ELPEGUARD®
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TR TECHNICAL REPORT

Silicone thick film lacquer

ELPEGUARD® DSL 1705 FLZ

Base: Polyorganosiloxane

- **colourless transparent, fluorescent**
- excellent corrosion protection of assembled pcbs/flat packs
- solvent-free/**VOC**-free (**V**olatile **O**rganic **C**ompounds)
- highly elastic, thus also suitable for flexible circuits
- fast thermal curing (15 min at 110 °C [230 °F])
- very good chemical and thermal resistance **(-45 up to +200 °C [-49 up to +392 °F])**
- **thermal class H = 180 °C [356 °F]**
- UL approval as **Conformal Coating** acc. to UL 746E

Indices: **DSL = thick film lacquer**
FLZ = fluorescent

LP061311 E-2 / 0103600e.002

Contents

Please read this technical report and the material safety data sheet according to directive 1991/155/EEC carefully before using the product.

1. General information

The silicone thick film lacquer **ELPEGUARD® DSL 1705 FLZ** is a solvent-free, addition cross-linking, colourless transparent, fluorescent 1-pack conformal coating that is thermally cured.

All symbols that are used in this technical data sheet and on our containers, such as , are explained on our website www.peters.de in the section "Service – Symbols on labels".

2. Application

The silicone thick film lacquer **ELPEGUARD® DSL 1705 FLZ** is used for permanent electrical insulation and reliable protection against extreme moisture stress and other aggressive environmental conditions. It is suitable for coating rigid and flexible pcbs that have to fulfil extremely high requirements regarding quality and service life.

ELPEGUARD® DSL 1705 FLZ is a protective coating for thick film application up to 3 mm that is distinguished by a high chemical and thermal stability as well as a very good resistance to weathering and UV radiation. Because it is a highly elastic material **ELPEGUARD® DSL 1705 FLZ** is particularly suitable for covering fragile components that are sensitive to mechanical stress. This elasticity and flexibility is permanently maintained within a broad temperature range so that almost no material tension during curing or in case of temperature changes occur. On the contrary, **ELPEGUARD® DSL 1705 FLZ** has a stress-compensating effect in case of temperature shocks and vibration. Since **ELPEGUARD® DSL 1705 FLZ** is an addition cross-linking system it can be applied in encapsulated surroundings (there is no danger of reversion caused by low molecular separation products).

The silicone thick film lacquer **ELPEGUARD® DSL 1705 FLZ** can be used within a temperature range of -45 up to +200 °C [-49 up to 392 °F] while at the lower and upper ends of this range the performance and efficiency of the material may be affected in case of some applications. In these cases additional pre-trials and controls are required.

For repair purposes **ELPEGUARD® DSL 1705 FLZ** is easily mechanically removed or soldered through at soldering iron temperature. After the repair work has been finished it can be reapplied to the previously cleaned substrate.

3. Special notes

The silicone thick film lacquer **ELPEGUARD® DSL 1705 FLZ** has been approved as a conformal coating at ® Underwriters Laboratories Inc.; Northbrook, Illinois 60062 under approbation no. File E80315. The approval contains the flame test acc. to UL 94 – a flame class rating of V-1 was reached – as well as electrical tests acc. to UL 746E.

The silicone thick film lacquer **ELPEGUARD® DSL 1705 FLZ** shows an excellent dielectric performance: Over a wide temperature range the dielectric constant is virtually independent of the temperature and frequency; that means that the dissipation factor tan δ that is important for signal transfer has a very low value that is also virtually independent of the temperature and frequency.

Since **ELPEGUARD® DSL 1705 FLZ** is a solvent-free system it is a sensible solution from a technological as well as from an economic standpoint, among others with a view to the EU-VOC regulation (VOC = Volatile Organic Compounds), which aims to determine and reduce solvents.

Further information regarding the content and consequences of the EU-VOC regulation can be found in our **t**echnical **i**nformation sheet **TI 15/110 E "EU-VOC regulations – Content and consequences for the PCB industry"**. In our report manual this technical publication is filed under group 15.

If the high temperature resistance of a silicone conformal coating is not required a whole range of colourless and coloured transparent **ELPEGUARD®** conformal coatings based on polyurethane, acrylic and epoxy resins are available as low-cost alternatives that also offer excellent protection against corrosion. Special attention should be paid to our **ELPEGUARD®** thick film lacquers of the series **TWIN-CURE® DSL 1600 E-FLZ**, a solvent-free 1-pack system based on a copolymerisate of

polyurethane and acrylate with the resistance of a 2-pack system, that due to two optimally synchronised curing mechanisms enables thick film application up to 500 µm at simultaneously short processing times. Special technical data sheets on these products are available upon request. In our report manual these technical data sheets are filed under group 1. On our report manual CD, technical data sheets can be accessed in the ”Products” section.

4. Safety recommendations

→ Please read our material safety data sheet according to directive 1991/155/EEC where you will find detailed specifications of safety precautions, environmental protection, waste disposal, storage, handling, transport as well as other characteristics.

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

5. Characteristics

Colour/appearance	colourless transparent, fluorescent (slightly turbid in liquid condition)
Solids content	100 %
Viscosity* at 20 °C [68 °F], ISO 3219	1 000 ± 200 mPas
Density at 20 °C [68 °F], ISO 2811-1	1.00 ± 0.05 g/cm³

* measured with Haake RS 600, C 35/1°, D = 100 s^{-1}, viscosity measuring unit supplied by:
Thermo Electron (Karlsruhe) GmbH (formerly Haake-Messtechnik GmbH + Co)
Dieselstraße 4, 76227 Karlsruhe, Germany
Phone +49 (0) 721 - 40 94 - 0; Fax +49 (0) 721 - 40 94 - 300
www.thermo.com

6. Properties

The silicone thick film lacquer **ELPEGUARD® DSL 1705 FLZ** is distinguished by the following properties:

6.1 General properties

- does not contain substances listed in the RoHS directive 2002/95/EC, EU End-Of-Life Vehicle directive 2000/53/EC and WEEE directive 2002/96/EC
- on account of its solvent-free formulation and dipping bath stability particularly suitable for dip coating
- for thick film application up to approx. 3 mm
- short processing times due to fast thermal curing
- good adhesion to all common substrates even without additional adhesive agents (self-priming)
- addition cross-linking, no separation products during curing, no cross-linking shrinkage
- highly elastic, thus suitable to cover stress-sensitive components
- also suitable for flexible circuits
- on account of its fluorescent adjustment (Index FLZ) the coating can be easily controlled under UV light (black light with a UV-A impulse at 350-375 nm)
- excellent protection against extreme moisture stress and other aggressive environmental conditions over a wide temperature range (-45 °C up to +200 °C [-49 up to 392 °F], see also Item 2 "Application”)
- high continuous temperature resistance (thermal class H = 180 °C [356 °F])
- very good chemical and hydrolytic stability even in case of high temperatures and extreme moisture stress (tropical climates)
- meets requirements of IPC-CC-830B
- excellent insulation properties
- excellent dielectric properties

- stress compensating in case of thermal shock and vibration
- resistant against weathering influences and UV radiation
- water repellent
- no decomposition on account of ozone
- UL approval as conformal coating per UL 746E, flame class V-1 acc. to UL 94, Approbation No. File E80315
- free of halogenated flame retardants
- can be easily removed mechanically or soldered through for repair purposes. After completion of the repair work **ELPEGUARD® DSL 1705 FLZ** can be reapplied to the previously cleaned substrate.

6.2 Physical and mechanical properties

Property	Test method	Result
Solvent/cleaning agent resistance	based on IPC-SM-840 C 3.6.1 Isopropanol Isopropanol : water (75 : 25) deionized water	 passed passed passed
Flexibility	IPC-CC-830B, 3.5.5	passed

6.3 Electrical properties

Property	Test method	Result
Dielectric strength	IPC-TM-650, 2.5.6.1 DIN EN 60243-1	57 kV/mm
Dielectric strength	IPC-CC-830B, 3.6.1	passed
Specific volume resistivity	VDE 0303, part 30 DIN IEC 60093	2.1 x 10^{14} Ohm x cm
Surface resistance	VDE 0303, part 30 DIN IEC 60093	2 x 10^{14} Ohm
Moisture and insulation resistance	IPC-CC-830B, 3.7.1 (65 °C [149 °F]/90 % r. h.)	1 x 10^{10} Ohm class A and B
Moisture and insulation resistance	85/85 test; ramp formed storage at high air moisture and high temperature, amongst others 3 days at 85 °C [185 °F] and 85 % r. h.	5 x 10^{9} Ohm
Thermal shock	IPC-CC-830B, 3.7.2	class 3 passed
Hydrolytic stability	IPC-CC-830B, 3.7.3	passed
Comparative Tracking Index (CTI, Tracking resistance)	DIN EN 60112 on base material with CTI 300	CTI > 600
Resistance to condensation	based on DIN 50 017 (BIAS 12 V, 40 °C [104 °F], 100% r. h.)	1.4 x 10^{10} Ohm
Thermal class	based on DIN IEC 60 085	H = 180 °C [356 °F]
Dielectric constant ε_r	based on ASTM D 150 at 100 Hz at 100 kHz	 2.64 2.66
Dissipation factor tan δ	based on ASTM D 150 at 100 Hz at 100 kHz	 0.001 < 0.001

7. Processing

The silicone thick film lacquer **ELPEGUARD® DSL 1705 FLZ** is generally suitable for an application by means of brushing, spraying, dipping or automatic selective coating units. On account of its good bath stability and the solvent-free formulation it is particularly suited for dip coating.

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. 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/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.

Stainless steel working tools and, if necessary, Teflon coated hoses are especially recommended for the processing of the lacquers of the series **ELPEGUARD® DSL 1705 FLZ**.

When silicone based and silicone-free inks are used at the same time problems, as for instance dewettings, may occur during the processing of the silicone-free lacquers.
Therefore, keep workplaces/tools separate to avoid the different ink systems coming into contact with each other, as for instance through contaminated working tools.

On account of aerosol formation in case of compressed air spraying there is a high risk of problems occurring when other lacquer systems are processed. Therefore, a processing by means of compressed air is not recommended. In case compressed air spraying is mandatory **ELPEGUARD® DSL 1705 FLZ** should only be processed under a fully functional extractor hood with a separate exhaust air zone.

Generally an even, bubble-free not too thick lacquer layer should be aimed for when processing **ELPEGUARD® DSL 1705 FLZ**. To achieve higher layer thicknesses up to 3 mm in one step an enclosure around the area to be coated should be created to avoid the lacquer dripping off on account of its low viscosity. Alternatively, in this case a double coating is also possible.

→ Ensure that the surface to be coated is clean, grease-free and dry.

Grease, moisture and contamination of the surface, as for instance due to organic tin compounds, sulphur and sulphur compounds, amides, amines, azides, urethanes, may lead to problems during curing such as bubbles and voids. Characteristic for such kinds of contamination is liquid, non-cured material at the interface between substrate and lacquer after thermal curing. Contaminations also have a negative effect on the adhesion so that water may deposit between the pcb and conformal coating and thus lead to corrosion/failure.

→ Therefore, clean the assembly of fluxing agents and other contaminations or ensure that the properties you require can be achieved by performing corresponding tests.
→ Make sure you check the assembly that has been manufactured under your series conditions after coating and curing in the subsequent operating environment.

7.1 Adjustment of viscosity

The silicone thick film lacquer **ELPEGUARD® DSL 1705 FLZ** must be processed in the condition supplied.

Do not add any solvents or thinners to reduce the viscosity.

7.2 Auxiliary products

- **Cleaning agent R 5817**
  For cleaning work place and tools we recommend our cleaning agent **R 5817**.

Do not use the cleaning agent to clean hands. Solvents extract the natural grease from the skin.

- **Peelable protective skin EH 13.150 AQ-T**
  blue transparent, solvent-free, water-borne 1-pack system for the protection of smooth surfaces, e.g. of lacquer coating machines and scales, against soiling from ink splashes or other contaminations. After drying, a highly elastic and tear resistant film results that can be peeled-off and renewed as required.

Special technical reports on these products are available upon request. In our report manual these technical reports are filed under group 5 and 13. On our report manual CD, technical reports can be accessed in the ”Products” section.

7.3 Manual processing

The silicone thick film lacquer **ELPEGUARD® DSL 1705 FLZ** can be applied by means of brushing. This process is especially suitable for repair work and small series’ as the ink can be applied selectively. But in this case uneven layer thicknesses may result.

7.4 Mechanical processing

7.4.1 Dip coating

Dip coating requires that the object to be coated is completely or partially dippable.

→ Determine the optimum dipping parameters for your application purposes by performing pre-trials. Reduce the emersion velocity or adjust a dwell time in the dip tank if air-bubbles form between pcb and components.

→ Keep the temperatures in the dip tank < 30 °C [86 °F] to extend the processing time.

The achieved layer thickness is dependent upon the component geometry and emersion velocity. Emersion velocities of 2 - 4 mm/s usually effect good coating results.

→ If necessary, reduce the emersion velocity so that less lacquer drips off and the layer thickness becomes more even.

→ Let excess lacquer drip off after emersion by turning and tilting the pcb at an angle of 30° if possible. This way a draining tip results so that drip residues only form there.

Ensure the dip tank is protected against contamination/moisture:

→ Use clean tools only.

→ Close or seal the dip tank when not in use, even in case of shorter breaks.

→ Clean the dip tank completely at regular intervals.

Upon request, we will gladly provide you with contact addresses of high-performance manufacturers of dip coating machines.

7.4.2 Automatic selective coating

The use of automatic selective coating units makes it possible to coat defined areas of the assembly with a uniform ink film.

Optimum equipment parameters depend upon the assembly geometry, the required final properties etc. and thus should be determined in co-operation with the corresponding unit manufacturer,

Lackwerke Peters GmbH + Co KG as well as the end user.

Upon request, we will provide you with contact addresses of high-performance manufacturers of such units as well as contract coating companies.

8. Drying/curing

The silicone thick film lacquer **ELPEGUARD® DSL 1705 FLZ** is thermally cured. The following rate shall serve as a guideline:

15 min* at 110 °C [230 °F].

* The curing time is dependent upon the lacquer layer thickness as well as the heat absorption of the assembly and thus must be extended if necessary.

The silicone thick film lacquer **ELPEGUARD® DSL 1705 FLZ** can be cured when encapsulated and is thus protected against volatile contaminations from the oven that may have an inhibiting effect on the curing reaction (see also Item 7 "Processing").

9. Standard packaging

The silicone thick film lacquer **ELPEGUARD® DSL 1705 FLZ** is packed for delivery as follows:

10 plastic bottles of 1 kg = 10 kg = 1 selling unit

Partial lots of the selling unit can be ordered but will entail surcharges to cover repackaging costs.

10. Shelf life and storage conditions

Labels on containers show shelf life and storage conditions.

Shelf life: In sealed original containers at least 12 months

Optimum storage conditions: +5 °C [+41 °F]

Storage conditions: +5 °C to +25 °C [+41 °F to +77 °F]
(This reduces the shelf life to 9 months.)

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.

11. Further literature/technical documentation

In addition to the recommendations given in this technical report, we can provide technical papers and information sheets written and compiled by members of our staff. A list of the technical publications available can be found in **TI 15/101 E** (technical papers) and **TI 15/100 E** (technical information sheets).

In our report manual all **t**echnical **i**nformation sheets **(TI's)** are filed under group 15. Alternatively, visit our website at **http://www.peters.de** or click on the "Service" section on our report manual CD.

12. Further products for the production of pcbs

We offer a wide range of **etch resists (photoimageable, UV curing, conventional curing), plating resists, solder resists (photoimageable, UV curing, conventional curing) as well as peelable solder masks, marking inks (photoimageable, UV curing, conventional curing), carbon-conductive inks, via hole fillers (purely thermal curing), thick film fillers, plugging pastes, heatsink pastes, special strippers for solder resists and further auxiliary products for screen printing (e. g. cleaning agents, thinners).**

Special technical reports are also available for these products and can be provided on request. On our report manual CD you will find technical reports in the "Products" section.

13. Further products for the electronics/ electrical engineering industries

We boast a wide range of **conformal coatings, thick film lacquers, silicone gels, casting compounds, casting resins, electro pastes, insulating lacquers, impregnating varnishes, adhesive lacquers and auxiliary products for electronics.**

Special technical reports are also available for these products and can be provided on request. On our report manual CD you will find technical reports in the "Products" section.

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.

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