MADE IN GERMANY

KERAFOL®
Keramische Folien GmbH & Co. KG

Preview

KERAMOLD®

Thermally Conductive Injection Molding Granulate

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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 different applications as well as differing application and working conditions in your environment that are beyond our control. KERAFOL® is, therefore, not liable for the suitability of our product for the 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. All specifications are subject to change without notice. Any liability in respect of the information in the Technical Data Sheet or any other written or oral recommendation(s) regarding the concerned product is excluded. In case KERAFOL® would be nevertheless held liable, on whatever legal ground, KERAFOL®'s liability will in no event exceed the amount of the concerned delivery. All KERAFOL® products are sold pursuant to the KERAFOL®'s Terms and Conditions of sale and delivery in effect from time to time, a copy of which will be furnished upon request.

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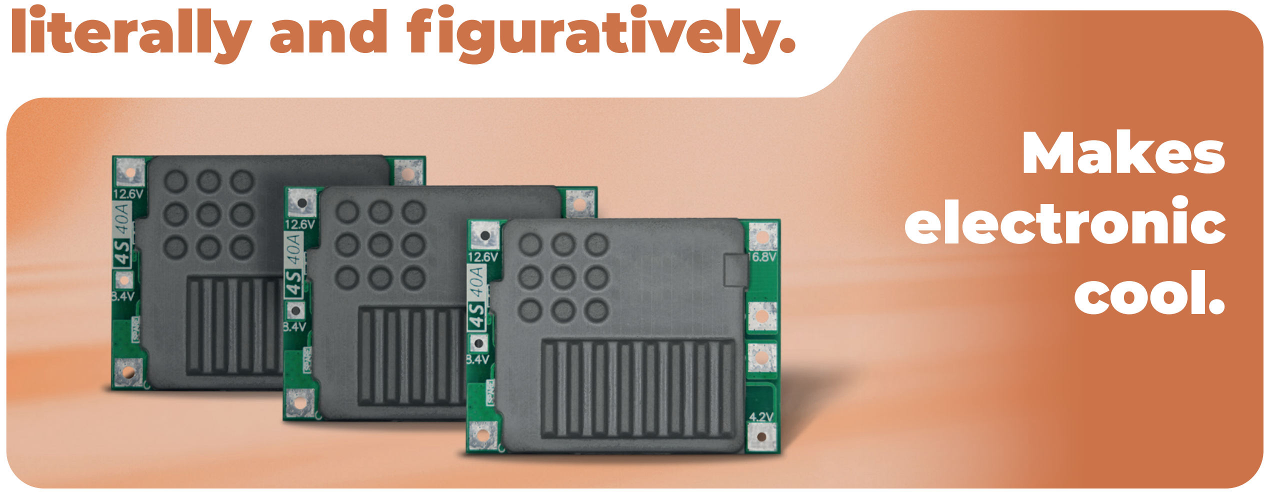
KERAFOL®

Your partner for Thermal Solutions and Development Services!

- Quality Assurance
- International Distribution Network
- Optimum Price-Performance-Ratio
- Environmental-Friendly

KERAFOL® makes it cool, **literally and figuratively.**



A journey into the depths of electronics.

The continuously increasing technical demands, placed by the electronics industry and electrical devices, have led to a dramatic rise in the problem of heat generation. Higher frequencies, component miniaturization, enhanced functionality and increased device power ratings all lead to high temperatures that need to be controlled to ensure excellent long-term stability and durability. Heat sinks, cooling plates and ventilators are often used to dissipate the heat and to reduce the temperature of the electrical circuits to a minimum. The thermal coupling of suitable conducting materials is also gaining importance in this area. KERAFOL® offers with KERATHERM® and KERAMOLD® products an effective, uncomplicated and cost-effective range of products for this purpose.

Injection Molding Granulate.

Besides the conventional Thermal Interface Material solutions in form of Tapes, Pads or Liquids, KERAFOL® has also developed a thermally conductive injection molding granulate (KERAMOLD®) based on a TPE polymer (Thermoplastic Elastomer). The new series of injection molding granulate makes it possible to achieve a 3D heat transfer and a high level of electrical insulation at the same time. In addition, electrical components can be completely covered with thermally conductive materials through the overmolding process. This means that electronic components can not only be cooled, but also protected from dust and mechanical influences – a real alternative to conventional potting materials due to the fast processing time.

Key Facts of **KERAMOLD®**

- Thermoplastic Elastomer
- Up to 2.5 W/mK
- Thermal conductivity: 3D instead of 2D
- Highly electrical isolating
- Hardness of Shore A
- Available as granulate or final part
- Processing possible for injection molding and over molding

For any inquiries, get in touch with our experts of our injection molding department. For more information about our thermal management products, please check our Keratherm® catalog.

Benefits of **KERAMOLD®**

- Very high thermal conductivity in combination with high level of electrical isolation
- KERAMOLD® is in comparison to common injection molding materials much softer which leads to a better absorption of vibrations
- Fast processing time
- Alternative to potting material
- Protection of electronic components against dust & humidity
- All in one solution

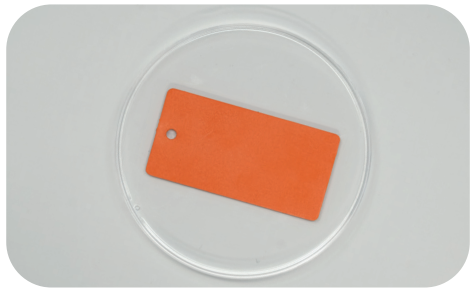
KERAMOLD® 15

(previously MT315) injection molding compound

Benefits

- Very good price performance ratio
- Production of 3D geometries and suitable for overmolding process
- Good thermal conductivity and high level of electrical insulation

Properties	Unit	KERAMOLD® 15
Colour		orange
Thermal Properties*		
Thermal resistance R_{th}	K/W	1.66
Thermal conductivity λ	W/mK	1.5
Electrical Properties*		
Dielectric breakdown voltage $U_{d; AC}$	kV	>16
Hardness	Shore A	65 - 80
Tensile strength	N/mm²	TBD
Application temperature	°C	-40 to +125
Glass transition tempera-ture	°C	-59
Density	g/cm³	1.9
Flame rating	UL-94	V-0**
MFI	g/10min	TBD



* Measured @ thickness 1.0 mm

** Kerafol Test according to UL 94

Data for engineer guidance only.
Observed performance varies in application.
Engineers are reminded to test the material in application.

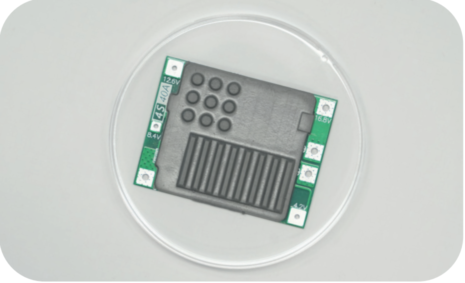
KERAMOLD® 20

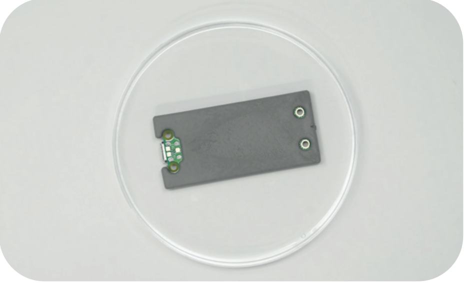
(previously MT320) injection molding compound

Benefits

- Very soft and elastic
- Production of 3D geometries and suitable for overmolding process
- Good thermal conductivity and high level of electrical insulation

Properties	Unit	KERAMOLD® 20
Colour		grey
Thermal Properties*		
Thermal resistance R_{th}	K/W	0.63
Thermal conductivity λ	W/mK	2.0
Electrical Properties*		
Dielectric breakdown voltage $U_{d; AC}$	kV	3.0
Hardness	Shore A	15 - 30
Tensile strength	N/mm²	0.2
Application temperature	°C	-40 to +100
Glass transition temperature	°C	-59
Density	g/cm³	1.91
Flame rating	UL-94	V-0**
MFI	g/10min	5 - 25 170°C / 2,16kg





* Measured @ thickness 1.0 mm

** Kerafol Test according to UL 94

Data for engineer guidance only.
Observed performance varies in application.
Engineers are reminded to test the material in application.

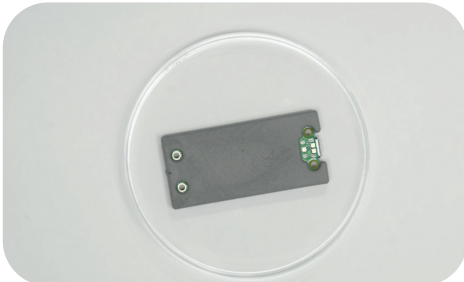
KERAMOLD® 20N

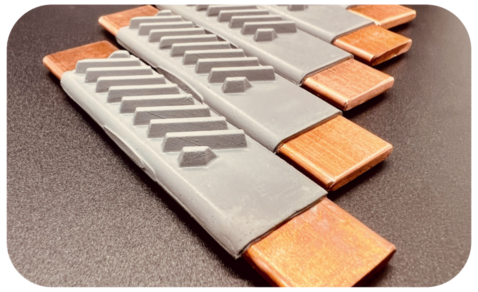
(previously MT320) injection molding compound

Benefits

- Very soft and elastic
- Production of 3D geometries and suitable for overmolding process
- Good thermal conductivity and high level of electrical insulation

Properties	Unit	KERAMOLD® 20N
Colour		grey
Thermal Properties*		
Thermal resistance R_{th}	K/W	0.63
Thermal conductivity λ	W/mK	2.0
Electrical Properties*		
Dielectric breakdown voltage $U_{d; AC}$	kV	3.0
Hardness	Shore A	30 - 45
Tensile strength	N/mm²	0.2
Application temperature	°C	-40 to +125
Glass transition temperature	°C	-59
Density	g/cm³	1.91
Flame rating	UL-94	V-0**
MFI	g/10min	5 - 25 170°C / 2,16kg





* Measured @ thickness 1.0 mm

Data for engineer guidance only.
Observed performance varies in application.
Engineers are reminded to test the material in application.

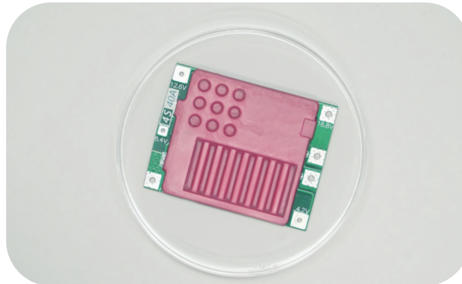
KERAMOLD® 25

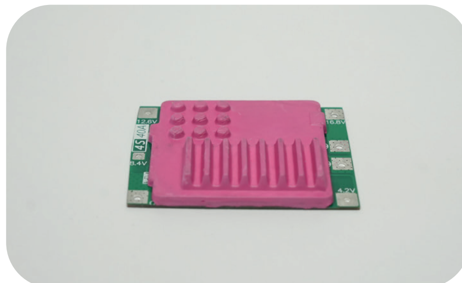
(previously MT103) injection molding compound

Benefits

- Very stable material
- Production of 3D geometries and suitable for overmolding process
- Good thermal conductivity and high level of electrical insulation

Properties	Unit	KERAMOLD® 25
Colour		red
Thermal Properties*		
Thermal resistance R_{th}	K/W	0.5
Thermal conductivity λ	W/mK	2.5
Electrical Properties*		
Dielectric breakdown voltage $U_{d; AC}$	kV	>16
Hardness	Shore A	40 - 60
Tensile strength	N/mm²	2.0
Application temperature	°C	-40 to +125
Glass transition temperature	°C	-57
Density	g/cm³	1.88
Flame rating	UL-94	V-0
MFI	g/10min	0,5 - 10 190°C / 2,16kg





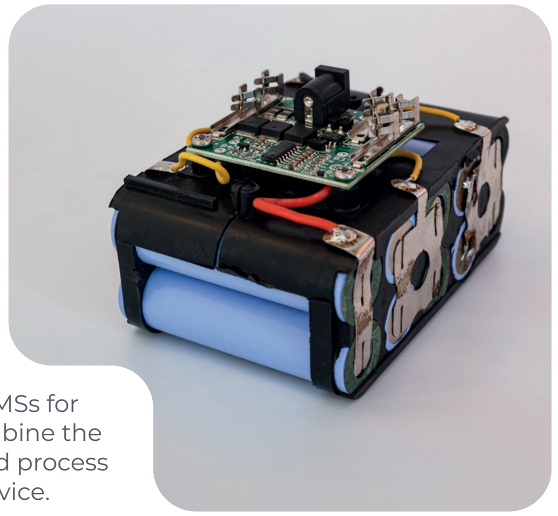
* Measured @ thickness 1.0 mm

Data for engineer guidance only.
Observed performance varies in application.
Engineers are reminded to test the material in application.

Case Study.

Overmolding of Battery Management System (BMS) with KERAMOLD® 20

The power density in electronic devices is continuously increasing. This high level of generated heat and temperature requires a smart thermal transfer from the electronics to the heat sink (e.g. cooling plate or alumina housing). Next to the thermal parameters, the voltage level in many applications is also continuously increasing which means, a reliable electrical isolation between electronics and housing is crucial.



With the current solution, the BMS of a cordless screwdriver is covered by a conformal coating to protect the electronic components from dust, vibrations and ensure the electrical isolation. That solution has two main disadvantages. The first one is the thermal management, as the conformal coating is not able to transfer or at least spread the heat. The result can be "hot spots" on critical components which may lead to a failure of the whole device or at least to a forced downgrade in the power. The second topic that must be optimized is the cycling time for applying the material. The conformal coating is often a manual and time consuming production step. Together with one of the leading manufacturers of BMSs for Power Tools, Kerafol was working on a new solution to combine the usage of a material that can be applied by a fast automated process and being able to increase the thermal efficiency of the device.

The new developed material KERAMOLD® 20 has a thermal conductivity of 2,0 W/mK and even if the filling level is very high, the material can be processed by a low-pressure overmolding process. With that kind of injection molding process, the cycling time will be much lower in comparison to conformal coating or potting. To demonstrate the effectiveness of using the KERAMOLD® material, a thermal analysis of four different printed circuit boards (PCBs) has been done.

The test setup, test results, and PCB overmolding where provided by X2F ("Extrude to Fill"). The X2F innovative process leverages low pressure and a patented pulse-packing method to mold parts that throw away the constraints of traditional injection molding. X2F technology combines patented hardware, sensors, and software and is available for prototyping and full scale production scale.
For more information visit ww.X2F.com.

Test Setup.

PCBs were setup as follows:

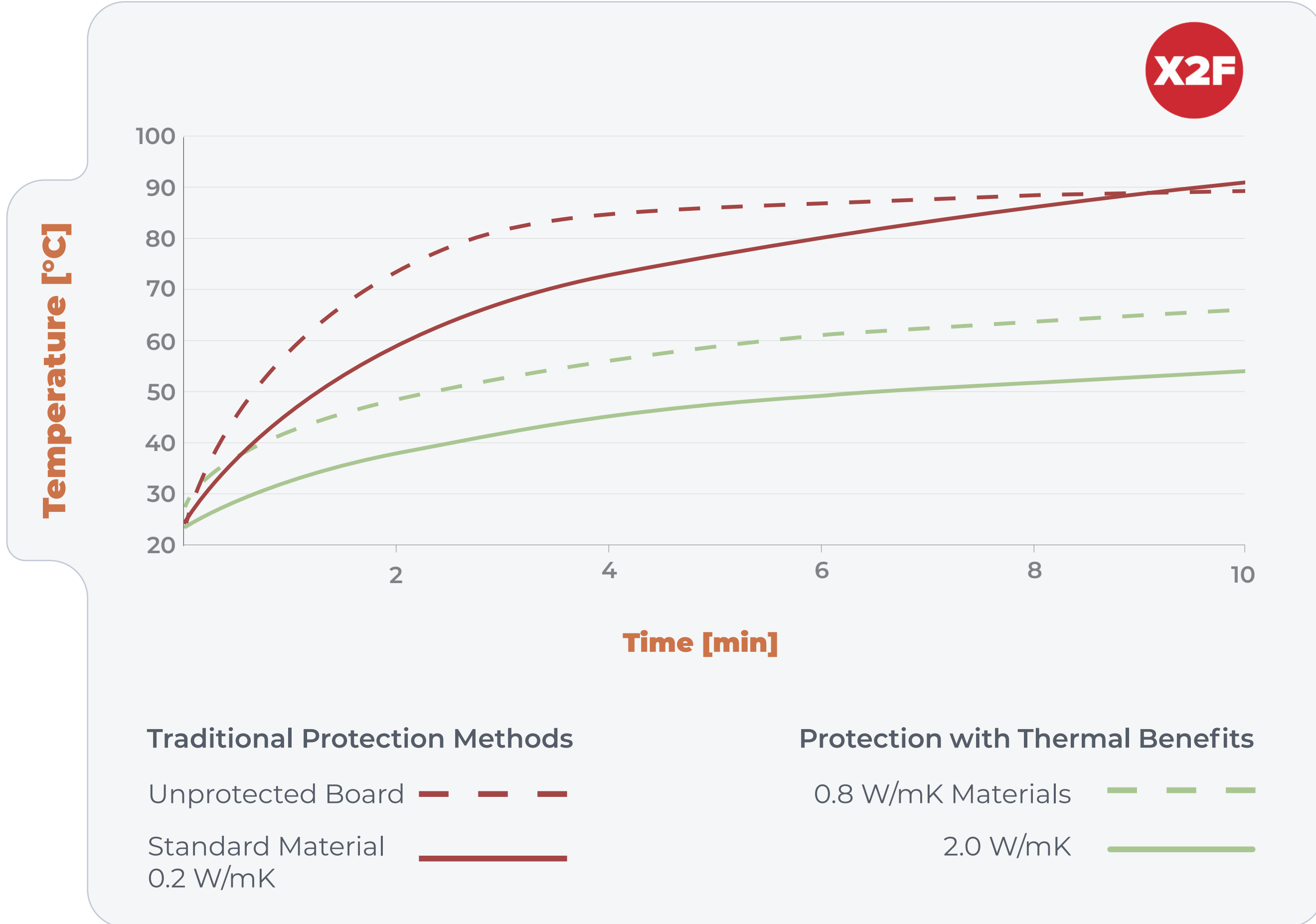
- **PCB 1** This "baseline" board had no overmolding material and no thermal management solution is applied
- **PCB 2** This board was overmolded by a conventional injection molding granulate without focus on thermal management by having a thermal conductivity of only 0.2 W/mK
- **PCB 3** This board was overmolded with a thermally conductive polymer composite with filles and a thermal conductivity of 0.8 W/mK
- **PCB 4** This board was overmolded by the KERAMOLD® 20 that has a thermal conductivity of 2.0 W/mK

Thermocouples were soldered to the back of each board, on the bottom-middle pad, and plugged into thermometer. A power supply was attached to each board to control current. 270mA of current was applied to each board for 10 minutes. Temperature readings were taken every 10 seconds over the 10-minute period. The temperature values were recorded graphically for each PCB tested.

Test Results.

The test results shown in Graph 1 clearly demonstrate the correlation between thermal conductivity of the injection molding material and the thermal performance for PCBs.

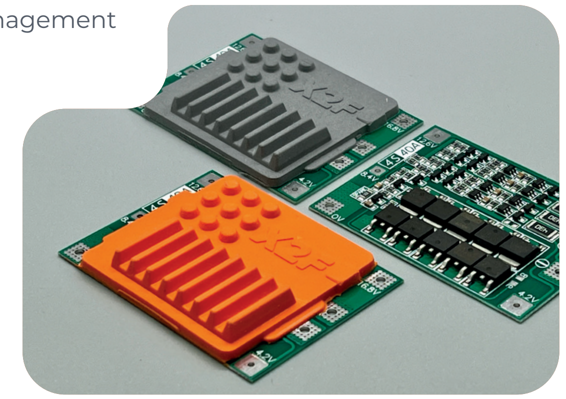
The KERAMOLD® 20 excelled in this study, reducing PCB temperature to 45°C compared to the PCB temperature with no thermal management solutions (90°C).



Conclusion.

The KERAMOLD® 20 is able to set new standards for Thermal Management in the field of injection molding materials.

- Improved thermal performance
- Protection against dust & humidity
- Compensation of vibrations
- Highly electrically isolating
- Saving production time in comparison to conformal coating or even potting materials
- Cost effective solution



Case Study.

Thermal Performance of Overmolding vs. Potting Materials

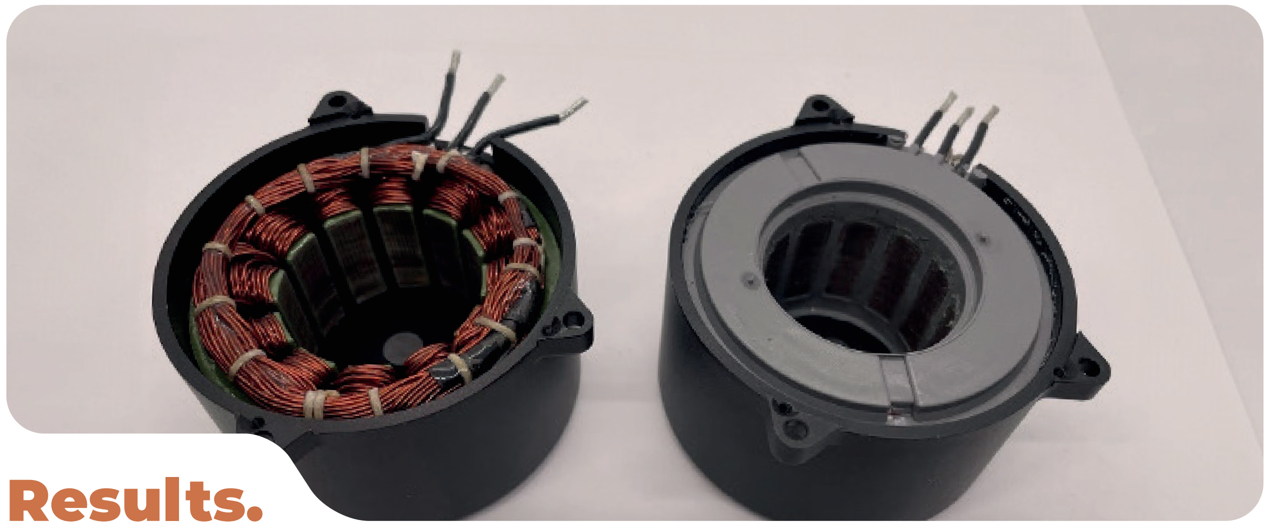
For electric motors of e.g. eBikes there is a requirement to withstand relatively high torque for an extended period without overheating or losing power.

Motor stators are often filled with a potting material, which can improve heat dissipation. In that case story, electric Motors with bare windings, solid potting, and overmolding (by the usage of Keramold® 20) have been tested to explain the difference in the thermal performance.

Methods.

The thermal test setup consisted of a motor dynamometer ("dyno") and thermistors inside the motor housing. The dyno applies a constant torque to the motor using an eddy current brake, and this torque is monitored using a dynamic torque sensor.

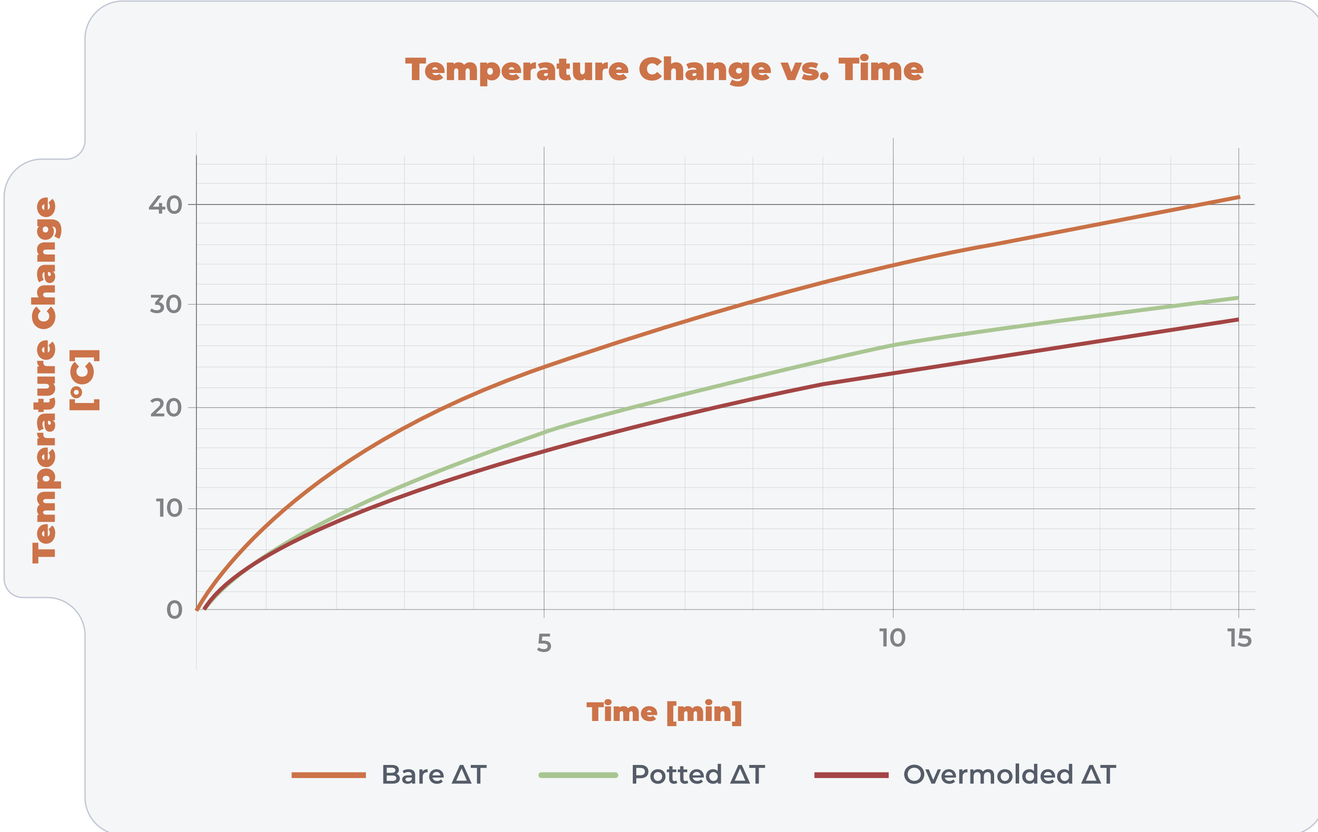
The motor is run at 1760 RPM, and once it reaches a steady speed, 1 Nm of torque is applied using the eddy current brake. This test is run until the motor reaches a steady temperature or, in some cases, when the eddy current brake exceeds its rated operating temperature of 100°C. The eddy current brake is then powered off, and the motor is allowed to continue running until it reaches a steady temperature. This test generally takes between 30 minutes and an hour to perform, exposing the motors to a realistic use cycle, with a reasonable climbing speed for half of the test, and a mostly unloaded, but still running, "downhill" section. All the motors used the same faceplate, electronics, rotors, and bearings to ensure a properly controlled test. Several motors were tested, including one without potting material ("bare"), three with solid potting ("potted"), and four with Keramold® 20.



Results.

The following charts show, that the thermal performance of the Keramold® 20 was better than the potted option, and of course way better than the bare option. In that case study, the molding process was not optimized due to cost reasons. This leads to the assumption, that the thermal performance can be still improved which will even further increase the difference to the potted material.

On average, the overmolded motors were able to maintain low temperatures longer than the potted and bare motors. Also the average time to reach 30° is much longer in comparison to the other options. This result is consistent with the expectations, as the Keramold® 20 material was chosen as a possible material due to its stated superiority to the current potting material.



	AVERAGE TIME*
Bare	8
Potted	13
Overmolded	17

*in minutes

Fig. 1 Temperature change curves for the first 15 minutes of all three options

Fig. 2 Test run until the electric motors reaches 30°C

Injection Molding
as a service.

Besides the pure granulate, KERAFOL® also offers injection molding technologies for prototyping as a service. Therefore, the experts of the KERAFOL® division “injection Molding” can offer different concepts.

3D parts
- Consulting
- Prototyping
- Serial production or also forwarding to external partners

Overmolding
- Consulting
- Prototyping
- Forwarding to external partners in terms of serial production

Further used
in the industry.


Power Tools


eBike


Automotive


Energy Industry


Lighting

Application.

- Batteries
- Battery Management System (BMS)
- Electric motors
- Bus Bars
- Power electronics

Have we aroused your interest?
Request a meeting at:
keramold@kerafol.com

Version 01-2024

Customized solutions.

We are looking forward to receiving your inquiry!

KERAFOL® products are applied in vehicle electronics, telecommunications, aerospace, computers and the semiconductor industry – in fact, in all areas in which generated heat has to be dissipated from sensitive components to the heat sink.

Discover our broad range of products and take advantage of the diverse application possibilities!

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