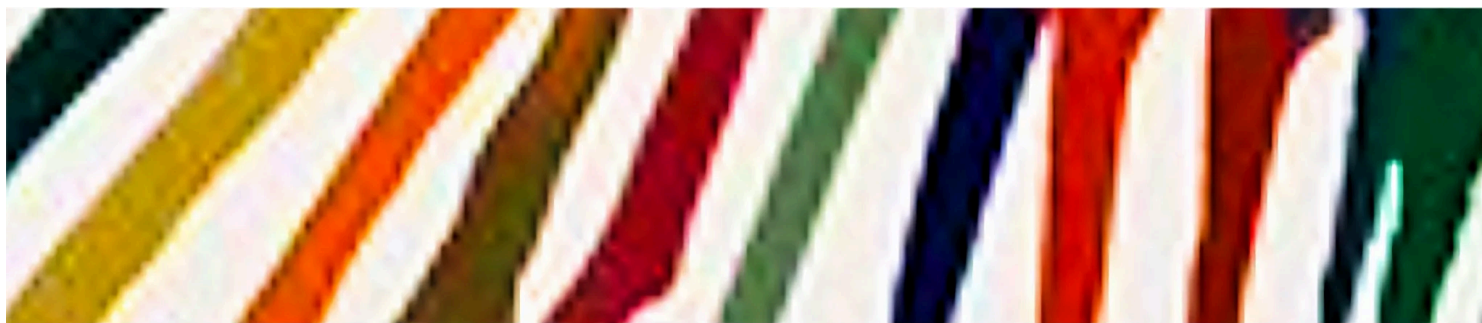


# Safe Painting in Fine Art



*a subject overview by Merle Spandorfer*

Morris Louis: Alpha Pi, 1961, acrylic on canvas,  
102 1/2in x 177in, (Courtesy Metropolitan Museum of Art, New York City,  
Arthur H. Hearn Fund, 1967.)

Many of the world's most treasured visions and images have been captured by painting, a form of expression familiar to artists, hobbyists and the general public. By contrast, the potential hazards in materials used in painting are less well understood.



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After a visit to New York in April 1953, where they saw the recent paintings of Helen Frankenthaler, Washington-based friends Morris Louis and Kenneth Noland began to similarly stain raw canvases with diluted pigment, rather than apply it with a brush. (...)

Alpha-Pi is one of about 150 Unfurleds he created, generally on mural-size canvases (this one measures over 8 feet by 14 feet). In all of them, irregular rivulets of different colors flow diagonally down toward the lower center of the canvas, but never quite meet; the center of the unprimed canvas remains blank. Heavily diluted, the poured colors soak into the canvas, becoming one with the surface, and maintain the flatness of the modern picture plane.

<https://www.metmuseum.org/art/collection/search/489653>

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There are today many paint mediums and processes available to apply in countless ways. To paint safely, artists should learn the ingredients and use of paint products.

In this essay we attempt to update essential information on paints so that artists can achieve a balanced approach to materials and methods in painting.

*Main Source: Making Art Safely: Alternative Methods and Materials in Drawing, Painting, Printmaking, Graphic Design, and Photography, by Merle Spandorfer (picture), Deborah Curtiss, Jack Snyder, MD | New York, 1992*



*Francesco Clemente: Sun, 1980, tempera on paper mounted on cloth, 91in x 95in. (Courtesy Philadelphia Museum of Art, Edward and Althea Budd Fund, Katherine Levin Farrell Fund, 20th Century Art Restricted Fund, and Funds contributed by Mrs. H. Gates Lloyd.)*

## Potential Hazards in Painting

The 1988 Labeling of Hazardous Art Materials Act requires manufacturers to list all potentially harmful substances in their paints and paint products. By now most labels should contain a fairly complete list of ingredients, including pigment composition, binder, solvents, and additives. Trade secret confidentiality, however, permits some manufacturers to withhold potentially important information from the customer. For example, if the amount of formaldehyde (a preservative) in a product is less than 1 percent, a manufacturer does not have to list this ingredient on the label. Unfortunately, the complete contents of some paint products, especially those purchased before November 1990, may be impossible to identify.

- Most paint generally consists of:
  - Coloring agents: pigments or dyes
  - A binder: acrylic, egg, gum Arabic or tragacanth, milk/casein, linseed oil, plaster, resins, wax, or a combination thereof
  - A liquid vehicle: organic solvent, oil, or water
  - Inert ingredients to add bulk: chalk, diatomaceous earth, marble dust, mica, silica, talc, or whiting
  - Paints may also include additives that affect paint characteristics:
  - Preservatives to decrease acidity and mold
  - Plasticizers, stabilizers, surfactants, and wetting agents to suspend and disperse color in the binder and vehicle
  - Retarders (antioxidants) or dryers to slow or accelerate drying time
  - Chemicals to prevent discoloration
  - Agents that affect sheen: matte or glossy
-



*Merle Spandorfer: Winter Jungle, 1990, acrylic paint, water-soluble printing ink, collage using methyl cellulose on Arches Cover paper, 30in x 40in. Due to respiratory irritation, I avoid using oil-based paints and inks as well as thinners. The only solvent required for 'Winter Jungle' a combination of painting, collage and collagraph, was water.*

# Coloring Agents

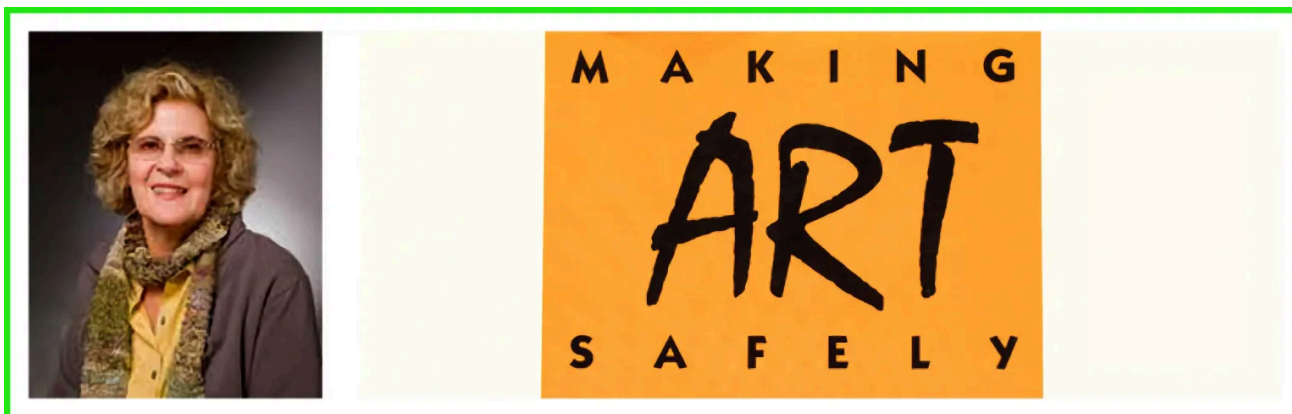
Pigments and dyes provide a broad range of rich, radiant colors. They are ubiquitous in art supplies. As long as artists maintain their voracious appetites for color, new hues will continue to be marketed and used despite absence of information concerning long-term health effects. Careful handling of these products is nonetheless appropriate because: (1) the contents of some pigments and dyes present well-documented health hazards and (2) the long term health effects of chronic exposure to mixtures of coloring agents remain unknown. We suggest the following:

- Buy premixed paints, inks, and crayons from high quality manufacturers with informative labels.
- Avoid dry pigments and agitation, spraying, sanding, heating, or other activities that create airborne powders.
- Avoid ingestion of paints by washing hands thoroughly after painting and before eating or smoking in the studio, and by eliminating unconscious hand-to mouth activities.
- Wear gloves and/or barrier hand cream to keep paints from contacts with skin.
- Learn which chemicals (and potential) are associated with a particular color; check the product label or Material Safety Data Sheets for the Color Index Number.

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<https://www.merlespandorfer.com>

*below: Merle Spandorfer*



## Pigments

Pigments are insoluble, naturally insoluble materials that are crushed into a fine powder and mixed with binders and vehicles to form paints.

Sources of pigments include:

- Inorganic minerals and metals, natural or manufactured, ground into a fine powder
- Organic (animal and plant) substances
- Synthetic (chemical) manufacture

Powdered forms of dry pigment are easily inhaled or ingested. Do not use powders around children. Even relatively safe powdered tempera colors should be premixed into solution by responsible, protected adults. If possible, mix all powdered pigments in a glove box. When grinding oils, wear a particle filter mask and use local exhaust ventilation. Observe daily cleaning procedures as outlined for pastels in chapter 5. As noted previously, few pigments will ever be fully tested for potential human health hazards. As of this writing, the metal-containing pigments raise the

most significant health concerns. The use of antimony, arsenic, cadmium, chromium, lead, lithium, manganese, mercury, and nickel has recently been curtailed by a few manufacturers of paint and ink pigments. In the classroom, do not use pigments known to contain these metals; in the studio, avoid inhalation, ingestion, skin contact, and contamination of the environment (Table: Metal Pigments used in Paints and Inks).



*Merle Spandorfer: Winter Jungle, 1990, acrylic paint, water-soluble printing ink, collage using methyl cellulose on Arches Cover paper, 30in x 40in. Due to respiratory irritation, I avoid using oil-based paints and inks as well as thinners. The only solvent required for 'Winter Jungle' a combination of painting, collage and collagraph, was water.*

## PIGMENTS AND TOXICITY

Although it has been banned from consumer paints for years, lead is still found in automobile, boat, and artist paints. The luminous and pearlescent qualities of lead white have been prized by some artists. Most health professionals, however, strongly discourage use of any lead containing products by artists of any age. Currently, there is unequivocal consensus among health experts that lead in the forms used by artists presents a substantial health hazard. We therefore strongly recommend the elimination of all lead containing products from the studio. Artists may wish to experiment with micaceous pigments to replace use of lead white.

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Some reds, oranges and yellows, highly prized by many artists, may contain cadmium, as suspected reproductive toxin and suspected carcinogen. As of this writing, artist advocacy groups are endeavoring to retain production of cadmium colors for artist use. Realistically, we know that some artists will persist in the belief that the aesthetic merits of lead white and cadmium colors outweigh any health risks. For those artists, we have three suggestions: (1) minimize dermal, oral, and inhalation exposure to any material known to contain these pigments; (2) inform everyone who enters the studio that toxic pigments are present; and (3) label any work that contains lead, cadmium, or any of the previously mentioned less common toxic metal pigments, so that purchasers and conservators have notice of the presence of a toxic metal.

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*Takashi Murakami, (c), Tan Tan Bo, (2001)*  
*the inventor of superflat art mainly works*  
*with acrylic paints*

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Pigments that contain metals such as iron oxides (Indian, Mars, Tuscan, bole, ochre, Venetian, Spanish oxide colors), silver, strontium, tin, titanium, tungsten, zinc, and zirconium have no known significant hazards. Pigments that contain metals such as iron oxides (Indian, Mars, Tuscan, bole, ochre, Venetian, Spanish oxide colors), silver, strontium, tin, titanium, tungsten, zinc, and zirconium have no known significant hazards.

Metallic, premixed paints with a sheen formed by combinations of aluminum, bronze, copper, gold, silver, stainless steel, tin, titanium, and zinc with other colors are relatively nonhazardous. Metallics containing mercury as well as lead should be avoided. Premixed iridescent and interference colors given a sheen by inclusion of mica and micaceous oxide (hematite) powders have not been associated with adverse health effects.



***Nathan Oliviera, Stanford University studio. There is a vacuum fan directly above the painting area to exhaust vapors. Artists, like those in other professions, must become aware of what they use in creating their work. Dangerous chemicals and solvents are no different for artists to use than anyone else. It is my belief that it is the responsibility of learning institutions to educate young artists about the hazards that do exist. It is then the artist's responsibility to use, or not use, safeguards as they see fit. I further believe that it is not in the interests of artists to ban hazardous materials from the marketplace.***

Organic Pigments and Dyes Organic pigments offer an increasingly diverse array of new, alternative colors. For many years, alizarin crimson and phtalocyanine blue and green were the only organic pigments of satisfactory quality for artist oil paints.

Some coloring agents incompatible with oil, however, proved to be miscible, brilliant, permanent, and colorfast in an acrylic base. Organic pigments and dyes attach or bind to materials (including skin) in the absence of a binding agent. Most of the organic coloring agents listed in Table 6.2 have no significant short-term health effects. Long-term effects remain unknown or are under study. Therefore, responsible, prudent artists avoid inhalational, oral, and dermal exposure when using organic pigments.

For many years, phthalocyanine colors were manufactured with polychlorinated biphenyls (PCBs). PCBs are probable animal carcinogens that may also cause skin problems (chloracne) and liver dysfunction in humans. PCB contamination of dry colors was strictly regulated by the Environmental Protection Agency in the early 1980s. If you phthalocyanine paints produced prior to 1982, discard them. Dry pigments produced after 1982 may still contain trace amounts of PCBs at levels less than 50 parts per million (Rossol 1988).

Many commercial dyes are marketed as dry powders that must be dissolved in water to color fabrics and other materials. There are fiber-reactive dyes, direct dyes, and mordant dyes containing agents that enhance permanent coloring. Natural dyes are prepared from plants, insects, and algae, while synthetic dyes are made primarily from five aromatic hydrocarbons: anthracene, benzene, naphthalene, toluene, and xylene.

Benzidine dyes are known to cause bladder tumors. Prior to 1979, more than 200 benzidine-containing products were used as direct dyes by craftspersons and textile workers. Benzidine dyes are no longer made or sold in the United States; if you have any in your studio, call your local agency for advice on proper disposal.



Six Soft Stones  
Sheila Hicks (©)  
1997

## Cold-water dyes

Cold-water (fiber-reactive) dyes, commonly used for batik and tie-dying, have occasionally been associated with respiratory and skin allergies. Dyes are not listed in Art and Craft Materials Acceptable for Kindergarten and Grades 1-6, as prepared by the California State Department of Education. Young children should not handle dye solutions. Mature children should work with dyes only under the supervision of adults who recognize the value of handwashing, protective gloves, and/or barrier

creams. Children also need frequent reminders to keep hands away from faces and mouths. Because of natural binding qualities and unknown health hazards, powdered or liquid dyes should be handled with care.

## Avoid inhalation of dye powders:

Use commercially mixed concentrated solutions whenever possible. Do not buy dyes by the ounce or pound; buy only in premeasured packets that will be used in their entirety. Do not leave partially used packages lying haphazardly around the studio. Submerge dye packets in water before opening to discharge powder directly into the water; some packets are made from materials that will dissolve.

Alternatively, mix dry dyes into concentrated solution inside a glove box or while wearing a NIOSH approved toxic dust mask.

Avoid ingestion of dye powders:

- Do not eat, drink, or smoke when dye powders and solutions are present.
- Keep them in well-labeled containers out of reach of children.

Avoid skin contact with dyes (liquid or dry) to prevent dermatitis or skin absorption; wear rubber gloves and an impermeable apron.

Most dyes are stable when exposed to light, air, and moisture; they also tend to resist biodegradation. There is no evidence, however, that dyes present a health threat when disposed of through sewage treatment systems or septic tanks. Thus, the artist can dispose of dye solutions down the drain with running cold water. However, dyes that contain concentrated acids may require neutralization prior to disposal.

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*Deborah Curtis: APSE (Synopsis Series), 1986, acrylic on two canvases: 24in x 33in inset in 66in x 54in. I began painting exclusively with acrylic polymer paints in 19689 to collage fabrics onto paintings and to work on unprimed canvas. Tube acrylics, diluted to stain into rinsed canvas resulted in muted, washed out colors until, in 1983, I discovered Golden's Fluid Acrylics (many ACMI AP). The brilliance and versatility of the colors continues to amaze and delight me.*

## Mordants

Mordants are chemicals (usually acids or alkalis) that make dye permanent. Alum, ammonium alum, cream of tartar, formic (methanoic) acid, Glauber's salt (sodium sulfate), urea, and vinegar are the safest mordants. Check Appendix I, Art Material Chemicals, for additional information on hazards and precautions.

Deborah Curtis: APSE (Synopsis Series), 1986, acrylic on two canvases: 24in x 33in inset in 66in x 54in. I began painting exclusively with acrylic polymer paints in 19689 to collage fabrics onto paintings and to work on unprimed canvas. Tube acrylics, diluted to stain into rinsed canvas resulted in muted, washed out colors until, in 1983, I discovered Golden's Fluid Acrylics (many ACMI AP). The brilliance and versatility of the colors continues to amaze and delight me.

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# SOLVENTS

co-authors | JH Shaw | M McCann | A Babin | C Randall | 2007-2023

## The Toxicity of Solvents



[LINK: Up-to-date Essay on Solvent Safety](#)

[LINK: Safe Solvent Alternatives](#)

According to  
Stanford University  
Airborne Fumes and Toxins  
are **1000 x Times**  
more harmful when used  
indoors

## Nonaqueous painting mediums

Nonaqueous painting mediums (alkyd, encaustic, magna, oils, and resins) require and/or contain organic solvents for mixture and use. Organic solvents are the primary components of:

- Aerosol sprays of adhesives, fixatives, and paints
- Brush cleaners
- Lacquers and lacquer thinners
- Mineral spirits and turpentine
- Paint removers and strippers
- Varnishes and varnish thinners

Many solvents are highly volatile (evaporate quickly in air); most are flammable or combustible. Prolonged inhalation, ingestion, or absorption of large quantities can lead to drowsiness, headaches, dizziness, feelings of intoxication, fatigue, mental confusion, increased heart rate, nausea, and loss of coordination. Inhalation of vapors from most organic solvents can also cause eye, nose, and throat irritation. High-level exposure may also cause breathing difficulty, convulsions, kidney damage, and even death.

**By 2023 health organizations reached widespread agreement that most organic solvents should be considered carcinogenic (even the ethyl alcohol in your drink).**

Solvents such as the aromatic hydrocarbons (benzene, toluene, xylene), chlorinated hydrocarbons (carbon tetrachloride, trichloroethylene), aliphatic hydrocarbons (petroleum distillates, kerosene, mineral spirits), and turpentine are all skin irritants that may be absorbed into the body. These solvents have been associated with the potential for both short- and long-term adverse effects on the nervous system. Although the mechanisms of solvent neurotoxicity are poorly understood, the adverse effects can be cumulative.

The presence or absence of odor is not correlated with or an indicator of, toxicity or potential hazard. For example, although deodorized mineral spirits may be less toxic because some of the aromatic hydrocarbons have been removed, adverse effects, such as headaches and drowsiness, may still occur in some people. In another example, highly undesirable solvents such as benzene and toluene have pleasant odors, while acetone has a strong, disturbing odor. Constant, prolonged inhalation of solvent vapors can decrease odor (and hazard) awareness.

Therefore, we recommend use of as little solvent as possible. (Today, there are many solvent substitutes that can facilitate much safer working conditions). Keep all solvent containers tightly closed when not in use. Contact lens wearers should avoid exposure to solvent vapors, which may shorten the lives of lenses by slowly dissolving the material from which they are made. Considering the array of potential problems associated with solvents, we encourage you to:

1) Avoid as many organic solvent exposures as possible by substituting water-soluble paints.

2) Adopt the safest available handling procedures for the toxic substances that you must use:

a. Prevent inhalation, ingestion, and skin contact with effective ventilation, careful work habits, and professional attire.

b. Keep only small amounts of organic solvents (a one-day supply) in the work area. (This also applies to supplies of alcohols and orange oil)

c. Store solvents and solvent-soaked rags in appropriate, labeled, and tightly capped safety cans.

3) Alert yourself to any symptoms that may be associated with the use of potentially hazardous art materials. If you believe your workplace may be contributing to a health problem, do not procrastinate: seek medical attention. Early detection and treatment promotes health and prolongs lives.

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**Many solvents can and should be totally avoided. We suggest you rid your studio of solvents.**

The following solvents present particularly potent hazards:

- Benzene
- Carbon Tetrachloride
- Methyl-n-butyl ketone
- n-Hexane
- Styrene

- Chloroform
- Dimethylformamide
- Trichloroethylene
- Trichloroethane

Ethylene Glycol, or glycol ether, perhaps the most common solvent, is used in a wide range of products from cheap acrylics and water-based paints to many domestic cleaning products, such as window cleaner. Paint engineers praise the chemical, often sold as 'Butyl Cellosolve', as the ultimate agent for making smooth emulsions and fast setting paint, without having to resort to the use of mineral spirits. But the health hazards of this clear, highly concentrated, and very volatile liquid have been underplayed and underestimated for years – new medical studies aimed at the field of painter decorators suggest otherwise. *The Toxicity of Solvents*

If you do use any volatile solvents dispose of them promptly and safely (see *Safe Disposal of Dangerous Materials*). Then consider safer substitutes for the solvents that you feel are necessary for your work. (Over the past 15 years or so artist paint manufacturers made great strides towards introducing safer paints and solvent alternatives, so the highly neurotoxic solvents can now be easily avoided in a painting studio. When you must work with nonaqueous solvents and solvent-containing materials, observe the following safeguards:

Use effective, specific exhaust ventilation and NIOSH approved organic respirator with fresh cartridge to carry vapors away from you and out of the studio.



Avoid skin contact by wearing protective attire and gloves. Many solvents penetrate gloves or dissolve glove material. Many solvents penetrate gloves or dissolve glove

material. Consult the section 'Glove Materials and their Attributes'. Use gloves according to manufacturers specifications, and have spare gloves available to replace those that have been dissolved or been penetrated. In addition, wear an appropriate hand cream whenever possible.

Avoid use of nonaqueous solvents to clean skin or hands. Instead, apply olive oil or vegetable oil to your hands to remove oily deposits, then clean with soap and water. For work area clean-up always wear gloves and use vegetable oil or baby oil (which is high grade mineral oil without solvent contamination) to absorb oily deposits. Work the oil into paint residue with a palette knife, let this mixture soak for a minute, then remove with a rag and dispose rags in a fireproof container. Products such as ZAcryl D-Solve can even lift dried up paint stains with ease. Many artists use a dish soap solution for final de-greasing of the work area.

If needed, use a waterless hand cleaner (Art Gel, Art Wipes, Artguard), followed by soap and water and a soothing cream.



## Orange Oil Solvents:

CitraSolv | De-Solv-it | Citrus King. There is a growing number of citrus-based solvents on the market. Some, like De-Solv-it can be bought in hardware stores. The key ingredient, D-Limonene, also known as orange oil, the safer and innovative solvent extracted from orange peel, can be purchased directly from the citrus industry. For example, see [www.citrusdepot.net](http://www.citrusdepot.net). This solvent is more powerful than mineral spirits, strong enough to dissolve hardened acrylics, oil paint, printing ink, (and even some plastics) with ease, yet medical studies have found fewer carcinogenic or neurotoxin hazards comparable to the petrochemical solvents. Users should, still handle the solvent with care: ensure good ventilation, use respiratory protection, and take fire precautions when using pure orange oil solvents. Unlike oil-based products, orange oil is considered biodegradable. CAUTION: some cheaper products are known to contain toxic petro-chemical additions.

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## Safer Stripping and Thinning with Orange Zest Solvents

Acrylics can be stripped off in a strong soda ash solution (1 part crystals to 3 parts warm water), or use one of the citrus-based safe solvents now on the market (such as 'DSolve' by ZAcryl, now discontinued) which may remove acrylics. Safer Solvents.

"This truly revolutionary solvent was formulated as an alternative to petroleum-based turpentines and thinners. It is made from 100% renewable agricultural resources of soy, corn, and citrus, and is non-polluting, non-carcinogenic, and biodegradable. (DS) will even strip dried paint from brushes, palettes and painting implements." Dick Blick, Marketing Materials

a similar product, made for artist use:

'NaturalEarthPaint' (<https://www.naturalearthpaint.com>). This website also contains a useful and informative 'how-to' page on making your own traditional painting mediums, using simple ingredients and recipes (Gouache, Egg Tempera, etc.)

*"Does not irritate the skin / Does not emit harmful vapors. / Soy-based"* (company quote).

## PAINTING PROCEDURES

In the pages that follow, we separate aqueous mediums, which may be thinned and cleaned with water, from nonaqueous mediums, which require organic solvents for mixture and cleanup. We identify as many ingredients as possible, their potential adverse health effects, appropriate precautions, and, when relevant or possible, safer material and procedural alternatives.

### PREPARING THE PAINTING SURFACE

Some painting processes require that the ground—whether canvas, paper, or panel—be sized, sealed, or primed to achieve a desirable painting surface. Most handmade or commercial papers for watercolor painting are presized as part of the manufacturing process, but many artists choose to modify them with coatings of Chinese white or acrylic or acrylic gesso.

Gesso originally referred to a concoction specifically designed to isolate wood panels so their resins would not bleed into egg tempera. Later, gesso also meant a procedure designed to size and isolate canvas from oil paints. Gesso began with two or more coats of rabbit-skin glue (dissolved in water in a double boiler) to seal the wood or size the canvas.

This was followed by one or more coats of whiting (calcium carbonate) and zinc or titanium white bound with rabbit-skin glue. With the advent of oil painting on

canvas, the procedure was often completed with one or two coats of white lead paint to provide a luminous undercoat. Each step involved hours of drying time, such that several days may be required to properly prepare wood panels or canvas by this method.

With the development of acrylic paints in the late 1940s, acrylic gessos were formulated to mimic the sizing and undercoating properties of traditional gesso.

Essentially nontoxic (some individuals may have allergic reactions to preservatives), premixed acrylic gesso consists of acrylic polymer mediums, titanium white, whiting (marble dust or calcium carbonate), and small amounts of ammonia and preservatives. Acrylic gesso simultaneously sizes, isolates, and primes a canvas for use with either water-based or oil-based paints. Equally effective with canvas, paper, wood, and synthetic panels, the ground support can be prepared for painting in half a day.

While easier, more convenient, more versatile, faster, and safer than traditional gesso, there is at least one hazard associated with acrylic gesso. To avoid accumulation of ammonia and preservative vapors, which irritate the eyes and mucous membranes, apply acrylic gesso in a well-ventilated space. Cross-ventilation with open windows and doors is usually sufficient.



*Richard Hamwi: Chime, 1983, watercolor and ink on paper collage using acrylic medium as adhesive, 36in x 36in. My choice of watercolor has to do with a preference for a paint which requires a nontoxic solvent and the qualities of transparency. I also use acrylic medium as an adhesive because it is nontoxic and has long-lasting conservation properties.*

## AQUEOUS MEDIUMS

Water-soluble paints offer the safest painting options. These paints, however, may develop mold or increase acidity, so preservatives must be added. Formaldehyde or formaline, mercury (phenylmercuric acetate), ammonia, bleach (sodium hypochlorite), and/or phenol (carbolic acid) can be found in paint formulations. Mercury was regulated in the manufacture of paints in 1990 but still may be present

in paints you may have on hand. Water-soluble paints containing mercury should be discarded. In most products, the amount of formaldehyde is very small; adverse health effects are not expected. However, if you use water-soluble mediums regularly (including drawing media and printing inks) and have breathing difficulty or skin rash typical of allergic reaction, seek medical evaluation. Watercolor paints contain finely ground pigments bound with gum Arabic or gum tragacanth.

When thinned with water, these paints deposit a light, translucent film of color onto paper (color plates). By definition, they are not waterproof; they may be altered by moisture. A wide range of quality and colors is available, in both tube and dried form. Tube colors may also contain nontoxic glucose and glycerin. The opacity of gouache colors is due to high concentrations of pigment and chalk, whiting compound, or talc opacifiers suspended in gum binder. Professional-quality gouache can be brilliant in its coloring power. Like tempera, casein, and acrylic colors, gouache may be used as underpainting to reduce time spent with nonaqueous solvent-based oil paints.

Binding power may be enhanced in watercolors or gouache by increasing the proportions of sugar syrup, gum arabic, or gum tragacanth. Always add gum powders in a glove box or while wearing a particle mask. Except for rare allergic responses to preservatives, watercolor and gouache are not associated with adverse health effects.

Tempera is a term with many meanings. It may refer to pigments sold in powdered form or suspended in a variety of binders and vehicles. The classic form of tempera is egg tempera, which uses egg yolk as the binding agent and water as the vehicle. Since egg serves as an emulsifier that allows mixing of oil and water, egg tempera can be combined with linseed oil, resin, wax, or gums. Each combination has unique qualities for the artist. Another common tempera mixture, known as distemper, contains dry pigments bound with rabbit-skin glue. Due to their brilliant flat color, distemper mixtures are frequently used to paint stage scenery. Tempera may also refer to cheaper forms of gouache sold in tubes.

Poster paints consist of dry paints and reducers (inert fillers such as whiting) in a medium of gum, water, and preservatives. Casein paints contain pigments mixed with a powerful binder derived from dried skim milk curd. While they may be

thinned with water, they become insoluble in time with exposure to air. Few pigments mix effectively with casein binder, but as it mixes well with gouache and tempera, bringing its binding power to them, a wide range of colors and effects is possible. Casein tempera is an emulsion of casein solution and oil. All of these paints tend to be brittle and should be used on a firm support to avoid future cracking and flaking. Since all the temperas contain water, they may be thinned and cleaned with water, preferably distilled or boiled to prevent contamination. Adverse health effects are not expected with the use of tempera as paint or as a method of painting.

Finger paints and other water-soluble for use by children are considered safe if they have the AP or CP seal of the Art and Craft Materials Institute (ACMI) and / or listing in the latest edition of Art & Craft Materials Acceptable for Kindergarten and Grades 1-6.

Acrylic polymer paints are water-soluble paints bound with synthetic acrylic resins. Acrylic polymer paints must be distinguished from organic solvent-based acrylics such as alkyd or magna paints. Acrylics use many of the same pigments as oil paints and, depending upon application, may be indistinguishable from oil paintings in texture, sheen, and overall appearance (pictures!). Acrylics dry quickly to form a permanent film that is impervious to water. Although hot water will soften them, acrylics are remarkably stable; extremely high temperatures (over 500 degrees F) are required for decomposition. Moreover, they are less likely than oil paints to be altered by changes of temperature or humidity. Acrylics are exceptionally flexible in use and application.



Dorothy Powers: 3BPE, gouache, inks, charcoal, colored pencils on paper, 50in x 38in. In 1988 I developed health problems and was advised by my doctor to avoid art materials and work elsewhere. I now spend weekends experimenting with nontoxic materials: watercolor, charcoal, and inks.

- They may be used on unprimed as well as primed paper, canvas and other fabrics,  
wood and Masonite panels, acetate, Plexiglas, or any oil-free surface.
- Pigments are easily mixed with a vehicle to provide great richness of color.

- They resemble watercolors when thinned with water, without loss of permanence.
- A flat, opaque, even color can be achieved.
- They may be applied with palette and painting knives for thick impasto.
- Addition of retarding medium slows drying time and enhances color blending on the canvas.
- Supplemental mediums, known as gels and modeling pastes, readily take on and extend colors to significantly increase the variety of consistencies and textures.
- The gluelike binding qualities of acrylic mediums allow incorporation of fabrics, papers, fibres, metallic particles, sand and other materials.
- Depending on the vehicle or medium, acrylics can have a matte, semiglossy, or glossy finish.
- When dry, acrylics are essentially inert and are not significantly altered by changes in temperature and humidity.



*image: Acrylic Paint Review, by Cindy Davis.*

Acrylic polymer paints are safer than oil paints, primarily due to the absence of toxic solvents. No reproducible adverse health effects have been associated with the use of acrylic polymer mediums. Like all water soluble paints, however, acrylics contain preservatives (usually formaldehyde in small amounts). Thus some individuals may experience occasional allergic reactions. These individuals may benefit from use of

exhaust ventilation or a formaldehyde mask offered by 3M. As of this writing, however, there is no NIOSH approved formaldehyde respirator.

A faint odor of ammonia can be detected in some acrylics, leading to eye and mucous membrane irritation when used extensively. General dilution or window exhaust ventilation should eliminate this problem. Miscellaneous components of acrylic paints may include:

- Surfactants (chemical agents that prevent pigment separation or polymer coalescence)
- Extenders and fillers: diatomaceous earth (Celite), silica, mica, or whiting (nontoxic)
- Antifoaming agents
- Antifreeze agents (usually small amounts that present no health hazard)

**SAFETY NOTE: some acrylics now carry a note warning of a possible cancer hazard; this may be related to a formaldehyde content or other carcinogens, (2012)**

Most manufacturers will not disclose the precise contents of their acrylic mediums. Thus, the artist must rely upon the ACMI seals of approval to determine safety. To keep acrylic workable, keep them moist by misting with water or by using a moisture retaining palette. Use distilled or boiled water to avoid contamination. Covering paints with a lid or plastic wrap can retain moisture for days. Some artists use acrylic retarders to slow drying and assist blending.

Brushes used with acrylic paints most commonly nylon bristles, unlike natural bristles of oil paintbrushes, are not significantly altered by water. Acrylic paintbrushes, however, must be kept moist to prevent paint from drying to a tough,

gummy film that is difficult to remove. We discourage use of brush cleaners and baths that contain toluene or xylene. As an alternative, soak brushes overnight in an acrylic medium to soften the paint. Afterwards, the brushes can be cleaned with strong laundry soap (Lava), warm water, and a good scrubbing. (and innovative safe solvents such as Z-Acryl 'D-Solve' can be used to clean hardened brushes with ease). Nylon brushes with wayward bristles may be reshaped as follows: suspend the bristles for one minute in boiling water; comb the bristles straight; press flat brushes with a weight or wrap round brushes with a rubber band; and allow brushes to dry.

The tough film provided by acrylics rarely needs varnish. If acrylic varnish is desired, apply with adequate general ventilation. Some acrylic varnishes are solvent based, and require more stringent precautions. Acrylic paints are not biodegradable; they may leave a residue in plumbing. To discard acrylics safely, let them dry in disposable containers. Recycle or discard as appropriate for solid waste. Commercial latex house paints have been used by some artists who are attracted by their relative low cost. We vigorously discourage this practice.

Quality-control standards for house paints have not been as rigorous as those for artist products, and prior to its regulation in 1990, mercury was routinely used as a preservative in latex paints. Also, the inclusion of various inexpensive fillers and extenders precludes precise determination of chemical composition of many of these products. Fresco is a highly specialized process. Water-soluble colors are applied to walls covered with wet lime plaster. The colors blend with the plaster and dry to a durable film of crystalline carbonate of lime, which contains varying amounts of corrosive calcium hydroxide. Fresco artists should wear protective gloves and goggles to avoid eye and skin irritation. In the twentieth century, fresco has largely been replaced by murals made from ceramic tiles or extremely tough epoxy resin paints (see next section).

## NONAQUEOUS MEDIUMS

# Oil Painting

For over 500 years oil painting has remained a highly esteemed painting process. Brilliant colors are achieved by grinding pure pigments into linseed oil and thinning with turpentine. Oils may be applied to a flexible ground of primed canvas on stretchers, wood or Masonite panels. Over the years the process of oil painting has been enhanced with drying oils, complex emulsions, laquers, varnishes, and a variety of thinners.

There are no adverse health effects associated with linseed oil itself. Potential hazards may arise, however, with the inclusion of pigments, turpentine, or solvents. Many volatile solvent-based products can be inhaled or absorbed through the skin. Thus, oil painting requires effective ventilation and appropriate skin and respiratory protection. (The newly developed water-miscible oil paints, however, do not present any inhalation hazard while offering a similar creative scope).

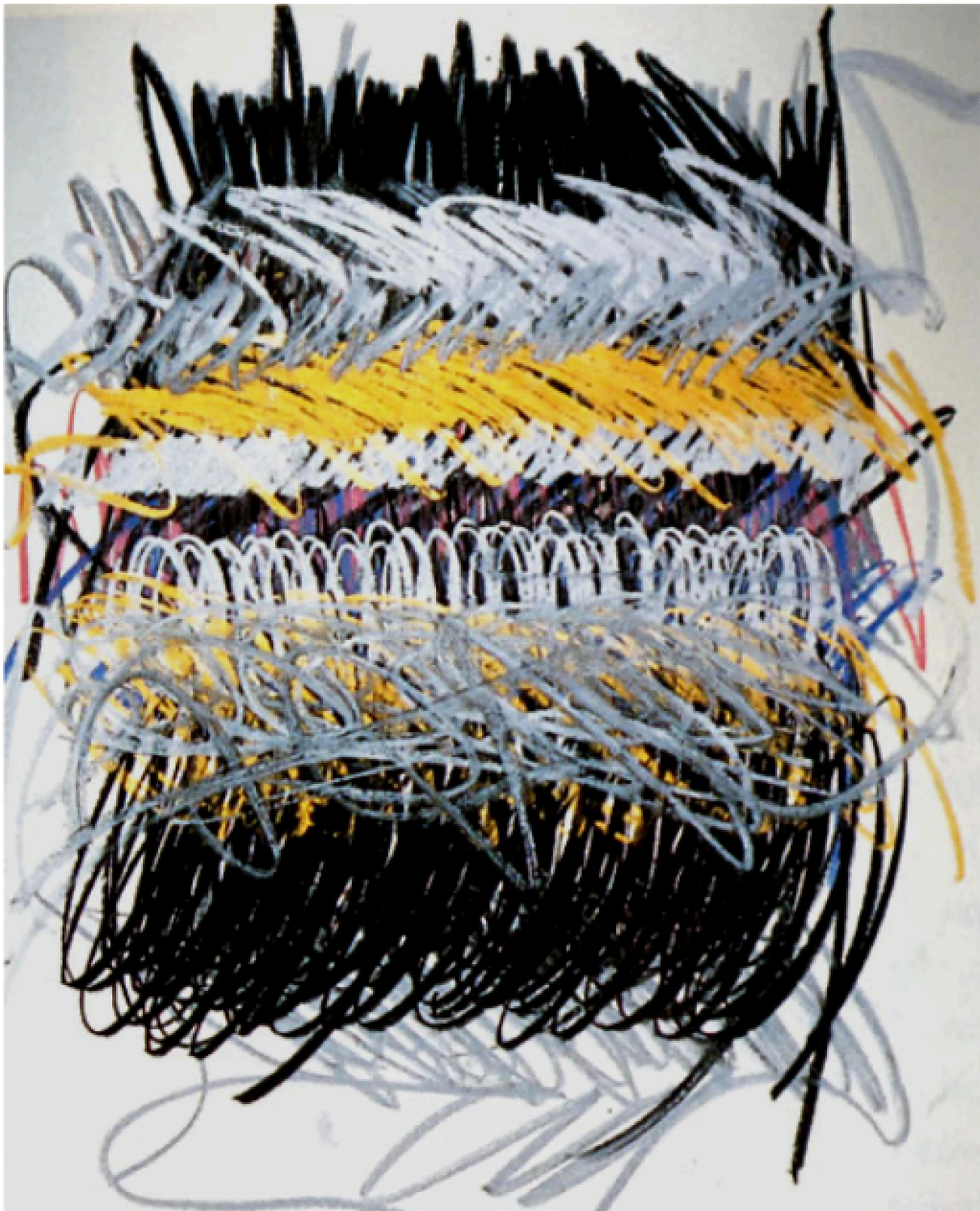
A variety of oil painting mediums improve the consistency of oil paints. Stand oil, which is linseed oil in a specially heated form, and resins are most commonly used. Resin dusts may provoke allergies in some individuals. Read labels and material

safety data sheets, and check for hazards and precautions.

Driers are commonly found in printing inks, oil paints, and painting mediums. Check labels and MSDSs. Cobalt linoleate is the preferred dryer. Products containing cobalt naphthenate, lead or manganese should be avoided.

Turpentine is the solvent most commonly used by oil painters. Turpentine vapors irritate the eyes and respiratory tract. Massive inhalation of turpentine may lead to headache, dizziness, nausea, confusion, and rapid pulse. Massive ingestions of turpentine have been associated with kidney damage, confusion, and even death. We strongly recommend that all artists replace turpentine with safer substitutes. (see 'The Safety of Solvents' for details).

Remember that rags and papers (those indispensable companions when painting) may become saturated with linseed oil and solvents. They are flammable and may ignite by spontaneous combustion. Store them only in safety containers especially designed for the purpose. Dispose of them frequently in a closed metal container.



*Joy Walker: Wig Walk: 1989, oil stick on steel sheet, 33in x 20in. In my early work with acrylics, I used airbrush and spray guns without ventilation. I started coughing. My doctors were not sure what caused the problem but I felt I had to change my way of working. I switched to oil stick on cutout galvanized iron sheets and now enjoy good health.*

For protection, finished oil paintings may be coated with a transparent film or varnish or lacquer. Most varnishes contain natural or synthetic resins suspended in multisolvent mixtures. They should be used only with appropriate exhaust ventilation, respirator, and protective attire. Spray varnish and lacquer products contain a high percentage of organic solvents and propellants relative to resin content, and spraying increases the possibility of inhalation of these solvents.

Small works may be varnished in a spray booth or outdoors. If your paintings are large, find an industrial spray paint room where you can spray varnish safely. The preferred method of brushing on varnish should be done in a well-ventilated indoor environment. In the absence of effective ventilation, wear a NIOSH-approved organic vapor cartridge mask.

During cleanup of solvent based paints, wear protective gloves and / or barrier creams on hands and wrists. Wash inadvertent paint splashes from the skin as soon as possible. First, soften with vegetable oil, then scrub with soap and water and follow with a protective skin cream. To clean oil paintbrushes, soak them overnight in baby oil or vegetable oil to loosen accumulated paint. Wipe them as clean as possible. Wash with as strong laundry soap in water.

Wear protective gloves, and use kitchen scrubbers to remove softened but stubborn paint. Let natural-bristle brushes dry thoroughly before reuse to prevent trapping of water. If you need to soak brushes in an organic solvent, place brushes in a capped container under a fume hood, or wrap aluminum foil around the brush handles and over the container to reduce to reduce solvent vapors in the workspace, and observe safe studio practices. If your preference is to work with oil paints and washes, exposure to solvent hazards may be reduced by using acrylic gesso (rather than an oil prime) and developing the imagery with water-soluble mediums such as casein, gouache, temper, and acrylics.

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## Other Solvent-Based Paints / Alkyd Paints

Alkyd paints are oil paints modified with synthetic resins and solvents to accelerate

drying. They offer no safety advantage; precautions for oil paints and their solvents should be observed at all times.

## Waterbased Oil Paints

reduce solvent use because they can be thinned and cleaned up with water. Some of these products, however, still contain solvents such as alcohol or turpentine. Most of the newly developed water-miscible oil paints however, do not present any solvent inhalation hazard. In any case, check the label or Material Safety Data sheet before purchase and use. More information on these innovative oil paints is given below.

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## Encaustic

is a suspension of dry pigments in molten, white refined wax. Encaustic may also contain drying oils, Venice turpentine, and natural resins. It is a potentially hazardous medium. Wear a particulate filter mask to prevent inhalation of powdered pigments. There is no mask cartridge that will protect against hot wax vapors (Rossol 1982) that arise from warming the palette to keep the wax workable. Heat accelerates evaporation and release of potentially harmful vapors and pigment fumes from the various ingredients. Thus, effective local exhaust ventilation is essential with encaustics.

Avoid overheating since hot wax may catch fire. Melt wax safely in an electric slow cooker (available in kitchenware stores) that maintains a dependable temperature below boiling. Alternatively, a double boiler on a hot plate may be used with caution. Never place a melted wax pot directly on the hot plate, and never use a flame heating element (torch) to heat wax applied to a surface. A heat-generating flood lamp in a ceramic receptacle with a bracket handle is safer. For cleanup, use Turpenoid with appropriate precautions. Avoid the more toxic solvents such as carbon tetrachloride. (The newly developed orange oil cleaners such as 'Citrus King' would seem like the safest cleaning option).

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Magna Paint from the 1960s. Early acrylics were solvent based and toxic.

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Solvent-based acrylic paints, also known as Magna colors, are permanent pigments ground in an acrylic resin with solvents and a plasticizer. These paints contain more solvents than many oil paints. (Note: currently Magna-type artist acrylics are no longer available. Magna represented the world's first artist acrylic paint, developed by Leonard Bocour and Sam Golden in 1947, and reformulated in 1960. Magna was miscible with turpentine or mineral spirits and dried rapidly to a matte or glossy

finish. It was used by notable artists Morris Louis and Roy Lichtenstein. Although toxic in their original formulation the Magna paints paved the way for today's water-based artist acrylics with their particularly safe handling characteristics.)

Epoxy Paints are pigments suspended in an epoxy resin to which an amine hardener is added immediately before use. These extremely tough paints are most often used for murals, especially on exterior walls. Some alkaline amines may irritate skin. Epoxy vapors may irritate the upper respiratory system, while epoxy mists irritate eyes and may damage the cornea. The hardener may contain toluene or another hydrocarbon solvent. Thus, work with epoxy paints requires effective ventilation. Both indoors and outside, a respirator with an organic vapor cartridge will enhance protection. In addition, we suggest heavyweight nitrile gloves and protective clothing to keep paint off skin. Have replacement gloves available since epoxy paint ingredients may occasionally penetrate some gloves.

Enamels, stains, and lacquers commercially produced for house paints and surface coatings have been employed by some artists. Many contain complex combinations of solvents, dryers, and extenders. Lingering emissions from commercial paints may contribute to respiratory irritation in poorly ventilated work areas. If and when you do use these products, do so only with effective ventilation, while wearing protective attire to prevent inhalation, skin contact and ingestion. Trade paints also have questionable archival quality, and works by artists who have employed them as recently as the 1950s (e.g. Jackson Pollock) have presented significant conservatorial challenge.

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## Safe Paints, Stains and Varnishes / Decorating

The magic of painting will continue to seduce some individuals to devote their lives to it, regardless of risk or price. The cost of succumbing to the charms of painting, however, does not have to include poor health. This essay has suggested how the artist might lower the price paid in terms of adverse health effects. Improved understanding of the painting environment can significantly decrease its contribution to health problems. Therefore, young people, students, and colleagues must learn how to use paint products and procedures in the safest way possible.

## Oil Painting Innovation: Water-Miscible Oil Paints

Many manufacturers of artist paints now offer a range of water-miscible oil paints. These innovative products use modified variants of linseed oil through clever chemistry and promise all the benefits of oil paint without the toxic hazards of solvent use: all the thinning and clean up is done using water. For example the brands Royal Talens and Holbein developed new lines of water soluble oil paint that include the entire range of hues typically used in oil painting.



### Cobra Water Mixable Oil Paint

'With Cobra paint, the oil painter is free from harsh solvents and the travel and health constraints that come with them. Cobra is a highly pigmented, highly permanent artists' oil paint that is easily cleaned up with water. All of the glazing and textural techniques that are possible with traditional oil paints can be achieved with Cobra all you're missing is the turpentine or mineral spirits! Cobra has a complete range of 70 colors from which to choose.' <http://www.wetpaintart.com>  
'Holbein Duo: Developed by Holbein to offer the same high pigment quality and archival characteristics of Holbein's Artists' Oil line while allowing soap-and-water cleanup, Duo Aqua Oils are characterized by rich hues, high chroma, and excellent resistance to light.'



*Merle Spandorfer, recent work: Hibiscus, mixed media on Paper, 16 1/2 x 11in*  
[merlespandorfer.com](http://merlespandorfer.com)

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**Safer artists' paint: how safe  
is it?**

Not all MSDS sheets are the same

For more complete information on the safety of artist paints.

we would advise consulting both the information printed on actual products (especially in small print) as well as material safety data sheets.

NOTE: In some states and countries some potentially harmful ingredients do not require listing on MSDS sheets, especially in low concentrations.

If in doubt: do some web searching, ask an expert,

...or consider checking the Californian hazard information on the product.

BLICK have extensive online MSDS info on artist paints... use it!

The unhealthy side of Safe Artists' Paint

Even presumably safe, safer, less-toxic, nontoxic, or eco-friendly products often include some hidden harmful or toxic ingredients.

Medical studies show that even such low concentrations can cause ill health. Watch out for a glycol ether content. Its true toxicity has only recently emerged in medical studies (may cause miscarriages / infertility).

Some manufacturers are straight with their customers about what's in a paint tube, but customers often aren't told what they are really buying, and how it should be used safely. Some makers of artist's products are smaller scale businesses who can't invest in extensive research, and are known to have followed misleading recommendations from the paint and solvent industry on safety issues, ...even if they got it wrong.

## Mislabeling

A common problem with many art products is mislabeling. Even some very reputable firms have been known to be at fault about giving misleading or insufficient product information.

With traditional, harmful paint products cross-bones and hazard warnings give ample warning that imply 'beware' ...you are dealing with volatile chemicals not

foodstuff.

With the new and increasingly widely sought after safe and nontoxic products – and on artists' paints in general – such warnings are frequently missing.

Few people spend more time around their paints and solvents than artists, so health hazards are exacerbated.

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## Painting like Van Gogh – Artist Paint isn't Food

The issues are complex and scientific, and hardly any paint product is food grade. Vincent Van Gogh is known to have eaten samples of his paints, and Jackson Pollock worked in a studio filled with toxic VOC fumes; both suffered neurological disorders.

The new VOC labeling is a very significant step towards safer and less unhealthy artists' paints and solvents, but not an ultimate resolution to the uncertainty that still surrounds the subject of safety in painting.

Safe Paints used safely: always use Good Ventilation!  
Anyone with in-depth knowledge of the subject would agree that the best strategy for health-aware paint practice is in a combination of:

- choose the least toxic artist materials and products
- wear gloves
- do not handle artist paints around kids
- study all ingredients and their potential side-effects
- maintain good ventilation
- do not inhale paint fumes
- avoid using traditional mineral spirits and thinners;
- Solvent Toxicity
- eco-and health-friendly solvent alternatives are now widely available

- Safe Solvents
- open windows and use fans to create a through draft when using paints in your home
- use local and general fume extraction in a professional setting
- wear organic respirators when needed
- acrylics may require a dry working environment or even heat-setting to help create a permanent surface without VOC off-gassing

(for instance BLICK have extensive online MSDS info on artist paints)

Some new models of respirator now protect against VOC exposure and are more comfortable to wear than the heavy-duty 'gas-mask' type.

Note: Most types of plain paper dust masks do not protect against paint fumes and VOCs.

## Protection against low level VOC exposure

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Today there are many paint products that are marketed as safe, yet there may still be harmful low-level VOC emissions, such as glycol ether.

Examples: many water-based paints, acrylic floor finish, some artist acrylics, low odor, low VOC solvents, and printmaking resists.

Although a full organic respirator may be impractical for a day's work we would recommend wearing a disposable light weight mask that offers some organic vapor protection. Dispose of the mask after a day's work (about \$ 5 per mask).

Product example: 3M Particulate Respirator 8514, N95, with Nuisance Level

## Organic Vapor Relief

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