

2-pack solder resists

SD 2446 and SD 2496 TSW

- application by screen printing
- excellent adhesion
- **SD 2496 TSW**: high reflectivity and excellent yellowing resistance
- excellent colour stability even after lead-free reflow soldering and tempering processes
- very good weather resistance (QUV accelerated weathering test)
- especially suitable for application in optoelectronics and the automotive sector
- halogen-free acc. to JPCA-ES01-2003/IEC 61249-2-21
- UL approval of **SD 2496 TSW**: best flame class UL 94 V-0, UL File No. E80315

This Technical Report is valid for the following adjustments:

- **SD 2446**, black opaque
- **SD 2496 TSW**, white opaque

Indices: **SD** = screen printing
TSW = thermally stable white

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Please read this technical report, the corresponding material safety data sheet and the Technical Information sheets TI 15/3, TI 15/10, TI 15/11 and TI 15/13 (see Item 4 and 7) carefully before using the product.

1. General information

The 2-pack solder resists **SD 2446** and **SD 2496 TSW** are solder masks in the sense of VDI/VDE 3710, sheet 4: "Fabrication of printed circuit boards; printing processes". They are permanent solder masks that are applied to those parts of the printed circuit board which are not to be tinned during subsequent soldering processes.

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

2. Application

The 2-pack solder resists **SD 2446** and **SD 2496 TSW** are thermally curing 2-pack systems that are applied by means of screen printing. They are distinguished by their excellent adhesion to all common base materials, also to selected flexible base materials, and thus are suitable for so-called "static flex" circuits.

On account of their exceptional colour stability compared to common solder resists, both under UV/sunlight exposure and after lead-free soldering processes, the solder resists **SD 2446** and **SD 2496 TSW** are particularly used in optoelectronics, e.g. as a reflective background in LED applications such as dashboards or headlights, on IMS printed circuit boards and in automotive electronics.

High luminous efficacy is achieved by the white opaque solder resist **SD 2496 TSW** which is distinguished by high reflectivity ratings. When applied underneath white LEDs it prevents the substrate from influencing the light colour.

A strong contrast of the LEDs to the substrate is ensured by the black opaque solder resist **SD 2446**. This feature is a particular benefit in visual LED applications such as information panels, traffic lights etc.

3. Special notes



Due to the large number of fluxes on the market preliminary tests are mandatory to check the compatibility, in particular in the case of no-clean fluxes.

When using chemical finish processes, perform pre-trials to verify the resistance of SD 2446 and SD 2496 TSW. Dry film thicknesses > 20 µm are recommended.

Take into account that the solder resists SD 2446 and SD 2496 TSW are not resistant to aggressive cleaning agents and solvents.

However, the solvent resistance acc. to IPC-SM-840E, 3.6.1.1 is fulfilled (see also section 6.2 "Physical and mechanical properties").

4. Safety recommendations

- Please read the corresponding material safety data sheet 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.
- Solvent vapours are heavier than air, thus when planning workplace ventilation arrangements, ensure that extractor units are positioned at worktop height.
- Please also pay attention to national guidelines or directives concerning the handling of flammable liquids as for example the German TRbF (technical regulations for flammable liquids) or European directives.
- Please read our **Technical Information sheet TI 15/3 "Protective measures when using chemicals including lacquers, casting compounds, thinners, cleaning agents"**. On our website, the technical information sheets can be accessed in the section "Service – Technical publications".

5. Characteristics

	SD 2446	SD 2496
Colour/appearance	black opaque	white opaque
Solids content of mixture, ISO 3251 (1 h, 125 °C [257 °F], 1 g weighed quantity)	70 ± 2 % by weight	70 ± 2 % by weight
Viscosity of mixture at 20 °C [68 °F] ISO 3219	31,500 ± 4,500 mPas	31,500 ± 4,500 mPas
Density of mixture at 20 °C [68°F], ISO 2811-1 Component A	1.30 ± 0.05 g/cm ³	1.43 ± 0.05 g/cm ³
Component B	1.01 ± 0.05 g/cm ³	1.01 ± 0.05 g/cm ³
Mixture	1.30 ± 0.05 g/cm ³	1.41 ± 0.05 g/cm ³
Pot life of mixture (18 – 23 °C) [64.4 - 68 °F], set-up quantity 500 g	approx. 8 hours	approx. 8 hours

* measured with Haake RS 600, C 20/1°, 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 solder resists **SD 2446** and **SD 2496 TSW** are distinguished by the following properties:

6.1 General properties

- do 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
- excellent printing properties, even in the case of high conductors
- suitable for rigid and "static flex" printed circuit boards
- outstanding adhesion to all common base materials
- **SD 2496 TSW**: high reflectivity and excellent yellowing resistance
- very good weathering and chalking resistance (QUV rapid weathering test), thus suitable for outdoor use
- excellent colour stability even after lead-free reflow soldering and tempering processes
- particularly suitable for use in optoelectronics, e.g. as a background in LED applications, on IMS printed circuit boards or in automotive electronics
- no embrittlement after multiple curing, e. g. subsequent prints
- superb adhesion of subsequent prints like marking inks and carbon-conductive inks
- halogen-free acc. to JPCA-ES01-2003 und IEC 61249-2-21
- UL approval of **SD 2496 TSW**: best flame class V-0 in acc. with UL 94, UL file no. E80315.

6.2 Optical properties of SD 2496 TSW

Property	Test method	Result
Remission at 460 nm	light source D65, 45°/0°, 10° standard observer, 40 µm layer thickness	91 %
Brightness (L index)		95
ΔE after thermal stress (1000 h at 125 °C)	ISO 7724-3	< 1*
ΔL after thermal stress (1000 h at 125 °C)		< 1*
ΔE after UV stress (1000 h xenon arc radiation, 550 W/cm ²)		< 1*

* The highest quality (least yellowing) corresponds to a colour change of $\Delta E < 1$. The grades in descending order to the lowest quality correspond to colour changes in ΔE as follows:

- $\Delta E = 0-1$: normally not visible
- $\Delta E = 1-2$: slight yellowing, only visible to the trained eye
- $\Delta E = 2-3.5$: medium change, visible to the untrained eye
- $\Delta E = 3.5-5$: marked change
(applies in the same manner to ΔL for changes in brightness)

6.3 Physical and mechanical properties

Property	Test method	SD 2446	SD 2496 TSW
Adhesion	IPC-SM-840E, 3.5.2.1	class H and T	class H and T
	IPC-SM-840E, 3.6.2.6 (ink on ink)	class H and T	class H and T
Cross hatch	EN ISO 2409 on copper on FR 4	Gt 1 Gt 0	Gt 0 Gt 0
Pencil hardness	IPC-SM-840D, 3.5.1	4 H	4 H
Flexibility	Mandrel bending acc. to DIN 53152, polyimide film, thickness: 50 μm	2 mm mandrel	1.5 mm mandrel
Resistance to solvents	IPC-SM-840D, 3.6.1.1	passed	passed
	Isopropanol	passed	passed
	Isopropanol : deionised water (75 : 25)	passed	passed
	D-Limonene	passed	passed
	10% alkaline cleaning agents	passed	passed
Monoethanolamine	passed	passed	
Deionised water	passed	passed	
Solder bath resistance	IPC-SM-840E, 3.7.1/3.7.2 IPC-TM-650, 2.6.8 UL 94	passed: 20 s at 265 °C [509 °F] passed: 10 s at 288 °C* [550.4 °F] passed: 20 s at 288 °C* [550.4 °F]	

* With a solder bath resistance of 20 s at 288 °C [550.4 °F], the solder resists **SD 2446** and **SD 2496 TSW** fulfil the required temperature resistance for lead-free soldering.

6.4 Electrical properties

Property	Test method	SD 2446	SD 2496 TSW
Dielectric strength	VDE 0303, part 21 DIN EN 60243-1	64 kV/mm	96 kV/mm
	IPC-SM-840E, 3.8.1	passed	
Surface resistance	VDE 0303, part 30/ DIN IEC 60093	2.0×10^{14} Ohm	2.0×10^{14} Ohm
Volume resistivity	IPC-TM-650, 2.5.17.1	3.7×10^{16} Ohm x cm	5.0×10^{15} Ohm x cm
Comparative Tracking Index (CTI, Tracking resistance)	DIN EN 60112, on base material with CTI 250	CTI 325	CTI 600

Note: Optimum electrical insulation values can only be achieved when all flux residues are removed thoroughly from the printed circuit boards.

7. Processing



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

7.1 Mixing

The two components are already packed in the correct mixing ratio. The volume of the container of component A is sufficient to accommodate the total quantity of component B and to allow perfect mixing.

→ Mix both components in the specified mixing ratio:



Component A : Component B = 100 : 2 (parts by weight)

CAUTION: The labels on our containers indicate both the volume [L] and weight [kg]. The mixing ratio applies to the weight.
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For stirring we recommend mechanical stirring equipment. For more detailed information on correct mixing please read our **Technical Information sheet TI 15/10: "Processing of 2-pack systems"**. On our website, you will find technical information sheets in the section "Service – Technical publications".

After thorough mixing the lacquer can be processed immediately.

7.2 Adjustment of viscosity

The 2-pack solder resists **SD 2446** and **SD 2496 TSW** are adjusted in such a manner that they normally can be processed in the condition supplied. If necessary, their viscosity can be reduced for processing purposes by adding the universal thinner **UV 5000** or the universal retarder **UZ 5100**. When the retarder is used the screen open time is extended.

DIL = To be thinned with universal thinner **UV 5000** or universal retarder **UZ 5100**

7.3 Auxiliary products

- **Screen opener HP 5200**

The screen opener **HP 5200** is a highly active spray for dissolving dried screen printing inks immediately and safely from clogged screens. **HP 5200** is silicone-free and does not contain oils or oily substances, so that no smearing occurs.

- **Anti-static spray HP 5500**

The anti-static spray **HP 5500** prevents and eliminates any electrostatic discharge that occurs during screen printing. **HP 5500** is silicone- and grease-free.

- **Cleaning agents R 5899, R 5821 and R 5817**

The cleaning agent **R 5899** does not have to be marked according to German dangerous goods regulations and can be handled simply and safely. Owing to its high flash point (> 100 °C [> 212 °F]) it is especially suitable for use in screen washing equipment. The cleaning agent **R 5899** is particularly distinguished by a low vapour pressure (< 0.1 hPa at 20 °C [68 °F]) and thus is not affected by the EU-VOC regulation 1999/13/EG which judges solvents by their percentage of volatile organic compounds (VOC = volatile organic compounds).

Furthermore, the cleaning agent **R 5821** is available which, owing to its high flash point of +32 °C [89.6 °F], is also suitable for use in screen washing equipment as well as for cleaning work tools. For the manual cleaning of screens and tools we recommend our cleaning agent **R 5817** with its fast and thorough cleaning properties.



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

Special technical reports for these products are available upon request. Further information regarding the content and consequences of the EU-VOC regulation can be found in our technical information sheet **TI 15/110 E "EU-VOC regulations – Content and consequences for the PCB industry"**. On our website, you will find technical reports in the "products" section and technical information sheets in the "service" section.

7.4 Screen printing

- Please read our **Technical Information sheets TI 15/11 "The screen printing stencil in the pcb industry"** and **TI 15/13 "Precleaning in the pcb fabrication process"**. On our website, you will find technical information sheets in the section "Service – Technical publications".
- Ensure that the surface to be coated is clean, dry and grease/oxide-free and that copper surfaces preferably have an average surface roughness of 2 µm.

recommended screen printing parameters

Screen fabric	Polyester 43-80 to 77-48 (acc. to old nomenclature polyester 43-77 T [lines/cm]) or corresponding steel fabric
Screen tension	at least 25 N/cm or according to the instructions of the screen mesh manufacturer
Squeegee	75-80 Shore-A hardness
Squeegee profile	right angled
Squeegee angle	approx. 75°

8. Drying/Curing

- Cure the solder resists **SD 2446** and **SD 2496 TSW** in a convection dryer under the following conditions:
30 min* at 150 °C [302 °F] or 60 min* at 130 °C [266 °F].

* Object holding time: The curing time starts when the panels reach the curing temperature.

SD 2446 and **SD 2496 TSW** are suitable for curing in conveyerised IR lines.

- Perform pre-tests to determine the optimum temperature profile of the equipment used to cure **SD 2446** and **SD 2496 TSW**.

9. Standard packaging

The 2-pack solder resists **SD 2446** and **SD 2496 TSW** are packed for delivery as follows:

Component A	Component B	Selling unit
10 tins of 1 kg	10 glass bottles of 0.02 kg	10.2 kg

Partial lots of the selling unit may 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 4 months



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

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.

Any questions?

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

The above information as well as advice given by our Application Technology Department whether in verbal or written form or during product evaluations is provided to the best of our knowledge, but must be regarded as non-binding recommendations, also with respect to possible third-party proprietary rights.

The products are exclusively intended for the applications indicated in the corresponding technical data sheets.

The advisory service does not exempt you from performing your own assessments, in particular of our material safety data sheets and technical information sheets, and of our products as regards their suitability for the applications intended. The application, use and processing of our products and of the products manufactured by you based on the advice given by our Application Technology Department are beyond our control and thus entirely your responsibility. The sale of our products is effected in accordance with our current terms of sale and delivery.

ATTENTION!

For new products, according to preliminary technical reports, adequate practical results are not always available which would permit a comprehensive assessment of such a product. It is therefore imperative to exercise particular care in the testing of such products with regard to the application intended!

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