ELPEGUARD®
peters

TR TECHNICAL REPORT

Thick film coatings of the series ELPEGUARD® Twin-Cure® DSL 1600 E-FLZ

The thick film coatings of the series **ELPEGUARD® Twin-Cure® DSL 1600 E-FLZ** are used to protect and insulate assembled pcbs so that they can fulfil higher requirements regarding reliability and service life. Owing to their very good resistance against moisture and condensation an excellent protection against corrosion (such as electro corrosion and migration) is possible even under harsh climatic conditions.

- basis: copolymerisate of polyurethane (UR) and polyacrylate (AR)
- solvent-free / VOC-free
- powerful protection through electrical insulation properties directly after UV curing
- chemical cross-linking reaction in shadow zones
- excellent chemical, climatic and mechanical resistance
- tested according to IPC-CC-830B and MIL-I-46058C
- UL-approval according to UL 94 (UL file No. E80315): best flame class V-0
- UL-approval of **DSL 1600 E-FLZ/75** according to UL 746E (UL file No. E80315)
- temperature range of -65 to +130 °C [-85 to 266 °F]
- the lower the viscosity, the higher the elasticity, and the easier material tension can be lowered even under rapid and extreme thermal shocks
- depending on the coating thickness also suitable for coating flexible circuits (“flex-to-install”, bend stress during assembly only)
- excellent edge coverage, wetting and underfilling of components (“micro-casting”), very good capillar-active behaviour, yet not suitable as underfill material
- excellent adhesion
- halogen-free according to JPCA-ES01-2003 and IEC 61249-2-21
- high transparency and yellowing resistance
- **DSL 1600 E/500** is especially suitable for lighting electronics
- when applied in thick layers, components may be fixed to protect against vibration
- can be mechanically stripped for repair purposes (blasting method).

LP 142708 E-9 / 0108802e.009

Characteristics

	Colour/ appearance	**Solids content**	**Viscosity* at 20 °C [68 °F]** DIN EN ISO 3219	**Density at 20 °C [68 °F]** DIN EN ISO 2811-1
DSL 1600 E-FLZ	colourless, fluorescent	100 %	2,300 ± 400 mPas	1.10 ± 0.05 g/cm³
DSL 1600 E-FLZ/75		100 %	75 ± 25 mPas	1.09 ± 0.05 g/cm³
DSL 1600 E-FLZ/150		100 %	150 ± 50 mPas	1.12 ± 0.05 g/cm³
DSL 1600 E/500	colourless	100 %	500 ± 100 mPas	1.06 ± 0.05 g/cm³

* measured with Haake RS 600, C 35/1°, D = 100 s^{-1}, or respectively, DSL 1600 E-FLZ with RS 600, C 20/1°, D = 100 s^{-1}, viscosity measuring unit supplied by:
Thermo Fisher Scientific, Dieselstraße 4, 76227 Karlsruhe, Germany
Phone +49 721 4094-444, Fax +49 721 4094-300, www.thermo.com

Indices: DSL = thick film coating, E = elastic, /75 = viscosity of 75 mPas, likewise /150 and /500, FLZ = fluorescent

Physical and mechanical properties

These values are achieved after UV curing and 14 days‘ storage at room temperature.

Property	**Test method**		**DSL 1600 E-FLZ**	**DSL 1600 E-FLZ/75**	**DSL 1600 E-FLZ/150**	**DSL 1600 E/500**
Temperature shock test	100 cycles, –40 °C [- 40 °F] up to +110 °C [230 °F], holding time 15 min each, temperature change within 10 s (Peters test regulation LP-43.0)		passed* (layer thickness ≤ 500 µm)	passed* (layer thickness ≤ 300 µm)		
Adhesion	IPC-TM-650, 2.4.28.1		passed			
Flexibility	IPC-CC-830B, 3.5.5		passed			
Glass transition temperature Tg	TMA		≈ 10 °C [50 ° F]	≈ 0 °C [32 °F]	≈ 10 °C [50 °F]	≈ 10 °C [50 °F]
Coefficient of thermal expansion (CTE)	TMA	< Tg > Tg	≈ 100 ppm/°C ≈ 160 ppm/°C	≈ 90 ppm/°C ≈ 300 ppm/°C	≈ 80 ppm/°C ≈ 200 ppm/°C	≈ 150 ppm/°C ≈ 270 ppm/°C
Young modulus	DMA	< Tg > Tg	≈ 1300 MPa ≈ 100 MPa	≈ 1200 MPa ≈ 7 MPa	≈ 2000 MPa ≈ 50 MPa	≈ 1300 MPa ≈ 50 MPa
Thermal conductivity	DIN EN 821		≈ 0.2 W/mK			

* The results of the temperature shock test strongly depend on the substrate and type of components mounted on an assembly, since they exhibit vastly different coefficients of expansion.

Electrical properties

These values are achieved after UV curing and 14 days‘ storage at room temperature (200 µm layer thickness).

Property	Test method	DSL 1600 E-FLZ	DSL 1600 E-FLZ/75	DSL 1600 E-FLZ/150	DSL 1600 E/500
Dielectric strength	IPC-TM-650, 2.5.6.1 DIN EN 60243-1	50 kV/mm	60 kV/mm	90 kV/mm	50 kV/mm
	IPC-CC-830B, 3.6.1	passed			
Specific volume resistivity	DIN IEC 60093 IPC-TM-650, 2.5.17.1	7.3×10^{14} Ohm x cm	6.3×10^{11} Ohm x cm	1.5×10^{13} Ohm x cm	5.5×10^{14} Ohm x cm
Surface resistance	DIN IEC 60093 IPC-TM-650, 2.5.17.1	2×10^{14} Ohm			
Moisture and insulation resistance	IPC-CC-830B, 3.7.1 (65 °C [149 °F]/90 % r.h.)	passed			
	85/85 test*	2.8×10^{8} Ohm	1.0×10^{8} Ohm	3.0×10^{8} Ohm	2.0×10^{7} Ohm
Electro migration	based on IPC-SM-840C, 3.9.2	none			
Electro corrosion	21 d, 40 °C [104 °F], 95 % r. h., 100 V DC	none			
Thermal shock	IPC-CC-830B, 3.7.2 -65 to +125 °C [-85 °F to 257 °F]	passed			
Hydrolytic stability	IPC-CC-830B, 3.7.3	passed			
Comparative tracking index**	DIN EN 60 112, on base material with CTI of 275	CTI > 600			
Resistance to condensation	based on ISO 6270-2 (BIAS 12 V, 40 °C [104 °F], 100% r. F.)	4.0×10^{9} Ohm	2.0×10^{8} Ohm	2.0×10^{9} Ohm	1.3×10^{9} Ohm
		no electro corrosion or migration			
Salt spray test	BMW GS 95003-4	passed			
Permittivity ε_r	DIN 53483 100 kHz 1 MHz 1 GHz	3.2 3.0 2.3	4.7 3.9 2.5	3.1 3.2 2.5	—
Dielectric loss factor tan δ	DIN 53483 100 kHz 1 MHz 1 GHz	0.055 0.056 0.055	0.14 0.12 0.09	0.035 0.044 0.043	—
TI (temperature index)***	DIN EN 60216 (IEC 60216) issue 2001 20 000 h (5 000 h)***	130 °C (150 °C)	125 °C (145 °C)	125 °C (145 °C)	130 °C (150 °C)

* ramp formed storage at high air moisture and high temperature, amongst others 3 days at 85 °C [185 °F] and 85 % r. h.

** Tracking resistance, CTI = Comparative tracking index

*** can be used in a temperature range of -65 up to at least +130 °C [-85 up to at least 266 °F]. Both at the lower and upper ends of this range the performance and reliability of the material can be negatively affected in some applications. In these cases, additional pre-trials and tests are required. Limit values for classification were a 25 % loss in mass and/or dielectric strength in comparison to the appropriate reference values.

Electrical properties immediately after curing

After UV curing, electrically insulating properties are already present; however, they may not yet reach the values stated above. Please consider this when performing functional tests directly after UV curing where the electrical values of the thick film coatings of the series **Twin-Cure®** are demanded. The final properties are only achieved after about 8-14 days.

Processing

	Please read this technical report and the publications listed below carefully before using the product. These sheets are enclosed with the first shipment of product or sample
MSDS	The corresponding material safety data sheet contains detailed information and characteristics on safety precautions, environmental protection, transport, storage, handling and waste disposal.
AI	Application information AI 1/2 ”Processing instructions for the thick film coatings of the series ELPEGUARD® Twin-Cure®“
TI	Technical information TI 15/3 “Protective measures when using chemicals including lacquers, casting compounds, thinners, cleaning agents“

The thick film coatings of the series **Twin-Cure® DSL 1600 E-FLZ** can be applied by automatic selective coating units, by brushing or by means of dispensing.

Protect from UV light

Protect against humidity

Since the many different permutations make it impossible to evaluate the whole spectrum (parameters, reactions with materials used, chemical processes and machines) of processes and subsequent processes in all their variations, the parameters we recommend are to be viewed as guidelines only that were determined in laboratory conditions. We advise you to determine the exact process limitations within your production environment, in particular as regards compatibility with your specific follow-up processes, in order to ensure a stable fabrication process and products of the highest possible quality.

The specified product data is based upon standard processing conditions/test conditions of the mentioned norms and must be verified observing suitable test conditions on processed printed circuit boards.

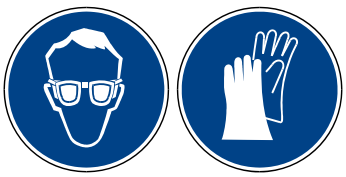
Feel free to contact our application technology department (ATD) if you have any questions or for a consultation.

Safety recommendations

→ When using chemicals, the common precautions should be carefully noted.

→ Ensure that the equipment used is in compliance with the requirements laid down in the material safety data sheet.

→ Observe the safety instructions below as the acrylates contained in Twin-Cure® may have a sensitising effect on some users:



- **Wear protective gloves and safety goggles!**
- **Avoid skin contact!**
- **Ensure sufficient technical ventilation in the workplace.**
- **Observe standard work hygiene measures (wash hands etc.).**

Auxiliary products recommended

- **Cleaning agent R 5817 and reactive thinners VR 1600 / VR 1630**
  For cleaning work place and tools we recommend our cleaning agent **R 5817.** Clean equipment with **R 5817** and then rinse with reactive thinner **VR 1600** or **VR 1630**; the latter is of red colour so that the beginning and end of the rinsing process is clearly visible. Please see also our application information sheet **AI 1/2**, item “Cleaning equipment”.

Drying/Curing

The curing process is based on two complementary chemical cross-linking mechanisms of different time lengths: UV curing and PUR curing.

UV curing

Curing can be effected in standard UV curing units.

➔ Cure the thick film coatings of the series **ELPEGUARD® Twin-Cure®** by applying the following UV radiation energy (given for a pure mercury lamp):

DSL 1600 E-FLZ **DSL 1600 E-FLZ/75** **DSL 1600 E-FLZ/150**	3000 ± 500 mJ/cm²
DSL 1600 E/500	4000 ± 500 mJ/cm²

UV curing with suitable UV lamps is mandatory. The specified final properties cannot be achieved by PUR curing alone.

The UV cured assemblies can already be packed or encapsulated 1-3 h after UV curing.

Humidity curing

In shadow zones, the coating will cure by reacting with atmospheric humidity. Depending on the layout and assembly of the printed circuit board, this reaction is completed after 8-14 days. Only after this time the final properties are achieved.

Standard packaging

	Packaging	Selling unit
DSL 1600 E-FLZ DSL 1600 E-FLZ/75 DSL 1600 E-FLZ/150 DSL 1600 E/500	Can of 15 kg	15 kg
VR 1600	1 can of 10 kg or 10 cans of 1 kg	10 kg
VR 1630	1 can of 5 kg	5 kg

Partial lots of the selling unit / smaller quantities available against surcharge.

Shelf life and storage conditions

Shelf life and storage conditions of the thick film coatings **Twin-Cure® DSL 1600 E-FLZ:**

Shelf life: In sealed original containers at least 6 months

Storage conditions: +5 °C bis +25 °C [+41 °F to +77 °F]

Protect from UV light

Protect against humidity

Shelf life and storage conditions of the reactive thinners **VR 1600 / VR 1630**:

Shelf life: In sealed original containers : VR 1600 at least 18 months
VR 1630 at least 12 months

Storage conditions: +5 °C bis +25 °C

For warehousing reasons, isolated cases may occur where the shelf life upon shipment is less than the shelf life indicated in this technical report. However, it is ensured that our products have **at least** two-thirds of their shelf life remaining when they leave our company. Labels on containers show shelf life and storage conditions.

Disclaimer

All descriptions and images of our goods and products contained in our technical literature, catalogues, flyers, circular letters, advertisements, price lists, websites, data sheets and brochures, and in particular the information given in this literature are non-binding unless expressly stated otherwise in the Agreement. This shall also include the property rights of third parties if applicable.

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 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.

Any questions?

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

Lackwerke Peters GmbH & Co. KG
Hooghe Weg 13, 47906 Kempen, Germany
Internet: www.peters.de
E-Mail: peters@peters.de
Phone +49 2152 2009-0
Fax +49 2152 2009-70

peters
Coating Innovations for Electronics