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COVER: *MOORING AT SUNRISE* (DETAIL), BY ROSS M. MERRILL

# AMERICAN ARTIST®

APRIL 1996 VOLUME 60 ISSUE 645

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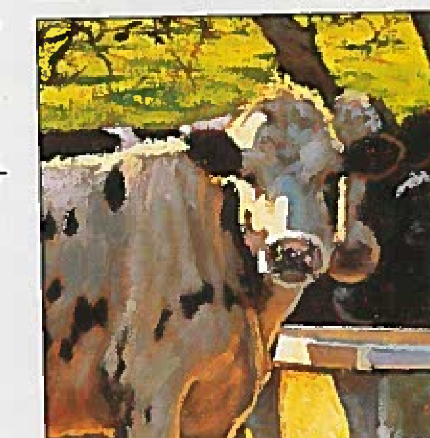
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**Cover: *Mooring at Sunrise* (detail), by Ross M. Merrill, 1994, oil, 24 x 40. Courtesy Susan Conway Gallery, Washington, DC.**


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methods and materials

edited by M. Stephen Doherty

# A REPORT ON ARTISTS' MATERIALS

*Two scientists from the Smithsonian Institution's Conservation Analytical Laboratory share some of their findings on the effects of relative humidity, termperature, and vibration on paintings.*

An infrared photograph of Winslow Homer's painting *Breezing Up (A Fair Wind).* Courtesy Conservation Division, National Gallery of Art, Washington, DC. The National Gallery of Art's Conservation Division and the Smithsonian Institution's Conservation Analytical Laboratory conduct a variety of scientific studies: from how to care for the nation's art treasures to how the works were actually made. One example is this Homer painting. By taking what is called an infrared reflectogram mosaic, curators and conservators can study the underlayers and underdrawings buried beneath the surface and examine what is invisible to the naked eye. This infrared photo reveals that originally Homer included an extra figure in the foreground boat's bow and two additional boats in the background.

*Breezing Up (A Fair Wind),* by Winslow Homer, 1873-1876, oil, 24⅛ x 38⅛. Courtesy National Gallery of Art, Washington, DC. In the finished work, Homer has painted out the figure in the bow as well as the two distant boats, leaving only one boat on the horizon. His reasons for doing this are not documented, but perhaps by simplifying the scene—at this time he was interested in the formal sparseness of Japanese art—Homer hoped to better balance the composition and to create a terse expression of life at sea.

In conjunction with the cover story on Ross M. Merrill in this issue, we asked two scientists who have researched artists' materials and techniques with him to share some of their findings. Marion F. Mecklenburg and Charles S. Tumosa, who work for the Smithsonian Institution's Conservation Analytical Laboratory in Washington, DC, have made important discoveries about the exhibition, preservation, and restoration of works of art that have been helpful to museum directors, conservators, and practicing artists. In particular, their research on packing and transporting paintings (which resulted in a series of workshops and two comprehensive publications entitled *Art in Transit: Studies in the Transport of Paintings* and *Art in Transit: Handbook for Packing and Transporting Paintings*) has yielded valuable information about the effects of relative humidity, temperature, and vibration.

As part of their research, Mecklenburg and Tumosa considered reasons why some paintings crack and deteriorate while others remain as fresh as the day they were created. They considered the effects of environmental conditions on materials such as canvas, rabbitskin glue, varnishes, and acrylic, oil, and alkyd paints.

Mecklenburg's and Tumosa's tests of alkyd and oil paints are particularly relevant to the article on Merrill since he uses both types of paints in his landscapes. The following interview lays out their findings and should prove helpful to artists working with either or both of these painting mediums. Some of their information is rather technical, but their general conclusion is that alkyds are quality products that offer artists the benefits of quick drying and a durable finish.

**American Artist:** *Could you first summarize the reasons you were testing artists' materials?*

**Mecklenburg & Tumosa:** We were attempting to determine the most important considerations for packing and shipping paintings. In the process, we tested the effects of relative humidity, vibration, temperature, and shock on various types of paints and painting surfaces.

**AA:** *What would you say were the most significant findings that could be helpful to practicing artists?*

**M&T:** It's difficult to summarize this extensive research, but we suspect artists would be most interested to know that **of all the environmental considerations, extreme temperatures can have the most damaging effects on paintings.** All you need to do is look at paintings that were hanging in unheated mansions during the eighteenth and nineteenth centuries, and you'll see the cracks that can occur when the temperature goes below freezing for a sustained period of time.

We did a lot of tests of the ways relative humidity and temperature might affect pictures made with oils, alkyds, or acrylics, and we found that there is some difference in the rate at which each paint absorbs moisture when the humidity is increased and shrinks when the temperature is lowered. **Alkyds proved to be stiffer and stronger than both oils and acrylics, but the differences were not so significant that we would recommend one over the other.** Of course, none of these paints would withstand environmental changes if it were applied to an improperly prepared or inappropriate surface.

**AA:** *Many of our readers try to emulate the work of the Old Masters by using the same materials and techniques. Did you find any differences in the durability of traditional versus modern materials and procedures?*

*This research shows that alkyds are quality products that offer artists the benefits of quick drying and a durable finish.*

**M&T:** As we've just said, all the paints we tested performed reasonably well, so we can't say that based on our research artists should abandon traditional oil paints in favor of modern acrylics and alkyds, or vice versa. And now that many manufacturers are reformulating their paints to include lightfast pigments, an artist can buy better paints than were available centuries ago.

**One of the traditional materials we would not recommend to artists is rabbitskin glue.** Any of the refined hide glues that have traditionally been used to seal the surfaces of canvas or to adhere liners to the back of canvases will remain responsive to environmental conditions. That means that the glue will expand and contract with relative humidity changes so much that it is likely to crack or to cause fissures in the paint applied over it. We found much more satisfactory results when surfaces were prepared with acrylic gesso or medium.

**AA:** *Because we are featuring the work of Ross M. Merrill in this issue, we are particularly interested in your findings about the alkyd paints he uses. Could you share some of these findings?*

**M&T:** As a medium, **alkyds have a number of qualities that should please many painters.** In numerous ways they handle like oils yet dry fairly quickly. As a result, glazes and scumbles can be applied without excessive dragging of the underpainting. Alkyd paints are available in many of the colors that oil painters prefer, and they require the same thinning solvents as oil (turpentine or mineral spirits).

No matter whether they use oils, alkyds, or acrylics, all artists are concerned about the durability of the finished painting. This concern can only be thoroughly addressed by considering all of the materials that are used in making the painting. These include supports (i.e. canvas, wood, particleboard, grounds, and sizes). It is impossible to discuss what might be expected from the paint itself without determining the factors affecting it and the measurable properties that signal changes in the paint. **The two most influential factors affecting artists' materials are temperature and ambient moisture (the moisture in the air).** The amount of moisture in the air is usually measured using the quantity relative humidity (RH). In general, the higher the RH, the higher the air's moisture content. All artists' materials absorb moisture as the RH increases and lose moisture as it decreases. **When the materials absorb moisture, they swell, and this can sometimes be a problem.**

*Of all the environmental considerations, extreme temperatures can have the most damaging effects on paintings.*

**AA:** *How do temperature and ambient moisture affect alkyds as compared to other paints?*

**M&T:** The ability of a paint film to respond to changes in RH is dependent upon many factors that affect the hydrophilic or hydrophobic nature of the film and the degree of cross-linking of the polymer. **Cross-linking, the crosswise connecting of parallel chains of atoms, enables alkyd paints to be less responsive to moisture than their oil counterparts.** In fact, over a range from 5% RH to 90% RH, alkyds swell about one-fourth (.8%) as much as artists' oil paints (3.6%). This is important when considering an alkyd painting's response to the environment and whether there is a concern for keeping a painting in a controlled climate.

The same effect can occur with a decrease in temperature, since alkyd paints tend to shrink with cooling. From room temperature (75°F) to about freezing (32°F), the paint will shrink only about .2%. As the temperature decreases further, the paint passes through a transition phase and the rate of shrinkage decreases dramatically. The temperature at which this effect occurs is called the glass-transition temperature and is quite important. For alkyd paints it is about 23°F. Alkyd paints above this temperature, and at nearly all RH levels, are still sufficiently flexible and have the capacity to be stretched without cracking. Below this temperature the paint acts exactly like glass. The precise determination of this behavior is ascertained by the mechanical test.

**AA:** *Could you explain what the mechanical test is?*

**M&T:** In the mechanical test, a material is stretched by the application of force. By conducting this test at different temperature and RH levels, an excellent picture of the material and its response to the environment is developed.

The behavior of an alkyd paint film when tested mechanically is also determined by the degree of polymerization of the film and the extent to which the film has been modified with fatty acids (usually oils). The amount of polymerization depends upon age, thermal treatment, and the types of modifying fatty acids. The pigment volume concentration and the type of pigment also contribute significantly to the mechanical behavior of alkyd paint films. With high pigment concentrations, the stiffness of the paint increases and the ability of the film to be stretched decreases. Certain pigments bind with the fatty-acid groups to make metallic soaps, and this leads to an increase (or sometimes a decrease) in the stiffness of the paint film.

**When compared to oil paints, alkyd paints tend to be stiffer and stronger, which reflects their more cross-linked structure. Alkyd paints compared to acrylic paints tend to be stiffer and stronger and are much less likely to become distorted at room temperature.** For alkyds, the problem occurs when the temperature drops below freezing.

When tested mechanically at room temperature and around 50% RH, an alkyd paint will stretch from 3% to 6% before breaking. If tested at room temperature and 5% RH, the paint will still stretch between 2% to 3%. In effect, this says that **relative humidity does not present a serious problem with the paint.** If however, the paint is tested mechanically at -23°F, it will only stretch between .2% to .4% before breaking. This is only a tiny fraction of the paint's ability to stretch at temperatures above freezing. **At these low temperatures, simple handling of an alkyd painting can cause a problem.** In the direction parallel to the grain, wood shrinks little, either from loss of moisture or temperature drops. Paint applied to this material is effectively restricted from contracting in the directions parallel to the grain. **If the temperature drops significantly, the paint wants to shrink but cannot, and cracks appear** as a result of forces developed in the paint. These cracks will propagate in a direction perpendicular to the grain of the wood. **On canvas supports, the biggest problem occurs when the painting is stretched tightly.** Under these circumstances, the paint film is not free to contract with temperature drops, and it will likely crack.

**AA:** *Can you elaborate on how extreme temperatures affect oil and acrylic paintings?*

**M&T:** Paintings constructed with oils or acrylics behave similarly to those made with alkyds. Oil paints pass through the glass-transition temperature at approximately 14°F. **Acrylics have a bigger problem in that the glass-transition temperature is around 40°F—considerably above freezing. All of these paints are relatively unresponsive to relative humidity but not completely,** especially when applied over a support sized with hide glue. ■

*Art in Transit: Studies in the Transport of Paintings* and *Art in Transit: Handbook for Packing and Transporting Paintings* were published by the National Gallery of Art in Washington, DC, in connection with the International Conference on the Packing and Transportation of Paintings held in London in September 1991. For further information, write: Conservation Division, Dept. AA, National Gallery of Art, Washington, DC 20565.