Silikal MMA resins
for cold plastic road markings
and traffic area coatings

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Silikal Technical Documentation

Road Markings

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Silikal's production and administrative headquarters in Mainhausen, Frankfurt am Main, Germany

... for more than 60 years!

It all started in Frankfurt am Main back in 1951. Having initially concentrated on screed construction, at the start of the 1960's we then began to develop new, modern synthetic resin-based products for the dynamically growing construction sector; primarily for floor coatings and engineering applications in trade and industry. We have continued on that path with countless research projects to date.

For the last few decades we have been active across the world, in Germany, Switzerland, Italy, Austria and almost all other countries in Europe. We are also active in North and South America, Asia, Africa and Australia.

As the markets developed, so did Silikal. With ever changing requirements demanding constant product developments, the product range grew from year to year. Today, our customers can choose from a large number of MMA, epoxy or PU products and specialities, whether coatings, sealants, mortars or PU concrete, tested to CE, TÜV and AgBB standards. On offer are resins for marking and orthopaedic applications, adhesives for filling cracks or testing tensile strength and resins for design floors or tactile guidance systems for the blind, to name just a few.

We pride ourselves on our advice, service, speed – and of course quality! Our response when customers need us is as fast as the curing times of our reactive resins. A whole team of specialists, technicians, applications engineers and developers are on standby for you, and our service really is "round the clock"! You can contact our hotline "live" 24 hours a day, even on Sundays and public holidays.

One thing you can be sure of: we're always here for you!

TÜV PROFI CERT
73 100/104 663

Certified Quality and Ecology Management Systems Reg. No. 73 100 / 104 663

AgBB GEPRÜFT

Tested in accordance with the AgBB framework for use in interior rooms.

Silikal® made in Germany seit 1951

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Technical Documentation
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Important note

The general technical documentation contains the following important and sometimes additional data sheets and chapters:

- **Data sheet for SILIKAL® hardening powder**
- **General advice on application**
- **The substrate**
- **Fillers and pigments**
- **Chemical resistance**
- **Information on safety and protection**
- **Storage and transport**
- **General cleaning advice**

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Technical Documentation
Issue SM 1.01.A
June 2016

Cold plastic MMA resins for road and safety markings are essential ...

... in order to ensure safe traffic guidance, e.g. to indicate the direction of travel, show pedestrians where they can safely cross the road, but also to warn of hazards and mark off areas for local public transport, etc. Silikal cold plastic MMA resins offer a number of important advantages:

- Low viscosity: our clear resins are pumped and handled very easily for further modification
- Good adhesion to asphalt without primer and also to concrete after priming
- Rapid curing times of 5–15 minutes and tack free after 15–40 minutes
- excellent resistance to UV radiation and weathering
- High abrasion resistance

Cold plastic based on MMA resins from Silikal ...

… offers significant advantages over conventional markings such as hot melts or dispersions:

- Heating to over 200 °C is not necessary as in the case of hot melts
- Much more durable than hot melts or dispersions
- Safe and easy application by hand or using a draw box
- easy manufacture of sprayable versions

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This technical documentation ...

... describes the road marking systems recommended by Silikal for the most important applications. The documentation also contains technical data on the Silikal marking resins and additives as well as general advice on application and regulations. Silikal reserves the right to make technical changes.

Silikal **guarantees** all the values listed in the technical data sheets, whereby tolerances are, of course, possible and deviations permissible in accordance with the individual application or processing. The correct processing of Silikal materials is always subject to correct handling by a qualified and experienced expert in the field. Silikal places great value on training and technical support for its customers, as well as providing comprehensive and application-specific advice, also on site when required. The recommended guideline recipes for the individual systems provide the best opportunity for achieving optimum results, but do not, however, relieve the user of the task of carefully checking and assessing the prevailing conditions in each individual case. In cases of doubt, tests should be carried out or Silikal should be contacted before the products are utilised. Through their many years of experience, Silikal users have wide-reaching knowledge and skills which go beyond the limits of application described here.

It is important to recognise that risks can arise in such cases. Silikal accepts no guarantee relating to individual applications which were not expressly agreed to in writing This refers, for example, to cases which go beyond the normal and generally accepted use, or observations in brochures or other documents which are of an exclusively descriptive nature. It also goes without saying that an officially prescribed and correctly executed road surface (e.g. road markings that are visible in the dark) cannot rule out accidents occurring at this point and that no guarantee can be assumed in this regard. As a general principle, always exercise caution when liquids, cleaning agents etc. come into contact with the finished surface and consult Silikal in cases of doubt. The same applies to the use of materials that have not been approved by Silikal.

It must be borne in mind that the task of a road marking or coating (in addition to other characteristics) is primarily to inform or warn road users and serve as a surface wear layer. Wear of the surface, in particular anti-slip surfaces, is subjective and dependent on the intensity of use, which means that it is often not possible to predict the absolute service life. When handled and maintained properly, road markings and coatings made from reactive resins often represent the best and most cost-effective solution. Silikal points out that all currently applicable standards and regulations have to be observed, including safety and environmental regulations, DIN, ISO and EU standards, data sheets and guidelines from the BEB (Federal Association of Screed and Floor Covering) and BASt (Federal Highway Research Institute), property rights of third parties and the recognised rules of sound engineering practice.

Updates

This technical documentation can be found on the Silikal website at **www.silikal.de** where it is updated regularly.

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Silikal MMA resins ...

... for cold plastic road markings and traffic area coatings

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Description

Based on the reactive monomer/polymer, mono- and multifunctional esters of (meth)acrylic acid, Silikal MMA resins have a wide range of properties varying in flexibility, reactivity and degree of whiteness/visibility.

Curing is initiated by creating a chemical reaction (polymerisation) by adding a catalyst, also called a hardener. A 50 % benzoyl peroxide (BPO) powder is particularly suitable for this task. Once the hardener has been added, the curing process cannot be stopped. A pot-life of five to fifteen minutes is usual, whereas the tack-free time ranges from fifteen to forty minutes depending on the type of resin, amount of hardener and temperature.

In general, the resins are of low viscosity and can be pumped and handled very easily for further modification. Depending on the intended use and properties, different pigments, fillers and, in some cases, additives have to be added, preferably in a paint factory or similar facility providing paint dissolver mixers. Ready-to-use cold plastic is usually packed into 10 kg or 25 kg tin pails and can be stored at least for six months at a moderate temperature below 25 °C. Some guide formulations are given in the product data sheets and are subject to customer modification, depending on national product regulations and specifications (e.g. skid resistance, colour, light reflection, curing time).

Resins are normally supplied in 180 kg steel drums or 900 kg IBC containers.

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1. Nowadays, solvent-based paints are used less frequently for road marking systems due to the environmental impact of acetone, MEK or toluene.

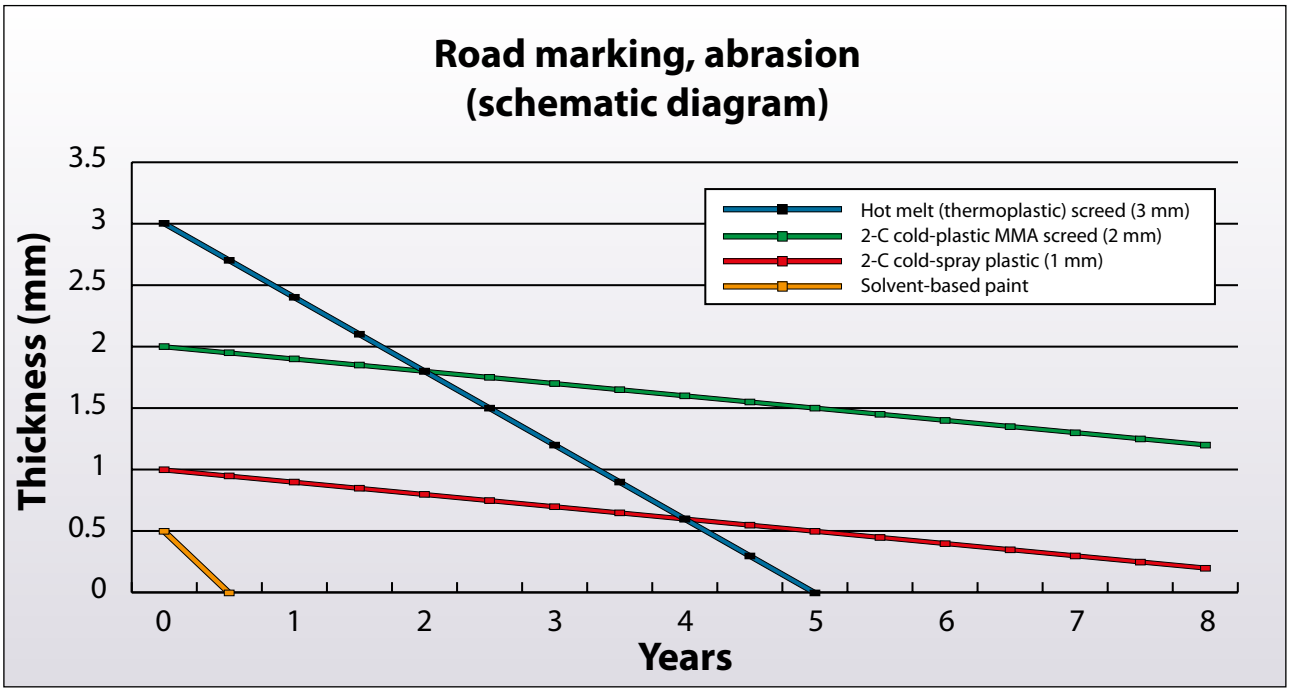
   Recently developed road marking paints partly use dispersion polymers as their binding agent, meaning they primarily contain water as the solvent thinner. This means they are very environmentally friendly but are a lot less durable.

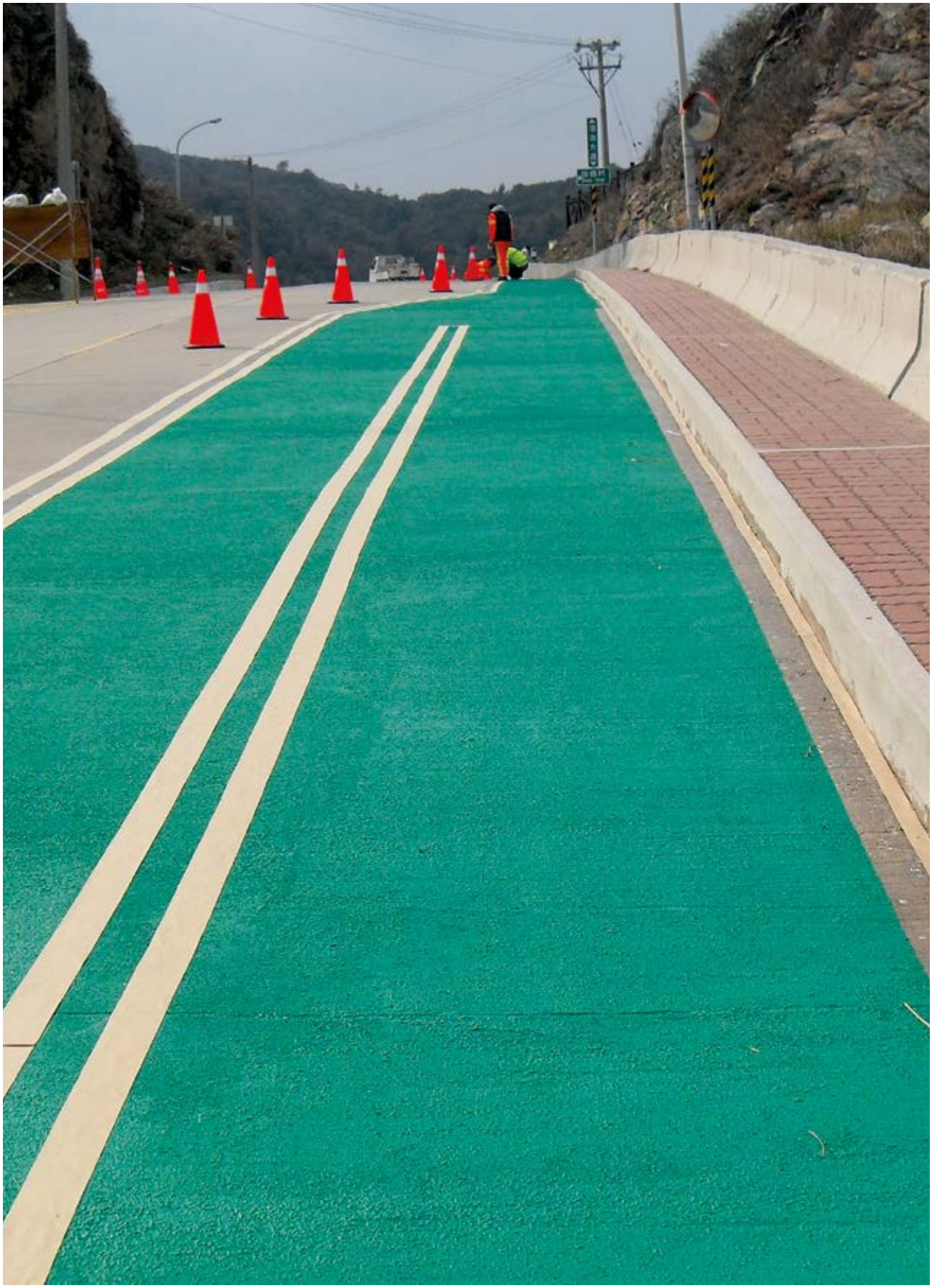
2. **In the last 50 years, hot melts or thermoplastics** have become an attractive alternative for permanent road markings. The hot melt is supplied as a solid block, bar or bucket and is then melted in a cooker at high temperatures between 200–260 °C. The melt then has to be extruded manually or using a machine with slit dies (draw box principle) and solidifies once cooled. Compared to MMA cold plastics, hot melts are highly abrasive, meaning they are durable up to two to three years depending on the traffic load.

   Similar to the extruded hot melts, they can be diluted with high-boiling solvent thinners or oils to achieve a lower viscosity. Under high temperatures, these low-viscous hot melts can then be sprayed onto a surface with a thickness of roughly 1 mm. However, the service life of these melts is then shorter, lying somewhere between those of solvent-based paints and hot melts.

3. For temporary road markings, such as on road construction areas, **PVC sheets with adhesives** are very convenient and popular, because they can be removed easily after construction has been finished without damaging the asphalt.

4. Then there are the **cold-plastic permanent road markings based on methyl methacrylate,** also known as MMA, methacrylate or acrylate resins. A standard cold-plastic compound can be applied at a thickness of 1.5–2.0 mm, or 0.4–1.0 mm as a spray-on version. Application is performed either manually (trowel, draw box) or automatically using small or large machines. At a thickness of 2 mm, the lifetime on highways is estimated to last for six years on average and up to 10 years in the case of good quality asphalt. Spray-on cold plastics with a thickness of 1 mm have a correspondingly lower lifetime of around 2–3 years.





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Without the use of primers, cold plastics adhere well to asphalt but not as well to concrete. For this reason, concrete has to be pretreated with a suitable concrete primer in order to seal off the capillary pores of the concrete surface. Most application faults are caused by unsuitable substrates or application on surfaces with temperatures above +35 °C.

Today, roads and poured asphalt contain bitumen in various quantities as a binding agent. This is why we speak of non-cured binding agents, which can become irrevocably deformed under load and heat (cold flow or Newtonian fluid). In order to counteract this effect, resins for cold-plastic markings have to be set flexibly so that they can follow the movements of the substrate to a large extent. Hard cold-plastic compounds, differing shock temperatures, high thickness and high content of bitumen in the substrate inevitably result in the formation of cracks, at least on larger coating areas such as zebra crossings, keep-clear zones and cycle paths).

If the adhesion to a surface containing bitumen is to be tested, this must only be done after waiting 24 hours. The marking can be exposed to the hardest traffic immediately after tack-free time but the bitumen underneath is still saturated with monomer MMA which takes several hours for delayed curing.

MMA cold plastic markings are very abrasion-resistant. With traffic under 10,000 vehicles per day, the average abrasion is approximately 0.2–0.3 mm per year. Shorter lifetimes sometimes result, not due to traffic, but rather because of improper application of the markings such as moisture in the substrate (dew point), moisture rising from the earth (in the case of concrete) or contaminated road surfaces (dust, oil).

Reactive MMA resins have different names on the market. Examples include methacrylic resins, acrylic resins, cold plastic resins, methacrylates, MMA, PMMA, etc. No matter what name, they are all of the same nature as described above. Flexibilisation is achieved by means of copolymerisation with longer-chain acrylates or by adding polyurethane acrylate prepolymers. Generally speaking, plasticisers are no longer common-place. As described in many books and as you may know yourself, these resins are fully weather-resistant: UV radiation, heat, snow and ice as well as rain do not affect the properties.

Environmentally friendly

All our MMA resins are free from solvents. Practically all of the monomers turn solid during the hardening procedure. Only a very small monomer amount can vaporise during application and can be identified by the typical odour of methacrylates.

During manufacturing, storage, transport and application, special safety regulations are applied in line with the ordinance on hazardous substances/goods. The MMA monomer and the resin made thereof are flammable liquids with a low flash point of +10 °C. Avoid open fires and sparks, refrain from smoking and do not allow receptacles to overheat. During transport and storage, certain restrictions for loading with other substances and for storage quantities have to be observed. Further details can be found in the safety data sheets and the statutory regulations concerning hazardous goods.

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2 mm screed applied by hand with a trowel

The standard cold-plastic compound is usually supplied in small buckets or pails to the road site. An electric drill with a stirrer or dissolver disk is required for mixing. To apply the compound, all that is needed is a simple trowel and some masking tape. Draw the pattern line around a stencil using chalk and put the masking tape along the outside of the line. Roughly calculate the amount of compound required for that area (2 kg per m^2 with 1 mm thickness). The amount of hardening powder required is adapted to the substrate temperature according to the hardener table and is then mixed for half a minute (in warm temperatures) to one minute (in cold temperatures). Pour it out and smooth it without leaving trowel marks behind. Immediately scatter some glass beads with white granules (approx. 100–300 g/m^2) onto the freshly painted surface so that they can sink into the compound while it is still liquid. Remove the tape before the marking has been fully cured, so that clear and sharp edges are formed.

2 mm screed applied by hand with a draw box

Prepare the cold-plastic compound as previously described. Instead of a trowel you will need a so-called draw box made of steel plate, similar to those used for hot-melt material. Place a piece of masking tape across the point at which the marking is to start and position the draw box in line with it. Fill the draw box with the liquid cold plastic which has been premixed with hardener and pull the draw box along a side marker (straight plank, roof batten or aluminium rail) up to the end of the line. Here, an end line can be made using masking tape again or a metal sheet can be used to collect the residual material from the applicator head. Finally scatter the glass beads.

2 mm screed applied with hand-pushed machines

Some simple machines exist on the market which work according to the draw box application method. It is a device which fixes the draw box in a mobile frame and has a bottom outlet plate which can be opened and closed using a push rod. The applied thickness can be varied by means of adjusting the height on the rear plate. The width of the lines can be changed by exchanging the respective draw box.

1.5–2 mm screed applied with extrusion machines

Cold-plastic compounds can also be applied with some commercially made machines which use different adapters in various ways and hardener dosages. One method is to divide the cold plastic into components A and B, whereby component B contains no accelerator and component A has been given twice the usual amount of accelerator. This means that the BPO hardener can be added to component B for at least 24 hours without a reaction taking place prematurely. Only when both components are mixed by the machine in the extrusion cycle at a ratio of 1 : 1 will the actual polymerisation take place in the normal curing time. By then the compound can be extruded in the desired thickness and style. This application method requires precise handling in order to avoid contamination of one component with the other, e.g. in the storage tank. A similar method is used in the 98 : 2 process, in which the BPO is automatically added in the form of a paste. The actual cold-plastic compound then has the same structure as a cold-plastic compound for manual application.

Safety or structured markings for improved reflectivity when wet

For improved reflectivity in wet conditions, smooth surfaces on road markings are avoided as this results in less light being reflected back to the vehicle. Instead, individual raised points are created which allow the rainwater to drain away and thus expose the glass beads on the surface which serve to reflect the light. These can be so-called structured markings, which comprise individual drops of cold plastic placed next to each other and still appear as an enclosed white marking when viewed. This structure is created by a special machine with a built-in rotating cylinder with spikes on it. For this reason, the cold-plastic compound has to have a more thixotropic consistency than normal cold plastics. The structured markings are designed to provide increased wheel noise when driven over. They also offer improved night visibility, better durability against snowploughs and reduced material consumption.

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0.5 – 1 mm spray-on application

Special resins are available for spray-on application. These resins have a very low viscosity and faster curing time. The fillers, too, must not be coarse in this case, as the spray nozzles can quickly become clogged or worn. For this reason, coarse fillers are scattered separately. The spray machine is usually an airless spray system. The mixing ratio is either 1 : 1 or 98 : 2. Furthermore, special spray resins are available with a very high reactivity so that the paint can be sprayed on as if it were a one-component paint without hardener. The hardener is finally added separately as a mixture, either with glass beads or special BPO-coated glass beads. The wetting property of the paint must allow the glass beads to sink down the entire film thickness to provide a safe curing. The thickness is around 1 mm including the scattered beads.

1 – 3 mm traffic area coatings

Besides ordinary road markings, cold-plastic compounds can also be used for traffic area coatings, such as bus stops, bicycle lanes, walkways, restricted areas, car parks, etc. A wide range of colours can be combined in order to achieve a highly decorative appearance. Single-coat application is possible on asphalt, but concrete has to be pretreated with a suitable concrete primer and rising dampness from the earth has to be prevented (blister formation).

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Our Silikal MMA resins for cold plastic are pure binder resins. In order to formulate the right compound for the end user, special pigments, fillers and additives have to be added to the resin.

Pigments

The most important pigment for producing a white colour is titanium dioxide. There are two types available: rutile and anatase. Rutile is the more common of the two, because the resin/oil absorption factor is very low, meaning a high percentage of pigment allows a low viscosity compound which is also highly resistant to weathering. Because anatase chalks under weather conditions, a small amount can be used together with rutile in order to achieve a desired chalking (self-cleaning) effect. If a small amount of anatase is combined, filler sedimentation can be stabilised much like with thixotropic agents. The amount of titanium dioxide also depends on the own colour of the fillers to be used, which is why these should be light in colour or even white. Pigment contents of 5–10 % represent a good value. Other pigments include iron oxides or organic pigments. Organic pigments are not always stable and can lead to a reduced shelf life and light fastness of the cold plastic.

Powder fillers

Cold-plastic compounds must always be made using a sieve line with different aggregate particle sizes. Powder filler is very important since it provides a high filler content at a good flow and helps stop filler sedimentation. The particle size itself is not very important due to the fact the entire filler mix has a final thickness of between 1 µm and around 0.8 mm. This also includes the pigment powder. We suggest using non-treated types of fillers such as calcium carbonate, silica powder, cristobalite, baryte, and dolomite, since hydrophobic types can have a negative effect on the chemical reaction. Excessive amounts of powder fillers can cause increased contamination during marking.

Granule fillers

Coarse particles not only provide good skid resistance but they are also very economical and thereby help to reduce material costs. Round-shaped aggregates such as silica sand are easier to handle since the oil absorption factor is very low and a high percentage can be added. On the other hand however, the skid resistance suffers. Crushed rock minerals, such as broken calcinated quartz (cristobalite) and aluminium oxide (corundum), have a bigger particle surface so that the aggregate adheres to the resin much better and thereby creates better skid resistance. Granule fillers should have a light white colour like the powder fillers.

Glass beads

Glass beads are also granule fillers as they are usually mixed in like sand. They provide improved light reflection in the dark and can only work effectively when they are partially exposed on the surface of the marking. When mixing in (15–25 %), finer or coarser particles can be used, whereas when scattering, the glass beads should be somewhat coarser in order to avoid premature contamination with dirt. In order to improve adhesion to the resin, special silane-coated glass beads are available from glass bead manufacturers. For the 1-C spray system, BPO-coated glass beads are also suitable.

Additives

The most important additive is a non-treated, amorphous, lightweight silica powder. A small percentage (0.1–0.5 %) stabilises the fillers during storage and prevents sedimentation. Other thickeners are not suitable in our opinion.

BPO hardener (powder or paste)

Hardener must be handled separately since it will immediately start the curing process once it makes contact with the resin or compound. When operating machines according to the A/B mixing system, make sure the containers are completely clean, since a small amount of hardener is enough to start polymerisation overnight.

As BPO represents a hazardous good, particular precautionary measures have to be taken during storage, transport and processing. Refer to the safety data sheet for further details. For the dosage, please observe the temperature-dependent hardener table. The powder variant of BPO is preferable.

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Here are some examples which may lead to curing problems:

a) After a long storage period (especially in the winter), the paraffin wax contained in the resin can become separated if it is not properly stirred before being taken from the drums or IBC containers. This can result in under or overdosage of the paraffin.

b) The amount of hardener was not calculated exactly to the quantity of material. Either there is not enough or too much.

c) Depending on the resin type, the max. surface temperature must not exceed +35 °C to +45 °C. This is why black lines must always be considered in strong sunlight.

d) Unsuitable pigments, fillers or additives can lead to massive curing problems, which at the very least will cause increased contamination when the surface is driven over.

e) Concrete and mortar admixtures, such as concrete retarder, accelerator or emulsion plasticiser, silane or silicon surface treatments as well as epoxy coatings can disturb the curing process. That is the reason why we recommend conducting tests on modified surfaces. The minimum and maximum thickness must be observed.

f) Selecting the incorrect elasticity of the binding agents is often responsible for faults. Flexible resins are preferable in cold regions. In warm regions, somewhat harder resins are better as they will be less prone to contamination.

The individual products are described on the following pages. For each product, a safety data sheet is available which we will be happy to provide on request or together with a delivery. Our technical product information applies only to the binding agent specifications defined by us and does not relieve the customer or user from the task of checking the suitability of such products for use in the specific application as well as compliance with other standards.

Silikal MMA resins provide just the binder resin for you to make your own road marking compound.

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SILIKAL® R 610 HW resin

Reactive methacrylic resin for 1.5–3-mm cold-plastic road and safety markings

Expect more from your floor.

SILIKAL® R 610 HW resin is a solvent-free, rapid-curing 2-component methacrylic resin with good elasticity. It is used as a binder for manufacturing 2-component cold-plastic road markings in 1.5–3 mm thickness in combination with various fillers and scattering agents. The rapid curing time of approx. 20–40 minutes and the good resistance to water, salt, grease and mineral oil ensures that the roads can quickly be reopened to traffic. Application takes place in the temperature range between 0 °C and +35 °C (surface temperature). Approvals for finished formulations are already available on the customer side.

Application

The cold plastics manufactured using SILIKAL® R 610 HW resin are usually applied in layers of 1.5–3 mm and primarily on asphalt road surfaces, either by hand or using automatically driven cold-plastic marking machines. The thickness depends on the mechanical load and on the evenness of the surface. It is important to ensure a sufficient minimum thickness, especially in the case of heavy traffic load.

When used on concrete road surfaces, the concrete has to be pretreated (e.g. milling, shot blasting, high-pressure water blasting) and an MMA-compatible concrete primer applied. The ready to use cold-plastic compound is dispersed without lumps, with 50 % BPO hardening powder and directly onto the surface using a trowel, rake or draw box.

For the pigmentation, we recommend using titanium dioxide rutile for white paints. Small amounts of anatase can be added to increase the chalking effect, although this will also increase the thixotropy of the cold-plastic compound. Inorganic pigments such as iron oxides are suitable for coloured paints. Carbon black is not suitable as black pigment. Furthermore, many conventional paint additives, such as silicone oils, some dispersing agents or anti-settling agents based on amines are not suitable or only partly suitable as they can affect the curing process.

The standard cold-plastic compound is also suitable for safety or structured markings, whereby only the viscosity has to be adapted to the road marking machine.

Grip scattering

On most public roads, skid resistant and reflective road markings are required. For this purpose, different grains of white quartz and/or silanate glass beads can be mixed in and scattered, depending on the required degree of skid resistance. Scattering agents such as granite, cristobalite, corundum, glass beads or similar can be used after testing them for suitability. Silanate glass beads stick well to the binding agent and are better integrated in the cold plastic mixture.

Special remarks

Formulated road marking or coating compounds based on our guide formulations must be modified and matched according to the local or national requirements. Silikal does not assume any responsibility for ready to use compounds, which are out of our influence. We only guarantee the product specification of our resins.

Further information is given in our “Technical Documentation” and “Material Safety Data Sheets”.

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Cold-plastic compound, white, trowelled on or 100:2 machine application

Guideline recipe and batch quantities (examples)

Item	Component	Guideline recipe (% by weight)	Comments
1	SILIKAL® R 610 HW resin	22.3 %	Resin
2	Titanium dioxide rutile	7.5 %	Pigment
3	Millicarb OG	15.0 %	Powder filler
4	Silica sand 0.1–0.3 mm	10.0 %	Fine sand
5	Cristobalite M 72	15.0 %	Grip
6	Fine corundum 1 mm	5.0 %	Grip
7	Glass beads, 3D silanate	25.0 %	Reflection
8	Wacker HDK N20	0.2 %	Thixotropic agent
9	**Total:**	**100 %**	**Average consumption: approx. 1.7 kg/m² per mm thickness**
10	SILIKAL® hardening powder	0.3–2 %, in relation to item 9	See “Hardener dosages” table for quantities

Characteristics of R 610 HW as delivered

Property	Measuring method	Approx. value
Viscosity at +20 °C (ISO 4 mm cup)	DIN EN ISO 2431	55–65 sec.
Density D_4^{20}	EN ISO 2811-2	0.98 g/cm³
Flash point	DIN 51 755	+10 °C
Pot life at +20 °C (100 g, 2 % pbw. hardening powder)	12–15 min.	
Application temperature (substrate)	0 °C to +35 °C	
Packing	180 kg steel drums or 900 kg IBC container	
Storage time	At least 6 months in original packing, below +25 °C	

Hardener dosages (calculated on ready to use cold-plastic compound)

Temperature	Hardening powder % pbw.	Pot life (temperature of material) approx. min.	Hardening time (temperature of substrate) approx. min.
0 °C	2.0	14–18	50
+5 °C	2.0	12–15	40
+10 °C	1.5	12–15	35
+15 °C	1.5	10–12	30
+20 °C	1.0	10–12	30
+25 °C	0.5	10–12	25
+30 °C	0.4	9–11	25
+35 °C	0.3	8–10	20

Other applicable documents	Data sheet
SILIKAL® Hardening Powder	SILIKAL® Hardening Powder
General advice on application	AVH
The substrate	DUG
Information on safety and protection	SUS
Storage and transport	LUT

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SILIKAL® R 611 A / R 611 B resin

SILIKAL® R 611 A resin – methacrylic resin for cold spray road markings including accelerator
SILIKAL® R 611 B resin – methacrylic resin for cold spray road markings without accelerator

Expect more from your floor.

SILIKAL® R 611 A / R 611 B resin is a high reactive, solvent free, very low viscous methacrylic resin for sprayable 2-component road markings with different mixing ratios, such as

1. **Airless spray 100 : 2 for 0.4 – 1 mm thickness**
2. **Airless spray 1 : 1 for 0.4 – 1 mm thickness**
3. **Airless spray 1-comp. (BPO drop-in) for 0.6 – 1 mm**

When manufacturing component A with fillers and pigment, an additional suitable accelerator can also be added in order to speed up the curing time (if too much is used the colour might turn yellowish after curing!). The appropriate hardener (benzoyl peroxide) is added to component B on site just before application.

Characteristics

SILIKAL® R 611 A / R 611 B resin is just the binder resin for different cold-plastic spray formulations. By varying fillers and pigments, final properties can be achieved which correspond to national requirements and regulations of road authorities. The recipe has to be individually adapted in particular with regard to skid resistance, light reflection, abrasion and whiteness. The curing procedure is a chemical reaction initiated by adding benzoyl peroxide as a hardener to the resin. Curing time depends on the amount of hardener and surface temperature. SILIKAL® R 611 A / R 611 B resin does not change its properties when it has been applied onto the road surface. It is also resistant to many traffic chemicals like salt, oil, water or fuel. Plasticiser should not be added if possible (dirt pick-up).

Characteristics of R 611 A / R 61 1 B as delivered

Property	Measuring method	Approx. value
Viscosity at +20 °C (ISO 4 mm cup)	DIN EN ISO 2431	60 – 90 sec.
Density D_4^{20}	EN ISO 2811-2	0.98 g/cm³
Flash point	DIN 51 755	+10 °C
Pot life at +20 °C 50 g comp. A resin + 50 g comp. B resin + 2 pbw. hardening powder	10 – 12 min.	
Curing time as per above quantities	20 – 30 min.	
Packing	180 kg steel drums or 900 kg IBC container	
Storage time	At least 6 months in original packing, below +25 °C	

Applications

SILIKAL® R 611 A / R 611 B resin is just the binder resin for cold-plastic spray formulations. The characteristics and properties of the ready to use paint are also determined by the type, quantity and particle size of the added pigments, fillers, accelerator/hardener, thixotropic agents and additives.

Formulations for sprayable cold-plastic paints are similar to normal extruded or hand-applied screed cold plastics. The main difference is that the formulation has to have a lower viscosity and higher reactivity. This results in an initial increase in the resin content. By sprinkling additional coarse aggregates like glass beads and/or white granules into the white fresh marking before hardening, the resin/filler ratio automatically increases to the normal amount. For this reason, it is important to ensure a good and stable thixotropy due to the lower viscosity of the sprayable cold-plastic paint.

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1. Airless spray 100:2 for 0.4–1 mm thickness

Guideline recipe and batch quantities (example)

Item	Component	Guideline recipe (% by weight)	Comments
1	SILIKAL® R 611 A resin	18.3 %	Resin
2	SILIKAL® R 611 B resin	18.3 %	Resin
3	Titanium dioxide rutile	13.0 %	Pigment
4	Millicarb OG	15.0 %	Powder filler
5	Cristobalite powder 3000	20.0 %	Powder filler
6	Silica powder 6400	15.0 %	Powder filler
7	Anti Terra 204	0.1 %	Thixotropic agent
8	Wacker HDK N20	0.2 %	Thixotropic agent
9	Bentone 27	0.1 %	Thixotropic agent
10	**Total:**	**100 %**	**Average consumption: approx. 1.5 kg/m² per mm thickness**
11	BPO hardening paste/40 %	2 %, in relation to item 10	Quantity consistent for all temperature ranges

BPO hardening paste will be automatically added by the spray machine in a ratio of approx. 100:2 (range 1–3 % pbw.). After spraying the paint in the required thickness, the non-skid aggregate/glass beads mixture must be sprinkled immediately into the wet film.

Consumption of spray paint: 0.8 kg/m² (0.6 mm paint + scattered material –> 1 mm).

The drop-on grip aggregate shall be a mixture of white aggregate, e.g. cristobalite with 0.5 or 0.8 mm grains and silanate glass beads of a similar grain. The consumption depends on the paint thickness and will be around 0.5 – 0.8 kg/m².

Suitable airless road marking machines are available on the market. These should work according to the principle of airless spraying.

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2. Airless spray 1:1 for 0.4–1 mm thickness

Guideline recipe and batch quantities (example)

Component A (with accelerator)

Item	Component	Guideline recipe (% by weight)	Comments
1	SILIKAL® R 611 A resin	36.6 %	Resin
2	Titanium dioxide rutile	13.0 %	Pigment
3	Millicarb OG	15.0 %	Powder filler
4	Cristobalite powder 3000	20.0 %	Powder filler
5	Silica powder 6400	15.0 %	Powder filler
6	Anti Terra 204	0.1 %	Thixotropic agent
7	Wacker HDK N20	0.2 %	Thixotropic agent
8	Bentone 27	0.1 %	Thixotropic agent
9	**Total:**	**100 %**	**Average consumption: approx. 1.5 kg/m² per mm thickness**
10	Hardener	Not used	

Component B (for absorption of BPO hardener)

Item	Component	Guideline recipe (% by weight)	Comments
1	SILIKAL® R 611 B resin	36.6 %	Resin
2	Titanium dioxide rutile	13.0 %	Pigment
3	Millicarb OG	15.0 %	Powder filler
4	Cristobalite powder 3000	20.0 %	Powder filler
5	Silica powder 6400	15.0 %	Powder filler
6	Anti Terra 204	0.1 %	Thixotropic agent
7	Wacker HDK N20	0.2 %	Thixotropic agent
8	Bentone 27	0.1 %	Thixotropic agent
9	**Total:**	**100 %**	**Average consumption: approx. 1.5 kg/m² per mm thickness**
10	Hardener paste BPO/50 %	2–6 %, in relation to item 9	Quantity consistent for all temperature ranges

Before filling the road marking machine, BPO hardening powder is added to component B at a quantity of approx. 4 % (in relation to the quantity of component B) (range 2–6 % pbw.). However, the quantity of component B mixed with hardening powder must be just enough for application on the same working day, as the mixture may jellify if it is left for a few days. Prevent the tank from warming up. Contamination of the two components during storage must be avoided at all costs. After spraying the paint in the required thickness, the non-skid aggregate/glass beads mixture must be sprinkled immediately into the wet film.

Consumption of spray paint: 0.9 kg/m² (0.6 mm paint + scattered material –> 1.0 mm).

The drop-on grip aggregate shall be a mixture of white aggregate, e.g. cristobalite with 0.5 or 0.8 mm grains and silanate glass beads of a similar grain. The consumption depends on the paint thickness and will be around 0.5 – 0.8 kg/m².

Suitable airless spray machines are available on the market. These should work according to the principle of airless spraying.

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3. 1-comp. spray application (hardener drop-in) for 0.4–0.8 mm

Guideline recipe and batch quantities (example)

Item	Component	Guideline recipe (% by weight)	Comments
1	SILIKAL® R 611 A resin	40.6 %	Resin
2	Titanium dioxide rutile	14.0 %	Pigment
3	Millicarb OG	15.0 %	Powder filler
4	Cristobalite powder 3000	20.0 %	Powder filler
5	Silica powder 6400	10.0 %	Powder filler
6	Anti Terra 204	0.1 %	Thixotropic agent
7	Wacker HDK N20	0.2 %	Thixotropic agent
8	Bentone 27	0.1 %	Thixotropic agent
9	**Total:**	**100 %**	
10	Hardener	See following text	

The BPO hardening powder must be sprinkled immediately together with the mix of anti-skid aggregates into the fresh film until full saturation. The content of BPO powder in the aggregate mix is approx. 3 % by weight (as previously described). There are also BPO-coated glass beads or anti-skid aggregates from different manufacturers on the market, which are preferable in order to prevent dust formation. In order to provide reliable curing, the thickness of the paint must not exceed 0.5 mm, otherwise the anti-skid aggregate will not be able to sink down to the bottom of the film. It must also be ensured when setting the viscosity and thixotropy that the aggregate is able to sink in completely.

Consumption: 0.7 kg/m² (0.5 mm paint + anti-skid aggregate –> 1.0 mm).

Hardener (benzoyl peroxide)

There are 2 types of BPO available: For all recipes used for application with the component B mixture, we always recommend using powder hardener, such as Lucidol CH-50.

For automatic hardener dosage 100 : 2 in the road marking machine, liquid hardening pastes (e.g. CADOX 40E) are preferable. Hardening pastes often contain water and/or emulsifying agents, which can have a negative effect on the thixotropy and curing. For this reason, only use the minimum quantities. Component B with premixed hardener is only stable for the day of application (perform storage tests!). Never spill component A and B resin parts and use separate tools or containers for mixing and storing otherwise the resin becomes jelly and can block or destroy your spray units.

Substrate

The recognised rules of sound engineering practice apply. Silikal reactive resins are usually applied on bituminous road surfaces. On concrete, composite or natural cobblestone roads, special measures and restrictions must be observed. In particular, additional bonding primers and maximum moisture values are to be applied. Information on this can be obtained from our technical department.

Special remarks

The above mentioned guide formulations do not represent any guarantee on the part of Silikal GmbH. The individual formulations must be tested and approved by the applicator and in some countries even by road authorities, when they are to be used on public highways. In private traffic areas (communities, industrial areas, parking garages), individual approval is generally not required, unless this is expressly requested by the client. Silikal GmbH makes no guarantee for the recommended recipes. We only guarantee the consistent characteristics of our resins.

Machines and tools can be cleaned with acetone, ethyl acetate or MEK. For health and safety please refer to our safety data sheets.

Other applicable documents	Data sheet
General advice on application	AVH
The substrate	DUG
Information on safety and protection	SUS
Storage and transport	LUT

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SILIKAL® R 613 resin

Reactive methacrylic resin for 1.5–3 mm cold-plastic road and safety markings

Expect more from your floor.

SILIKAL® R 613 resin is a reactive, solvent free, high viscous liquid methacrylic resin based on MMA for the manufacture of 1.5–3 mm long-life road and safety markings in various designs. Application is performed manually by means of draw box, trowel or spreader. The compound can be applied directly to asphalt, whereas a concrete primer must be used before application on concrete surfaces. Benzoyl peroxide, a so-called hardening powder, is used for the hardening procedure. Areas of use are bicycle lanes, bus stops, pedestrian walkways or traffic islands. The decorative design of traffic areas in various colours is also very popular.

Characteristics

SILIKAL® R 613 is characterised by high durability on all types of traffic surfaces. Depending on the formulation with fillers, pigments and additives, it can be adapted to meet the requirements of local authorities concerning abrasion, colour, skid resistance, light reflection, surface texture and durability. Hardening (chemical reaction) takes place once it has been mixed with hardening powder (benzoyl peroxide 50 %). The curing time is between 10 and 15 minutes depending on the temperature and hardener quantity. After 30–60 minutes the surface will be tack free for traffic. The road markings and coatings are permanently flexible and resistant to abrasion, weathering and chemicals. A prerequisite for the good characteristics is a suitably good quality of the substrate.

Characteristics of R 613 as delivered

Property	Measuring method	Approx. value
Viscosity at +20 °C (ISO 6 mm cup)	DIN EN ISO 2431	80–100 sec.
Density D_4^{20}	EN ISO 2811-2	0.99 g/cm³
Flash point	DIN 51 755	+10 °C
Pot life at +20 °C (100 g, 2 % pbw. hardening powder)	12–15 min.	
Curing time depending on amount of hardener	20–50 min.	
Packing	180 kg steel drums or 900 kg IBC container	
Storage time	At least 6 months in original packing, below +25 °C	
Application temperature (substrate)	0 °C to +35 °C	

Cold-plastic compounds based on SILIKAL® R 613 resin are applied with 1.5–3 mm thickness preferably on asphalt road surfaces by hand using a trowel. The thickness depends on the mechanical load and on the evenness of the surface. It is important to ensure a sufficient minimum thickness, especially in the case of heavy traffic load.

When used on concrete road surfaces, the concrete has to be pretreated (e.g. milling, shot blasting, high-pressure water blasting) and an MMA-compatible concrete primer applied. The ready to use cold-plastic compound is dispersed without lumps, with 50 % BPO hardening powder and directly onto the surface.

For the pigmentation, we recommend using titanium dioxide rutile for white paints. Inorganic pigments such as iron oxides are suitable for coloured paints. Carbon black is not suitable as black pigment. Furthermore, many conventional paint additives, such as silicone oils, some dispersing agents or anti-settling agents based on amines are not suitable or only partly suitable as they can affect the curing process. SILIKAL® R 613 resin can also be mixed with SILIKAL® R 610 HW resin to reduce viscosity.

SILIKAL® R 613 resin is the pure resin used as a binder for manufacturing the cold-plastic compound or coating compound. The formulation is usually manufactured in a slow-moving dissolver. Warming of the material above +35 °C due to the shearing forces must be avoided. After mixing, it must be cooled to below +25 °C, as warmth may result in sedimenting of the coarse aggregate in the bucket during storage.

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Cold-plastic compound for traffic areas, pigmented, trowelled on

Guideline recipe and batch quantities (example)

Item	Component	Guideline recipe (% by weight)	Comments
1	SILIKAL® R 613 resin	30.0 %	Resin
2	Iron oxide, e.g. red	4.5 %	Pigment
3	Millicarb OG	25.0 %	Powder filler
4	Silica sand 0.1–0.4 mm	10.0 %	Fine sand
5	Silica sand 0.4–0.8 mm	15.0 %	Grip
6	Silica sand 0.7–1.2 mm	15.0 %	Grip
7	Wacker HDK N20	0.5 %	Thixotropic agent
8	**Total:**	**100 %**	**Average consumption: approx. 1.7 kg/m² per mm thickness**
9	SILIKAL® hardening powder	0.3–2 %, in relation to item 8	See “Hardener dosages” table for quantities

Grip scattering

On most public roads, skid resistant and reflective road markings are required. Since a high percentage of grip aggregate is already included, additional drop-in grip aggregate is not always necessary, depending on the customer’s request. If required, coloured silica sands, granite, corundum or basalt can be used, according to the desired colour.

Special remarks

Formulated road marking or coating compounds based on our guide formulations must be modified and matched according to the local or national requirements. Silikal does not assume any responsibility for ready to use compounds, which are out of our influence. We only guarantee the product specification of our resins.

Further information is given in our “Technical Documentation” and “Material Safety Data Sheets”.

Hardener dosages (calculated on ready to use cold-plastic compound)

Temperature	Hardening powder % pbw.	Pot life (temperature of material) approx. min.	Hardening time (temperature of substrate) approx. min.
0 °C	2.0	14–18	50
+5 °C	2.0	12–15	40
+10 °C	1.5	12–15	35
+15 °C	1.5	10–12	30
+20 °C	1.0	10–12	30
+25 °C	0.5	10–12	25
+30 °C	0.4	9–11	25
+35 °C	0.3	8–10	20

Other applicable documents	Data sheet
SILIKAL® Hardening Powder	SILIKAL® Hardening Powder
General processing information	AVH
The substrate	DUG
Information on safety and protection	SUS
Storage and transport	LUT

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