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FOREST PRODUCTS LABORATORY

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PAINTING EXTERIOR WOODWORK

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Good paint is, of course, a necessary element in good paint maintenance, but it is far from being the whole story. For many years technical study and writings have dealt with paint composition almost to the exclusion of other factors in paint service some of which are even more important. As a result there is a tendency to believe that satisfactory paint service can always be expected provided only that a sufficiently good paint is purchased and that, when paint fails prematurely, there is necessarily something wrong with the paint purchased. A better understanding on the part of purchasing agents and maintenance men of the other important elements upon which the serviceabloness of paint depends should help materially in securing more satisfactory painting and in avoiding unnecessary disputes.

The Forest Products Laboratory has been studying the painting of exterior wood surfaces for more than 10 years. Two principal sources of information are utilized, namely, (1) observation of the behavior of paint on buildings in service that are brought to the attention of the Laboratory, usually because of unsatisfactory experience with paint, and (2) practical exposure tests in which paints of known composition and methods of application are observed carefully throughout their life on different kinds of wood. Such exposure tests are made throughout the United States at stations representing various climatic conditions.

The major objective of painting studies at the Forest Laboratory is to learn how to get the most satisfactory service from wood when painting is involved and how to do so with a maximum assurance of results and a minimum expense. This point of view is unique in paint testing and has led to significant improvements in methods of evaluating paint service and to a better understanding of the various factors upon which satisfactory paint service depend. The competitive claims made for different paint ingredients, for example, have not been allowed to overshadow the importance of proper proportioning of ingredients, variation in behavior on different kinds of wood, application of paint in sufficient quantity, repainting before the old coating has worn too badly, and avoidance of certain abnormal conditions of service that rapidly ruin the best of paints.

Experiments by the Forest Products Laboratory are confined almost entirely to paints of known composition, usually manufactured at the Laboratory. Such paints can be described fully and can be formulated to bring out general principles of paint composition to best advantage. The

Laboratory has not been concerned directly with the special problems of paint purchasing, such as specifications for paint and the relative merits of proprietary paints, but knowledge of the more general problems that it has been studying should prove helpful in the purchasing of paint as well as in the maintenance of painted buildings.

Moisture Failures of Paint

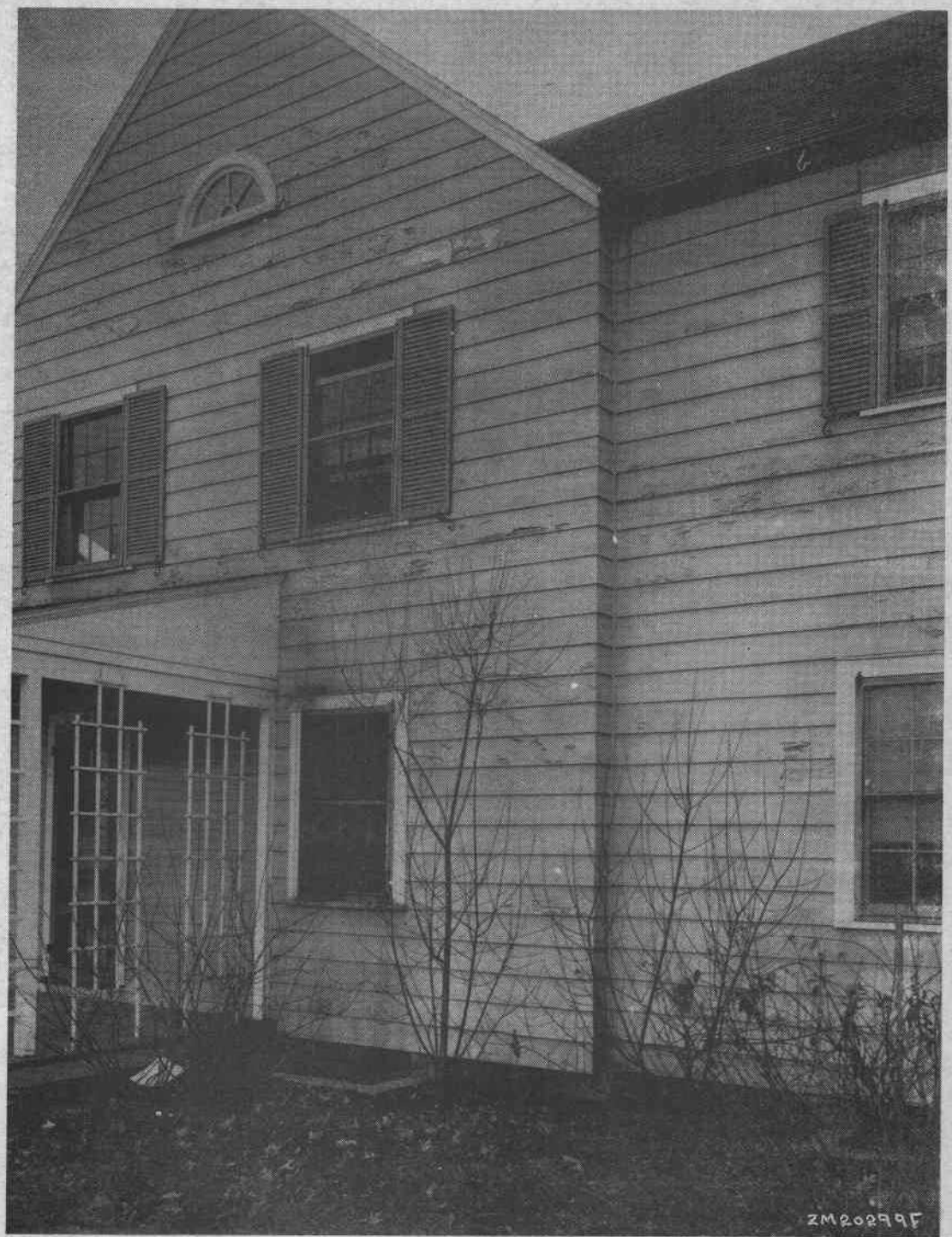
Probably the most frequent and costly cause of premature failure of paint on buildings is moisture getting behind painted woodwork, especially when the temperature behind the painted surface is higher than it is in front. Under such conditions good paint may fail within a few months after application and the failure may leave a surface that is unusually expensive to repaint properly. In pronounced cases failure begins with blistering and sometimes peeling; the blisters may subsequently disappear but in any case scaling or flaking of the coating sets in long before break-down of the coating should be expected. In less characteristic cases the first form of failure observed is flaking of the coating from the harder parts of the wood surfaces, just as is ultimately to be expected, but the failure sets in much too soon. Failure of the latter type is especially likely to be attributed falsely to inferior paint because the form in which failure takes place lacks the distinguishing characteristics of typical moisture failures.

All linseed oil paints, good, bad, and indifferent, are subject to moisture failures if the causative conditions arise. To be sure pure white-lead paint escapes relatively unscathed under moderately severe conditions that prove disastrous to all other paints but if the conditions are bad enough white lead fails also. The only certain cure for moisture failures is to eliminate the moisture. In new buildings the moisture may get into the sidewalls when improper methods are followed in drying the plaster. A second source of moisture is open joints or inadequate flashing around windows, chimneys, dormers, eaves troughs, or other junctions in the construction. A third source of moisture, often the most difficult to remedy, is sweating or condensation within the sidewalls during cold weather.

Durability on Different Woods

Paints last much longer on some kinds of wood than on others. The variation results from the fact that linseed oil paints become brittle after they have been exposed to the weather for some time and when brittle they no longer hold firmly to the dense, hard, horny bands of summerwood present in softwood lumber. For that reason aged coatings flake from the summerwood, leaving it bare. The larger the areas of summerwood the sooner flaking becomes serious. The heavier the wood and the wider its annual growth rings the larger are the bands of summerwood and the less desirable it is for durable painting. Of the native softwoods the best for painting

The side walls of this house become wet every winter and by spring the boards of siding are thoroughly wet and scaling of paint results. The house was painted in March of one year, repainted in July the next year, and photographed the following year.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are western red cedar, Port Orford cedar, Alaska cedar, southern cypress and redwood, followed closely by northern white pine, western white pine and sugar pine; somewhat less desirable for painting are ponderosa pine, Eastern spruce, Sitka spruce, true firs, eastern hemlock and western hemlock; paint fails soonest on Douglas fir, southern yellow pine, and western larch.

There is, of course, much variation between boards of the same species. In general the lightest boards and those with narrowest growth rings are best for painting. Edge grain boards are always superior for painting to flat grain boards of similar wood.

Priming Paints for Wood

Two paints are outstandingly superior for priming new wood surfaces, namely, pure white-lead paint and aluminum paint. White-lead paint has the advantage of being white or easily tinted to a variety of colors so that it lends itself readily to two-coat painting. Priming-coat white-lead paint should be mixed with plenty of pigment; it should contain only slightly more liquid than a finishing-coat paint and the liquid should be mostly linseed oil with only a small proportion of turpentine. So-called "reinforcing oils" and varnish should not be used in white-lead paint.

Aluminum paint should be made by adding 2 pounds of aluminum bronze powder or paste aluminum to 1 gallon of long-oil spar varnish made specifically for mixing exterior aluminum paint. Aluminum priming paint has the advantage of markedly retarding the flaking of paint from the bands of summerwood. It is therefore the best priming paint for woods like ponderosa pine, southern yellow pine, and Douglas fir. It has the disadvantage of requiring two coats of white or of light colored finishing paint to hide its color adequately.

Finishing Paints for Wood

On buildings for which there is no systematic plan of paint maintenance and on which the paint may be neglected for considerable periods pure white-lead paint often proves the most satisfactory finishing-coat paint. Such paint is not more durable than paints that contain proper mixtures of zinc oxide with other white pigments, but when it becomes brittle it changes from a sound coating into a loosely adherent mass of chalk that continues to hide and color the surface fairly well provided the wood is one containing only narrow bands of summerwood. Such a surface is easily repainted. Paints that contain zinc oxide, on the other hand, flake in a more conspicuous fashion after they have become brittle and if repainting is put off the surface may prove difficult to repaint satisfactorily.

For buildings that are repainted promptly when old coatings become brittle, paints that contain reasonable proportions of zinc oxide and white lead with or without some of the newer opaque white pigments, such as the titanium and zinc-sulfide pigments, are superior to pure white-lead paint in that they protect the wood adequately against moisture for a longer time and if tinted they hold colors better. For white paint the presence of titanium or zinc-sulfide pigments is particularly desirable because such paints are less seriously discolored with dirt.

Finishing coat paints should not be mixed with too much linseed oil. After the volatile thinner has evaporated at least 28 percent of the coating by volume should be pigment and of this pigment at least 80 percent by volume should be made up of opaque white pigments (unless the paint is one of dark color in which there is little or no white pigment).

Purchasing agents who wish to know the real value of the paints they buy should provide themselves with tables of the bulking values (volume per unit weight) of the important paint pigments and liquids and learn to compute the proportions of paint ingredients by volume from formulas or analyses expressed in percentages by weight.

Importance of Spreading Rate

Next to the use of too much linseed oil the most common mistake in painting is probably the stingy application of paint. Purchasing agents will do well to regard with suspicion paints whose makers claim that they will cover more area per gallon that other paints. On smooth wood surfaces priming coat paint should not cover more than 575 square feet per gallon and second-coat or third-coat paint should not cover more than 600 square feet per gallon. Rough surfaces, such as sawed surfaces or badly weather-beaten surfaces consume still larger quantities of paint.

Stingy application of paint leads first to early loss of gloss and particularly to uneven or spotty loss of gloss. If the paint is tinted loss of gloss is followed quickly by fading of the color. The ultimate durability of coatings is often seriously impaired if they are applied too thin.

Publications

More detailed discussions of the topics summarized in this paper are given in the following publications. Single copies of these publications may be obtained free upon application to the Forest Products Laboratory, Madison, Wisconsin:

List of Publications on Wood Finishing Subjects, mimeograph R454.
Some Causes of Blistering and Peeling of Paint on House Siding, mimeograph R6.

Testing House Paints for Durability, mimeograph R1011.
Properties of Wood that Determine the Service Given by Exterior Paint Coatings, mimeograph R895.
Why Some Wood Surfaces Hold Paint Better than Others, Leaflet No. 62.
When and How to Paint Farm Buildings, mimeograph R962.
Effect of Aluminum Priming Paint on the Durability of House Paints on Wood, mimeograph R1015.
Weathering and Decay, Technical Note No. 221.