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Coating Innovations
for Electronics

TI TECHNICAL INFORMATION

Selection criteria and processing instructions for casting compounds/casting resins

TI 15/2

This technical information sheet contains detailed and extensive information and advice that must be considered for a safe and reliable processing of our casting compounds/casting resins.

A processing according to our instructions is mandatory to achieve optimum results.

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Contents

1. Application

A large number of today's electronic control units, sensors and components for the electronics and electrical engineering industries are largely insensitive to vibration and temperature fluctuations. However, only the protection from environmental influences, interfering electric currents, etc. facilitates a wide range of application for those products, even under extreme conditions. As a rule, this protection can be achieved by encapsulating the electronics with high-quality casting compounds and casting resins. On the strength of over 35 years of experience covering the entire field of electronics, particularly as regards casting resins and casting compounds, LACKWERKE PETERS can offer solutions for a variety of different requirement parameters.

2. Requirements

Experience has demonstrated that the most different demands are made of casting compounds/ casting resins, for instance:

- low heat development in the curing phase as well as low shrinkage pressure after curing
- encapsulation of electronics against humidity, moisture and aggressive media such as acids and various chemicals
- dielectric properties to protect components from interfering electric currents (EMV)
- mechanical stability
- elasticity to compensate material stress in the case of thermal shock loads across as wide a temperature range as possible
- little embrittlement even at temperatures far below freezing point.

These can be supplemented by individually different requirements, such as:

- temperature resistance, for instance the compliance with certain thermal classes based on DIN IEC 60 085
- self-extinguishing properties as per UL 94
- both high transparency and light transmission with casting resins used in the field of optoelectronics and optical sensors
- camouflage and protection from direct access by potting, casting of electronic components

A single casting compound is naturally not capable of meeting all requirements. Under item 3 "Choice of types", the casting compound types based on different binder systems are described and their individual special features and preferred ranges of application presented.

3. Choice of types

You will find a current and complete overview of our casting compounds and resins in the survey reports of group 3 “Casting compounds, transparent“ and group 4 “Casting compounds, opaque“. On our report manual CD and on our website, survey reports can be accessed in the “Products“ section.

3.1 Polyester systems

These systems show a very intensive heat development in the curing phase and a considerable shrinkage resulting after the curing process. For the majority of the components used, the high temperature load during the curing phase is excessive. The shrinkage of the casting may lead to mechanical damage of the components or a separation of the components from the substrate. Furthermore, an unpleasant odour of varying intensity is produced by the monostyrol contained in those systems. The positive properties of polyester systems, such as the very good resistance to the different media, cannot make up for the disadvantages enumerated above. That is why our product range does not contain any casting compounds on polyester basis.

3.2 Epoxy systems

Besides their excellent adhesion to the different substrates, casting compounds based on epoxy resins stand out for their high mechanical strength and hardness. However, with the exception of the Wepox casting compounds of the series **VU 4085**, even casting compounds on epoxy resin basis substantially warm in the curing phase - as do the polyester systems - (refer to item 6 "Curing instructions"). Although the warming is lower than with polyester systems, it is too high for most applications in electronics. Furthermore, it must be verified whether the shrinkage pressure of the Wepox casting compounds affects the function of the potted component. For instance this can be the case when utilising pressure-sensitive components like ferrite cores.

Casting compounds and casting resins based on epoxy resin are frequently employed as casting compounds for insensitive components and as heat-conducting casting compounds for all kinds of solenoids.

3.3 Silicone-rubber systems

Silicone-rubber casting compounds and casting resins have an ideal attitude towards heat development in the curing phase because no heating worth mentioning occurs (refer to item 6 "Curing instructions").

The silicone-rubber systems are of particular interest because of their high permanent temperature resistance (thermal class H = 180 °C or higher), their high elasticity and repairability. Silicone-rubber systems can be cut so that, in case of a replacement of defective components, the cast component can be cut free by means of a cutting/scratching tool and replaced. Casting can be resumed after the repair.

There is a general difference between addition cross-linking and condensation cross-linking silicone-rubber systems.

For the use in hermetically encapsulated housings, we recommend the application of addition cross-linking types, because the use of condensation cross-linking types may result in a resoftening (reversion) of the casting compound owing to low molecular separation products in the cross-linking process which is not the case with addtion cross-linking systems. Since the binders prescribed in silicone-rubber systems are relatively expensive, those systems should preferably be used when high temperature stability and, at the same time, high permanent elasticity are required. When merely a high permanent elasticity but not a high temperature resistance is required, highly elastic polyurethane casting compounds can be a genuine alternative.

3.4 Polyurethane systems

With polyurethane systems, the curing reaction is coupled with a low heat development (refer to item 6 "Curing instructions") and the volume shrinkage after the curing phase is low. Further, the polyurethane systems manufactured by our company are available in a wide range of hardnesses and elasticities and guarantee almost universal applicability of these products, not least due to their good mechanical and chemical resistance.

4. Casting compounds/casting resins for sensor technology

According to "Brockhaus", the German encyclopedia, sensor technology or sensorics is the scientific/ technical discipline - section of metrology - which covers the development and application of sensors.

Sensors are the sensory organs of the technical world. They are high-tech products because they can see, feel, even smell and taste. By means of miniaturization and integration with microelectronic components, tiny, highly intelligent micro-sensors can be produced. For this new technology, we also produce "intelligent" protective lacquers, casting resins and casting compounds.

The requirement profile for casting compounds/casting resins for sensor technology generally does not differ from that for other electronics (refer to item 2).

Of the casting compounds/casting resins mentioned in item 3, however, those listed in the following table are particularly recommended for use in the field of sensor technology:

Field of application / Temperature range	- optical sensors - illuminated displays	- proximity switches - capacitive sensors - temperature sensors and many more	- sensors with UL requirement (flame class UL 94 V-0)
- 40 to + 90 °C	**VT 3402 KK series** **VT 3404 LS**	**VU 4453 series**	**VU 4444/31 SB-WB** **VU 4458 SB** **VU 4459/41 SV-HF**
- 40 to + 120 °C	**VT 3601 E**	**VU 4452 series**	**VU 4452/41 SV-HF**
- 40 to + 165 °C	**VT 3601 E**	**VU 4445**	———
- 40 to + 200 °C	**VT 3601 E**	**VU 4691 E** **VU 4694 E**	———

Definition of indices: VT = casting compounds, transparent, VU = casting compounds, opaque, E = elastic, HF = halogen-free, KK = crystal-clear, LS = light diffusing, SB = hardly flammable SV = self-extinguishing, WB = weather resistant, /31 = mixing ratio, in this case 3 : 1

5. Processing

The processing of the casting resins/casting compounds is effected in three steps:

1. Preparation of the individual components (resin component A and hardener component B)
2. Mixing of the components
3. Casting in moulds and/or embedding of components

5.1 Preparation of the components

Since the solids contained in some resins can settle after prolonged storage, it is suggested to carefully stir the highly viscous resin component A prior to removing it from the original containers, without, however, stirring air into it. In order to remove possible air inclusions, it is advisable to evacuate the resin component A at about 30 mbar. The time required for a good evacuation can be considerably reduced by heating component A to about 40 to 50 °C.

ATTENTION:
As the processing time (pot life) is reduced when mixing the warm resin component A with the hardener component B, the resin component A should be cooled down to room temperature prior to mixing in order to ensure unrestricted processing of the mixture.
The original containers must be closed carefully after the components have been removed in order to protect them from moisture.

5.2 Mixing of the resin component A and the hardener component B

The mixing ratio of the components A and B is indicated in parts by weight on the container labels. The two components of our casting compounds (resin component A and hardener component B) are packed in the correct mix ratio. The volume of the container of component A is sufficiently large so that the entire quantity of component B can be accommodated. When using a different batch volume, the components must be weighed according to the mixing ratio. If mixing is effected volumetrically, the corresponding parts by volume must be converted based on the mixing ratio and the specific gravity of the components A and B.

Mechanical stirring units should be used for the mixing process; stirring time should be 10 minutes, if possible. Make sure that no air is stirred in during the mixing phase. Our **Technical Information sheet TI 15/10** "Processing of 2-pack systems" contains detailed information regarding "correct" mixing. **TI 15/10** is available upon request. On our report manual CD and on our website you will find technical information sheets in the "Service" section.

Since 2-pack casting compounds/casting resins have a limited processing time (pot life), the batch volume should be just sufficient to enable perfect processing during the pot life.

5.3 Manual casting and embedding

In order to achieve a perfect casting, the following instructions should be observed:

- Prior to casting, ensure that the surface of the components to be potted with the casting compound/casting resin is clean, grease-free and dry.
- Pretreatment of the components to be cast
  Mould release agent
  Casting compounds/casting resins based on polyurethane/epoxy resin have a good adhesion to almost all substrates. If the casting compound is to be removed again after curing, the surfaces of the components to be cast must be pretreated with a mould release agent (refer to item 8).
  Grip coating
  Generally, silicone-rubber casting compounds do not have good adhesion so that the base on which a good adhesion is to be effected has to be pretreated with a grip coating (refer to item 8).
- Avoid air inclusion
  During the mixing of resin component A and hardener component B, air is frequently stirred into the mixture. If no or inadequate evacuation of the casting compound/casting resin compound is effected after the mixing process, this air remains inside the compound or at its surface in the form of air bubbles - particularly in the case of high-viscosity casting compounds/casting resins. On the one hand, this will prevent the formation of a closed, homogeneous surface and on the other hand, the electrical and mechanical final properties are impaired. In order to remove the air bubbles, we suggest that you evacuate the casting compounds/casting resins before or, if possible, directly after the casting process.
  It is also possible to stir the hardener component B into the resin component A heated to 40 to 50°C. By mixing the hardener component B with the heated resin component A, the viscosity of the mixture is reduced so that air bubbles will escape more easily.
  ATTENTION: The mixing of the warm resin component A and the hardener component B reduces the processing time (pot life).
- Insufficient flowability with complicated mould design
  In order to improve the wetting of component geometries which are difficult to access, it has proven to be particularly practical to heat the component and/or the mould immediately prior to the mixing process in addition to mixing the heated resin component A with the hardener component B as mentioned above.

5.4 Processing in mixing and dispensing units

In order to promote reliable processing, particularly in the case of casting compounds/casting resins with a short pot life, we suggest using mixing and dispensing equipment. The use of a mixing/dispensing unit guarantees independence of the processing time/pot life. Since the mixing ratio is indicated in parts by weight, the corresponding parts by volume must be converted based on the specific gravities of the components A and B when volumetric mixing and dispensing equipment is used (also refer to **TI 15/10** "Processing of 2-pack systems").
Capable manufacturers of such equipment can be named upon request.

6. Curing instructions

Casting resins and casting compounds cure at room temperature or through heat application. The individual drying conditions are specified in the relevant technical reports. The curing/cross-linking of casting compounds/casting resins is based on an exothermal reaction, i.e. heat is released in the curing process which accelerates the curing of the compound.
General rule: The larger the casting compound quantity, the higher the temperature and the faster the curing cycle.
Contrary to silicone-rubber and polyurethane resin casting compounds/casting resins, with which the temperature will not exceed approx. 40 °C in the course of the curing process - even in the case of large quantities - a substantial temperature increase can occur during the curing phase when using epoxy resin casting compounds/casting resins. Depending on the epoxy resin system, the temperature with casting compound quantities of > 1 kg can well exceed 100 °C. Since many components in electronics and electric engineering do not withstand such high temperatures, we suggest stepwise processing, i.e. casting, incipient hardening, casting, final curing, when casting large quantities.

ATTENTION: Regarding thermal curing, it should be taken into consideration that - owing to higher heat conductivity - cast- metal parts and many other materials heat and/or cool faster than the casting compound. In order to avoid internal mechanical strain caused by excessive temperature differences between component and casting compound, a thermally cured casting compound should not be cooled down in cooling units (e.g. refrigerators), but (slowly) at room temperature.

6.1 Control of through-hardening

The through-hardening of casting compounds/casting resins can be checked by measuring the Shore hardness. The hardening process is completed when the Shore hardness measured has reached the value indicated in the relevant technical report.

7. Error analysis (Trouble Shooting)

Principally, the use and processing of casting compounds/casting resins is very reliable. However, if errors still arise, unnecessary costs can occur.

The following table highlights typical causes of errors and indicates effects and remedies:

Error	Cause	Remedy
1. Casting compound will not cure thoroughly	Mixing fault (mixture not homogeneous)	1. Carefully stir resin component A prior to removing it from the original containers 2. Check mixing ratio 3. Carefully mix resin component A and hardener component B
	Component B has become useless owing to absorption of moisture	Since the hardeners of some casting compounds can react with air humidity, opened containers must be protected from moisture by closing them properly.
2. Considerable formation of bubbles on the surface („foam“)	Large quantities of air stirred in during the mixing process	1. Avoid air inclusion by mixing carefully, if necessary, reduce stirring speed (refer to **TI 15/10** "Processing of 2-pack systems") 2. Check agitator Propeller stirrers that stir in considerable quantities of air should be replaced by paddle stirrers or stirring basket (refer to **TI 15/10**) 3. Evacuate casting compounds/casting resins before or, if possible, directly after the casting process 4. Heat resin component A to about 40 to 50 °C prior to mixing **ATTENTION:** When adding the hardener component B to the heated resin component A, the processing time/pot life is reduced. 5. Heating of the component and/or casting mould to about 40 °C - 50 °C; mini transformers can be heated to 80 °C without problems.
	Moisture on the surfaces to be cast	Before casting make sure that the surfaces of the parts to be potted are clean, grease-free and dry.
3. Considerable expansion of the casting compound under thermal load.	Air inclusion inside the casting compound.	Refer to item 2.1 - 2.5
4. Incomplete wetting of the components to be cast	Excessive viscosity of the casting compound (too thick)	1. Use casting compounds/casting resins of lower viscosity. 2. Refer to items 2.4 and 2.5.

8. Auxiliary products for the processing of casting compounds/ casting resins

- **Sealing mastic**
  For the sealing of casting moulds and for cable outlets or connecting wires, we recommend the use of the sealing mastic **EH 13.271**, a sealing mastic that is characterized by the following properties:
  solvent-free, self-adhesive, permelastic, easily deformable and highly temperature-resistant.
- **Mould release agents**
  Epoxy (EP) and polyurethane resins (PUR) have a good adhesion to almost all substrates. If the casting compound is to be removed again after curing, the surfaces of the components to be cast must be pretreated with the mould release agent **EH 13.650**.
  The aqueous release agent **EH 13.650** ensures a safe, clean and easy removal of the casting compound even in case of complicated mould configurations. **EH 13.650** is solvent-, silicone- and grease-free.
  The application onto the clean and grease-free surface is effected by means of spraying, dipping, by brush or wiping with a lint-free cloth. The frequency of the application depends on the geometry and the surface finish of the component to be cast and should therefore be determined by practical testing. Drying at room temperature results in a non-adhesive white film that prevents the casting compound from sticking.
- **Grip coating**
  Generally, silicone-rubber casting compounds do not have good adhesion so that the base on which a good adhesion is to be effected has to be pretreated with a grip coating.
  The following grip coatings are available:
  Grip coating **G 4660** for addition cross-linking silicone-rubber casting compounds.
  A single application (by brush, spraying, dipping) of the grip coating **G 4660** onto the cleaned and degreased base results in a white, non-adhesive film after the drying phase; together with an addition cross-linking silicone-rubber casting compound, this film creates a highly adhesive connection during the polymerization process.
  Grip coating **G 4610** for condensation cross-linking silicone-rubber casting compounds:
  The grip coating **G 4610** is coloured red transparent so that a secure identification of the pretreated areas is possible. Pretreatment can be effected by brushing-on, spraying or dipping. Casting can be effected after drying.

9. Cleaning

To remove casting resin or casting compound residues from implements, casting moulds, etc., we recommend the use of our cleaning agent **R 13.780**. However, cleaning should be effected immediately after the processing of the casting resin or casting compound because cleaning becomes more difficult the further the curing progresses.

Do not use the cleaning agent as a thinner or for washing hands since solvents remove the natural grease from skin.

10. Literature

In addition to the recommendations given in this technical information sheet, we can provide technical reports and technical information sheets written and compiled by members of our staff. Please visit our website at **http://www.peters.de** or click on the "Service" section on our report manual CD for further information.

Any questions?

We would be pleased to offer you advice and assistance in solving your problems. Free samples and technical literature are available upon request.

The above information as well as advice given by our Application Technology Department whether in verbal or written form or during product evaluations is provided to the best of our knowledge, but must be regarded as non-binding recommendations, also with respect to possible third-party proprietary rights.
The products are exclusively intended for the applications indicated in the corresponding technical data sheets.
The advisory service does not exempt you from performing your own assessments, in particular of our material safety data sheets and technical information sheets, and of our products as regards their suitability for the applications intended. The application, use and processing of our products and of the products manufactured by you based on the advice given by our Application Technology Department are beyond our control and thus entirely your responsibility. The sale of our products is effected in accordance with our current terms of sale and delivery.

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