

Inside Water Clues

The following situations are typical of moisture blistering and peeling problems caused by moisture from inside the structure.

1. Blistering or peeling caused by condensation of moisture vapor in side walls (cold-weather condensation) can often be observed under the following typical conditions:
   a. It is usually most severe on the coldest (north) side of the building or outside unheated rooms such as closets.
   b. It is likely to be concentrated outside rooms having high humidities, such as bathrooms, kitchens, or bedrooms in which water vaporizers are used.
   c. The blisters appear in localized areas on the house in late winter or early spring before the spring rains.
(d) The damage occurs on wood protected from rain and dew, as well as on wood which is unprotected from the weather.
(e) The damage occurs only on heated buildings.
(f) The house has no vapor barrier.
(g) The house has a humidifier and window frames and sills are badly stained. (Water condensation on the glass was excessive.)

(2) Blistering or peeling caused by plumbing leaks. Such damage is not seasonal and is localized.
(3) Failure of paint at the gable ends and high on the side walls of a house indicates moisture condensation in the attic and inadequate provision for ventilation to keep the attic dry.

Solving the Problem

Outside Water

If outside water is getting in, the following steps will block its entry:

(1) Apply water-repellent preservative to all joints before repainting. Repaint with a nonporous primer and top coat.
(2) Calk or putty open joints and cracks after treating with water-repellent preservatives and priming.
(3) Repair roof leaks.
(4) Check eave troughs and downspouts for leaks, cleanliness, pitch, and capacity. Watching their performance during a heavy rain can be very revealing. Downspouts should empty into splash blocks to drain the water away from the building.
(5) Do not allow ice to form on roof edges and valleys. Removing the snow from the roof, increasing the insulation in the ceiling, and increasing ventilation in the attic will prevent ice dams.
(6) When re-roofing, lay a strip of rolled roofing under the new shingles along all horizontal roof edges. This will give further protection if ice dams form.
(7) Apply nonporous primer to areas that have peeled down to the wood.

Inside Water Vapor

If the paint failure is caused by cold weather condensation, the following procedures are recommended:

(1) Increase the resistance to the penetration of vapor by painting the ceilings and the interior surfaces of the outside walls. Aluminum paint serves this purpose well. It protects against vapor and can be painted over with decorative paints. In remodeling and including new paneling, a polyethylene film placed over the surfaces to be covered will be more effective than the aluminum paint.
(2) If the paint is peeling on the gable ends, increase the insulation and ventilation in the attic. The total screened area for attic venting purposes should be approximately 1/225 of the ceiling area of the house. A minimum of 6 inches of dry insulation should be maintained on the attic floor.

(3) Reduce the humidity. Shut off humidifiers and vent gas heaters, clothes dryers, and kitchen exhaust fans to the outside. A ground cover in the crawl space will cut down on the moisture inside the building. A lumber dealer can recommend a good ground-cover material.

**Repainting After Correcting the Water Problem**

If the general condition of the paint does not require a complete repainting, it is best to spot paint the areas of wood laid bare by failure. First, scrape away the loose paint. Apply one coat of water-repellent preservative to the bare wood. Then use one coat of zinc-free, oil-base nonporous primer, and topcoat to match the rest of the house.

When the house needs a complete repainting, a thorough scraping of loose paint is essential. Then treat the scraped areas with water-repellent preservative. If failure is due to penetration of rain and dew through porous paint, apply a coat of nonporous oil-base primer over all, and then topcoat with oil or latex house paint. If moisture blistering and peeling have been severe, it is best to use a zinc-free topcoat as well as primer. The topcoat can be oil base or latex base. In changing from oil to latex, apply nonporous oil-base primer to the old paint surface before applying latex, to insure good bonding of latex and to prevent excessive penetration of rain and dew.

After correcting the moisture problem, a complete repainting may be needed. If it has been less than 3 years since the last paint job, a thorough washing of the old paint will guard against intercoat peeling later because of a poor bond between the new and old topcoats. Use a solution of trisodium phosphate or a commercial paint cleaner in warm water. Rinse well with clean water. Then proceed as indicated above for complete repainting.

For additional protection against intercoat peeling, always wash such sheltered areas as the eaves and porch ceilings before repainting. It is best not to repaint these sheltered areas more often than every other time the body of the house is painted. Allow no more than 2 weeks between coats in the first paint job or in two-coat painting.
Experience has shown that three coats are usually required for the first painting to protect new wood. The so-called "breather" oil paints (usually alkyd resin blended with oil) and latex paints are more porous than conventional oil paints. If these paints are used on new wood without a good oil primer, or if any paint is applied too thin on new wood (a skimpy two-coat paint job, for example), rain or heavy dew can reach the wood by direct penetration of the paint coating.

When this happens, water-soluble extractives in the wood may come to the surface and discolor the paint when the wood dries. In addition, the new paint may crack and peel early and without blistering. Another coat of nonporous paint is needed if this condition is present. Wash the old surface if it is heavily stained or if it has been less than 3 years since the house was painted.

Experience has also made it clear that very old, thick house paint can be troublesome. Therefore, it is best to allow at least 5 years between complete repaintings. Too frequent repainting usually requires complete paint removal.

If the source of the water is determined soon after the moisture problem develops and the corrective measures are taken, moisture blistering and peeling of the house paint should no longer be a problem. However, if the excessive wetting has occurred for many years with scraping and repainting at short intervals, a complete paint removal may be the only good solution.

For Further Information

Several Forest Service Research Notes touch on various phases of finishing. Single copies of these are available from the Forest Products Laboratory, Forest Service, U.S. Department of Agriculture, Madison, Wis. 53705.

U.S. F.S. Research Note

FPL-046  Forest Products Laboratory Natural Finish
FPL-0123  Wood Finishing: Painting Outside Wood Surfaces
FPL-0124  Wood Finishing: Water-Repellent Preservatives
FPL-0126  Wood Finishing: Temperature Blistering of House Paints
FPL-0127  Wood Finishing: Intercoat Peeling of House Paints
FPL-0128  Wood Finishing: Mildew on House Paints
FPL-0129  Wood Finishing: Cross-Grain Cracking of Oil-Base House Paints
FPL-0131  Wood Finishing: Discoloration of House Paint by Blue Stain
FPL-0132  Wood Finishing: Discoloration of House Paints by Water-Soluble Extractives in Western Redcedar and Redwood
FPL-0133  Wood Finishing: Finishing Exterior Plywood
FPL-0135  Wood Finishing: Weathering of Wood
FPL-0125  -7-