

MATERIALS INFORMATION and TECHNICAL RESOURCE for ARTISTS - Grounds and Primers

A ground layer, or primer, typically follows the size layer in an easel painting. A thinly applied ground layer can also be used to coat certain paper supports. Grounds serve multiple purposes:

- They can counteract the uneven absorbency of a panel/fabric/paper support.
- They can be toned/pigmented to provide certain desired aesthetic affects.
- They can help to make paint application easier and consistent.
- They provide “tooth” which ensures the proper adhesion of subsequent paint layers.
- They can help to isolate or buffer the effects of humidity on supports.
- The visually distortions caused by paint becoming more transparent over time are less obvious on white grounds than on paintings executed on darker grounds.

NOTE: The term “Gesso” traditionally refers to an animal-glue bound ground containing calcium sulfate or gypsum. In fact, gesso literally means gypsum. While many commercially available products use this term as a generic descriptor, “gesso” will not be used as such in this document. Grounds/primers will instead be classified according to their actual chemical composition (i.e. glue, acrylic dispersion, oil, etc.).

THE EVOLUTION OF GROUNDS IN ART

Ground layers can be applied with a brush or a spatula (each layer can also be pumiced or finely sanded in-between applications to create a final surface that is smooth). Each ground layer should be applied evenly and thinly, avoiding pinholes or other application defects unless the artist desires otherwise. Traditional glue-grounds should not be applied to flexible supports as they are more susceptible to cracking and other problems in response to changes in the environment. Such grounds tend to be rather brittle and should therefore only be applied to rigid supports. Oil, acrylic dispersion, and alkyd grounds, however, can be applied either to fabric or rigid supports. For paper supports, acrylic dispersion grounds are generally recommended as long as the substrate is resilient and able to withstand exposure to water (oil/alkyd grounds are considered too heavy for most paper substrates and can cause the support to discolor and even rot over time).

Early panel paintings were prepared with glue-based grounds. Glue and chalk grounds tended to be more popular in Northern Europe while traditional gesso grounds were used in the South. Starting around the end of the 15th century, canvas became increasingly more popular. The earliest oil on canvas paintings in

Italy tended to have a thin gesso layer covered by an oil containing later to cut absorbency. Oil grounds grew in popularity in the 1500s. Throughout the 16th century, color grounds became more common as did the use of an *imprimatura* (a pigmented layer applied atop the ground). By the 17th century certain artists began to embrace double oil colored-ground systems, often a lower, darker layer covered by a lighter, upper layer. There are also examples of the use of starch, calcined bone, and other ground systems in the 17th and 18th centuries. The nineteenth century witnessed the birth of pre-primed canvases and a wider range of grounds began to be used by manufacturers other artists continued to prime their own supports. White and pale colored emulsion grounds, absorbent grounds, etc. became available and consisted of many different types of materials including glues, egg, oils, clay, starch, and other ingredients depending on the desired effect. By the 1950s, titanium and zinc white had mostly replaced the use lead white in most commercially available pre-primed supports. Today, acrylic dispersion pre-primed grounds are the most common among contemporary painters. Some of the current, commercially available pre-primed grounds are heat-set.

COMMERCIALY AVAILABLE PRE-PRIMED GROUNDS

As with all art materials, there are advantages and disadvantages to purchasing pre-primed, commercially available substrates. Artists are able to save considerable time in purchasing pre-primed supports, avoiding the hassle of preparing the surface (i.e. stretching the canvas, sanding the panel), sizing the support, preparing the ground (if necessary), and applying the ground, as well as the lengthy dry time required for oil grounds. Disadvantages to using pre-primed supports center around the fact that it can be impossible to find out which pigments, fillers, binders, and other additives may be present in the ground layer unless this information is disclosed by the manufacturer. Artists should note that as more and more brands of commercially, pre-primed supports become available, the quality and longevity of one product versus another can vary greatly. Some artists have experienced unpredictable and problematic outcomes with commercially available supports, highlighting the importance of establishing a dialogue with those manufacturers who are willing to discuss the nature of their products.

The conservation community has recently identified potential problems with certain components in grounds, in particular those containing high amounts of aluminum soaps (often used as dispersants/surfactants) and zinc white present in alkyd and oil pre-primed canvases. Excess aluminum soaps can weaken paint films and migrate into other layers and zinc white has been found to react with components in oils and alkyds and form “metal soaps,” which in turn can give rise to delamination, wrinkling, the formation of white-colored aggregates, and the softening of ground/paint layers. Research is presently being carried out to determine the extent of damage that can occur when these materials are present.

CLASSIFICATIONS OF DIFFERENT GROUNDS/PRIMING MATERIALS

Traditional Glue Grounds

Traditional glue grounds are prepared by mixing an animal glue (produced from a wide range of animal tissues such as hides, bones, etc.) with an inert filler (i.e. chalk/calcium carbonate, gesso/calcium sulfate, etc.). Additions of other pigments can also be present. These water soluble grounds tend to make a hard but absorbent foundation for painting. Traditional gesso grounds are usually applied in multiple layers, sometimes as many as 12-20 for some purposes. During the Medieval and Renaissance periods, the initial gesso layer typically contained coarse gypsum particles (*gesso grosso*), often a simple mixture of plaster and animal glue, while the final layers consisted of finer gypsum particles (*gesso sottile*). The hard, brittle nature of glue grounds makes them more appropriate for rigid rather than flexible supports. Unless the support is properly sized (refer to the “Adhesives and Sizes” document), water containing grounds can leach organic material out of certain types of supports. This phenomenon referred to as *support induced discoloration* (SID). An appropriate size layer will help avoid potential SID in a water thinned grounds.

Artists should consider the following if glue bound grounds are to be used:

- Glues respond readily to changes in temperature and relative humidity. Animal glues will shrink as the humidity drops and swell and soften when the humidity rises. These changes can lead to delamination and/or flaking of the overlying ground and paint layers and to planar deformations in the support.
- Glue-based grounds should be used with rigid supports (or to a canvas adhered to a rigid support). The rigidity of the substrate helps to mitigate cracking in the ground layer.
- Glue-based grounds should only be used with glue-based sizes. With addition of the proper size or secondary priming layer, most paints can be used on substrates with a glue-based grounds. Acrylic dispersion paints, however, are probably best applied over acrylic dispersion grounds.
- To counteract the absorbency of glue-grounds artists might consider applying a sealant layer, additional size, or additional oil priming layer. Care must be taken to make sure that this layer is not too slick or thick otherwise it could cause adhesion problems and result in delamination of subsequent paint layers. Artists might also consider applying an *imprimatura*, a pigmented layer bound in oil, glue, etc. that cuts the absorbency but which can also impart a colored tone.
- As with most water-based grounds, several coats are required to build up a suitable ground and sanding may be required throughout the application process. Remember that inhalation of any type of fine, particulate material is

potentially hazardous and, therefore, a dust mask should be worn during and sanding. Glue-based grounds can also be scraped down using a tradition style metal scraper (a cabinet scraper is a common, contemporary tool for this purpose).

Oil- and Alkyd-Based Grounds

Oil- and alkyd-bound grounds generally consist of white pigments (e.g. lead white, titanium white, zinc white, etc.) with various additions of inert fillers (e.g. chalk, calcium sulfate, barium sulfate, silica, etc.). There is little data concerning the qualitative differences in the aging properties of oil vs. alkyd grounds in terms of preservation (see the “Mediums” document for more information on oil vs. alkyd mediums) although some alkyd grounds appear to retain a certain degree of flexibility while oil grounds tend to become slightly more brittle over time. The choice of pigmentation and fillers has a major influence on this, making comparisons difficult. The presence of metal driers present in the alkyd medium can allow an alkyd grounds to dry faster than oil grounds, particularly oil grounds that do not contain lead white (zinc and titanium white are slower driers in oil). Both types of grounds can be applied onto sized canvas supports and to most rigid supports, using a wide brush or spatula. Pre-primed grounds are also available; however, artists should take note when purchasing oil/alkyd grounds that contain zinc white and/or significant amounts of aluminum stearates as both materials have been found to cause potential cracking, delamination, wrinkling, and the formation of unsightly agglomerates known as “metal soaps.” In general, oil/alkyd grounds are far less absorbent than traditional glue grounds (and therefore are less likely to lead to problems with “sinking in”). They can be more or less absorbent than acrylic dispersion grounds. A more definitive comparison cannot be made as acrylic dispersion grounds, vary greatly in their composition and performance.

If oil- or alkyd-based grounds are to be used, artists should consider the following:

- Both types of grounds can become brittle over time and are therefore susceptible to cracking. This can be potentially avoided if a rigid support is used or if canvas is applied over a rigid support.
- These grounds are not compatible with most water-based mediums such as watercolors, gouache, or acrylic dispersion paints.
- When applying either type of ground to a canvas support it is essential that the canvas support is adequately sized (see “Adhesives and Sizes” for more information on sizing) to prevent the oil/alkyd from coming into direct contact with the fabric. Over time the acidic nature of the oil/alkyd medium can accelerate the deterioration of the canvas. Glue sizes, PVA sizes (pH neutral), and certain acrylic dispersion sizes can be used.
- In general, two or more thin coats of an oil and/or alkyd ground are applied to the support. Too many coats can lead to an overly thick and brittle ground and too few coats can lead to an overly absorbent ground.

- Oil/alkyd grounds need to be thoroughly dry before painting can begin. To assess whether your ground is sufficiently dry, the “fingernail test” can be used: If you can press your fingernail onto the oil ground without making a dent in it, it’s ready to paint on. It is preferable to allow an oil ground to dry as long as possible before beginning to paint.
- When purchasing pre-primed supports, artists should check with the manufacturer to see if zinc white and/or aluminum stearates are part of the formulation as these materials (when present in significant amounts) can cause issues later on. If artists choose to use oil/alkyd grounds containing these materials, simply record what materials are present in the ground on the back of your artwork.
- It can be more difficult to wipe away thin applications of paint during the initial painting stages when working on absorbent grounds and those that have a lot of tooth due to the addition of coarser particles (some acrylic dispersion grounds will exhibit this characteristic).
- If your ground is too absorbent this could lead to problems associated with “sinking in” (see “Varnishes” document for more information on sinking in). Artists can modify/adjust their ground formulation, using less solvent/water, or applying a very thin layer of oil and/or alkyd medium on top of the ground to cut the absorbency. This layer should not be slick or overly thick in order to avoid potential adhesion issues and possible delamination of subsequent paint layers. Painting can begin once this layer has sufficiently dried although some artists prefer to paint into this layer while it is still wet.
- Oil/alkyd grounds are not recommended for use on paper supports (or most absorbent supports unless they are specifically formulated to do so) as these mediums can cause irreversible staining. Acrylic dispersion grounds are better suited for this purposes.
- It is possible to gently sand the surface of oil/alkyd grounds. Remember that inhalation of any type of fine, particulate material (particularly if hazardous pigments are present) is not recommended and that a dust mask should be worn during sanding. It is best to avoid sanding or scraping of grounds containing lead or other toxic pigments. Once you are finished sanding the ground, wipe down the ground using a cloth dampened with odorless mineral spirits to absorb any remaining loose pigments/particles (be sure to properly and properly dispose of the cloth).

Acrylic Dispersion Grounds

A wide range of acrylic dispersion grounds are now available to artists. Acrylic grounds generally consist of a) acrylic resin dispersed in water b) white pigment(s) (i.e. titanium white, zinc white) c) various additives to aid in extending shelf-life, avoid separation, etc. (e.g. surfactants, anti-freezing agents, anti-fungal agents, anti-foaming agents, etc.) and/or c) various types of inert fillers (e.g. chalk/calcium carbonate, silica, pumice, etc.). The amount and type of fillers added

is what dictates whether an acrylic ground has more “tooth,” is more absorbent, or is fairly smooth. Although many acrylic dispersion grounds are often labeled “gesso,” they are completely different from traditional gesso grounds that are glue-based. In general, acrylic dispersion grounds tend to be slightly more absorbent than oil grounds (although this can depend on the amount and type of additives, fillers, and/or pigments present) and less absorbent than glue grounds. Acrylic grounds offer certain benefits over glue and oil/alkyd grounds as preparation, application, and clean-up procedures tend to be fairly simple not to mention the quick dry time (within 24 hours). However, acrylic dispersion grounds contain a large amount of water which can be problematic depending on the type of support being used. This is why more coats are generally required during application as compared to oil or alkyd grounds.

While acrylic dispersion grounds can be used as a primer for both oil and acrylic paints, acrylic grounds can leach organic material out of certain types of supports, a phenomenon referred to as *support induced discoloration* (SID). Properly sizing the support (refer to the “Adhesives and Sizes” document) before applying acrylic dispersion grounds will help avoid potential SID. While there is a wide range of pre-primed supports (both flexible and rigid) available to artists, not all of these acrylic grounds are created equal. Some of these commercially available products have been found to delaminate from their supports, possess uneven levels of absorbency, and behave inconsistently from one batch to another, possibly due to the presence of certain additives and perhaps inconsistent application techniques and manufacturing processes. Artists are encouraged to initiate a dialogue with the respective manufacturer regarding the contents of pre-primed acrylic supports as a first step in learning more about the nature and quality of a specific product.

If acrylic dispersion grounds are to be used, artists should consider the following:

- While acrylic dispersion grounds can be used on both flexible and rigid supports, it is considered best practice to adhere flexible supports to a rigid support to prevent potential cracking and planar deformations. Artists working in oils or alkyds on acrylic grounds should seriously consider this suggestion since acrylic dispersion grounds retain their flexibility while the superimposed oil containing paints will become more brittle as they age.
- As with most art materials, price can matter. Generic and economy grade acrylic “gessos” are often more prone to problems while higher quality acrylic dispersion grounds made by respectable art materials manufacturers appear to be free from the same issues.
- When applying acrylic grounds, it is essentially that the support is first properly sized (see “Adhesives and Sizes” for more information on sizing) to prevent support induced discoloration (SID). PVA sizes (pH neutral) and certain acrylic sizes can be used. Avoid using glue-based sizes.
- Due to the high water content in acrylic dispersion grounds, four coats are generally applied to the support to create a suitable ground layer. This may vary from manufacturer to manufacturer.

- Certain acrylic sizes/mediums (generally two coats) can serve as clear, transparent grounds for artists who wish to leave their support visible. However, the type of size/medium is used this process may dictate what type of paint can be applied to the surface.
- Some acrylic paints/grounds that are allowed to remain in the wet state for an extended period of time may yellow/discolor and/or separate. Often this has little impact on the final color of the film although artists are encouraged to paint out small amounts to ensure that this is the case. On the other hand, this may or may not indicate that the product has exceeded its designated shelf-life (artists are advised to check with the manufacturer and/or distributor if they suspect the product is not suitable for use).
- Even though acrylic grounds/paints appear to dry within 24 hours, moisture continues to evaporate from these materials over an approximate 30-day period. Artists should keep this in mind when planning ahead, particularly when it comes to varnishing and/or packaging in the artwork. Varnishing is recommended only once this 30-day period is complete to avoid potential issues with bloom (see the “Varnishing” document for more information).
- When purchasing pre-primed supports artists should attempt to check with the manufacturer to see what type of additives, pigments, etc. might be present. If this information cannot be determined, simply record the brand and date of purchase on the back of the artwork. As with most pre-primed supports, artists are encouraged to first test out their painting technique to assess whether or not the ground is satisfactory.
- If your ground is too absorbent this could lead to problems associated with “sinking in” (see “Varnishes” document for more information on sinking in). Artists should consider choosing a different type of acrylic dispersion ground/pre-primed support or try to use less solvent/water during the painting process. Another option is to apply a very thin layer of acrylic dispersion medium, oil and/or alkyd medium on top of the ground to cut the absorbency, depending on the intended paint system. This layer should not be overly slick or thick in order to avoid potential delamination of subsequent paint layers. Painting can begin once this layer has sufficiently dried although some artists prefer to paint into this layer while it is still wet. Note that it is NOT advised to continue painting in acrylic once a layer of oil or alkyd has been applied.
- If your acrylic ground contains zinc white or significant amounts of aluminum stearates it is best not to use them in conjunction with oil or alkyd paints. Studies have shown that when oil paints were applied over acrylic grounds containing these materials, delamination between the paint and ground layer could potentially occur. It is best to stick with acrylic paints if your acrylic ground does contain these materials (or even if you are unsure as is the case with many pre-primed supports).
- Acrylic grounds can be used on paper supports (or most absorbent supports) however proper precautions should be taken to avoid planar distortions

(buckling and wrinkling) form occurring during the application process due to the high water content present in these materials.

- It is possible to gently sand CERTAIN brands of more rigid acrylic dispersion grounds. Remember that inhalation of any type of fine, particulate material is not recommended and that a dust mask should be worn during sanding. Once you are finished sanding the ground, wipe down the ground using a cloth dampened with water to absorb any remaining loose pigments/particles (be sure to properly dispose of the cloth).

Casein Grounds

Casein is a natural phosphorus-containing protein found in milk that can be employed as a binder. Casein grounds are arguably among the strongest of the grounds and grow water resistant as they age; however, casein grounds can also be quite brittle (they are less flexible than both acrylic and oil/alkyd grounds) and for this reason they should only be used on rigid supports. For easel painting, there are two methods that are commonly used to hydrolyze the protein after soaking casein powder overnight: 1) with borax and 2) with ammonia. As with most water-based grounds, several coats are required to build up a suitable ground and sanding may be required. Remember that inhalation of any type of fine, particulate material is not recommended and that a dust mask should be worn during sanding. Casein grounds can also be scraped down using a like a traditional cabinet scraper.

ADDITIONAL RESOURCES AND REFERENCES

"Sizes and Grounds" in *The Painter's Handbook: Revised and Expanded* by Mark David Gottsegen (New York: Watson-Guption, 2006), pp. 51-72.

Golden Artists Colors – Preparing a Painting Support

https://www.goldenpaints.com/technicalinfo_prepsupp

Golden Artists Colors – Grounds for Painting and Drawing

<https://www.goldenpaints.com/products/ghesso-ground/grounds-for-painting---drawing>

Golden Artists Colors – Using Acrylics with Oils

<http://www.justpaint.org/using-oils-with-acrylics/>

Natural Pigments – Lead Oil Grounds for Painting

<http://www.naturalpigments.com/art-supply-education/cat/grounds-art-info/post/lead-oil-grounds-painting/>

Gamblin Colors - Sizes and Grounds

<http://www.gamblincolors.com/sizes.grounds/index.html#ground>

Winsor & Newton – Priming with W&N Artists' Acrylic Gesso

<https://www.youtube.com/watch?v=CoLESiad0ZI>

Ampersand Art - Priming with Oil Grounds

<http://www.ampersandart.com/tips/priming-with-oil-grounds.html>

New York Studio School – Notes on Sizing and Priming

http://www.nyss.org/media/uploads/workshop_pdf/Stretching_Demo_Workshop_1.pdf

Natural Pigments – The Influence of Grounds on Painting Preservation

<http://www.naturalpigments.com/art-supply-education/grounds-paint-preservation/>

University of Delaware – Kress Technical Art History Website: Traditional Ground Preparation

<https://www.artcons.udel.edu/about-us/kress/historical-materials-techniques/ground-preparation>

National Gallery of Art - Acrylic Primers

<http://www.nga.gov/content/ngaweb/conservation/materials-study-center/amrsc-acrylic-primers.html>

Queen's University Masters Thesis - "Delamination of Oil Paint from Acrylic Grounds," by Yonah Maor

<http://www.collectionscanada.gc.ca/obj/thesescanada/vol2/OKQ/TC-OKQ-1487.pdf>

Kremer Pigmente - Casein

<http://kremer-pigmente.de/Texte/casein-en.pdf>