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**HEALTH AND SAFETY
RISKS ASSOCIATED WITH
HANDLING PRODUCTS USED
IN PAINTING, DRAWING
AND PRINTMAKING**

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Every painting, drawing or printmaking studio entails certain risks depending on the hazardous properties of the chemical products used therein and by the way these are handled and stored. This is why, when examining chemical hazards, different types or categories can be established, such as:

- Fire and/or explosion hazard.
- Hazards associated with dangerous chemical reactions which can be detrimental to workers' health and safety.
- Inhalation hazard.
- Skin absorption hazard.
- Skin or eye contact hazard.
- Ingestion hazard.
- Risk of parenteral contamination

The hazard degree of chemical species varies according to their nature and they may contain different substances which can have harmful effects on health. These may become important depending on:

- The amount of material that is handled.
- The degree of purity of the product.
- The environmental conditions the products may be subjected to.
- The frequency of contact with the substance.
- The (short or long) time of contact with the product.
- The physical characteristics of the person who handles the product (total weight, physical condition).



[Warning, prevention and protection measures in order to minimize the health and safety risks associated with handling chemical products.]

As far as health hazards and detrimental effects are concerned, the most direct ways of contamination from chemical substances are those which involve:

1_ Inhalation or diffusion through the respiratory tract: it is the primary way of contamination. Substances in solid state of matter and, more specifically, those in powder form which are in the air are inhaled and easily pass through the lungs into the bloodstream. On the other hand, liquids such as solvents or thinners and acids are highly volatile and generally evaporate fast permeating the surrounding atmosphere. Solvent vapour from the air is inhaled and, just like powder, easily passes through the lungs into the bloodstream. Likewise, vapour of products in gaseous state such as aerosols can cause the irritation of the respiratory system or the eye and nasal membranes, leading in extreme cases to chronic bronchitis and similar illnesses. Also, high concentrations of acid vapours can lead to pulmonary oedema and other lung damage.

2_ Skin and eye contact: many substances pass directly through the skin into the bloodstream. It is worth underlining that the acids used in etching irritate the skin and, when the solutions are concentrated, they may cause serious chemical burns, especially to the eyes.

3_ Ingestion or oral contamination: all the products can be ingested orally through contact with hands, drinks, food and contaminated cigarettes. The ingestion of small amounts of acids may cause damage to the stomach or even death.

Effects caused by brief, short-term, exposure to substances in powder form are usually irritant and of little significance, with the exception of lead, a very dangerous mineral which can cause damage to the digestive tract, the blood, the central nervous system and the kidney, giving rise to colics, shock, anaemia, kidney damage and encephalopathies. Exposure to lead can cause death and its effects might not appear in an immediate way. Medical monitoring is advisable. It is worth stressing that the most serious



effects caused by a single exposure to a high amount or high concentration of a solvent or acid are eye, nose and throat irritation; in contact with skin, they can cause eczema and irritation, since solvents dissolve the very fats of the skin; they can affect the CNS and as a result, cause narcotic effects (drowsiness), and give rise to nausea, vomiting, dizziness and headaches.

On the other hand, the effects caused by frequent exposure for a long period, long-term exposure, can affect lungs and the respiratory system. As mentioned above, lead is very toxic, either by skin contact or by inhalation or ingestion. This mineral passes into the bloodstream and subsequently, into the medulla and bone tissue, the kidneys and the liver. It is eliminated through faeces and urine. It causes damage to soft muscles, arterial blood vessels, nervous tissue and blood. Clinical symptoms are asthenia, dyspepsia, bowel ataxia, diaphoresis, rheumatic pain, vertigo, cephalalgia, shaking, etc. These symptoms can progress to much more serious manifestations such as saturnine encephalopathy, impotence and sterility. Chemical products classified as carcinogenic (which is the case for red lead) and mutagenic, as well as those which can be harmful to reproduction, must be removed and replaced with less hazardous ones. Although they occur in extreme cases, the possible effects and consequences arising from prolonged and repeated exposure to solvents, acids and aerosols should not be ruled out since they can progress to: kidney damage (kidney failure in serious cases); liver damage (symptoms such as loss of appetite, nausea, diarrhoea, vomiting, a bad taste in one's mouth); lung damage: breathing problems, baritosis, fibrosis, pneumoconiosis, pulmonary oedema, asthma; damage to bone marrow: anaemia; skin damage: almost all the aerosols produce reddening, urticaria, dryness, dermatitis or skin burns in contact with the skin; eye damage: conjunctivitis, reddening, blurred vision, serious deep burns, pain; respiratory tract damage: sore throat, rhinitis, pharyngitis, laryngitis; alterations in smell and taste; neurological disorders, effects on the nervous system; abdominal cramps and pain; decrease and differences in phosphate levels; alterations in human reproduction; the action of these compounds as sensitizing factors cannot be ruled out.

The best way to reduce risks related to hazardous chemical substances is to eliminate the need to use them, modifying the process in which



these substances are used for this purpose. If this option is not feasible, the hazardous substance shall be replaced with another one, the use of which involves a lesser health and environmental risk. In case none of the above options is possible to apply, the necessary prevention and protection measures shall be adopted in order to minimize the risks that exposure to the said substances involves. This will be carried out by measures such as:

- The isolation of the process in which contaminants are released;
- The reduction of contaminant release through the improvement of the process;
- The application of technical solutions in order to minimize the concentration of contaminants in the exposure area;
- The use of PPE whenever necessary.



[Various elements of an appropriate Personal Protective Equipment (PPE).]

Safety with regard to handling products used in painting, drawing and printmaking as a work system is widely dealt with in an enormous variety of legal texts, handbooks, offprints, studies, guide books, etc. However, all the existing regulations and information make no sense if the individual attitude, primarily, and the collective one in the studio, secondly, are not adopted as rules of conduct.

For these purposes, we consider it is advisable to specify safety procedures for product handling according to each product's state of matter and, consequently, we have agreed to study them considering the three possible states of matter: solid, liquid, and gas. With the aim of making appropriate specifications,



we provide taxonomy of the products corresponding to each state of matter.

Safety with regard to handling products in solid state used in painting, drawing and printmaking.

Most of the solid products used in painting, drawing and printmaking are in powder form. Therefore, we will generically refer to all of them as powders for the purposes of analysing safety with regard to their handling.

Preventive measures in order to avoid exposure to hazardous substances in powder form that occur in different art studios are:

- Appropriately ventilate the premises, either naturally or mechanically.
- Use closed systems in order to minimize the release of contaminants.
- Install ventilation or local exhaust ventilation in the area where contaminants are released.
- Clean and replace ventilation and exhaust ventilation system filters according to the manufacturer's instructions.
- Carry out periodic environmental control.
- Clean tools in well ventilated premises.
- Keep containers tightly closed.
- Use, when necessary, the appropriate PPE, which must bear the EC mark.
- Provide containers with automatic closure lids for the disposal of cloths and other materials containing these products.
- Provide exposed studio users with information on hazards and appropriate training in hazard prevention.

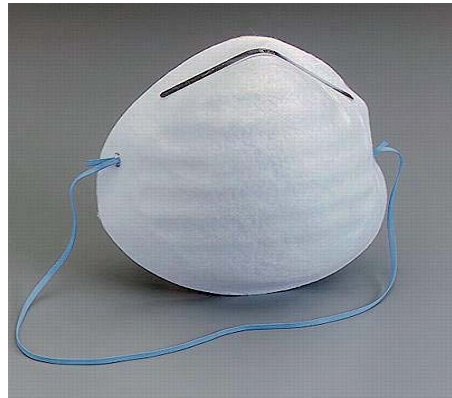
With regard to the main measures for the safe handling of powdered substances, we can list the following:

- Personal Protective Equipment (PPE) shall always be used.
- Eating, drinking and smoking are not allowed in the art studio. Accidental ingestion is possible, since powders and vapours from different sources can contaminate food, tools or cigarettes.
- When powdered substances must be handled, a type P2 or P3 face mask must be used to protect against toxic powder inhalation (P1 type



face masks are not recommendable).

- Eye protection: use adjustable safety glasses.
- Skin protection: use appropriate gloves (nitrile gloves are recommended instead of latex, which shows a high degree of sensitization), clothes and shoes.
- Inhalation of powder of any kind or exposure in places with large amounts of powder shall be avoided.
- Once the activity is finished, the working area must be cleaned with a damp mop or an oil impregnated dust cloth to avoid dust accumulation. Dust circulation must be avoided. Dust must not be swept since it may be stirred up.
- Powdered substances must be kept in closed plastic containers, and a spatula or an appropriate tool must be used to handle them.
- When hazardous products are handled in the art studio, appropriate personal hygiene is necessary. After finishing work, hands, nails, forearms and face must be washed with water and soap.
- People who suffer from allergies and asthma must avoid using powdered products.
- Exposure to pigment powders, such as those based on lead, is particularly hazardous for the unborn baby, so pregnant women must avoid handling lead until childbirth or the end of breastfeeding. During this period it is recommendable to use alternative materials.
- Children must never be exposed to lead, especially in powder form.



[Disposable respiratory protective masks against inhaling toxic powder.]



List of solid products used in painting, drawing and printmaking: _

>PIGMENTS

Some pigments, such as those containing lead, silica dust or asbestos can cause serious pulmonary damage or diseases and may have very detrimental effects if the appropriate hygiene measures and procedures are not employed. When powdered pigments are handled, the hazard generally lies in the inhalation of the small particles of the pigment but also in the skin contact or in the ingestion; it is necessary to be familiar with the chemical properties of each of them in order to be able to proceed with due caution, according to their chemical composition. Some of the pigments which are highly detrimental to health are the following:

- Naples Yellow/Lead Antimonite.
- Lead White/Basic Lead Carbonate.
- Zinc Yellow/Zinc Chromate.
- Chrome Yellow/Lead Chromate.
- Barium Yellow/Barium Chromate.
- Cadmium Yellow/Cadmium Sulphide.
- Cadmium Red/Cadmium Sulphoselenide.
- Aureolin/Potassium Cobalt Nitrate.
- Vermilion/Mercuric Sulphide.
- Cobalt Violet/Cobalt Arsenate or Phosphate.
- Manganese Violet/Manganese Ammonium Pyrophosphate.
- Prussian Blue/Ferric Cyanoferrate.
- Cobalt Blue/Cobalt Oxide-Aluminium Oxide.
- Manganese Blue/Barium Manganate.
- Cobalt Green/Cobalt Oxide
- Zinc Oxide.



[Nitrile gloves for skin protection]



[Latex gloves for skin protection]

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>>List of PIGMENTS

- Lead Pigment: Chrome Yellow / Lead White / Naples Yellow
- Zinc and Cobalt Pigments: Zinc Yellow / Zinc White / Cobalt Blue / Cobalt Violet
- Barium and Manganese Pigments: Barium Yellow / Manganese Blue / Manganese Violet / Manganese Black
- Titanium Pigments: Titanium White
- Cadmium Pigments: Cadmium Yellow / Cadmium Red
- Iron Pigments: Ercolano Red / Mars Red / Natural Ochre / Raw umber and Burnt umber / Burnt Sienna / Black Earth / Mars Violet / Mars Black / Prussian Blue
- Chrome Pigments: Chrome Green
- Carbon Pigments: Lamp Black
- Sulfide Pigment: Ultramarine Blue / Ultramarine Violet
- Copper and Phthalocyanine Pigments: Phthalocyanine Blue / Phthalocyanine green
- Tolidine Pigments: Tolidine Red
- Anthraquinone Pigments: Alizarin Crimson
- Naphthol Pigments: Naphthol Yellow
- Quinacridone Pigments: Quinacridone Violet / Quinacridone Red /
- Quinacridone Magenta

>MINERALS

The main natural pigments used in painting are of mineral or biological origin. Most mineral pigments are dry colorants, usually in fine powder form. The hazard it involves depends on the particle size.

The minerals used in drawing and painting which are not considered pigments are stated below.

>>List of minerals:

- Haematite / Limestone / Graphite / Silver



>Binding AGENTS

These products have specific risk rates and, although those of natural origin are considered non-hazardous, it is advisable to take the usual precautions applying to handling chemical products.

>>List of Binding Agents:

- Vegetable gums and glues: Gum arabic / Cherry gum / Gum tragacanth / Sarcocolla / Starch / Dextrin / Alginate
- Animal glues: Fish glue or isinglass / Rabbit-skin glue / Hide or parchment glue / (semi-solid) Gelatine glue / Casein glue
- Synthetic glues: Methyl cellulose
- Natural resins: Rosin (Colophonia resina) / Dammar resin / Chios mastic gum / Sandarach resin / Shellac resin / Copal resin / Asphalt
- Synthetic resins: Alkyd resins / Acrylic resins / Vinyl resins



>ADDITIVES

The additives here classified in fillers, natural and synthetic waxes, siccatives or retarders, and disinfectants and preservatives are of different nature, so their state of matter may be solid (often in powder form) or liquid.

Likewise, these products can be natural or synthetic, which means their characteristics are different, although it does not make a difference to their degree of hazard.

>>List of Additives

- Fillers: Calcium carbonate / Aluminium Hydroxide / Talcum / Plaster or Chalk / Kaolin / Calcium hydroxide / Quartz sand / Barium sulphate / White asbestos / Magnesium carbonate
- Natural and synthetic waxes: Beeswax / Carnauba wax / Paraffin wax
- Siccatives or retarders: Soap
- Disinfectants and preservatives: Beta-naphthol / Potassium carbonate / Ammonia / Sodium pentachlorophenate



Safety with regard to handling products in liquid state used in painting, drawing and printmaking_

Liquid products used in painting, drawing and printmaking can be classified in two large groups: solvents or thinners, and acids, in the specific case of indirect incision techniques used in printmaking. Nevertheless, we will also list here the binding agents and additives in liquid state of matter.

The physicochemical, toxicological and ecotoxicological characteristics of solvents or thinners, and acids oblige users to take a series of precautions to avoid accidents or incidents in the art studios.

The presence of flammable materials (paper, cardboard, cloths, resins) and sources of combustion (gas or electric fires, the electrical system itself or accumulated static electricity) in the painting, drawing and printmaking studio, make it necessary for the users to maximize precautions when handling and storing regularly used flammable chemical products such as solvents and the products which contain them. Thus, the fire or explosion hazard will be avoided or minimized.



[Proper storage of solvents by chemical species with good visibility of product labeling]

In order to prevent fires and improve safety in the painting, drawing and printmaking studio, the following precautions must be taken:

- The said substances must be available only in the necessary amount for everyday activity. The rest of them must be kept in the warehouse or in safety cabinets.
- In case flammable liquids are decanted, manual or mechanical means must be used.
- Do not smoke in the art studio and do not handle products containing solvents near burners or heaters, etc.
- Do not eat, drink or smoke inside the studio.
- The warehouse for these and other products shall be located in a different building, separated from the working area, and shall be properly ventilated.
- In areas with flammable atmospheres an explosion-proof electrical system is necessary. The electrical system must be checked and kept insulated and protected.
- Fire extinguishing systems must be available as well as detection and alarm mechanisms, and regular maintenance must be provided.
- Emergency exits must be marked and kept clear.
- An emergency plan must be available and studio users must be provided with instructions. Periodic emergency evacuation drills must be carried out.

[Manual pump to decant flammable liquids]



In order to avoid explosions due to the formation of explosive atmospheres of air and organic vapours (of solvents, spray paints, varnishes, etc.) in the art studio, it is necessary to control the concentration of flammable dust, gases and vapours. For this purpose, the following preventive measures must be taken:

- Use solvents and acids in areas with good ventilation, either natural or mechanical, and employ a local exhaust ventilation system to extract the generated vapours.
- Use appropriate PPE, such as gloves, aprons and safety glasses.
- Substitute, insofar as possible, very toxic substances for others of lower toxicity.
- Never use solvents to remove paint or grease from skin. Use water and soap or waterless hand cleaners.
- In case of contamination by inhalation or ingestion, seek immediate medical attention.
- Change contaminated clothes when leaving the studio.
- Exposure to solvents and acids is especially hazardous for the development of the unborn baby, so pregnant women must avoid handling solvents until childbirth or the end of breastfeeding. It is recommendable to use alternative materials during this period. Children must never be exposed to solvents.

List of liquid products used in painting, drawing and printmaking: _

>SOLVENTS or THINNERS

Solvents are often found in daily use products and are used in the formulation of a wide variety of art materials and products, such as inks, acrylic paints, varnishes, lacquers, siccatives and fixatives.

Solvents can be harmful if they are not used following the appropriate hygiene measures and procedures. In recent years, new solvents classified as “non-toxic, healthy and natural”, mainly derived from citrus peel, have been



marketed. One of their main constituents is limonene, which is considered natural and biodegradable. Nevertheless, some studies of harmful effects of limonene on animals have proven that it is a highly toxic product. The American Industrial Hygiene Association (AIHA) established that the TLV¹ of limonene is much lower than that of other toxic solvents including turpentine, toluene, ethyl alcohol and N-hexane².

No solvent is innocuous and healthy. All of them, be they natural or synthetic, are potentially hazardous. This depends on the type, manner, and time of contact, and of the amount of substance used. Toxicity and evaporation levels of organic solvents are varied. Many solvents cause skin irritation (acetone, for instance, can cause mild irritation) and others can be absorbed by the skin and cause reactions in the bloodstream. An excessive vapour inhalation can affect the central nervous system and cause drowsiness, thus increasing the risk of accidents apart from other disorders.

Chemical products classified as carcinogenic (which is the case for benzene) and mutagenic, as well as those which can be harmful to reproduction, must be removed and replaced with less hazardous ones.

>>List of solvents

- Aromatic hydrocarbons: Benzene, Toluene, Xylene, Limonene,

¹TLVs are reference values for the concentrations of chemical agents in the air and they represent the conditions which, based on current knowledge, most workers can be exposed to daily, during all their working life, without suffering adverse effects on their health. The Threshold Limit Values (TLVs) of the American Conference of Governmental Industrial Hygienists (ACGIH) can be used as a reference.

There are two categories of TLVs: TLV-TWA and TLV-STEL. TLV-TWA represent the conditions which, based on current knowledge, most workers are considered to be able to be exposed to for 8 hours daily, 40 hours weekly, during all their working life, without suffering adverse effects on their health.

TLV-STEL is the reference value for the EC, limited to a maximum time of 15 minutes.

TLVs are not reliable as absolute criteria, since they depend on the working conditions of each art studio.

²Rossol, Monona, The artist's complete health and safety guide, Allworth Press, New York, 2001, p. 90.



Styrene.

- Aliphatic hydrocarbons: n-pentane, n-hexane, n-heptane and other saturated hydrocarbons (paraffin).
 - Halogenated hydrocarbons: Dichloromethane, Carbon tetrachloride, Trichloroethylene, Perchloroethylene.
 - Ketones: acetone, Butanone, Hexan-2-one, Isophorone.
 - Alcohols: Methyl alcohol, Ethyl alcohol, Butyric alcohol, Isopropyl alcohol and Glycerine.
 - Alicyclic hydrocarbons: Turpentine, Cyclohexane.
- Petroleum-derived solvents: Stoddard solvent, Petrol, Solvent naphtha (mineral turpentine), White spirit.

>>List of thinners

- Oils or essences for oil painting techniques: Linseed oil / Walnut oil / Poppy seed oil / Turpentine / Lavender essence / Clove essence.

>ACIDS

Acids are not combustible but, if they are oxidizing agents (such as nitric acid), they can react in contact with flammable or combustible products, acting as oxygen in the combustion reaction (oxidizing agent).

In case of fire, acids give off toxic irritating gases. In order to prevent fires in the art studio it is essential to handle and store acids and their waste far from flammable substances, organic (such as acetone or acetic acid) and combustible compounds. For this reason, it is recommendable to store acids in appropriate places or cabinets, close to the etching facilities and separated from solvents, which shall be stored in safety cabinets in the printmaking area.

The main rules to follow for handling acids are those established by the standard safety procedures for handling corrosive products:

- In order to avoid splashes and spills when decanting solutions, funnels, beakers and other appropriate pumping methods must be used.
- It is essential to use containers which allow the user to see the process in order to avoid spilling the liquid.

- When handling acids, Personal Protective Equipment (PPE) must always be used.



[Pumping system liquids decant.]

As far as respiratory protection is concerned, it is advisable to consider the levels of exposure in order to decide whether protection is absolutely necessary to use or it is simply a precautionary measure. For example, for handling iron trichloride, the appropriate protection is a P2 type of particle filter. An FFP2 type of filtering face piece or a P2 filter for a face mask can be used. Carbon filters do not filter nitric acid and nitrogen oxides properly.



- .1. Filtering face masks FFP1 type.
- .2. Filtering face mask FFP2 type
- .3. Filtering face mask FFP3 type.

Other protection measures to be taken into consideration are the following:

- Use approved eye protection bearing the EC mark.
- Use viton, butyl or nitrile rubber gloves for hand protection (resistant to diluted and concentrated acids).
- Use cotton laboratory coats to protect street clothing, especially if the latter is made of fibre, since it may adhere to the skin if it comes into contact with certain chemical products; also use neoprene, viton or butyl rubber aprons (do not use PVA or polythene ones), which resist acid splashes.
- Shoes must be comfortable, closed-toe and breathable. They must fasten the foot well and be provided with nonslip soles. Heels will not be higher than 3 centimetres.
- In case of inhalation or ingestion seek emergency medical attention.
- Use ventilation (either natural or mechanical) in the area and, whenever necessary, local exhaust ventilation.
- Hazardous spills must be confined and shall not be absorbed with cloths. An appropriate absorber and neutralizer must be used.
- Generated waste shall be managed as hazardous waste.
- It is obligatory to wash hands after work and change contaminated clothes when leaving the printmaking studio.

A well-equipped printmaking studio should be provided with etching facilities separated from printing facilities and an exhaust ventilation system for the vapours and gases generated during plate corrosion.

Apart from the general preventive measures mentioned with regard to handling acids as corrosive products, the following measures must be taken during the process of corrosion of metal plates:

- Do not handle plates immersed in the acid with your fingers. Use adhesive tape like a big handle or hanger behind the plate in order to handle it from outside the tray or tank which contains the corrosive bath.

- Carefully immerse and take out the plate from the corrosive bath. Wash the plate with water after taking it out of the tray. If iron perchloride is used for etching, immerse the plate in a tray with vinegar to avoid oxidation and remove the etch residues.
- Corrosive baths are different depending on the type of metal to be etched, and every metal plate must be immersed in the appropriate acid bath. It is advisable to adequately indicate the type of metal corresponding to each tray.
- Rinse the plate thoroughly with water and properly dry it before leaving the etching facilities.
- Do not enter the etching facilities with flammable products such as solvents, alcohols, etc.
- Wash hands with water and soap before leaving the etching facilities.
- Do not eat or smoke on the premises.
- When trays and vertical tanks containing acids are not used, they must be covered to avoid gas and vapour release.

>>List of acids

- Acetic acid, Citric acid, Hydrochloric acid, Hydrofluoric acid, Phosphoric acid, Nitric acid, Sulphuric acid, Potassium chlorate, Dutch mordant, Phenol.

>>List of corrosive salts

- Iron Trichloride, Copper sulphate, Sodium persulphate, Sodium chloride.

>>List of binding agents

- Vegetable gums and glues: Latex
- Synthetic glues: White glue (liquid emulsión)

>>List of additives

- Siccatives or retarders: Cobalt siccative / Glicerine / Ethylene glycol

monohexyl ether

- Disinfectants and preservatives: Formaldehyde

Safety with regard to handling products in gaseous state used in painting, drawing and printmaking_

Most gaseous products contain solvents in their chemical composition and for this reason, they are highly flammable and increase fire risk. This risk is especially high for aerosol paints and varnishes (sprays). Aerosol cans are pressurized and contain highly flammable propellants. Most spray varnishes contain a mixture of solvents, such as aromatic and aliphatic hydrocarbons, and petroleum-derived solvents like white spirit and naphtha. Some quick drying aerosol varnishes such as re-touch varnish or Dammar varnish are mainly compounded of alicyclic solvents (turpentine) and alcohols, sometimes accompanied by white spirit. These main solvents which contain products in gaseous state are flammable, highly volatile and can easily cause an air/solvent vapour explosive mixture. For this reason, as we have previously stressed, they can be the source of a fire if they are not stored, handled and disposed of as waste, taking the appropriate preventive measures.

Aerosol cans generally bear the flame and the F+ danger symbols, which indicate the flammability potential and the high risk of fire. All the products which contain solvents, and most particularly aerosols, must be handled according to the safety regulations given in the section of safe handling of substances in liquid state.

As we have already mentioned, and owing to the fact that products in gaseous state used in painting, drawing and printmaking are based on a mixture of different substances, we will not provide a list of these since they have already been specified with reference to the products in solid and liquid state.



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