

Processing Recommendations for RAPID-Polyurethane Resins (manual and machine processing)

General

Shelf Life

The shelf life of both components is 12 months from production date in closed cans.

Incoming Inspection / Storage

Defective containers must not be used. Received goods need to be in a sheltered area that complies with below mentioned properties, on a drip pan, and must not be left outdoors.

The prescribed storage of resin and hardener is in a cool, dry and well vented location at ambient temperatures between 5 °C and 40 °C, ideally at 20 °C on a drip pan. Non-conformance with the thermal storage requirements of minimum 5 °C may cause crystallization of transparent hardener visible as opaque appearance or chunks. Reversion of crystallization can be achieved by warming up to 50°C for a short period of time. This should be followed by an intense homogenization (stirring).

At temperatures above 40 °C the sedimentation process of fillers in the resin component may be accelerated, making the processing and homogenization more difficult.

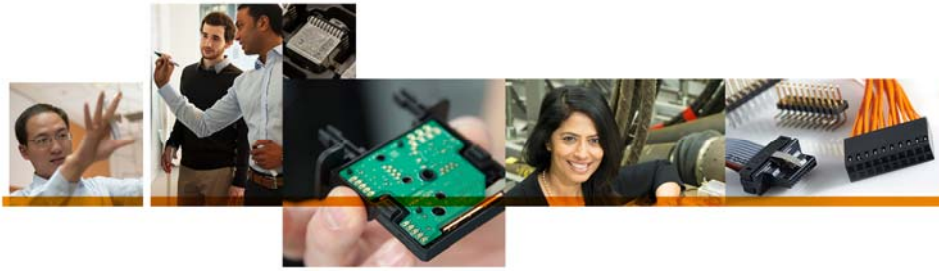
Material Preparation

Before opening the containers, covers and closures need to be free of dust and dirt. Before further processing, the temperature of both components need to be leveraged to ambient temperature of the production environment.

If the hardener was stored for a short period of time (<24 h) below 5°C, it needs to be stored for at least 48 h at room temperature (min. 20 °C) before processing according to the instruction.

Resin and hardener need to be protected from moisture. Multiple opening and homogenization may cause moisture absorption. In case the moisture scavenger is saturated and the moisture induced damage becomes visible after processing with the hardener only (creation of voids and bubbles). If there is need to frequent opening of containers, it is recommended to transfer the media into smaller units.

It is recommended to stir and homogenize the material before withdrawal, if last withdrawal wasn't done same day. Filled resin components in particular may show sedimentation of fillers at the bottom of the containers.



Consequently this may influence the quality of the end product due to wrong mixing ratio. “Unfilled” resins contain solids (moisture scavengers), which may set, too and therefore should be homogenized as well.

Homogenization can be done manually with a rod or spatula or machined by a mixer or a drilling machine with applied mixer. To avoid air being trapped during machined stirring, we recommend a mixing speed of 100 to 300 rpm.

After homogenization it is recommended to de-vent the material in vacuum (at 100-200 mbar for 5-30 minutes. Air humidity during potting and curing must not exceed 45 %.

Manual Processing

With manual processing, it is recommended to adjust quantity of mixed components to the amount that can be potted within the pot life. It has to be considered, that the pot life is reduced with increasing mixing quantity.

At mixing quantities of less than 100 g deviations in weighing may have a significant impact to the quality of the quality of the end product. Definition of corrects mixing ratio are stated in the Technical Product Data Sheets. To achieve the exact mixing ratio it is required to use a sufficiently precise lab balance. The deviation must not exceed 2%. (Example: mixing ratio 100:10 -> acceptable deviation between 100:9,8 to 100:10,2) Excess of hardener may cause reaction with air moisture and creation of bubbles. Excess of resin acts as softener.

Both components need to be mixed in a clean and dry cup for 2-3 minutes until a homogeneous mixture is formed. When using a machine for mixing, a T-shaped mixing rod applied under the surface avoids air trapping in the liquid. Note that areas close to wall and bottom of the cup are mixed properly, too. Before application of mixture to the product, we recommend to fill the mixture in a second clean cup to separate from the material sticking to walls and bottom.

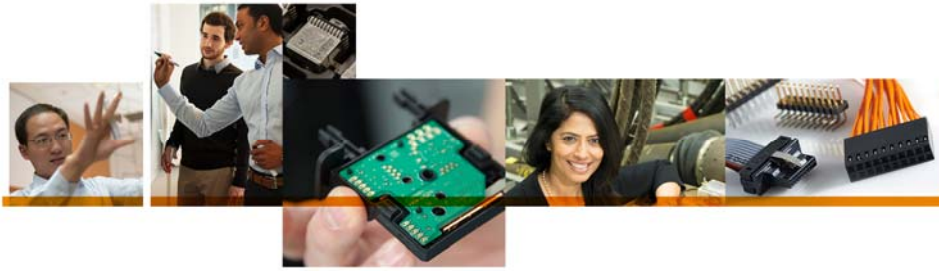
If necessary, the mixture can be de-aerated in vacuum for 2-3 minutes at 20-100 mbar.

Machine Processing

Filling of Storage Tanks

A mix-up of storage tanks at filling must not happen, because a complete cleaning of tanks and tubes, eventually renewal of tubes may become necessary.

For filling of hardener tank, multi-use vacuum lances must not be used, as remaining hardener in the lance will harden with air moisture and will block the openings.



Before filling the hardener tank, a visual check of the hardener has to be conducted. If tarnishing occurs in the transparent hardener, it may be damaged due to too cold storage or by contact with moisture when the storage bin was not closed properly.

For the resin components, particularly for filled products, it is recommended to measure the density after homogenization in the original containers. The deviation must not exceed +/- 0,03 g/ml.

After filling the storage tanks, cover sealing need to be cleaned and checked for proper sealing function. To avoid setting of fillers of the resin component, periodical stirring is recommended. Example: Daily 2x 30 minutes at 50 to 100 rpm during breaks or prior to start of shift.

For feeding components with gas pressure 0,5 bar - 1 bar for the hardener, resp. 1 bar - 3 bar for the resin component is sufficient.

If the pressure is changed, the mixing ratio needs to be re-checked.

The pressure gas (air or nitrogen) needs to be dried, ideally by a central dryer, alternatively by gas bottles and / or additional drying with Silicagel.

Pressure free storage tanks need to have venting valves with Silicagel to protect the material from moisture.

Vacuum process of both components

When processing potting in vacuum, both components need to be evacuated prior to processing.

The mixer of the resin storage needs to be covered with resin sufficiently and should be located in the tank as deep as possible.

Under vacuum, stirring of hardener may be necessary to avoid skin building at the surface.

Process under atmospheric pressure

If process is conducted under atmospheric pressure, stirring of hardener is not required.

The storage tanks for resin and hardener need to be sealed air-tight. When pressure balance is done with air, it needs to be dried with Silicagel.

Pre-heating of Resin Component

When filled resin component are pre-heated, a circulation pipe is mandatory, to avoid sedimentation of fillers in the tubes. Circulation is recommended to start directly in front of the mixing head. Depending on type of resin, a pre-heating up to 40 °C - 60 °C may be applied. Increasing temperature further does not reduce the viscosity significantly but reduces the pot life and increases sedimentation of fillers.

Heating of hardener is not recommended.



Operation

We recommend to adapt the filling volume of the storage tanks to be adapted to the consumption; the content should be used up within one week.

Before every shift, we recommend to measure and document the mixing ratio and the density of the resin component. The result of the mixing ratio measurement must not deviate by more than 2% from the required value. The deviation of density must not exceed +/- 0,03 g/ml.

Potential process to determine the mixing ratio: The amount of each component per shot is taken from the mixer, weighed and the true mixing ration calculated.

Additionally, a mixed shot can be taken and hardened according to supplier's instruction. The surface of the specimens needs to be free of streaks, and appear homogeneous when cut. As additional criteria Shore hardness can be measured. The deviation from the prescribed value shall not exceed +/- 5 units.

For selection of mixing tubes of static mixers: If the mixing tube is too short, mixing of components may be insufficient. With long mixing tubes and short pot life, there is a risk of blockage by hardened material.

Using dynamic dispensing machines, selection of the optimum mixing speed is important: too low speed may result in poor mixing, while too high mixing speed may add thermal energy causing shorter pot life.

Breaks in operation may require idle shots to avoid gelation in the mixing head. It is necessary, that the cycle time is lower than the pot life. Increasing the material's temperature by 10°C cuts the pot life by half.

Depending on the processed material, it may be necessary to rinse the mixer after 3 idle shots, or to change the mixing tube. At continuous operation of the dynamic mixer it is recommended to clean / rinse the dynamic mixer in fixed intervals.

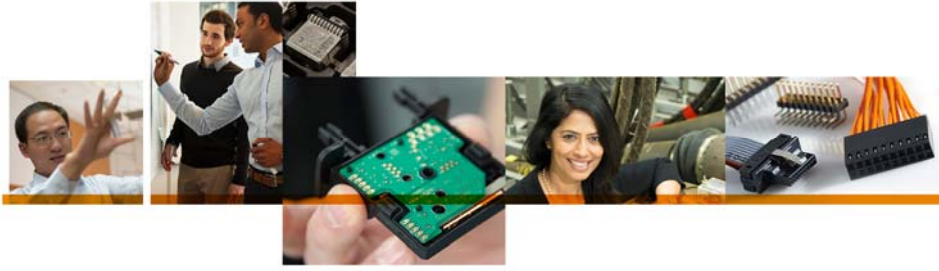
For selection of cleaning media please contact the machine manufacturer.

Downtime of Equipment

In pressurized storage tanks, pressure needs to be reduced to ambient pressure, but tanks need to be kept closed from ambient air.

Operating dispensing machines at vacuum, we recommend to switch off vacuum over night or over weekends, otherwise cause damage of the components may occur. Material heating needs to be switched off as well, while the circulation is recommended to continue to operate.

It is recommended to operate the dispensing machines at least twice a week and the content in the storage tanks is recommended to be used up within one week. Otherwise materials in storage tanks shall be replaced and connecting hoses need to be rinsed with fresh material.



For longer downtime all storage tanks need to be emptied and cleaned.

Preparation of devices to be filled

The surfaces of devices to be potted must be free from adhesion reducing substances (oils, mold release agents, flux, etc.).

Every surface has some moisture from ambient atmosphere on it, which may cause creation of bubbles during the hardening process. Desiccation for 1-2 hours in 60-80°C is sufficient. This is important for coils and similar product with multi-layer wound wire.

Pre-heating of devices is influencing the material flow in a positive way as the heat is reducing the viscosity and by the faster filling the air is getting out faster as well. Temperature up to 80°C does not damage the potting material, but accelerates the curing process.

Curing

When curing at ambient temperature, a 95% cross linking is achieved after 12-24 hours. Cross linkage is completed after 7-14 days at ambient temperature.

To accelerate the curing process, the parts can be cured at 60-80°C for 1-3 hours.

Maintenance of Dispensing Machine

Maintenance needs to be conducted in accordance with the machine manufacturer's specification.

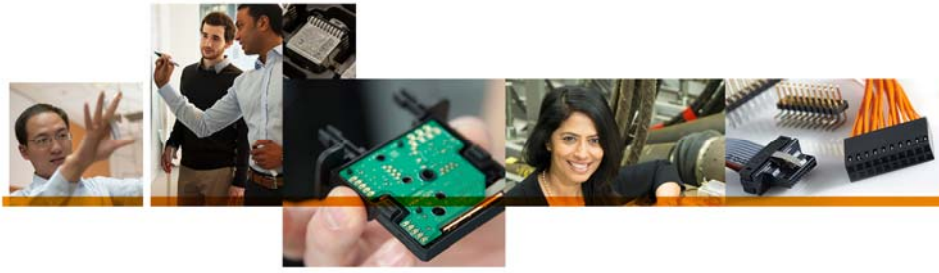
Mistakes in Processing

Sticky / incomplete hardened potting material

Potted devices need to be cured for 1-3 hours at 60-80°C. If hardness does not increase the amount of hardener was too low. This may be the result of insufficient mixing or the mixing ratio was not correctly maintained. Another reason could be that the mixture was in contact with other chemicals (non-hardened material, solvents, oils, release agents).

Partially soft / hard areas of potting material

Insufficient mixing leads to insufficient or excessive cross linking (inhomogeneity). This may result from areas at walls or the bottom of mixing containers used for manual mixing. This can be avoided, if the mixture is filled in a second container prior to potting of the device, to avoid use of material sticking to walls and bottom of the mixing container.



Creation of Bubbles

Bubbles in the potted end product may have different reasons:

a.) *Air, which was trapped during the mixing process, which could not disappear during the potting process*
This can be avoided to evacuate the mixture or the product after potting in vacuum.

b.) *Ascending air that exits to the surface from certain areas, when gelation has already started.*

Pre-heating of devices to be potted lowers the potting material's viscosity and allows air to easier float. Curing at ambient temperature causes to cure slower and allows air to escape.

Adaptation of filling process (orientation, inclination, force bottom-up filling) may be necessary to get air better from the potted device.

c.) *Large bubbles caused by moisture.*

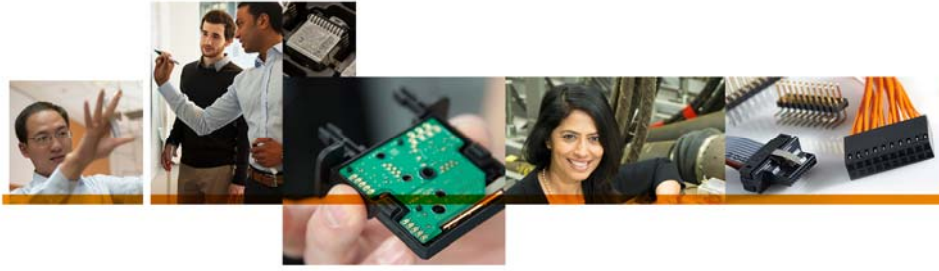
- Multiple homogenization or opening of storage container may cause excessive moisture absorption. To check this, set up test mixtures with correct mixing ratio in a dry can and cure it in an oven for 1-3 hours at 60-80°C. If large bubbles are found all over the cross section in a cut specism, the resin is damaged and must not be used further.
- High humidity on surfaces may occur with housings made from polyamide or with coils. Typical failure pictures are bubbles close to walls or above coils. We recommend potting after drying of devices in an oven.
- Contact with chemicals (non-hardened material, solvents, oils, release agents) prior to curing must be avoided. When doing multi-step potting, first layer needs to be completely cured.

Change of Properties

Pot life / Hardening

The pot life of the offered materials is in the range between 10 and 50 minutes but may vary for certain formulations. Data sheets for all materials are available upon request. A modification of pot life can only be achieved by changing the amount of catalyzer in the resin and not by changing the amount of hardener. For manual processing a potting material with longer pot life is recommended.

Curing of resin can be accelerated in an oven at 60-80°C or with infrared radiators (depending on the thickness of the resin layer).



Viscosity

The viscosity **cannot** be modified by changing the mixing ratio between resin and hardener. Increasing the resin component's temperature, its viscosity as well as the mixing viscosity can be lowered. This shortens the pot life of the mixture. If this does not have the desired effect, a different potting material needs to be selected. Please contact your supplier for recommendations.

Hardness

The hardness **cannot** be modified by changing the mixing ratio between resin and hardener. Changing the mixing ratio leads to a change in cross linking and influences electrical and mechanical properties. If a different hardness is desired, a different potting material needs to be selected. Please contact your supplier for recommendations.

Please contact our application engineering department for further technical consultancy (resin@krueger-werke.de).

While TE has made every reasonable effort to ensure the accuracy of the information in this brochure, TE does not guarantee that it is error-free, nor does TE make any other representation, warranty or guarantee that the information is accurate, correct, reliable or current. TE reserves the right to make any adjustments to the information contained herein at any time without notice. TE expressly disclaims all implied warranties regarding the information contained herein, including, but not limited to, any implied warranties of merchantability or fitness for a particular purpose. Product designations or names may be protected trademarks.