Information on ACRYLAC® water-based dispersion varnishes

General

This technical information sheet provides information about the processing, application, drying, viscosities (draining times) and organoleptic characteristics of water-based dispersion varnishes.

The technical details of specific dispersion varnishes can be found in the respective technical information sheets.

DruckfarbenEcho 1, a publication of the **huber**group, discusses fundamental data, properties and application procedures for dispersion varnishes.

Application-related information pertaining to the use of dispersion varnishes

Storage and shelf life

The varnish has a shelf life of 6 months from delivery if the container is not opened. After opening the container, the varnish should be used up as quickly as possible. After being stored for a period of 6 months, the properties of the varnish must be verified.

Our dispersion varnishes should preferably be stored at room temperature (see above).

If dispersion varnish is stored over a period of several months, this can lead to slight increases in viscosity caused by the formation of structures in the varnish, which can amount to approximately 20% of the viscosity on delivery. The original viscosity can usually be obtained again by stirring the varnish well. Only in exceptional cases will it be necessary to adjust the viscosity by diluting with water. The characteristics of the varnish are not adversely affected by such adjustments (max. 2 – 3 % water).

Avoid storage temperatures in excess of 40 °C, because they promote greater increases in viscosity.

Special varnishes have a limited shelf life; for example, thermosealable (weldable) varnishes keep for only 3 months. Please read and observe the special instructions in the corresponding Technical Information sheets.

Freeze stability

Dispersion varnishes freeze at temperatures below –5 °C (depending on the varnish type), a possibility that cannot be ruled out when transporting over long distances in winter. The important thing in such cases is that frozen varnishes are thawed slowly at room temperature in their original container. They may only be used once they have reached room temperature and been thoroughly stirred. As a basic rule, a storage temperature above 0 °C should be adhered to.

Viscosity of dispersion varnishes

(measured in acc. w. DIN 53211)

Dispersion varnishes are set to an optimum processing viscosity prior to delivery. We are able to do this, however, only if we have the following information:

- Will the varnish be processed in an indirect or direction application system in a sheet-fed offset press?
- Make and model of the application system.
- Make and model of the varnishing machine, if applicable.

In the case of dispersion varnishes, it is the draining time with a 4-mm DIN cup that is measured instead of the viscosity. The exact measuring method is defined in DIN 53211. If it should become necessary to reduce the viscosity of a varnish for reasons related to a particular application, do so by diluting with water, stirred it in slowly. Maximum dilution must not exceed 5 %, otherwise this could impair important functions of the varnish. If you wish, we can supply you with graphs of the draining time shown as a function of the degree of dilution of our varnishes.

The viscosity specified has been adjusted for a temperature of 20 °C. Large variations in temperature lead to noticeable differences in viscosity.

The purpose of measuring a draining time for a varnish is to obtain a parameter with which flow behaviour can be assessed easily and accurately enough for operational purposes.

In terms of their application, the draining time is an important criterion for specifying dispersion varnishes.

Draining times of approx. 25 – 100 s are common in offset presses and varnishing machines, depending on the application system. Dispersion varnishes are usually delivered adjusted to the draining time required for processing.

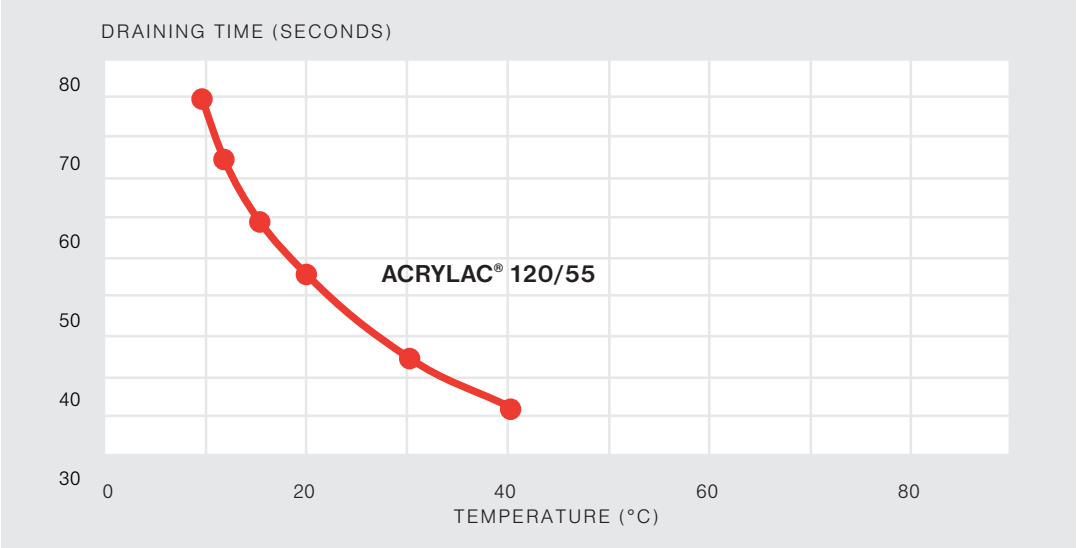
End users may need to determine the draining time:

- to check incoming materials
- to measure varnishes diluted in-house.

To ensure precise measurement, the criteria cited in DIN 53211 must be observed:

- use a DIN 53 211-4 cup (100 ml capacity)
- according to the DIN norm, the temperature of the varnish and DIN flow cup must be 23 ±0.5 °C prior to measurement. In accordance with the delivery agreement with the supplier, a temperature of 20 °C is commonly used.

Example of the correlation between temperature and draining time on the basis of **ACRYLAC® 120/55.**



Measuring draining time with a DIN cup (DIN 53 211)

Dispersion varnishes often display thixotropic characteristics after extended storage (pseudoplasticity), leading to an apparent increase in draining time. The same applies when the varnish has become „foamy“ due to vigorous agitation or pumping.

The following procedure is therefore recommended when determining the draining time of dispersion varnishes:

- Measure the temperature of the sample and DIN 53 211-4 cup and adjust if necessary.
- To reduce thixotropy, agitate the varnish without incorporating air.
- Measure the draining time using a stopwatch.
- Stop timing as soon as the stream of liquid beneath the outlet nozzle breaks for the first time.

Only through accurate measurement is it possible to prevent unnecessary or excessive dilution of varnishes, which can degrade their properties during processing (foaming) or even after drying (e.g. decrease in gloss).

DIN 53 211 can be obtained from:
Beuth-Verlag GmbH
Burggrafenstraße 6
D-10787 Berlin

Film forming

One decisive influence on the ability of the applied varnish to form a film is the processing temperature of the varnish. Our dispersion varnishes are formulated for a minimum film forming temperature (“MFT”, see DIN 53 787) of between +5 and +10 °C.

For safety reasons, the varnish should be allowed to adjust to room temperature before it is applied. Working at a temperature below the MFT usually leads to wetting and adhesion problems.

These problems can also arise if air at a temperature below 40°C is blown on prior to stacking in order to promote drying (e.g. air blade). In this case, the problems are caused by the extraction of heat through evaporation.

Processing instructions

Applying from indirect systems

The essential difference between indirect and direct application is the fact that indirect systems involve a longer transport path for the varnish, since it travels via the plate cylinder. The drying speed of varnishes for such systems therefore often needs to be reduced in order to prevent premature drying and tackiness.

If a dispersion varnish is applied from systems that allow the fount application unit to be converted to varnishing devices, we recommend that you replace the fount roller with a varnish application roller with a hardness of approx. 45 Shore and the water fountain with a varnish pan.

When applying from the water fountain of an offset press, the water fountain and fount rollers must be cleaned thoroughly. A separate fount roller set should be available. Careful adjustment of the fount rollers promotes uniform application of the varnish.

If applied too quickly, dispersion varnish tends to squeeze out at the rear edge of the sheet. It is therefore absolutely essential that you cut out the board backing under the rubber blanket to the size of the surface being varnished, in order to eliminate squeeze beads that might tend to stick. If the sheet does not occupy the entire width of the press, we recommend attaching suitable squeeze rollers or blades to the fountain roller. This counteracts any build-up or drying of varnish on rollers, the printing plate or the rubber blanket.

The backing should be cut out to a size smaller than the sheet format. Varnish must not be applied beyond the edge.

Applying from direct systems

In this case, the varnish film is transferred directly from the forme roller to the forme cylinder and from there to the stock.

It is generally advisable to work with compressible rubber blankets that are not too soft. As a rule, direct varnish application systems are less complex than indirect ones, since in most cases there are only two rollers that need to be aligned.

One particular advantage is the large quantity of varnish that can be applied, even inline, wet-on-wet. In some cases, this quantity is twice as much as with the indirect method. Dispersion varnishes used in this context can be formulated by the supplier to dry more quickly, in order to compensate for the greater film thicknesses. Installation of suitable IR radiators and hot-air blades with air extraction is essential.

Applying by means of screen roller and chambered doctor blade

Varnishing units are meanwhile being supplied in increasing numbers with such flexographic configurations where nothing but the pickup volume and the screening determine the amount of varnish transferred. It can be altered only be changing the screen roller.

The following guideline gives an idea of the amount of varnish transferred:

About 40 – 50% of the stated pickup volume of the screen roller is transferred to the substrate, e.g. if the pickup volume is 10 cm^3/m^2, 4 to 5 g/m^2 of wet varnish will be transferred.

This means that the pickup volume of the screen roller must be approx. 12 cm^3/m^2 in order to transfer the same amount of varnish as in conventional direct varnishing systems, which transfer a maximum of 6 g/m^2 of wet varnish.

These varnishing systems sometimes cause greater foaming of the dispersion varnish due to severe turbulence occurring in the chambered doctor blade. This should already be taken into account when the varnish is delivered.

We advise the pressman to inform us accordingly when ordering, so that we can make up a special low-foaming version of the varnish.

Preventing drying during processing

On the one hand, dispersion varnishes need to form a tack-free film as quickly as possible in the stack; on the other hand, they must not start to dry (pile) in the application system. Obviously,

the correct drying time is an important criteria governing the quality of a water-based dispersion varnish.

In terms of press engineering, incipient drying can be counteracted as follows:

- by pumping the varnish in a continuous circuit
- by dripping water onto the roller edges
- with indirect systems, by attaching blades and roller blades to the pickup and metering rollers.

While printing, pay particular attention to areas where no varnish is being picked up, i.e. particularly at the plate edges. If varnish builds up there, wash as soon as possible, otherwise drying varnish could create problems.

Cleaning the press

If the press is stopped briefly, spraying the plate and rubber blanket with **ACRYLAC® Fit 10 T 0606** slows down varnish drying and prevents the sheets of stock from sticking when the press is restarted. Prior to longer interruptions in production, the plate and rubber blanket must be thoroughly cleaned by washing. Cleaning can be simplified by adding approximately 5% **ACRYLAC® Cleaner 10 T 0045** to the water used for washing. In concentrated form, this solution will remove even dried-on varnish residues. The cleaning solution is miscible with water in any proportion.

Most modern application systems include pieces of equipment or functions which make manual cleaning easier. For example:

- water spray units
- before the press stops and after the printing units have shut down, a few sheets are run through the varnish applicator with the varnish application roller shut off, in order to remove varnish.

Never use ordinary washup solutions that contain naphtha, petroleum, turpentine or other similar substances.

Varnish application rate; gloss

The amount of varnish applied (wet film thickness) basically depends on the application system:

- indirect system: 2 – 4 g/m^2
- direct system: 4 – 8 g/m^2
- varnishing machine: 8 – 20 g/m^2

As a rule, varnish application should be set up such that inspection in raking light reveals a smooth, continuous coating and no squeezing at the edges. The amount of varnish to be applied also depends to a great extent on the absorbency of the stock.

One considerable difficulty is the fact that there is at present still no way to determine and display the varnish film thickness online.

The following offline methods are in general use:

- consumption measurement
- gloss measurement with prior calibration
- inductive measurement on prepared sheets after calibration (for special cases).

These measurements must be performed on a standardised basis on specimen sheets.

The degree to which varnishes and inks have dried has a great influence on gloss measurements. This is due to the “drawback effect”, i.e. a reduction in gloss after varnish application.

It often makes sense to use quick-setting, intensive inks.

The gloss achieved with dispersion varnishes is always greater with wet-on-dry application than with wet-on-wet.

Consistent amounts of varnish (i.e. film thicknesses) can be applied by varnishing units equipped with screen roller/chambered doctor blade systems. The varnish film thickness is determined by the pickup volume of the screen roller. Such systems ensure greater reliability when using functional varnishes requiring specific film thicknesses.

Areas left blank in varnished surfaces and gluing of varnished surfaces

Solvent-based systems are not recommended for downstream processing of varnished surfaces (e.g. solvent-based adhesives for film lamination), because the solvent causes the varnish film to swell. This results in decreased adhesion to the stock.

Varnished surfaces are suitable for gluing if appropriate dispersion adhesives are used. Any manufacturer of dispersion adhesives can supply products suitable for this purpose. Despite good gluing capability, the folding-box production sector today almost always leaves blank areas when varnishing. The reason for this is that the dispersion adhesives set considerably faster directly on the unvarnished, absorbent stock. As a result, shorter cycle times can be achieved in packaging machinery.

To leave blank areas when varnishing, proceed as follows:

- Compressible rubber blankets with a thick rubber layer can be “stripped”, that is cut out, to the correct shape.
- Make up a “Nyloprint” letterset plate (preferable for indirect varnishing).
- Make up a soft photopolymer plate (Nyloflex, Cyrel) for direct varnishing.
- Glue a suitable film onto an aluminium plate, then cut it out to size (risk of film detachment with longer print runs).

To prevent the blank areas from “filling in”, avoid excessive varnish application.

Fastness properties of inks

Dispersion varnishes are generally slightly alkaline. The offset inks used with them must therefore be “alkali-fast”, otherwise wet-on-wet or wet-on-dry varnishing may produce colour changes.

For this reason, the colours HKS® 33 and PANTONE® Purple can not be varnished, because they will almost definitely change colour.

The following colours (with no fastness against alcohol, solvent mixtures and alkalis) are particularly critical in this respect:

HKS® 27
HKS® 43
PANTONE® Rhodamine Red
PANTONE® Violet
PANTONE® Blue 072
PANTONE® Warm Red
PANTONE® Reflex Blue (alkali +, not suitable in low concentrations in mixed colour formulae).

Practical experience has shown that the risk of colour changes increases when very small amounts of these basic inks are used. A minimum of 15 % of these colours should therefore be used in mixed colour formulae.

Whenever varnishing such inks, you should, after starting the print run, always check the stack for any changes in colour, because it is not possible to simulate actual practical conditions during laboratory testing.

Alternatives using suitable “fast” pigments do not have identical shades and colour purity is lower.

One exception is Process Magenta. Despite low alkali fastness, these inks can be varnished with dispersion varnishes without any problems.

Bleeding due to a lack of fastness must in this connection not be confused with a “normal change in colour” after varnishing of inks showing a bronzing effect if left unvarnished.

Printing stocks

Water-based varnishes are mostly used today in the folding-box sector, where almost the only stock used is coated board. That said, metallised papers and label papers are also varnished, usually inline, wet-on-wet. One major problem still remains the poor dimensional stability of paper as a printing stock where moisture comes into play. Dispersion varnish contains a great deal of water. Stocks that are to be dispersion varnished should therefore have a grammage of no less than approx. 90 g/m^2. It is very important that the stock being used is stated, so that the right dispersion varnish can be chosen.

Health and safety at work and environmental protection

According to EU Directives or the German law on hazardous substances (GefStoffV), dispersion varnishes do not require special labelling. The dry varnish film contains no components that are either toxic or detrimental to health.

Laws relating to food

Under German food regulations, dispersion varnishes are considered suitable for the manufacture of foodstuff packages if properly processed and used. The varnishes must not come into direct contact with the packaged foodstuffs.

Disposal of dispersion varnishes, wastes containing dispersion varnish and waste water

1. Dispersion varnishes must never be dumped into sewage systems. The same applies to residues and to water that has been used to clean varnishing units and associated equipment.

   Water-based dispersion varnishes belong to water endangerment category 1 (WGK 1). Specific procedures must be discussed with the relevant local authorities, since there are no uniform guidelines on this subject.
2. Dispersion varnishes usually may be discharged into sewage systems only after removal of solids and neutralisation to pH 7.
3. Left-over varnish and residues must be disposed of as special waste.
4. Left-over varnish should not be mixed into freshly delivered material. Depending on the condition of the left-overs, this can result in flocculation and problems due to dried varnish or incompatibility.
5. When cleaning with solvents or special agents, observe all hazard warnings and safety instructions applicable to these products.

Safety instructions

Avoid contact with skin and eyes. Wash contaminated skin thoroughly with water. If contact with eyes occurs, rinse thoroughly with water and consult a doctor if necessary.

Drying of dispersion varnishes

Principle of the drying process

Dispersion varnish systems dry exclusively by physical processes. They contain about 55% water. The better and quicker this can be absorbed into the stock, the faster the drying process will be. In the stack, an additional advantage of an absorbent stock is that its reverse side can also take up moisture. Problems that arise, despite drying aids (IR radiators, hot air), when inline-varnishing stocks such as board film-laminated on the reverse side can be attributed to the absence of this absorption capability.

Dispersion varnishes dry for the most part by absorption of the water. The amount of drying that occurs by evaporation of water is relatively small and usually overestimated.

The importance of these two processes can be expressed roughly as follows:

- absorption 70 %
- evaporation 30 %

Film formation in dispersion varnishes is largely complete even when 20 – 30 % of the water is still present in the varnish ("immobilisation point").

The time necessary for drying is determined by the:

- absorbency of the stock
- evaporation rate of the water
- specific properties of each varnish.

Film formation problems arise if the processing temperature of a dispersion varnish is below the minimum film forming temperature (MFT). This is usually set to between +5 and +10°C, specific to the particular varnish type.

Drying aids

For a given stock, drying can be accelerated only if residual water is quickly evaporated from the varnish film. This can happen, however, only if the evaporated water is also removed from the surface.

The following methods are in common use today in the industry:

- A combination of a hot-air blade and infrared radiator is a reliable way to promote drying. The convective heat transferred by hot air is not sufficient, in the time available, to produce appreciable heat transfer and consequently evaporation of water. Simultaneous use of short- and medium-wavelength IR radiation effects rapid energy transfer and therefore rapid heating of the varnish and the stock surface. The hot air, with its relatively low humidity, serves primarily to "scrape off" the water-vapour-laden boundary layer above the varnish and carry it away.

  Cold air is unsuitable, since evaporative cooling can damage the varnish film.
- The hot air, which is now carrying water vapour, must be extracted. The volume of air extracted should correspond to at least the volume of hot air blown in.
- Hot air flow and IR radiator output are optimum when the following temperatures are measured in the delivery stack:

  Paper: approx. 8 – 10°C above the temperature in the feeder stack
  Board: approx. 10 – 15°C above the temperature in the feeder stack
  (assuming an optimum room or stack temperature of 20 °C).

  The temperature in the delivery stack must be measured using a fast-response instrument, so that the drying equipment can be set such that the temperatures stated above are not exceeded.
- At high press speeds, an extended delivery is advantageous as it aids installation of the drying equipment and makes it more effective.
- Excessive short-wavelength IR radiation can cause blocking in the stack, especially if thick ink films are being printed. In particular, dark inks are heated up a lot and cause "sticking" in combination with the varnish film.

Alternative drying methods

High-frequency (microwave) dryer

The mechanism of this drying method, which uses the principle of the microwave oven, should be ideal. However, there are limitations that have so far kept its use limited:

- field breakdown (short circuit) caused by metal parts, such as grippers
- field breakdown with thick varnish films, caused by very high water concentrations
- field breakdown with inks containing metallic pigments (gold or aluminium).

General

1. The hot air used for drying must not interfere with the operation of the spray powder unit. The powder unit should therefore always be installed after the drying section.
2. In presses equipped with an air cushion drum, the filter cartridge should be replaced frequently, so that the air flow can provide an initial “pre-drying” effect.
3. The basic principle is always to dry only to the point where the stack is tack-free. Additional energy is ineffective.
4. Non-absorbent stocks, or stocks with low absorbency, require measures to accelerate drying. The same also applies when ink coverage is very high (>250%). In this case, we recommend you use quick-setting, intensive inks, and if necessary under colour reduction (UCR) from the repro.
5. Blister varnishes should be dried as completely as possible, since thick varnish films are required with these products (depending on the mass of the contents being welded in). In addition, these varnishes form “softer” films than ordinary gloss varnishes and therefore have a greater tendency to block in the stack.
6. Cooling the sheets with cold air after they have passed through the drying section usually has little effect. If air stream cooling is used, dehumidified air should be used.
7. Only special dispersion varnishes with wet blocking resistance are allowed to be used for double-sided varnishing. We recommend you allow a drying time of approx. 48 hours before performing the second pass.

Our production programme includes a comprehensive range of varnishes with different drying and gloss properties. For assistance in selecting the most suitable product for a specific job, we recommend you contact our technical service department:

Phone +49 (0)89 9003-327
Fax +49 (0)89 9003-540

Properties of dispersion varnishes

Rub resistance

The drying speeds of dispersion varnishes are set so that the varnishes are tack-free in the stack with standard wet film thicknesses. Nevertheless, light spray powdering – preferably with starch powder – is required for very thick ink films with wet-on-wet application. The rub resistance of varnished products depends to a great extent on the stock and the quantity of varnish applied, and is reduced by powdering. Rub resistance should not be tested until 48 hours after application. Avoid using calcium carbonate powder.

Heat-sealing resistance

Since heat-sealing resistance depends on a number of parameters, we recommend testing on a case-by-case basis under field conditions. The following details are required for testing:

- sealing temperature (°C)
- sealing time (s)
- pressure (bar)
- film type
- number of film plies
- package contents.

Suitability for printing with hot-stamping film

The adhesion of hot-stamping film depends on the substrate used (paper or board).

As a rule, most high-gloss and standard varnishes can be printed with hot-stamping film although some specially formulated varnishes may produce better results in this respect. Different hot-stamping films have also been found to vary in their suitability.

If special substrates are used (in particular, cast-coated or mother-of-pearl stocks), it is advisable to carry out a test prior to starting the production run. In cases of doubt, laboratory tests may also be helpful.

Effect of moisture and package contents

When moisture will be acting on a varnish film, a varnish with particularly good wet blocking resistance must be used; for example, when varnishing on both sides and laminating printed, varnished paper onto board, moisture can cause the varnish layer to begin redissolving. In such cases, varnishes with very good wet blocking resistance must be used, since otherwise blocking will occur.

Varnishes must always be appropriately tested in cases where package contents (moisture, grease, alcohol, surfactants, alkalis, etc.) may have an influence on the folding box.

Organoleptic characteristics

Extensive investigations have shown that our dispersion varnishes do not produce any changes in the odour or taste of package contents in the foodstuff sector.

The test method used was the “Robinson test” as specified in DIN 10 955 (Testing of packaging materials and packaging for foodstuffs), which is also standard in the food industry.

Despite this, there have been reports of cases in which a definite odour was perceptible in the stack – especially after varnishing of coated papers intended for products such as food wrappers and board – and about which complaints were made.

Stock	Robinson test odour evaluation	
	without varnish	with varnish
Paper 1	0.5 – 1.0	0.5 – 1.0
Paper 2	1.0 – 1.5	3.0

The table above shows a typical example.

Although the same varnish was used under identical conditions, there are considerable differences between the two stocks.

The reason was found to be that a number of grades of paper and board generate a relatively strong odour simply by being moistened with plain water. Dispersion varnishes contain approximately 55 % water, so this interaction, probably with components of the paper coating, can lead to odour generation.

We therefore recommend that you conduct preliminary tests similar to the Robinson test to determine whether or not the stock selected is suitable.