Property Design & Material Qualification of 3D-Thermoset SLS powders

Public transport & Rail applications

Forum France Additive
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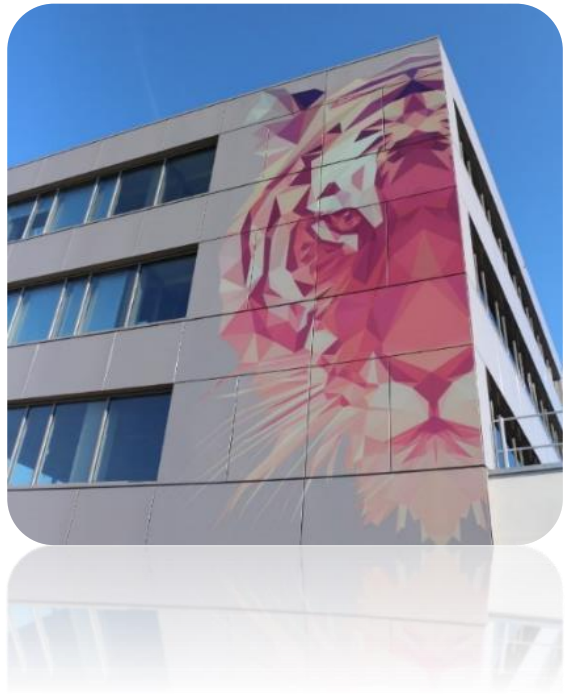
AGENDA

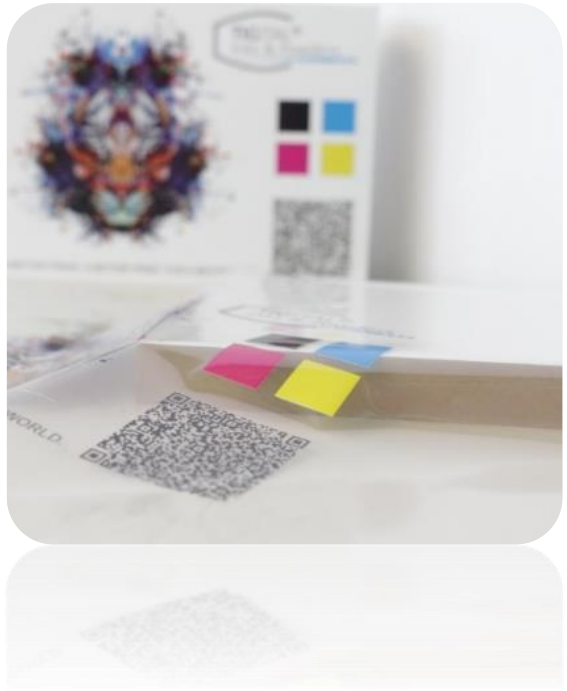
- **Introduction**
- **SLS printing with thermosets**
- **Processing of thermosets**
- **Customer applications**
- **Outlook**
- **Q&A**

INTRODUCTION
TIGITAL® 3D-Set SLS

Additive Manufacturing

The TIGER 4x4 (4 regions x 4 business units)





TIGER Drylac® Powder Coatings

TIGITAL® Inks

TIGITAL® Tattoo

TIGITAL® 3D-Set

SLS Printing with Thermosets

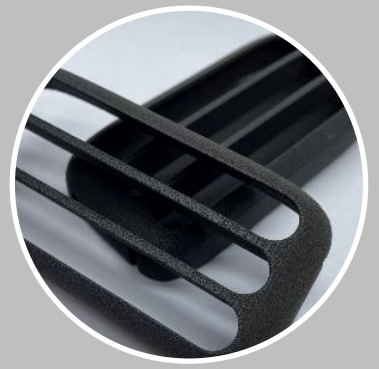
Process

SLS PROCESS CHAIN

Preprocess

Print

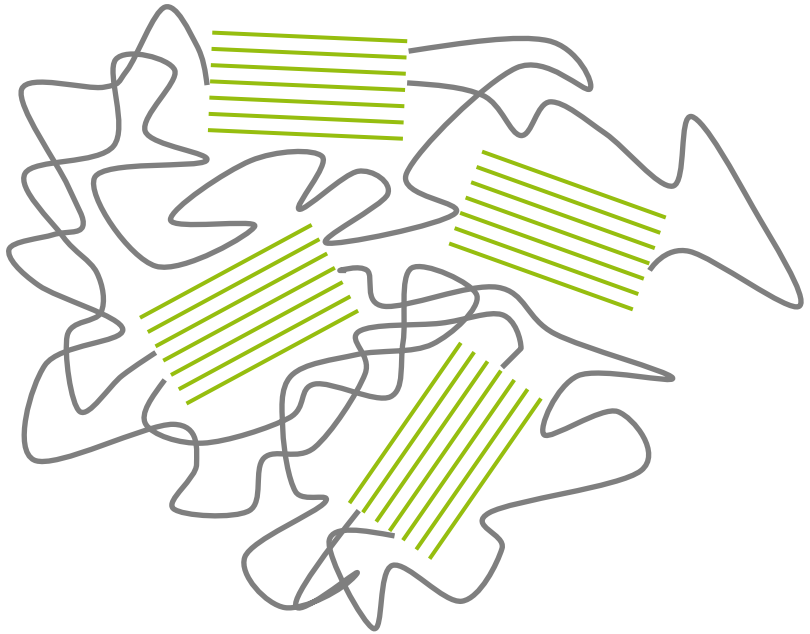
Postprocess



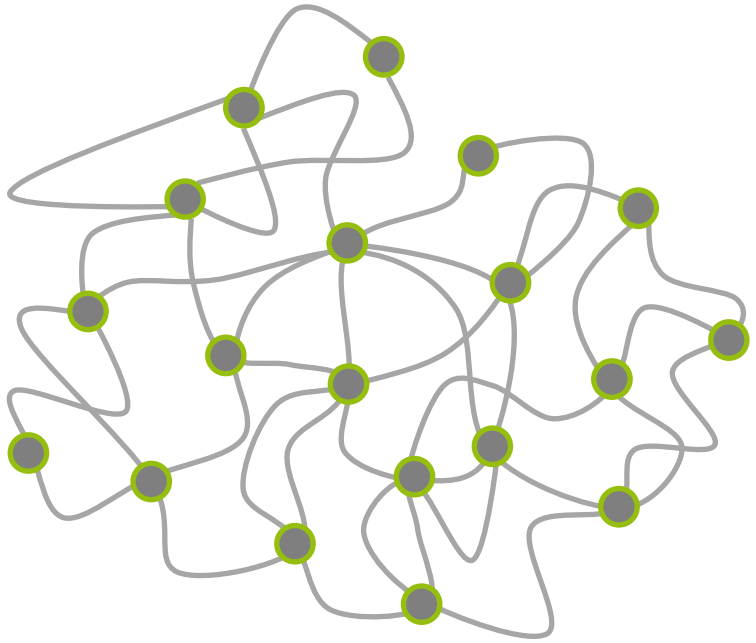
Part

Complete Qualification Process

THERMOPLASTICS vs. THERMOSETS

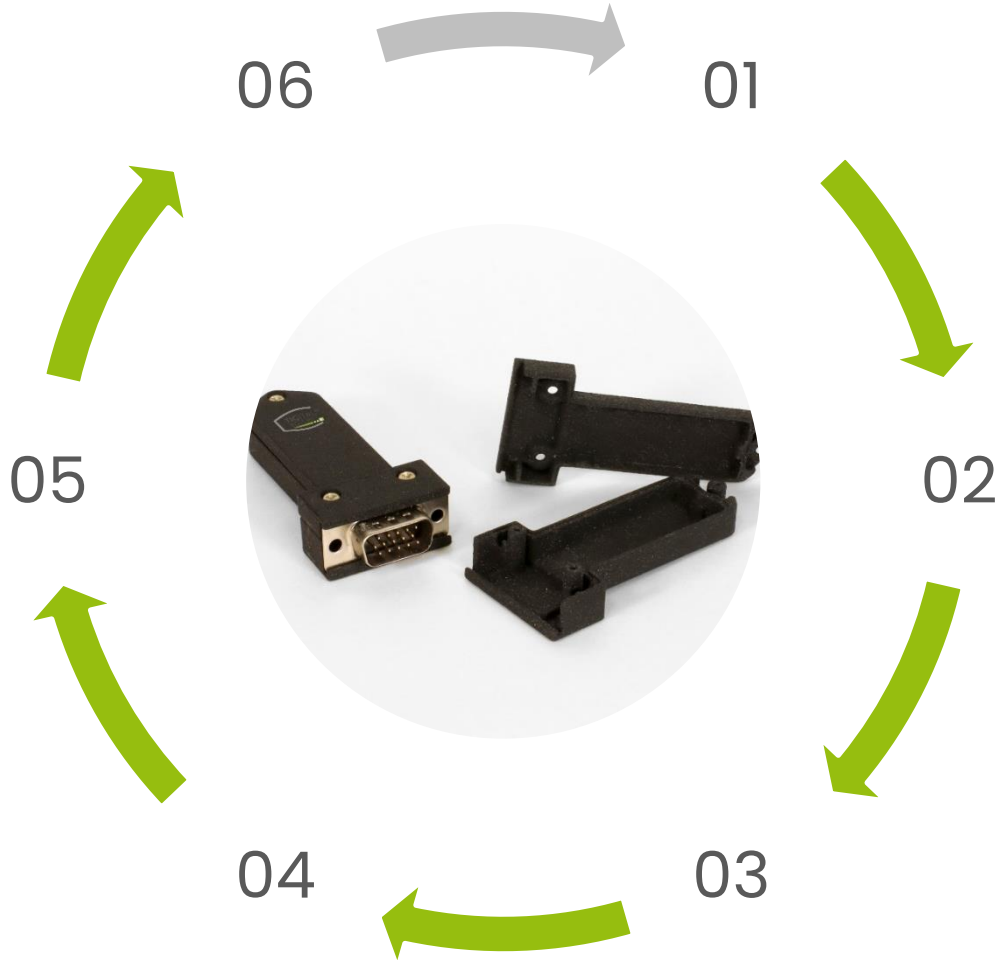


Thermoplastics:
linear or branched structure



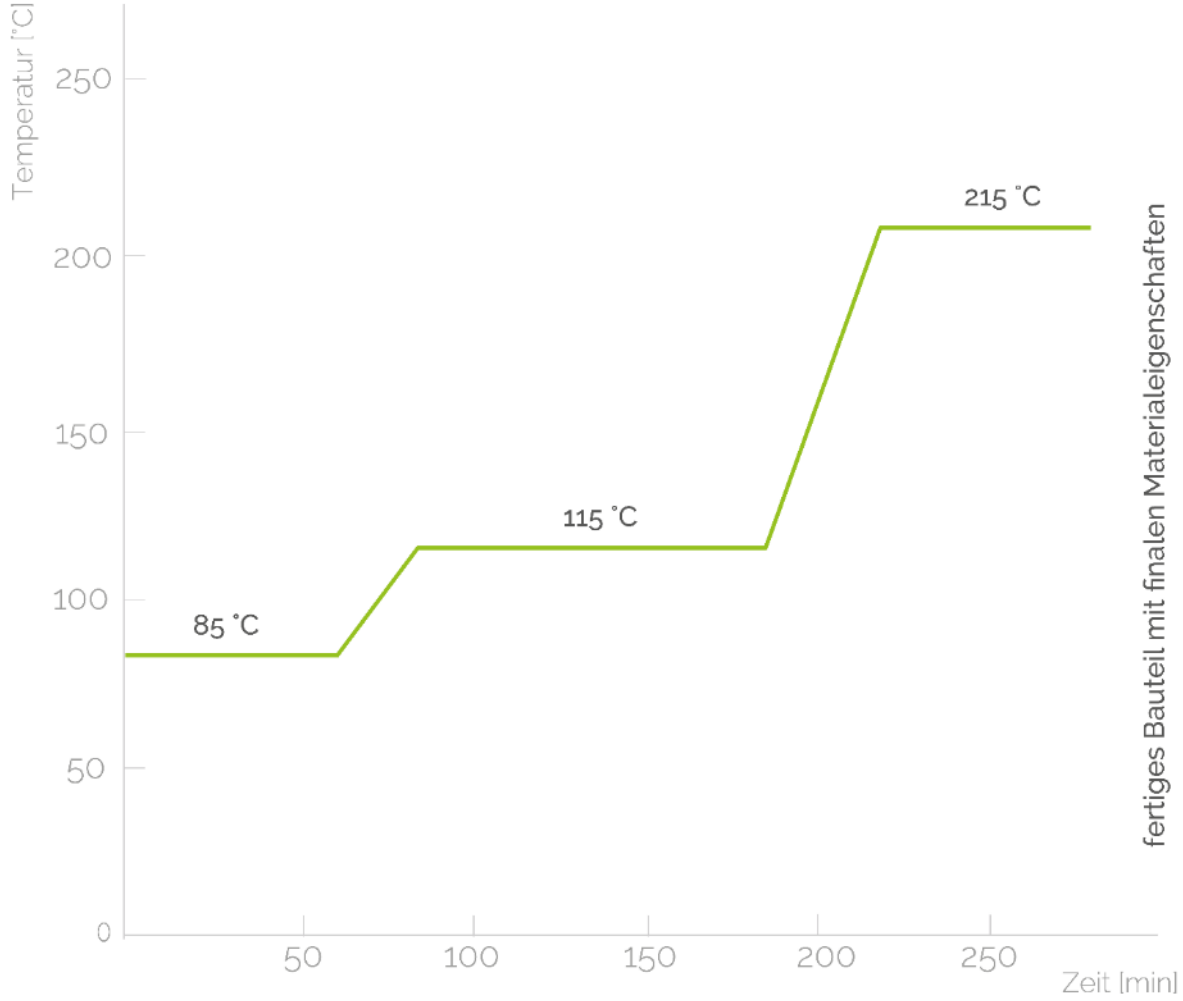
TIGITAL® 3D-Set:
interconnected cross-linked structure

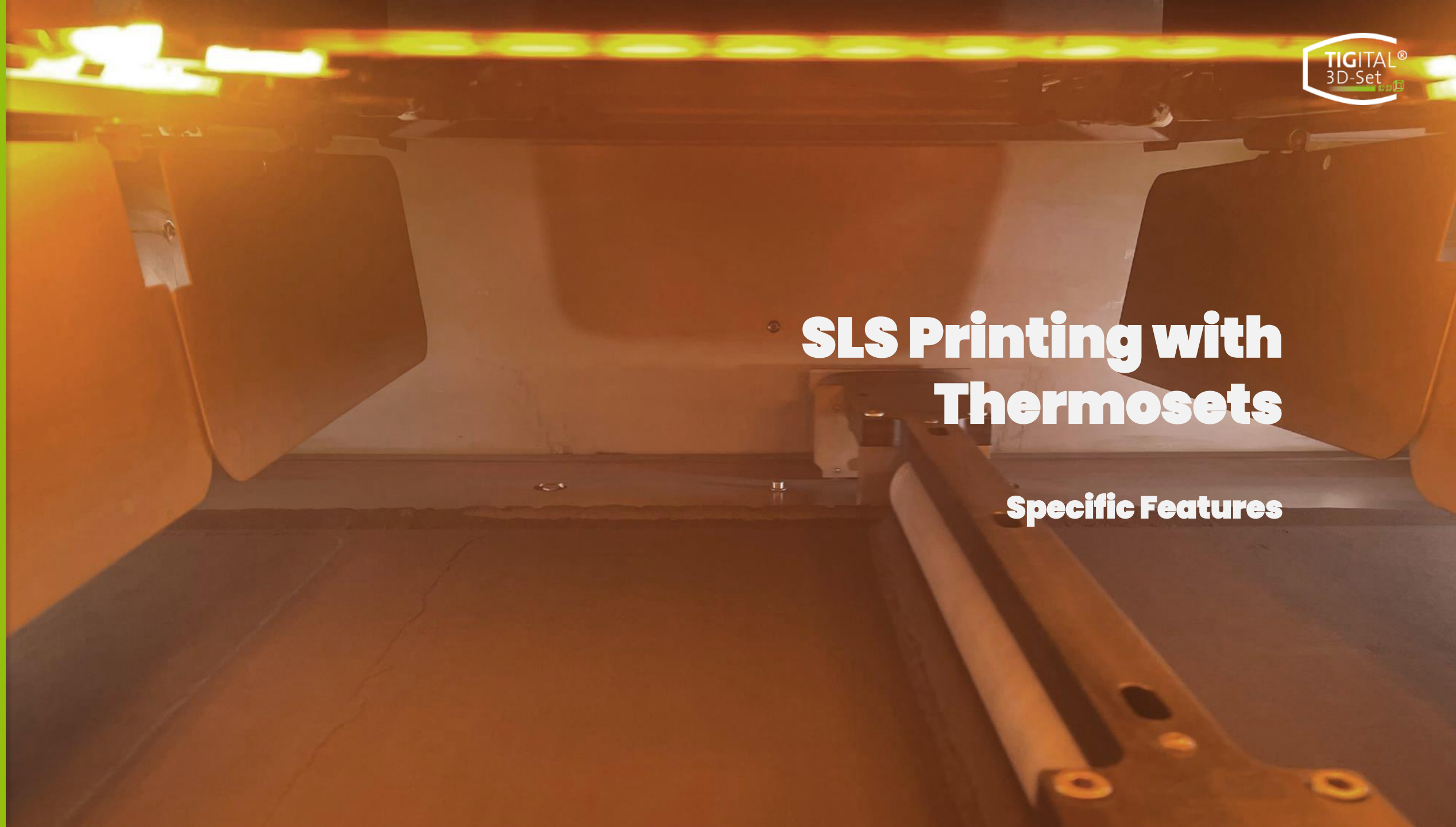
PRINTING PROCESS



1. Part design
2. Material preparation
3. Printer preparation
4. Printing process
5. Part depacking
6. Curing step

CURING STEP

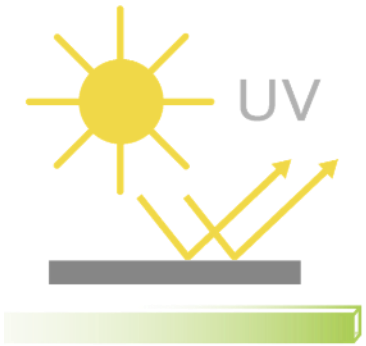

Temperatur [°C]
250
200
150
100
50
0
85 °C
115 °C
215 °C
50
100
150
200
250
Zeit [min]
fertiges Bauteil mit finalen Materialeigenschaften

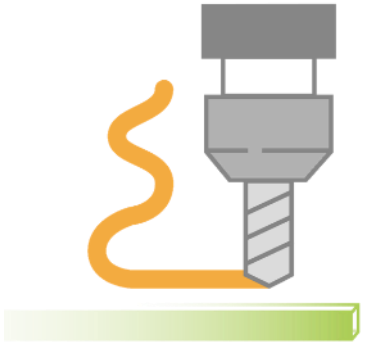


SLS Printing with Thermosets

Specific Features

SPECIFIC FEATURES

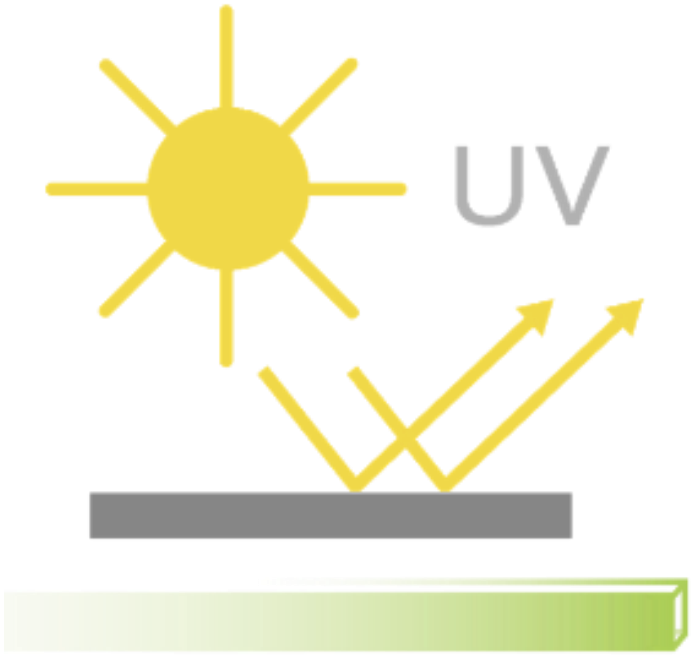




FLAME RESISTANT

- **Halogen-free flame-retardant.**
- **Fulfills**
  - UL-94 V0 at 2,5 mm
  - UN ECE 118 Annex 6, 7 & 8
  - EN 45545
    - HL 1, 2 & 3
- **Re-use more than 70%.**
- **No pre-drying.**
- **Other properties upon request.**

UV RESISTANT



- **Superb outdoor stability.**
- **Fulfills different standards for hot light ageing according to ISO 506-B06.**
- **High Re-use (>70%).**
- **No specific pre-treatment or drying necessary.**
- **Can be additionally coated to fulfill even higher specifications.**

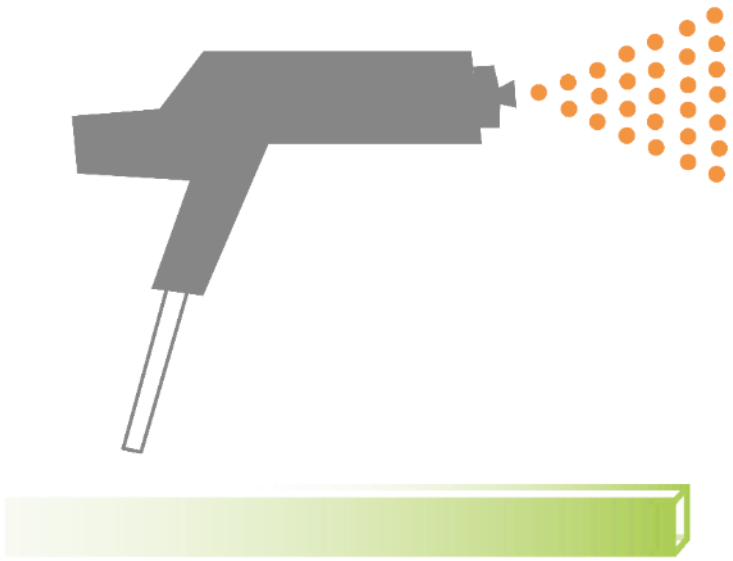
LOW PRINTING TEMPERATURES

- Very low printing temperatures ranging from 65 to 67°C.
- Fast production cycles even with additional curing steps.
- Reduction of overall energy consumption.
- High Re-use content (>70%).
- Depacking time reduced due to lower printing temperatures.

CHEMICAL RESISTANCE

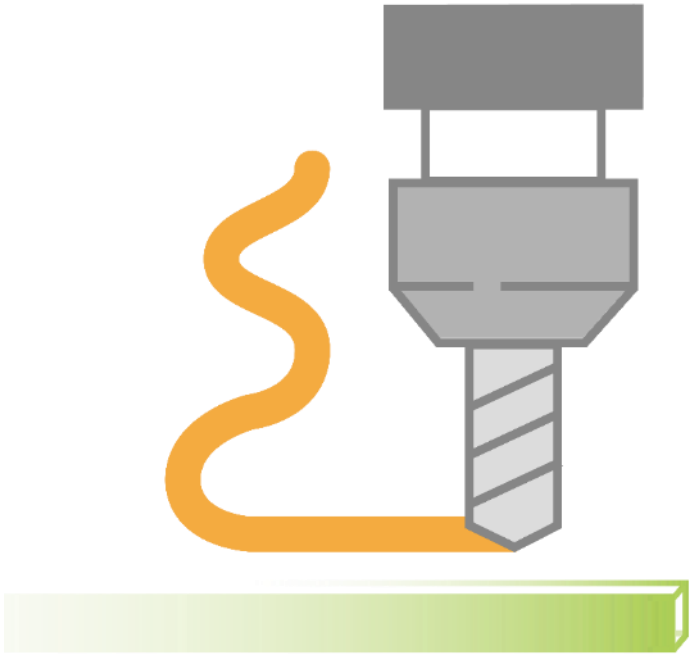
- **Chemical stability**
- **High resistance to environmental stress cracking according to ISO 22088-3.**
- **Works in harsh environments where surfactants, acids or other chemicals are present.**
- **High stability against cosmetics or care products according to DBL 5404.**

SURFACE FINISHING



- By applying a superior TIGER drylac® coating you enable electro static discharge for your parts.
- Additionally the coating enables you to a world full of colors and other specific properties upon request.
- Surface smoothing via tumbling possible to get even better surface quality.

MACHINING

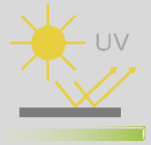


- With 3D printing you want to avoid mechanical work on your parts.
- However our materials are mechanically workable with high accuracy.
- The parts will not brake due to the outstanding balance of stiffness to toughness ratio when overworked.

TIGITAL® 3D-Set

Combination of features

Flame retardant properties



Superior UV resistance

High chemical stability

Post finishing

Powder coating & color

Machine compatibility

All open SLS Printing Machines like

FARSOON TECHNOLOGIES

PRODWAYS

WEIRATHER MASCHINENBAU UND ZERSPANUNGSTECHNIK GmbH

nexa3D

SINTERIT

Additional benefits

Reduction in energy consumption

Short unpacking time

TIGITAL® 3D-Set Applications

Bus and Rail

Material requirements (public transportation)

- **Material needs to pass UN-ECE R.118**
  - HFFR - no dripping during burning (at least UL94 V1)
- **Charpy notched impact >1,8 kJ/m² at 23°C**
- **High chemical resistance (DBL 5404 or equivalent)**
- **Tensile strength >40 MPa, Elongation >5%**
- **HDT-A value >80°C**
- **Re-Use factor >50%**

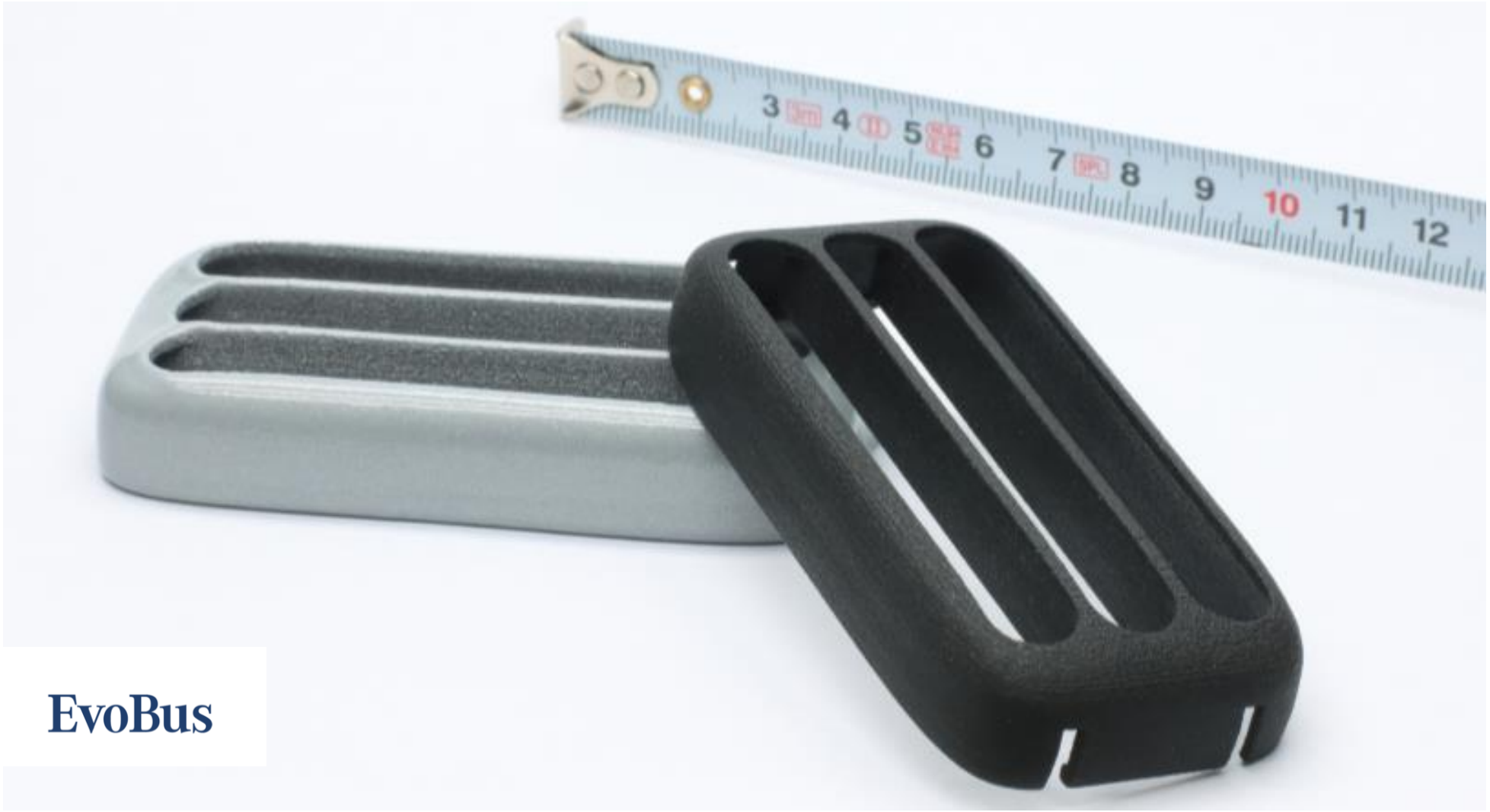
Material: PPP 371/80002

Other requirements according to DBL 5404

Test	Standard [Unit]	TIGITAL® 3D-Set 371/80002
1,3-butadiene content	DIN 13130-4 [mg/kg]	1
Fogging	DIN75201-B [mg]	1
Emissions VOC	VDA 278 [µg/g]	1
Emissions fog	VDA 278 [µg/g]	1
Odor	VDA 270 [rating]	1
Resist. to stress cracking	ISO 22088-3 [rating]	2
Resist. to cosmetics	- [rating]	2
Resist. to care products	- [rating]	2
Hot light ageing	- [rating]	2
Burning test	DBL 5307.10 [mm/min]	<100
Burning behaviour	ECE R118.03 [mm]	3

Material: PPP 371/80002

EXAMPLE (Production of on demand of spare parts)



Material: PPP 371/80002

EXAMPLE (Production of on demand of spare parts)

Material: PPP 371/80002

Material requirements from customer (rail)

- Flame retardancy according to DIN EN 45545 R22 & R23 (HL1, 2 & 3)
- Easy to print on open printing systems (Farsoon, Prodways, Weirather)
- High reuse rate (>70%)
- Good mechanical properties (high stiffness)
- High dimensional accuracy
- Black color – Optional coating possible (interior rail certified)

Material: PPP 371/80008

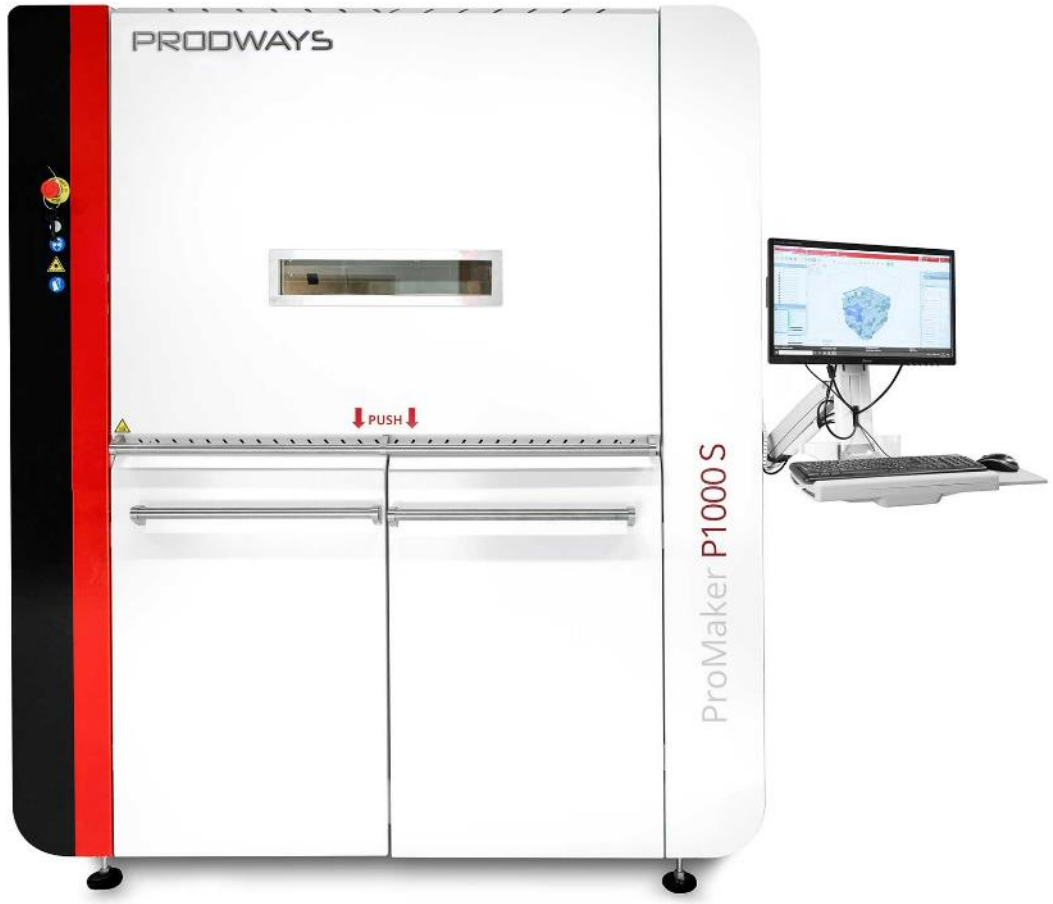
EXAMPLE (train applications)

Classification according to DIN EN 45545-2:2020-10				*Limits (Reqirement R22 / R23)*		
Test standard	*Parameter*	*Unit*	*Value*	*HL1*	*HL2*	*HL3*
EN ISO 4589-2	Oxygen Index	%	50	≥28	≥28	≥28
EN ISO 5659-2	D_s max.	-	42,6	600 / -	300 / 600	150 / 300
EN 17084 (1)	CITG	-	0,15	1,2 / -	0,9 / 1,8	0,75 / 1,5

specific requirements according to
DIN EN 45545 can now be fully fulfilled
for 3D printed SLS parts with TIGITAL® 3D-Set

Material: PPP 371/80008

Cooperation with Wabtec & Prodways



Material: PPP 371/80008

EXAMPLEs (rail parts)

Wabtec CORPORATION

PRODWAYS
THE NEW WAY OF PRODUCING

Material: PPP 371/80008

Material requirements (interior decoration)

- Low water and surfactant uptake (<1%)
- Easy to print and cure on open SLS printing systems
- High reuse rate (>70%)
- Balanced mechanical properties
- Dimensional stability over time in combination with chemical resistance
- Surface finish – Powder Coating applicable

Material: TPP 371/80006

EXAMPLE (Production of functional parts)

Material: TPP 371/80006

COOPERATIONS and CALL to ACTION

TIGITAL® 3D-Set

TIGER

PRODWAYS
THE NEW WAY OF PRODUCING

FARSOON TECHNOLOGIES

Wabtec CORPORATION

TIGITAL® 3D-Set

SINTERIT

TRIVION
A Trademark of Umdasch Group Ventures

WEIRATHER
MASCHINENBAU UND ZERSPANUNGSTECHNIK GmbH

Impossible Objects

nexa3D

Q&A

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