TECHNICAL GUIDE LINE for Laminating with LOCTITE LIOFOL Laminating Adhesives

PRODUCT DESCRIPTION
LOCTITE LIOFOL laminating adhesives are 1- and 2-component polyurethane solvent-based, solvent-free (100 %) and waterbased laminating adhesives.

Application Areas:
Combinations of various Plastic films and foils including paper can be used for the manufacture of duplex or multiplex laminates. The most common substrates are polyethylene, polypropylene, polyester, Polyamide, unplasticized PVC, PVDC, polycarbonate, cellophane, foil. The composition of the laminate depends on the intended use of the laminate.

Basically there are two types of laminates:
- technical laminates and
- laminates for food stuffs

Laminates used in food packaging have to meet special requirements and have to comply with strict food packaging regulations (please refer to technical data sheet of used product).

Product Properties:
Laminates made with LOCTITE LIOFOL laminating adhesives exhibit high bond strengths, excellent transparency and heat seal strengths. The product range consists of adhesives for standard laminates, medium performance laminates and particularly foil laminates as well as boil and sterilisation proof laminates.

LOCTITE LIOFOL laminating adhesives perfectly meet the often conflicting requirements of high solids content - low viscosity - high initial tack - good wettability.

These requirements can especially be met by chemically crosslinking adhesives which despite a relatively long pot life rapidly cure between the laminated substrates.

The cured adhesive film is transparent, odourless, elastic, age-resistant and heat seal resistant within the usual sealing temperatures.

DIRECTIONS OF USE
Preliminary Statement:
Prior to application it is necessary to read the Safety Data Sheet for information about precautionary measures and safety recommendations. Also, for chemical products exempt from compulsory labeling, the relevant precautions should always be observed. Please also refer to the local safety instructions and contact Henkel for analytical support.

Coated Films:
Cellophane: Usually the uncoated side is laminated. If the coated side of cellulose nitrate lacquered cellophane has to be laminated it has to be used as secondary web. When laminating PVDC-coated films, inferior transparency may be achieved. Whenever laminating coated, metallised or co-extruded substrates it has to be made sure that the adhesion of the coating allows the use as primary (carrier) web.

Pre-Treatment:
Polyolefines require a surface pre-treatment in order to increase the surface tension to an extent that wetting and laminating will be possible. The common treatment method is the Corona discharge. When laminating, the following minimum treat levels have to be achieved:
- Polyethylene 41 mN/m
- Polypropylene 38 mN/m

The level of treatment which takes place directly after film extrusion usually decreases during longer storage and may be reproduced before laminating if required. The treatment level can be found out by wettability tests with testing inks or by contact angle determination.

Films with a large amount of slip agents usually have a treatment level of less than 40 mN/m.

Packed Goods:
Aggressive ingredients from packed goods (acids, spices, perfumes, detergents) may adversely affect the bond strength of the adhesives used. Although a short term test at increased storage temperatures (e.g. 100 h at 60 °C) may already show initial basic evaluation data we recommend long-term storage tests under practical conditions.

Suitable Solvents:
Preferably Ethylacetate. Acetone and Methylthylketone (MEK) are also suitable but due to its strong odour MEK may not be used in many cases. Alcohol, Isopropylacetate and aromatic solvents (Toluene) are not suitable. The water contents - particularly with regard to the manufacture of high performance laminates - should not exceed 300 ppm since a reaction with humidity increases the viscosity, worsens the wettability and reduces the pot life.
Dilution:
Most of our solventbased LOCTITE LIOFOL adhesives have a solid content of 60-75 % and have to be diluted before use in order to achieve a machineable viscosity which normally is suitable at 30 - 40 % solids content.
Special "high solid" products are available for a ready-for-use concentration of 40 - 50 % solids content.

Mixing:
In order to achieve a homogenous mixture with the curing agent it is necessary to dilute the resin with the solvent first. Only then the hardener has to be added by intensive stirring. As the LOCTITE LIOFOL 2-component products are supplied in conveniently proportioned containers, dosing errors as far as the hardener is concerned should not occur.

Pot Life:
The pot life depends on the following factors: the solids content of the laminating adhesive, the temperature and the water content of the solvent used. Ready-for-use adhesive solutions when kept in unopened containers have a pot life of 1 - 2 days without substantial viscosity increase. An increase in viscosity during operation may occur due to loss of solvent caused by evaporation and can be adjusted by redilution (with automatic viscometers if available).

If the solid content of the mixture is too low after the solvent has been added and the viscosity is too low the wet coating weight has to be increased accordingly. When reconditioning adhesive mixtures from the pan the following information should be observed:

Upon longer machine stops we recommend to add LOCTITE LIOFOL CL 2000 into the roller gap to stop the reaction of the adhesive. This will increase durability of the rubber rollers.

Reconditioning:
Remaining adhesive mixtures in the pan tend to thicken faster than freshly prepared mixtures in closed containers due to the contact with humidity in the coating unit. In order to limit the viscosity increase we recommend to separate the remaining adhesive mixture after work and to store it in closed containers overnight. Such a reconditioned mixture should only be added proportionally to the freshly prepared adhesive mixture. The reconditioned adhesive mixture should not be used for high quality and heat resistant laminates as a possible pre-reaction may adversely affect the quality of the laminates.

Application:
The solventbased LOCTITE LIOFOL laminating adhesives can be applied with all common roll coating systems. Depending on quality and properties of the films/foils coating advantages can be obtained by choosing one of the three application systems: direct gravure, roll reverse and roll kiss coat.

Direct gravure coating rolls allow continuously even coating weights when using adhesive solutions with constant solids. Most suitable for the direct gravure systems are either pyramidal screen rolls with for instance 60 screen cells per cm which have the shape of an inverted square pyramid and which are divided by a screen wall or lines screens with for instance 48 diagonal hatchure lines per cm. By varying the solids of the adhesive solution it is possible to slightly change the coating weight by using the same screen roller. PUR dispersion are preferably applied with 60 hatchure lines in reverse direction.

Smooth rolls are suitable for direct and reverse coat. Roll reverse coat is recommended for rough film surfaces or for printing inks with bad wetting properties in order to improve wettability.

Usually the laminating adhesive is applied on the printed substrate provided that the substrate at the same time is more resistant against thermal and mechanical stress when passing the drying tunnel.

Application Weight:
Depending on the film or foil combination and the intended use of the laminate, the application weight may range from 1.5 to 3.5 g/m² dry.

Higher coating weights are required for:
- fully printed substrates
- laminates exposed to thermo forming
- substrates with rough absorbent surfaces
- deep-drawable laminates depending upon intended use

When using gravure rolls the coating weight can be adjusted by altering the solids of the adhesive mixture. Smooth rolls allow adjustment of the applicator gaps. Substantial decline of the dry adhesive weight during lamination will lead to a deterioration of transparency, bond strength and wettability which can only be partly adjusted by increasing the reverse roll speed of the transfer roller and by increasing the temperature of the nip roller.

Application Weight Control:
The coating weight can be determined during production by comparing the laminated surface of the substrate and the amount of adhesive used. A simplified method is to ascertain the difference in weight between laminated and pure substrates or coated and uncoated carrier films.

Colouring:
The solventbased and the waterborne LOCTITE LIOFOL systems can be coloured with adhesive compatible dyes. Depending on the amount of dyes used colouring may reduce bond strength. When using new dyes or new colour-shades the compatibility with the adhesive has always to be checked.

Manufacture of Laminates

Laminating Process:
Solvent-based, solvent-free and to a minor degree waterbased polyurethane adhesives are used for laminating films/foils. As the adhesive coating has completely dried before lamination of the substrates takes place this laminating process is called "dry lamination". Apart from this process, new methods for the use of solvent-free or waterbased laminating adhesives have been developed.
Drying:
The solvents in the adhesive mixture must have completely evaporated before the laminating process takes place. For this purpose the coated web has to pass through a drying tunnel. Drying temperature, machine speed and heat sensitivity of the film have to correlate with each other.

Working Conditions:
As a matter of principle we recommend to always heat up the nip roller. Temperature: 50 - 90 °C (depending upon the film/foil quality).

Advantages compared to laminating with cold rolls:
- better flowing properties and higher yield of the adhesive
- higher transparency and bond strength of the laminates

Substrates sensitive to temperature and pressure must be laminated with cold nip rolls, provided that the films/foils have smooth surfaces and exhibit good wetting properties.

Cleaning:
Coating systems and other machine parts should be cleaned immediately with a suitable solvent such as Ethylacetate or MEK. Hardened adhesive can be removed with LOCTITE LIOFOL CL ECOPOWER. Upon machine stops LOCTITE LIOFOL CL 2000 neutralises the adhesive and increases durability of the rubber rollers. Separate datasheets for our cleaners are available on request. During clean up local safety regulations as well as specifications of the supplier have to be adhered to. Skin contact with the solvents has to be avoided. Hands must be protected with gloves.

Curing:
Curing is usually achieved after 8 days of storage at room temperature so that further processing of the laminates can be effected. High performance laminates may require a curing period of up to 14 days. Curing temperature should not turn below 18 °C, otherwise the chemical crosslinking reaction will be delayed. Higher temperature will increase the curing speed.

STORAGE
LOCTITE LIOFOL
Technical Guide Line laminating adhesives and hardeners usually have a storage life of 9 months (unless otherwise stated) when stored in the original unopened containers at temperatures between -30 °C and +30 °C (-20 °F and +86 °F). Waterborne laminating adhesives can be stored 6 months at 0 °C - 30 °C.

Once opened, containers have to be closed tightly again and the material should be consumed within a short period

The day of manufacture is mentioned as a four-digit number next to the batch number and production site on the label.
10-digit code, e.g. 25 0234 5687
First 2 digits = production site
next digit = year of manufacture (0 for year 2000)
the following 3 digits = day of manufacture (234th day)
the following 4 digits = batch number

ADDITIONAL INFORMATION
Film Requirements:
Film additives - particularly slip agent content in LDPE, MDPE and CPP films - packed goods, printing inks, pre-treatment and coating of films are of significant importance to the intended use of the laminates and may affect the performance properties either straight away or later

The most common additives are slip agents, antioxidants, antistatics, antiblocking agents, stabilisers and plasticizers.

Calendar auxiliaries often form a film on the surface of unplasticized PVC. Wetting difficulties can be avoided by using a solvent suitable for diluting the adhesive and a well heated nip roller.

Plasticizers, e. g. soft PVC plasticizers, tend to migrate into the adhesive and may therefore reduce bond strength and heat resistance.

Cellophane film additives may, depending on the composition, interfere in the crosslinking reaction of the laminating adhesives and thus delay or prevent crosslinking.

Due to the different effects of film additives it is always necessary to run practical trials before going into production or when replacing films/foils.

Slip Additives:
Depending on strength and amount, slip additives may also adversely affect the laminate properties. The slip additives most widely used are oleaacidamide (OL) and eruccaacidamide (ER). Slip agents provide the films with better machineability due to a lower coefficient of friction (C.O.F.). According to our experience larger amounts of oleaacidamide are not so effective on the bond strength of our Liofol adhesives as comparative amounts of eruccaacidamide. On the other hand, with eruccaacidamide results a lower C.O.F. than with oleaacidamide. The amount of slip agent is also depending on the thickness of the film. With the same amount of slip agents thicker films in the laminate show a lower C.O.F. and thus a lower bond strength than thin films. Before laminating films containing slip additives practical trials have to be made in any case.

Printing Inks:
When laminating printed substrates it has to be made sure that the printing inks are suitable for laminating and that they are compatible with the LOCTITE LIOFOL adhesives. Due to different binding agents and colour systems testing can only be done by means of trials on the laminating machine under operational conditions (wetting, heat exposure, solvent retention). Alcoholic solvents retained from printing inks may react with polyurethane adhesives thus leading to quality problems.
Product Range:
We offer the following types of flexible packaging adhesives:

- Adhesives for wet lamination of Foil/Paper, Film/Paper, Foil/Cardboard and Film/Cardboard
- Waterborne PU-Dispersions for dry lamination
- Adhesives for high-gloss lamination
- Primer for extrusion and PVDC-coating
- Solvent-based laminating adhesives for flexible packaging
- Solvent-free laminating adhesives for flexible packaging
- Laminating adhesives for special applications
- Primer for extrusion and PVDC-coating

Cleaners:
- **LOCTITE LIOFOL CL ECOPOWER:** Cleaning agent for PUR laminating adhesives
- **LOCTITE LIOFOL CL 2000:** Co-Solvent and softening agent upon machine stops

These directions are given generally. Some products are requesting special conditions for achieving optimised results. Please ask for the Technical Data Sheet, which is available for each single product as well as the Material Safety Data Sheets.

Disclaimer
Note:
The information provided in this Technical Data Sheet (TDS) including the recommendations for use and application of the product are based on our knowledge and experience of the product as at the date of this TDS. The product can have a variety of applications as well as differing application and working conditions in your environment that are beyond our control. Henkel is, therefore, not liable for the suitability of our product for production processes and conditions in respect of which you use them, as well as the intended applications and results. We strongly recommend that you carry out your own prior trials to confirm such suitability of our product.

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