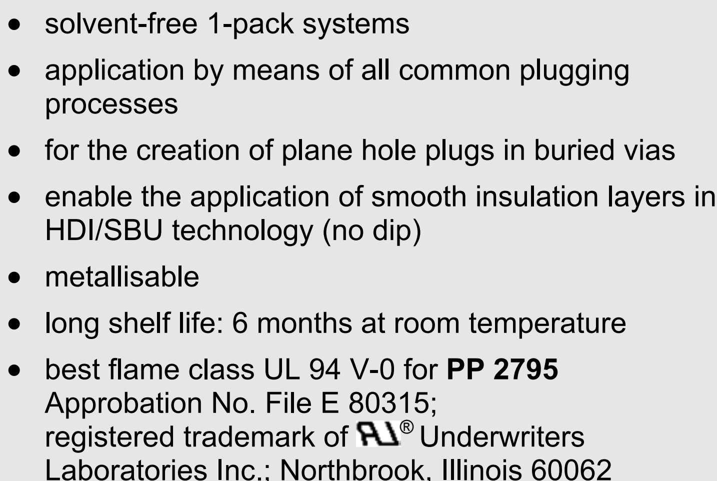
Lackwerke Peters GmbH + Co KG
Hooghe Weg 13, D-47906 Kempen
Internet: www.peters.de
E-Mail: peters@peters.de
Telefon (0 21 52) 20 09-0
Telefax (0 21 52) 20 09-70
Ein Unternehmen der PETERS-Gruppe

PETERS
Speziallacke für die Elektronik

TR TECHNICAL REPORT

Plugging pastes of the series

PP 2795



- solvent-free 1-pack systems
- application by means of all common plugging processes
- for the creation of plane hole plugs in buried vias
- enable the application of smooth insulation layers in HDI/SBU technology (no dip)
- metallisable
- long shelf life: 6 months at room temperature
- best flame class UL 94 V-0 for **PP 2795** Approbation No. File E 80315; registered trademark of UL® Underwriters Laboratories Inc.; Northbrook, Illinois 60062

This technical report is valid for the following adjustments:

- **PP 2795, white**
- **PP 2795 HV, white**

Indices: **PP = plugging paste**
HV = highly viscous

Contents

1. General information 2
2. Application 2
3. Special notes 2
4. Safety recommendations 3
5. Characteristics 3
6. Properties 4
6.1 General properties 4
6.2 Physical and mechanical properties ... 4
6.3 Electrical properties 5
7. Processing 5
7.1 Adjustment of viscosity 5
7.2 Auxiliary products 6
7.3 Screen and stencil printing 6
7.4 Vacuum plugging processes 7
7.5 Roller coating process 7
8. Drying/curing 7
8.1 Further processing 7
9. Standard packaging 8
10. Shelf life and storage conditions 8
11. Further literature/ technical documentation 8
12. Further products of the production of pcbs 8
13. Further products for the electronics/electrical engineering 8

Please read this technical report, the material safety data sheet according to directive 1991/155/EEC and the Technical Information sheet TI 15/15 (see item 7) carefully before using the product.

LP 060512 E-2 / 0208802e.002

1. General information

The 1-pack plugging pastes of the series **PP 2795** are used for the planar filling/plugging of buried vias in High Density Interconnect (HDI) / Sequential Build Up (SBU) technology. The diameter that can be filled is between approx. 0.1 and 2 mm and is very much dependent upon the "aspect ratio" of the via holes to be plugged.

Owing to the required stability of the inner layer the minimum pcb thickness for the roller coating process is 0.3 mm. In case of pcb thicknesses of > 2.1 mm it becomes increasingly harder to fill the holes completely.

The remaining residues of the paste on the bare copper material are removed after curing by means of deburring brushes or ceramic rollers.

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 – Symbols on labels“.

2. Application

Blister-free, very plane hole plugs that are distinguished by a good adhesion and metallisability can be created by means of the plugging pastes of the series **PP 2795**. The plugging pastes of the series **PP 2795** can be applied by means of all common plugging processes (see item 7 “processing”). Owing to their solids content of 100% the wet film thickness virtually corresponds to the dry film thickness, so that nearly no volume shrinkage occurs during curing which renders possible the application of multiple plane insulation layers as required in HDI / SBU technology.

The low coefficient of thermal expansion grants a safe further processing of the inner layer core up to the soldering process without any cracking or delamination of the applied layers.

To ensure a maximally safe "plugging" process the use of the plugging pastes of the series **PP 2795** instead of 2-pack solder resists should be preferred as due to the solvent content of the latter an increased volume shrinkage occurs meaning that holes may remain partially open. Moreover, when using 2-pack solder resists to fill metallised holes there is always a potential risk of solvent inclusions that may evaporate explosively during subsequent soldering processes (reflow soldering, wave soldering) and may damage and/or destroy the filling.

Since the plugging pastes of the series **PP 2795** are solvent-free 1-pack systems they offer very long processing times i.e. there is no limitation in the processing time owing to evaporation of solvents or the chemical reaction of resin and hardener.

The plugging pastes of the series **PP 2795** can be copper plated/metallised by means of processes that are commonly used in pcb technology.

Furthermore, the plugging pastes of the series **PP 2795** are distinguished by their good and easy grindability that renders the creation of very smooth surfaces possible. After curing (see also item 8 "drying/curing“) the plugging pastes of the series **PP 2795** can be sanded plane. Upon request we will gladly provide you with contact addresses of manufacturers of suitable brushing and sanding machines.

The plugging paste **PP 2795 HV** is a highly viscous adjustment of the plugging paste **PP 2795** that enables the filling of extremely thick printed circuit boards/higher “aspect ratios”.

3. Special notes

The screen-printable via hole fillers of the **series SD 2361** and **SD 2768 NB** are used if a safe filling of via holes is required, as for instance to seal vias for vacuum adaptation during incircuit testing or to avoid solder bleeding, and not where very smooth and metallisable hole plugs are needed. Owing to their 100% solids content the via hole fillers of the **series SD 2361** ensure a reliable processing (no danger of entrapped solvents) while the via hole filler **SD 2768 NB** is non-bleeding (Index NB = no bleeding) and thus particularly suitable for via-in-pad applications due to the fact that no bleeding onto gold or other metal surfaces occurs.

Special technical reports on these products are available upon request. In our report manual these technical data sheets are filed under group 2. On our report manual CD, technical reports can be accessed in the “Products“ section.

The plugging paste **PP 2795** is approved acc. to the best flame class V-0 in accordance with UL 94 (Approbation No. File E 80315, registered trademark of UL® Underwriters Laboratories Inc.; Northbrook, Illinois 60062).

Moreover, the plugging paste **PP 2795** is certified for space applications, having passed the **Outgassing Test** acc. to ASTM E595.

The **NASA** (**N**ational **A**eronautics and **S**pace **A**dministration) approved test method is based on the measurement of two parameters:

- Total mass loss (% TML)
- Collected volatile condensable material (% CVCM).

These two measuring values are decisive for the use of products in a vacuum. Outgassing materials may condensate on sensitive electronic components and thus lead to problems/failures.

The contracted test institute **Trace Laboratories-East** confirms the fulfilment of the substantial test criteria: The determined values are far lower than the limit values of 1.00% for TML and 0.10% for CVCM that are required for most applications.

Thus the plugging paste **PP 2795** is the ideal product for use in space electronics. This approved product is listed in the NASA specification D-8208 "Spacecraft Design and Fabrication Requirements for Electronic Packaging and Cabling; Section 3.6, Printed Wiring Boards; Table 3.6-5: Acceptable Via Hole-Fill Material".

Upon request we will gladly provide you with the full test report of Trace Laboratories-East. On our report manual CD and on our website you will find the test report in the "Service – Certificates" section.

Our **Technical Information sheet TI 15/15** with the title "Plugging processes – Filling of buried vias by means of the plugging process“ on the complete plugging process is also available. We will gladly send you TI 15/15 upon request. On our report manual CD and our website **http://www.peters.de** technical information sheets can be accessed in the “Service“ 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

	PP 2795	**PP 2795 HV**
Colour/appearance	white	white
Solids content	100%	100%
Viscosity* at 20 °C [68 °F] ISO 3219	22 000 ± 3 000 mPas	37 500 ± 2 500 mPas
Density at 20 °C [68 °F] ISO 2811-1	1.54 ± 0.05 g/cm³	1.53 ± 0.05 g/cm³

* measured with Haake RS 600, C 20/1°, D = 50 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 plugging pastes of the series **PP 2795** are particularly 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
- solvent-free 1-pack systems, thus nearly no volume shrinkage while curing
- long processing time
- creation of blister-free, very smoothly surfaced hole plugs in buried vias
- secure plugging of metallised vias
- good adhesion
- enable the application of smooth insulation layers in HDI / SBU technology (no dip)
- avoid the collection of fluxing residues that can create critical microclimates in vias and/or under components
- good grindability
- excellent metallisability
- best flame class UL 94 V-0 for **PP 2795** (see item 3)
- free of halogenated flame retardants
- long shelf life: 6 months at room temperature.

6.2 Physical and mechanical properties

Property	Test method	Result
Glass transition temperature Tg	**TMA** method (**t**hermo **m**echanical **a**nalysis)	approx. 140 °C [284 °F]
Coefficient of thermal expansion CTE	**TMA** method (**t**hermo **m**echanical **a**nalysis)	approx. 40 ppm/° C < Tg approx. 150 ppm/° C >Tg
Adhesion	IPC-SM-840 C, 3.5.2.1	class H and T
Pencil hardness	IPC-SM-840 C, 3.5.1 acc. to Wolff-Wilborn	9 H 9 H
Solvent resistance	Isopropanol, 20 °C [68 °F], 1 h Methylethylketone, 20 °C [68 °F], 1 h	passed passed
Resistance to acids	10% by volume HCl, 20 °C [68°F], 1 h	passed
Resistance to lyes	10% by weight NaOH, 20 °C [68°F], 1 h	passed
Solder bath resistance	IPC-SM-840 C, 3.7.2 MIL - P 55 110 D UL 94*	passed: 20 s at 265 °C [509 °F] passed: 10 s at 288 °C [550.4 °F] passed: 20 s at 290 °C [554 °F]

* With a solder bath resistance of 20 s at 290 °C [554 °F] the plugging pastes of the series **PP 2795** meet the temperature resistance requirements for soldering processes with lead-free solder.

6.3 Electrical properties

Property	Test method	Result
Surface resistance	VDE 0303, part 30 DIN IEC 60093	2 x 10^{14} Ohm
Volume resistivity	VDE 0303, part 30 DIN IEC 60093	1.2 x 10^{16} Ohm x cm
Moisture and insulation resistance	IPC-SM-840 C, 3.9.1	class H and T
Comparative Tracking Index (CTI, Tracking resistance)	DIN EN 60112 on base material FR 4 with CTI 275	CTI 500
Dielectric constant ε_r	DIN 53483 1 kHz 1 MHz 1 GHz	 2.8 2.5 2.8
Dielectric loss factor tan δ	DIN 53483 1 kHz 1 MHz 1 GHz	 0.005 0.010 0.020

7. Processing

The plugging pastes of the series **PP 2795** can be applied by means of screen and stencil printing, vacuum plugging processes and roller coating. The specified processing parameters are meant for orientation purposes and, depending on the layout of the printed circuit board and “aspect ratio” of the plated-through holes to be filled, must be optimised and adjusted to the prevailing production conditions.

➔ Please read our **Technical Information sheet TI 15/15 “Plugging processes – Filling of buried vias by means of the plugging process“** where you will find detailed advice on processing. In our report manual this technical information sheet is filed under group 15. On our report manual CD and our website **http://www.peters.de** technical information sheets can be accessed in the “Service“ section.

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.

7.1 Adjustment of viscosity

The plugging pastes of the series **PP 2795** are adjusted in such a manner that they can be processed in the condition supplied. A process-relevant reduction of viscosity is only possible by using reactive thinner **VR 2795**.

DIL **To be thinned with reactive thinner VR 2795**

As the reactive thinner VR 2795 participates in the curing process it is not possible to use any other thinners. The quantity to be added should not exceed a maximum of 3% because if larger quantities are added the properties of the plugging paste PP 2795, such as hardness and coefficient of thermal expansion, will change.

7.2 Auxiliary products

We recommend the following products as auxiliary products:

- **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 cleaning the machine 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"**. In our report manual these technical publications are filed under group 5 and 15. On our report manual CD you will find technical reports in the "Products" section and technical information sheets in the "Service" section.

7.3 Screen and stencil printing

Recommended screen printing parameters

Screen fabric	Steel fabric: - 224/100 - 245/65 - 265/50
Screen printing stencil	Free spaces in the screen fabric > hole diameter (0.3 – 0.5 mm larger, depending on print format size) A high stencil build-up is not necessary because the ink should be printed into the drill holes only. As a rule it is sufficient to close the screen mesh with a thin coat of emulsion or a thin capillary film.
Printing underlay	Base material with a thickness of approx. 3 mm that was drilled with the same drill program but where the diameters of the holes are five times the size of the actual vias. (The printing underlay enables the filling of the holes since there is no resistance caused by air pockets under the holes.) An undergrid would also be acceptable provided it does not permit the printing substrate to spring.
Snap-off	Low
Flooding	Rubber squeegee 75 Shore A push stroke 70°
Printing	Rubber squeegee 75 Shore A, squeegee profile 30-45°, printing angle 90° As high a squeegee pressure as possible (4 bar) and as low a printing speed as possible

7.4 Vacuum plugging processes

The following parameters are meant for orientation purposes only and may vary considerably.

Recommended parameters

	for mid range aspect ratios (5:1)	for high aspect ratios (10:1 to 15:1)
Paste pressure	2.5 - 3 bar	3.5 - 4 bar
Print speed	20 - 30 mm/s	20 mm/s
Print passes per board	1	2

7.5 Roller coating process

During this application process the plugging paste is pressed into the metallised holes from a storage tank below via a roller. The transport speed and contact pressure of the squeegee depend strongly on the printed circuit board layout, particularly the “aspect ratio”. Excess material is doctored by means of afollow-up squeegee.

Upon request we will gladly provide you with technical documentation on the roller coating process.

8. Drying/curing

➔ Thermally cure the plugging pastes of the series **PP 2795** at the following conditions:
45 min at 150 °C [302 °F] (object holding time)*

* Object holding time: The time is measured from the point when the panels reach the curing temperature.

Owing to the potentially higher thermal absorption of thicker printed circuit boards the curing time may have to be increased.

A controlled stepped cure may promote an improved cross-linking and a higher Tg. This must be verified by appropriate individual pre-tests.

In the case of application by roller coating a very thin film of plugging paste may remain on the copper surface. In this case, longer curing times and/or higher curing temperatures (as far as the base material can withstand them) must be considered since the plugging paste cures slower in thinner layers than in thicker ones. Longer curing times and higher temperatures up to 180 °C [356 °F] do not negatively affect the functionality of the plugging paste.

➔ Store the pcbs vertically during curing to avoid the plugging pastes of the series **PP 2795** dipping into the holes.

The plugging pastes of the series **PP 2795** are also suitable for curing in IR conveyorised ovens. The curing parameters are, among others, dependent upon the pcb thickness and the percentage of copper on the pcb.

➔ Determine the corresponding curing parameters by means of pre-trials.

8.1 Further processing

After curing the printed circuit board is brushed by means of deburring brushes or ceramic rollers to remove the remaining material from the pcb.

Then the filled holes can be metallised, thus making a multilayer structure as required by HDI/SBU technology possible. Metallisation is effected by means of the common methods practised in pcb production, but also can be carried out without desmear. If the desmear process is used to pre-treat the surface, a postbake for 30 min at 120 °C [248 °F] is necessary before electro copper plating. By means of longer curing / higher curing temperatures or by adapting the desmear parameters an improved resistance can be achieved if the plugging paste is attacked too strongly in the desmear process (see item 8 “Drying/curing”).

9. Standard packaging

The plugging pastes of the series **PP 2795** are packed for delivery as follows:

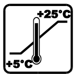
2 buckets of 5 kg in one carton = 10 kg = 1 selling unit.

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

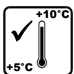
10. Shelf life and storage conditions

Labels on containers show shelf life and storage conditions.

Shelf life: In sealed original containers at least 6 months



Storage conditions: +5 °C to +25 °C [+41 °F to +77 °F]
Storage temperatures below +5 °C [41 °F] make the material unusable.
Storage temperatures exceeding +25 °C [77 °F] reduce the shelf life considerably and must be avoided at all costs.



Optimum storage conditions: +5 °C to +10 °C [+41 °F to +50 °F]
(increases the shelf life)

Protect against frost

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 of 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

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.

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.

Lackwerke Peters GmbH + Co KG
Hooghe Weg 13, 47906 Kempen

Internet: www.peters.de
E-Mail: peters@peters.de

Phone: 0049-21 52-20 09-0
Fax: 0049-21 52-20 09-70