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SURFACE PREPARATION AND FINISHING OF WOOD AND WOODEN PRODUCTS 1/

by

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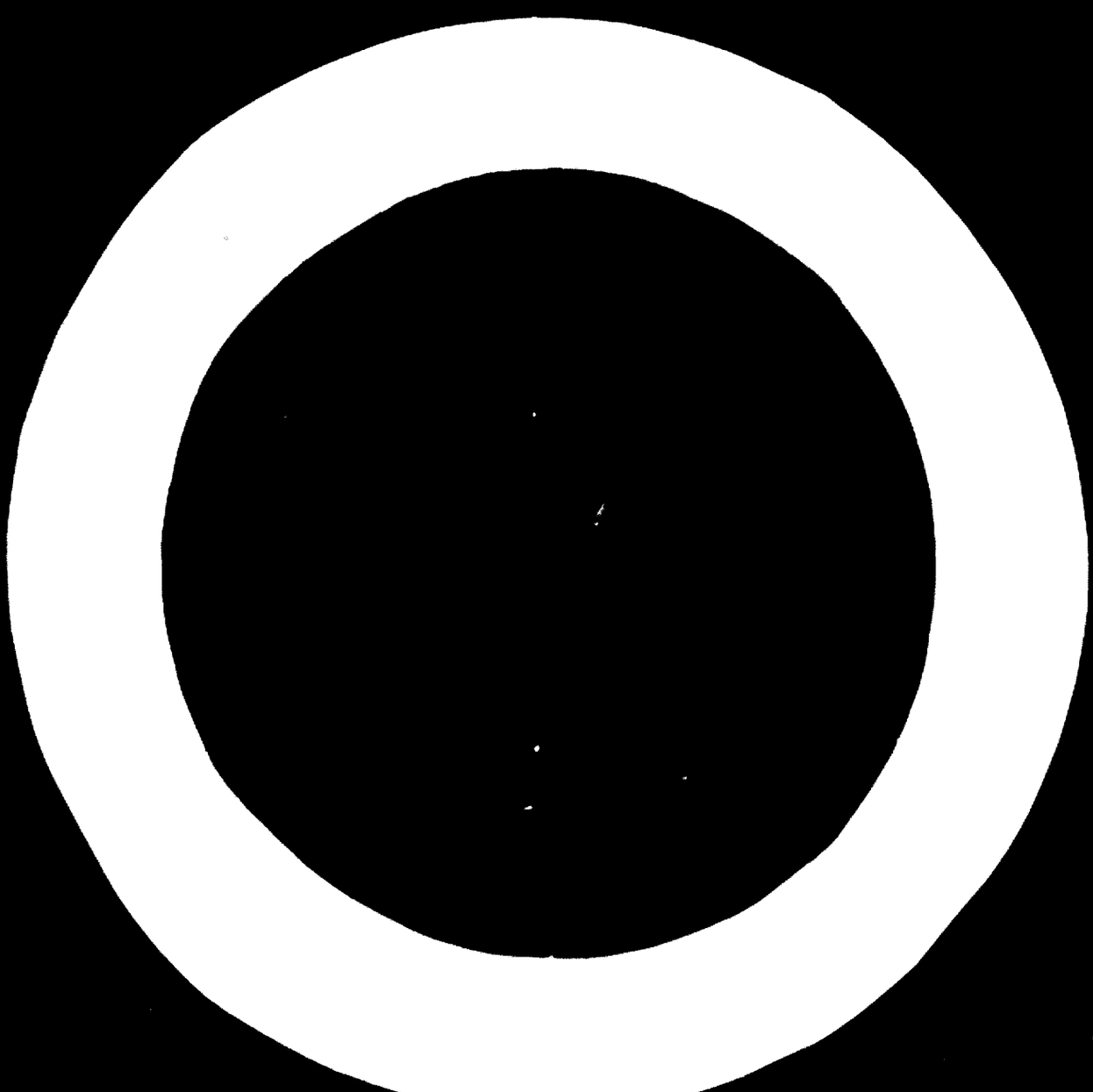


General

There is today a multiplicity of finishing materials available for the surface preparation of wood. There is also a great variety of methods of application of these materials. And you have, of course, a lot of different kinds of wood qualities. So the picture for the man who is going to do the finishing job is really somewhat complicated. And we all know that the beauty of any wood depends on its finish. It takes time and patience to obtain a good finish. You must try different methods to finish your article, you have woods with big pores and you have woods with small pores. Sometimes you like to pronounce the big pores to get an effect you wish for some purpose. As finishing man you must always also know for what purpose an article, furniture, windowframe, door etc. will be used in the practice. Without knowing that it is difficult, perhaps quite impossible to do the right choice of finishing material. So therefore always remember the end use of your article, under which conditions it will be utilized. In risky cases get in contact with your suppliers of finishing materials.

Paint is a formulation of a binder, different white or coloured pigments, solvents and small amounts of additives. In air drying paints the additives can be lead, cobolt and manganese derivatives. Earlier we used linseed oil as a binder, today the alkyds have taken over. Many people call the alkyds also synthetics. Apart from alkyds we have many, many other binders, such as polyvinylacetates and acrylates in the water thinnable paints, polyurethanes, polyesters, epoxies and combinations of different resins. As white pigment is today almost everywhere used TiO_2. As solvents we use white spirit but in many paints stronger solvents such as xylene, toluene, acetates, ketones and alcohols.

.1 Preparation of the surface for finishing

Proper preparation of the surface is of great importance in wood finishing. The finish coat will not cover defects, in reality it will magnify them. Before the finishing starts the surface must be clean and smooth. Rough edges and other rough spots should be removed by sanding, planing etc. And the wood must, of course, have the right degree of moisture.

The moisture content of the wood is in equilibrium with the relative humidity in the air in the neighbourhood e.g. at a relative humidity of 100 %, at 20°C, the moisture content will be 25-30 % in the wood. At this condition the wood contains no water in a free form but all water is bound hygroscopically. When the wood takes up more water, you will have water in a free form in the cells. When the wood lies in water, it will take up water very rapidly, but a diffusion of water in vapour form is a rather slow process. When the wood takes up water or dries, it swells and shrinks and this process is quite different in different directions. When the wood swells about 0,5 % in the length direction you will have a radial swelling of about 5 % and a tangential swelling of about 10 %. Exact figures are difficult to give, because different kinds of wood react in a different way and there are big differences in the same kind of wood, too. "The living" of the wood is furthermore not constant over the whole surface e.g. in the boundary line between spring and autumn wood the "living" is much bigger than the average for the whole surface. (see ID/WG 105/22 Rev.1) The greater part of the wood we are using can easily be attacked by microbes and fungi. Sometimes you will have only a change in colour e.g. blueing, but sometimes the wood will furthermore begin to rot. Not only the wood, but also the paint film can be attacked by the microbes and it has been observed, that microbes living between the paint film and the wood surface can have an injurious effect on the adhesion of the paint film. The nice look of a painted surface can very often be destroyed by mould, but the paint film can still be fully intact.

As I said before the Finnish joinery factories use different kinds of wood. The most important are, of course, pine, spruce, oak and birch. But we are using also quite a lot of tropical wood species such as mahogany and teak. None of these woods can stand up to the elements without surface finishing. An exception is perhaps teak wood, because its mechanical properties do not decrease, although the wood will get grey in a short time and lose the nice colour through the influence of the rain and the sun.

Pine and spruce must be protected against microbes by brushing or dipping in wood preservatives. Oak and mahogany do not need this preparation. Some tropical wood species, such as teak, contain agents which can make their surface finishing difficult. These agents can prevent an alkyd lacquer from drying. When the lacquer dries after a long time, the adhesion will be very bad and you will have blistering and peeling very soon.

Before you can finish such wood species, you must wash the surface with a solvent such as xylene or thinner for nitrocellulose lacquer. By washing the surface you get a good drying and adhesion. Deep inside in the wood these products are still left and from there they can penetrate to the surface and destroy the paint film. Prolonged investigations have shown that the best results can be received by priming the surface with produtts, which prevent these agents from coming into contact with the real surface finishing. The two-component polyurethane-products and also some special acid catalysed lacquer are usable for this purpose. The real finish can then be done with urethane or alkyd lacquers.

I have spoken very much about the influence of moisture on paintings, but I think it is a very important part of the preparation of wood, such as window frames, for the consumer.

In an investigation done in Sweden into the durability of paintings on window frames the conclusion was that 20-80 % of the frames had failures on the lower parts of the frames within a year, so you can see how important this question really is. Of course, you never have the same problems on joineries for inside use.

Sanding

Sanding is a very important operation in preparing the wood for a finish. It must be done to remove defects in the surface and to emooth it so that the reflective properties of the finishing materials will accentuate the full beauty of the wood grain. By taking time to do a good job of sanding, using correct procedures and selected grades of abrasives, you can produce a finish of profeesional appearance and quality. Especially by using glossy finishing materials in dark colours every small defects in the surface can be observed very easily.Always use a fine sanding paper, No. 150-240, for the last sanding and you will do a fine job, and save some money in finishing material. Using a fins sanding paper will take a little more time and may cost you little more in sanding paper, but your finishing material will have the best possibilities to give you the first quality. Always remember to do the final sanding directly with the grain.

Patching

Before you apply any finish, fill nail holes, open joints, twig holes etc. with a non-shrinking plastic wood.

Butter them slightly more than full. Let the filler dry and sand smoothly. If you don't have any plastic wood, you can make some filler yourselves. Take a piece of the same wood you have to fill, scrape this to get as fine a powder as possible. This powder you can mix with a binder such as nitrocellulose lacquer. If you wish to finish the surface with a pigmented system, you can use any typ of filler, but the filler must withstand the solvents in the finishing system. ester putties of a softer type are used in Finland for this purpose but also high pigmented one-component putties. After the primer is applied you have to look over the items again and put on some more putty.

10.1.3 Bleaching and staining

Bleaching of wood is done by the use of chemicals. In Finland we don't use methods like that, because it is very difficult to get constant results. Instead of that use special primer lacquers, which don't wet the surface too much. We can also add small amounts of a white pigmented product (0,5 %) of the same binder type and in this way give an impression of whiter wood.

Staining is done with products dissolved in water but a more mod method is to put a colour solution in the primer lacquer and get colour and prin applied in one operation. The colour solution must, of course, have an excell resistance to fading.

10.2 Industrial painting and varnishing

In the furniture industry in our country industrial painting and varnishing has b done for a long time. Also in factories producing kitchen equipments, doors different decoration plates and window frames we have the same.

In the last time many factories have invested much in application machines. W still have factories using brushes and rollers, but more developed factories us spraying techniques withair and airless guns and curtain coating machines. More machines in industrial painting give more application methods and make bigger demands on the paints and lacquers. Developments to speed up the dryi properties of the finishing products has allowed the coated articles t be piled or packed directly and passed on to the store or transported to the customer.

The quality of the finish must be first class and you must get it in so few ap cation times as possible.

In the board industries e.g. hardboard and blockboard surface finishing is being done more and more by the producers themselves.

2.1

Blockboard is puttied on roller coaters with products normally based on alkyds. These putties contains volatile solvents and you will have to do the application at least twice.

Today we are going over to polyester putties. Polyester putties are solvent free and boards coated once with these are completely smooth and have a compact surface. The drying process is forced by UV-radiation. Drying time in special ovens with UV-radiation is only 15-30 seconds. On this surface you get an excellent finish with only one application. Normally acid catalysed paints are used.

Hardboards can also be precoated with UV-polyester putties, but today we normally use precoating with an acid catalysed primer and after that an acid catalysed finish paint. Often it's enough only with one finish paint. Application is done by spray or with the curtain machine.

.3 Pigmented systems

Procedure for painting of furniture , kitchen equipment. and doors of birch, hardboard or blockboard

3.1 Acid catalysed system

Holes filled with alkyd putty. Coating with acid catalysed primer, 80-120 g/m^2.
Sanding
Smooth with alkyd putty
Sanding
Topcoat with an acid catalysed finish paint, 80-120 g/m^2.

The primer is applied with spray guns or curtain machine. After drying at room temperature at least 2 hours, at higher temperatures a shorter time, sanding is done with a sanding machine.

When you still have defects in the surface after the sanding then you fill them up by hand with alkyd putty. The alkyd putty should dry fast, in thin coats in a few minutes, after that you can sand the repairs.
The topcoat is applied by curtain coating machine on boards or with a spray gun.

Kitchen equipment , which is put together, is sprayed with air or airless gun. Surfaces inside the equipments, shelves and surfaces outside, which you don't see, normally don't get any putty. Surfaces inside can be coated only once with the primer - or better with the topcoat.

10.3.2 Reinforced acid catalysed system

For high quality finish on furnitures and doors for the equipment you can apply second topcoat after the last filling with putty.

10.3.3 UV-putty - acid catalysed system

- UV-polyester putty, 80-120 g/m^2 depending on the quality of the blockboard.
- Sanding
- Topcoat with acid catalysed paint, 80-120 g/m^2.
- The use of UV-putty is possible only on boards.

10.3.4 Polyester system

- UV-polyester putty, 80-120 g/m^2 depending on the quality of the blockboard.
- Sanding
- Topcoat with polyester paint

10.3.5 Dipping method for small details

An easy method for furniture details such as cabinet legs is to dip them in pa based on nitrocellulose, alkyds or alkyd/melamine (acid catalysed). With the last mentioned type of paint you must consider, the pot life of mixed paint is only 8-12 h, so that the alternation in the bath must be big enough.

10.4 Unpigmented systems

Procedure for lacquering of furniture equipment doors etc.

10.4.1 Lacquer for light kinds of wood

Light kinds of wood, when you like to keep the surface as light as possible.

Primer lacquer, which keeps the wood light, doesn't wet the surface too much it contains preservatives against UV-light.

Sanding (light)

Toplacquer either with the same lacquer or with a normal acid catalysed lacqu (matt or glossy).

10.4.2 Lacquer for dark kinds of wood

Dark kinds of wood and stained light kinds of wood.

- Acid catalysed primer lacquer
- Sanding
- Acid catalysed top lacquer

The staining can be done with water based stains, but today we use very much a colour solution, which we mix in the primer lacquer before the application. In this way we get the stain and the priming in one operation. The pigment dissolved in a solvent has excellent resistance to light.

0.4.3 Teak

Teak is finished twice with a thinned acid catalysed lacquer.

0.4.4 Palisander

Priming with a special palisander primer lacquer. With normal lacquers you mostly get a greenish colour.

Topcoat with acid catalysed lacquer.

0.5 Window frames from coniferous wood

.5.1 Wood preservative system

Treatment with a clear wood preservative based on linseed oil. The best application method is dipping. After that you can apply 1-2 coatsof a coloured wood preservative.

.5.2 Alkyd system

Pretreatment as 5. 1. Fill the holes with an alkyd putty. Don't use putty on the outside of the frames.

Priming with a quick-drying alkyd primer

Smooth with alkyd putty again.

Sanding

Undercoating with a quick-drying alkyd paint

Sanding

Topcoat with a quick-drying alkyd paint

The application is normally done by air or airless spray

.5.3 Acid catalysed system

Treatment with wood preservative. Fill holes with alkyd putty.

Priming with an acid catalysed primer

Smooth with alkyd putty

Sanding

Topcoat: Acid catalysed finish paint

The acid catalysed paints should be of a special quality, so that they withstand the "living" in the frames. Acid catalysed paints normally used for kitchen equipment inside are too hard for this purpose.

10.5.4 Polyurethane system

Treatment with a wood preservative or a special primer lacquer.

Fill the holes with an alkyd putty.

Priming with polyurethane primer.

Sanding.

Topcoat with a polyurethane finish.

10.6 Some words about the paints, which have been mentioned

.6.1 Alkyd paints

The alkyd resins we use for the production of alkyd paints are manufactured by heating mixtures of higher alcohols such as glycerol or pentaerytrol with dicarboxylic acids such as phthalic acid anhydride and fatty acids of drying or non-drying oils. The properties of the resin you get will depend on how you do the heating and from which raw materials you have started.

10.6.2 Nitrocellulose

Nitrocellulose is still a commonly used material for wood finishing because of its speedy drying. The nitrocellulose products dry by evaporation of the solvents. With good ventilation at room temperature or higher you can speed up the drying. The nitrocellulose products have almost a very low flash point so you must be careful with fire and see that no static electricity can occur. Furthermore these products have a very low solid content and we must therefore apply many coats (3-6) before the articles can be brought on the market.

10.6.3 Acid catalysed products

This is the biggest group of the industrial finishing materials for wood in Finland. The acid curing products are normally based on urea formaldehyde/melamine/ combinations. The alkyd is of a non-drying type. In the presence of the catalytic acid we mix in before we use the paint, the urea resin reacts with the alkyd to a rather hard film. The film has a good abrasion resistance, being resistant to alcohol and other "chemicals" we use in the household.

Don't combine an acid catalysed topcoat with a primer based on linseed oil or alkyd. Normally this underlay is too soft for the topcoat and you will have

cracking within a short time. Further more the paint film of an acid catalysed type will be harder if the relative humidity in the air is low at the curing time. When the relative humidity increases risks of the paint film cracking exist. We are testing our paints so that they can stand changes in the relative humidity from 20-80 % without cracking. Don't apply more than 2 coats the same day unless you can dry in an oven.

The acid catalysed products withstand dry heat of 100°C. They also don't burn easily so yards are now using boards finished with acid catalysed materials for linings on ships.

A metal surface can be finished with A. C. paints, but for this purpose you must pretreat the surface with an etch primer.

6.4 Polyurethanes

We can use pigmented or unpigmented polyurethanes on outdoor furniture. These are not yet used very much in Finland, but these are the most sophisticated products and they still are at the stage of development. The polyurethane films have high chemical and moisture resistance. Normal polyurethane products consist of an isocyanate component and a component with two or more hydroxyl groups. When these two components are mixed a chemical reaction will start and a film is produced by crosslinking. The isocyanate component is very sensitive to water or moisture. Within a short time you will get a gelling in the can, if the can is closed badly. The isocyanate is, of course, thereby reacting with the hydroxyl groups in the water.

6.5 Polyester

I also mentioned this type of finishing material in connection with the surface coatings for inside furniture. These products are not used very much in Finland. In some smaller series people use them on items like tables, TV-boxes etc. These materials consist also of two-components, which you have to mix before use. The pot life of normal polyester products for air spray is only a few minutes so they are difficult to use in the practice. With forced heating you can use these products also on the curtain machine by using another hardener composition, which gives a longer potlife to the mixture. There is also special air spray equipment on the market. In these the components are mixed together in the spray gun immediately before the paint leaves the gun.

10.7 Painting equipments

Last but not least I´d like to say something about painting equipment and the air condition in the painters shop. The equipment we use today is the whole register brush, roller, curtain coating machine, dipping, roller coater, spraying techniques etc. Which equipment or painting method is the best depends on the article to be coated and on the most economic way to do the job.

By air spray the surface finishing material is transported from a pressure container (0,5 - 1,5 kp/cm^2) through a hose to the gun and atomized by air by 2,5 - 4 kp/cm^2. By airless spray the paint or lacquer is passing a hydraulic pump (air pressure: hydraulic pressure = 1 : 25 - 1 : 40) and atomized by passing through nozzle of the gun. Different nozzles giving varying amounts of finishing material per time unit at constant pressure and with varying spray angles are available. Air spray is mostly used on small items or when extremely high smoothness of the surface is desired. We hereby normally use a more thinned paint or lacquer and spray it at as low a pressure as possible. Airless spray is used on bigger flat surfaces and on items such as cupboards, when you have to spray the inside. The overspray with air spray is hereby much bigger because of bigger rebounding.

Applying of paints and lacquers on wood using electrostatic spraying equipment is also possible. The paints and lacquers should have a flash point higher than +23°C. The moisture content of the wood should be 8-10 % and the contacts to the earth not too far away from each other (50-60 cm). The method has advantages on small items, where the overspray with other methods is rather high. However, investigations into the possibilities of using this spraying technique should always be carried out before investments are made.

When you intend to make investments in equipment for application of paints or for drying them, speak with the manufacturers of these articles and speak not only with one of them, before you make your decision.

Drying of applied finishes (e.g. acid catalysed paints) is in many factories forced by using high temperature ovens. In modern equipment you can reduce curing times to about 40-60 sec. Special care should be given to the adhesives you are using so that they can withstand the high temperatures. Wood of evergreens are difficult to dry at high temperature because their pitch content will be forced out. For such wood drying temperatures of 50-60°C will be enough.

An advantage of the coating machine and roller coater over all other application equipment is that the film thickness is easily controllable and it is easier for you to make your calculation of the painting costs.

Air conditioning ie ventilation, in the painters' shop it is very important, so that the content of solvent vapours and paint dust can't rise to too high a level. Bad ventilation increases both health and fire hazards and gives you worse surface finishing. When we have too many solvent vapours in the air, we come closer to the explosion limits. These limits are different for different solvents.

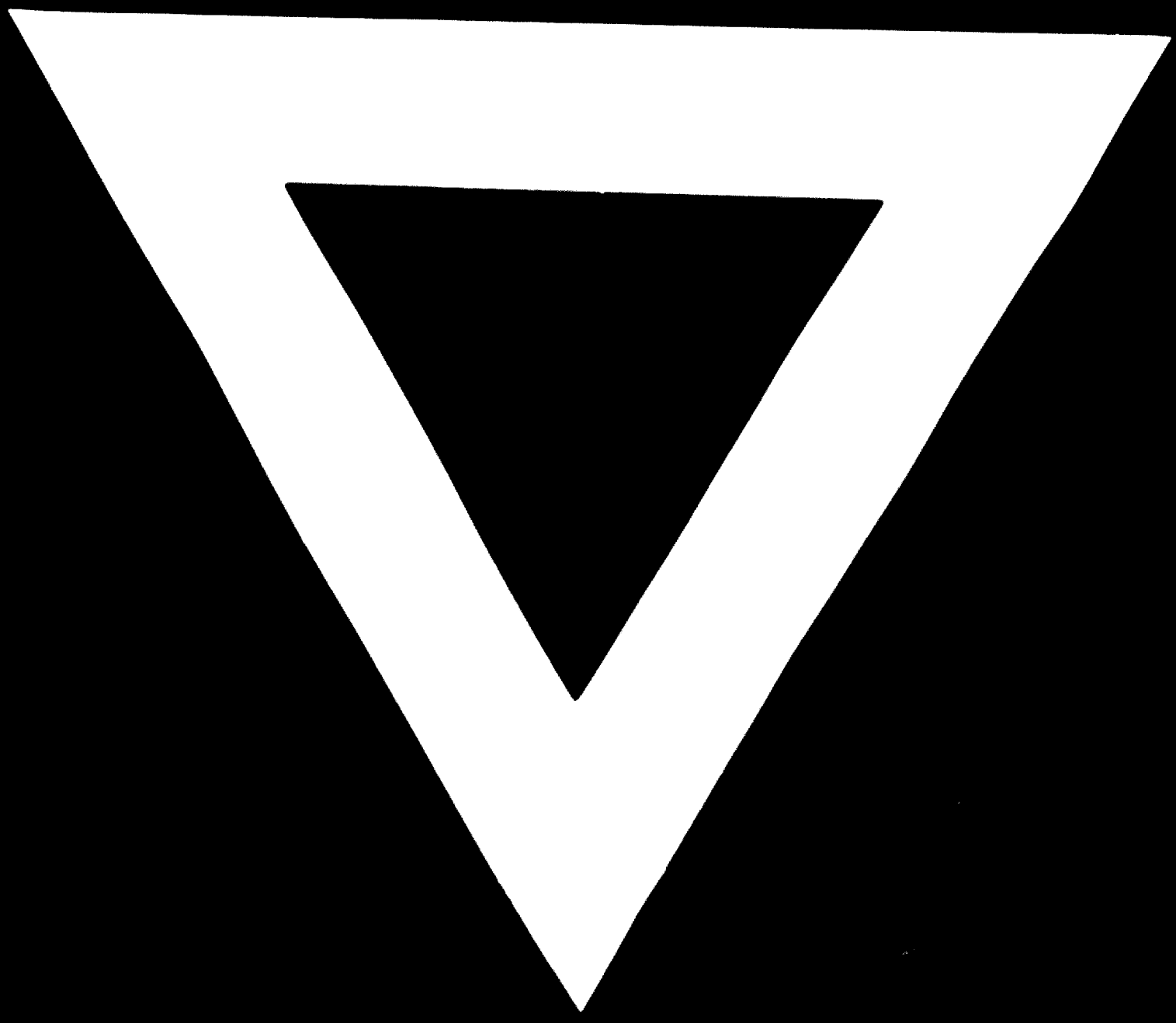
Examples:

Solvent	Flash point °C	Explosion limits vol. %	MAC value cm^3/m^3
Butyl acetate	+22	1,4 - 7,6	200
Ethyl "	+12	3 - 19	1000
White spirit	+30	0,7 - 4	500
Xylene	+23	1 - 6	200
Toluene	+ 6	1,3 - 6,7	200
Trichlorethylene	-	-	100
Turpentine	+35-40	-	100
Acetone	-15	2,1 - 13	

MAC = Maximum air concentration

The degree of ventilation dspends on how big the painters' shop is and on the painting method. In Finland the law says that air must be changed 30 times an hour in a shop with spray application. The efficiency of the ventilation depends not only on how many m^3 we blow in or out but also where we place the ventilator.

With only universal ventilation you will never get air conditions that are good enough. On such placee where the solvent evaporation is high in spray boothe and in the neighbourhood of dipping equipments must local ventilation must be arranged. When planning the ventilation, pleaee also keep in mind that solvent vapours are heavier than air.



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