



# Additive Fertigung in der Praxis

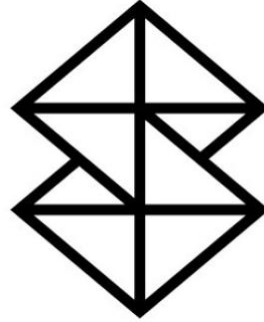
Dominik Müller

Stratasys GmbH

Teamleiter Vertrieb D-A-CH



# Drei Jahrzehnte voller Innovationen



Wir sind seit über 30 Jahren führend in der additiven Industrie:

- **Produktentwicklung** zur Erfüllung von Kundenbedürfnissen
- **Beta-Programme** um Produkte von Kunden validieren zu lassen
- **Partner** um die Produkte zu den Kunden zu bringen

**140,000 +**  
Installationen

**\$627m**  
Umsatz (2023)

**5**

Technologien

**1,400+**

Erteilte oder laufende Patente

# Partnerschaft

## Alphacam & Stratasys

- ◆ > 25 Jahre erfolgreiche Zusammenarbeit in der D-A-CH-Region
- ◆ Applikationsberatung
- ◆ Musterteile-Herstellung
- ◆ Installation & Schulung
- ◆ Verbrauchsmaterialverkauf
- ◆ Wartungsverträge
  
- ◆ Mitglied im **Global Manufacturing Network** von Stratasys



1992



2024

# Technologien

## für den Produktentstehungsprozess (PEP)



Design

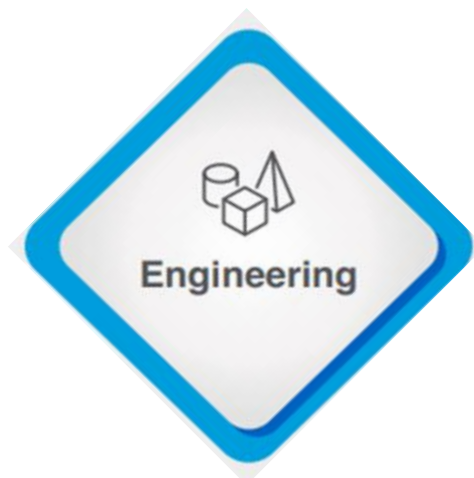
PJ



SLA



- ✓ Vollfarbe
- ✓ **Multimaterial Drucke**
- ✓ Textildruck
- ✓ Verbesserung Produktdesign



Engineering

FDM



SLA



- ✓ Schnelle Iterationen
- ✓ Funktionelle Prototypen
- ✓ Technische Materialien
- ✓ **Zertifizierungen**



Manufacturing  
Aids

FDM



SAF



- ✓ Schnellere Markteinführung
- ✓ **Optimierte Werkzeuge**
- ✓ Gewichtseinsparungen
- ✓ Verbesserung Ergonomie



Production

SAF



DLP



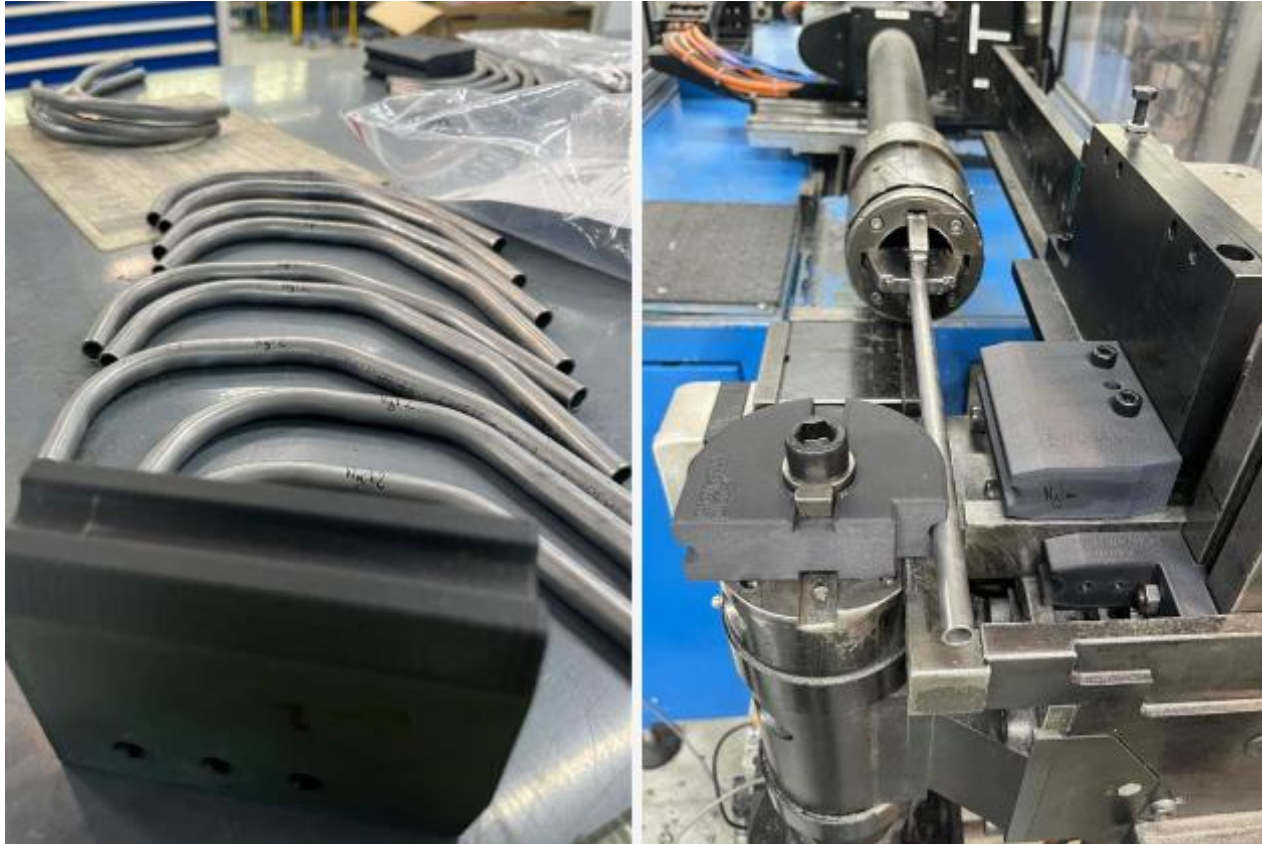
FDM



- ✓ **Agile Produktion**
- ✓ Kundenspezifische Produkte
- ✓ Resilienz der Lieferkette
- ✓ Große Materialauswahl

# Werkzeugbau

## Rohrbiege-Einsätze aus dem Material Nylon12CF



# Werkzeugbau

## Partikelschaum-Bauteile aus gedruckten Ultem1010-Formen



**ENTWICKLUNG EFFIZIENTER VERFAHRENS-  
TECHNOLOGIEN INNERHALB DES  
GESCHLOSSENEN PARTIKELSCHAUM  
WERKSTOFFKREISLAUFS**

Gefördert durch:  
  
 Bundesministerium  
für Wirtschaft  
und Energie  
 aufgrund eines Beschlusses  
des Deutschen Bundestages

BETREUT VOM  
  
 Projektträger Jülich  
Forschungszentrum Jülich

*Im Rahmen des Technologietransfer-Programms Leichtbau*

[gepart.plattform-forel.de](http://gepart.plattform-forel.de)

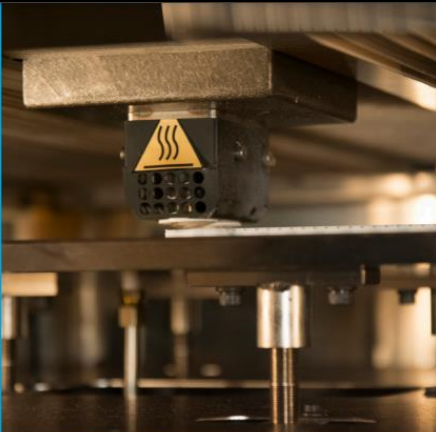
Abmusterung des Demonstrator – Werkzeugs mit dem Materialtyp VR20 von Kaneka



Benchmark:	V1 konventionell	V2 KS-Werkzeug	Delta
Fülldruck/Staudruck:	2,00 Bar	2,00 Bar	0,0%
	10,00 sec	10,00 sec	0,0%
Quersdampf fest:	1,50 Bar	1,50 Bar	0,0%
	3,00 sec	1,00 sec	-66,7%
Quersdampf beweglich:	- Bar	- Bar	0,0%
	- sec	- sec	0,0%
Autoklav:	2,90 Bar	2,90 Bar	0,0%
	8,00 sec	3,00 sec	-62,5%
Kondensieren:	3,00 sec	3,00 sec	0,0%
Kühlen:	50,00 sec	15,00 sec	-70,0%
Nachkühlen:	10,00 sec	10,00 sec	0,0%
Stabilisieren:	5,00 sec	5,00 sec	0,0%
<b>Zykluszeit:</b>	<b>130,00 sec</b>	<b>87,00 sec</b>	<b>-33,1%</b>
Dampfbedarf (Ventiltheorie)	2,9 kg	1,60 kg	-44,8%
Druckluftbedarf (Ventiltheorie)	9,3 Nm <sup>3</sup>	9,30 Nm <sup>3</sup>	0,0%
Wasserbedarf (Ventiltheorie)	41,67 l	15,50 l	-62,8%
<b>CO2 Emission Gesamt</b>	<b>2,673 kg</b>	<b>2,06 kg</b>	<b>-23,0%</b>


# Studie

## zur Wiederholbarkeit und Leistung von FDM-Maschinen



**A Characterization of the Repeatability and Performance of Stratasys Fused Deposition Modeling (FDM) Systems**

Rachael Wratkowski, Eric O'Hara, Bruce Solheim, Chris Cates, Chris Rollag, Sanja Wallace, Adam R. Pawloski  
 Stratasys Inc., Manufacturing Business Unit, 7665 Commerce Way, Eden Prairie, MN 55344



White Paper

Table 3 - History of FDM Machines					
System Type	Machine Name	Manufacture Date <sup>1</sup>	Build Odometer <sup>2</sup> (Days)	Machine Notes	Materials Printed on System
F370	371	Dec-2018	78		ASA
	372	Dec-2019	73		ASA
	374	Mar-2017	291		ASA
	375	Mar-2017	262		ASA
Fortus 450mc	451	Sep-2014	2270	Gen1 with High Performance Upgrade	ASA, ULTEM™ 9085 resin
	452	Oct-2014	2195	Gen1 with High Performance Upgrade, Composite material hardware upgrade	ASA, Nylon 12CF, ULTEM™ 9085 resin
	453	Sep-2014	2220	Gen1 with High Performance Upgrade, Composite material hardware upgrade	ASA, Nylon 12CF, ULTEM™ 9085 resin
	454	Sep-2014	2259	Gen1 with High Performance Upgrade, Composite material hardware upgrade	ASA, Nylon 12CF
	455	Dec-2015	895	Gen2	ULTEM™ 9085 resin
	456	Mar-2018	39	Gen2, Composite material hardware upgrade	Nylon 12CF
F900	901	Mar-2010	1806	900mc Gen I, Fortus 900mc PLUS upgrade	ASA, ULTEM™ 9085 resin
	902	Aug-2015	134 (since Feb -2020) <sup>2</sup>	900mc Gen II, F900 system upgrade	ASA, Nylon 12CF, ULTEM™ 9085 resin
	903	Aug-2011	1195 (since Apr-2013) <sup>2</sup>	900mc Gen I, Fortus 900mc PLUS upgrade	ASA, ULTEM™ 9085 resin
	905	Apr-2012	1296	900mc Gen I, F900 system upgrade	Nylon 12CF
	906	Jul-2018	255	F900 Gen III	ASA, Nylon 12CF, ULTEM™ 9085 resin
	909	Apr-2018	324	F900 Gen III	Nylon 12CF

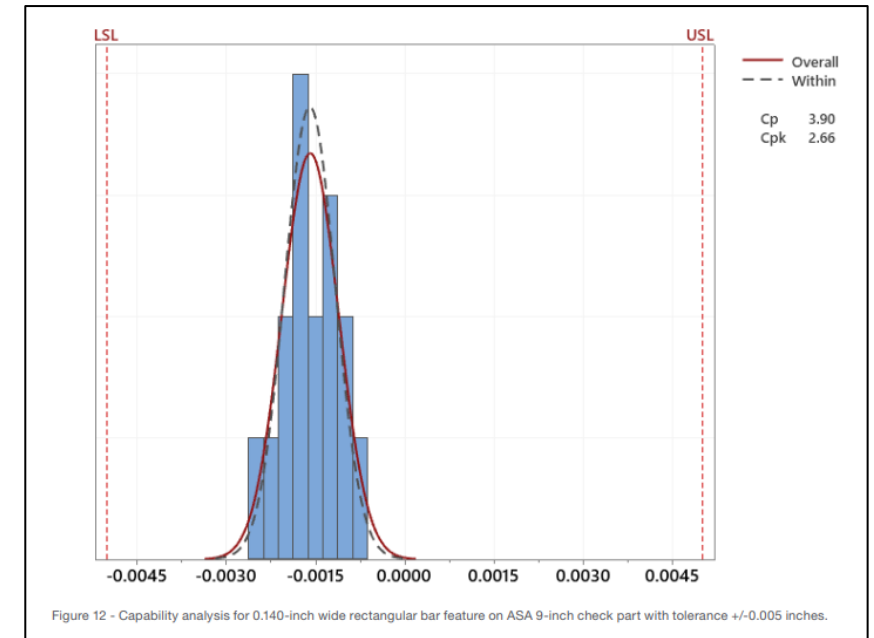


Table 18 - Calculated Part Yield			
System Type	F370	Fortus 450mc	F900
Total Parts	1586	3984	4844
Failed Parts	10	279	381
Good Parts	1576	3705	4463
Part Yield	99%	93%	92%

# Serienfertigung

## zertifizierte FDM-Materialien

### Aerospace



FAR 25.173

### Railway



EN45545-2

### Bus/Coach

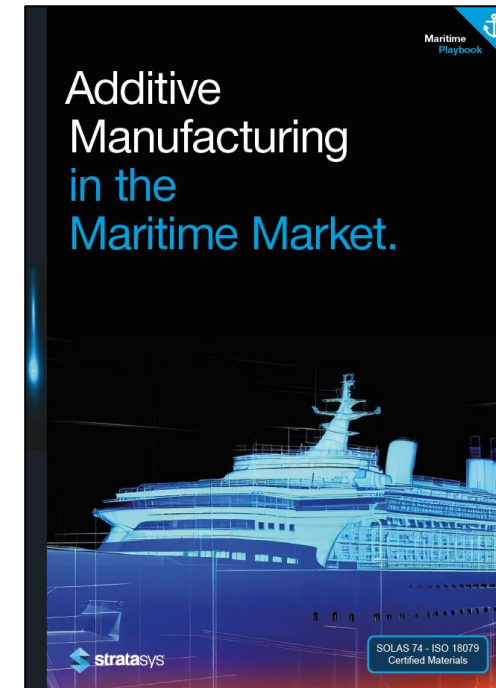


ECE R118

### Maritim

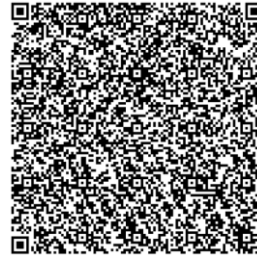


Solas 1974

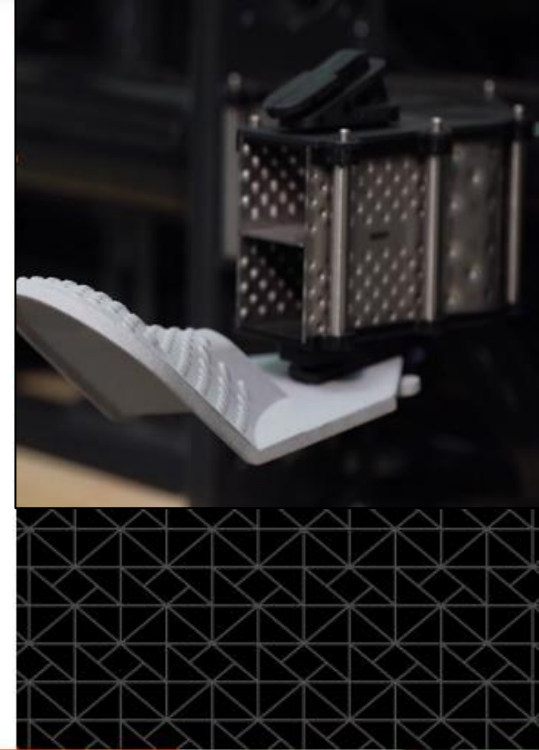




# Landwirtschaft

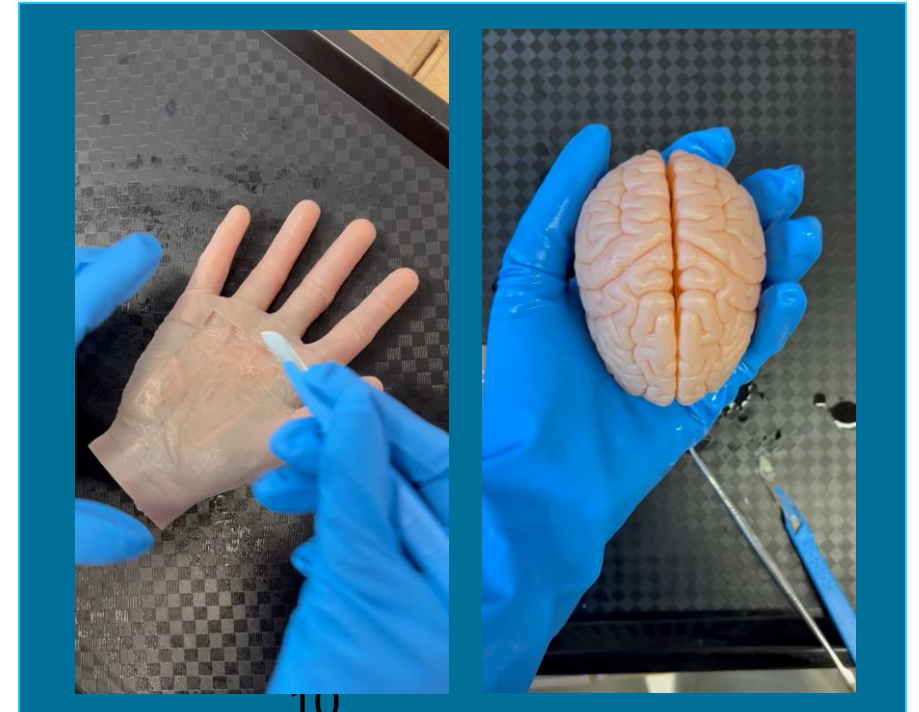
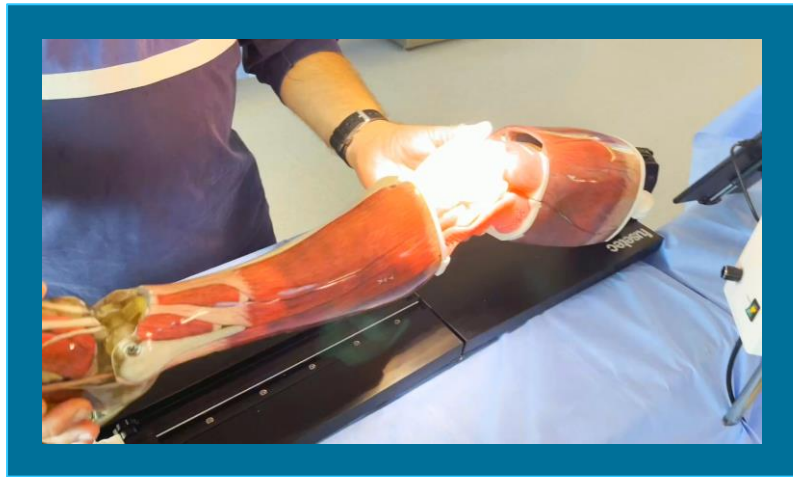
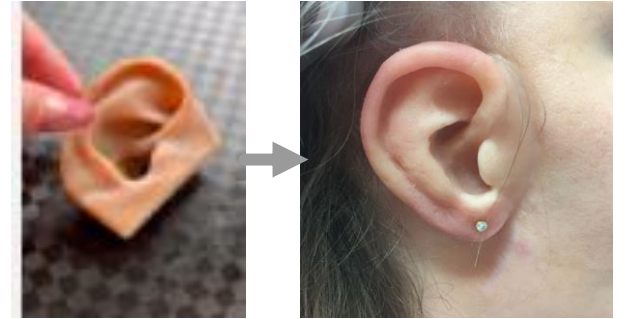
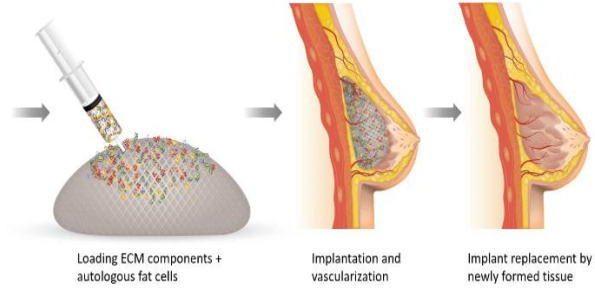
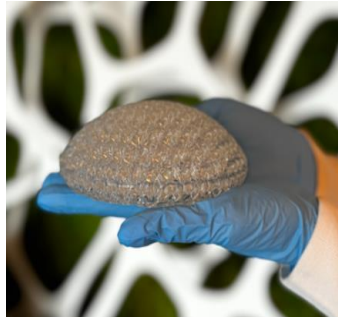
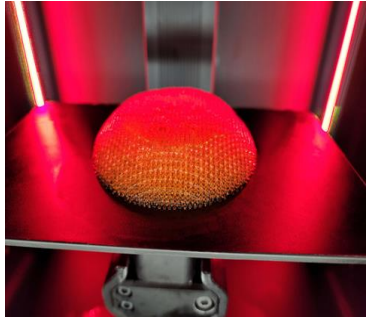


**Revolutionierung  
der Landwirtschaft:  
RAUCH nutzt  
SAF™ und FDM®  
Technologien für  
die Herstellung  
innovativer Geräte.**

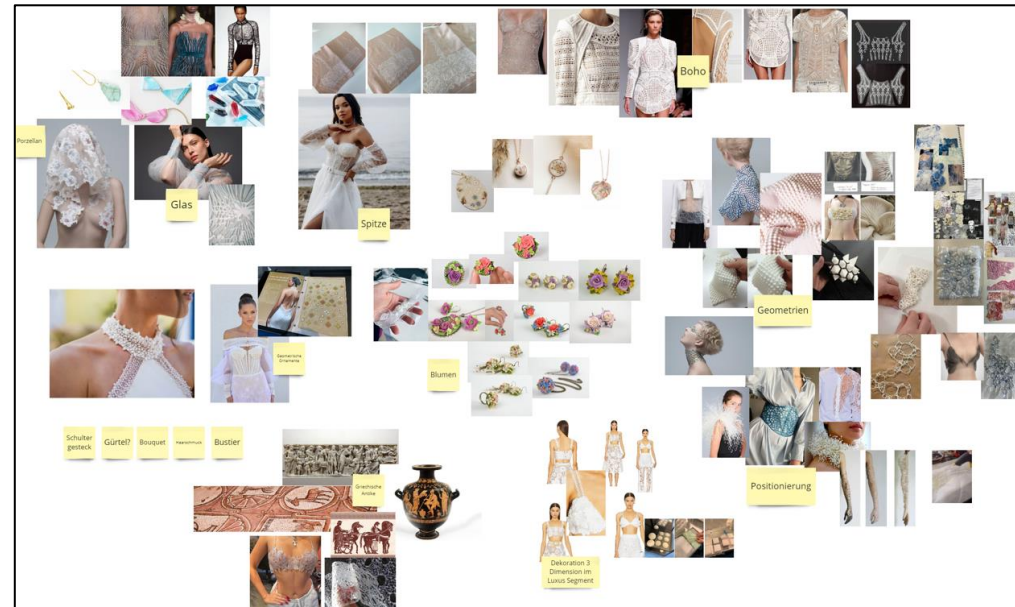
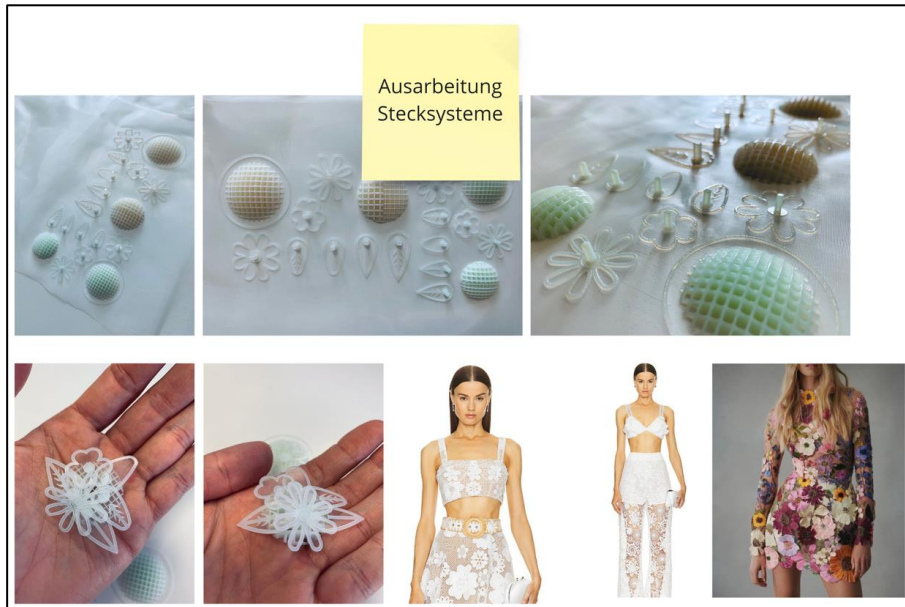


# Gesundheits-Industrie

## von der OP-Planung bis zur Prothese



# 3D-Druck auf Textilien von der Bekleidung ...



Make additive work for you™

**SYMPOSIUM**  
ADDITIVE FERTIGUNG in der Textilindustrie  
26. September 2024

KARL MAYER in Kooperation mit dem TITV Greiz und dem STFI Chemnitz

titv KARL MAYER stfi

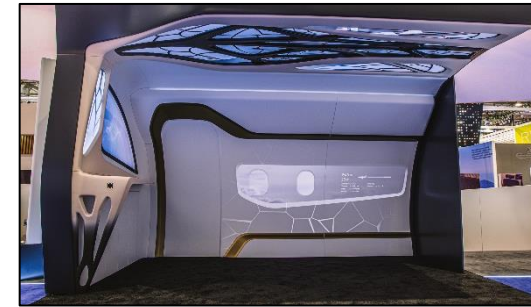
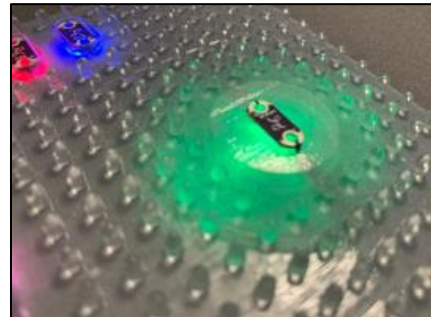
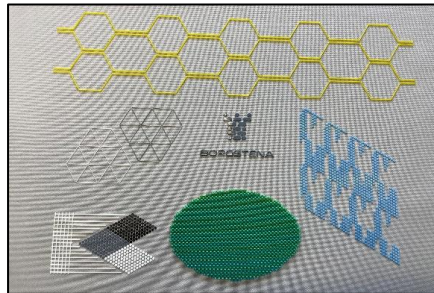
Yanfeng  
stratasys  
creativewave

DP SOLUTIONS  
Hochschule Niederrhein  
University of Applied Sciences  
alphacam  
CREATE  
NEXT EDUCATION  
TEXOVERSUM

stratasys Make additive work for you™

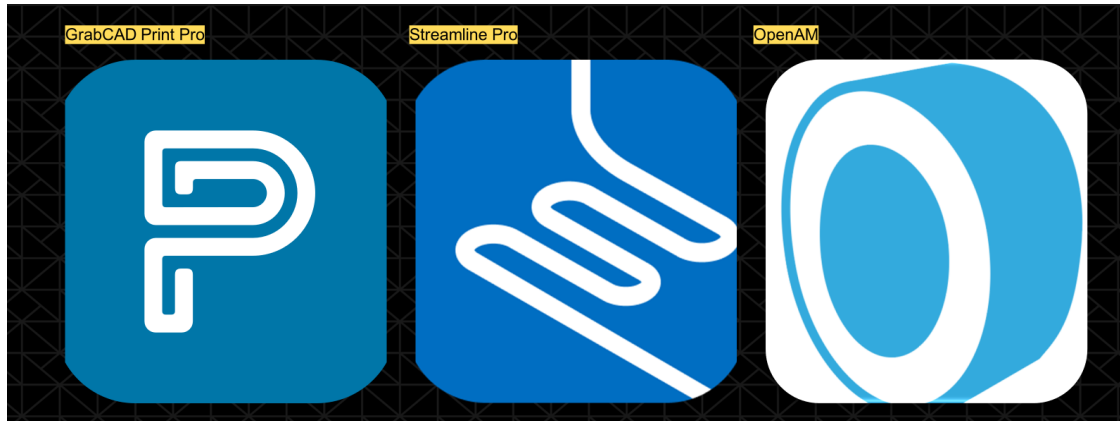
# 3D-Druck auf Textilien

... bis zu technischen Textilien und Veredelung



# Software

## Übersicht und Workflow



## GrabCAD Print Pro Feature Line-up

Feature/Tools	Standard Vs Pro	FDM	SAF	PolyJet	Origin (DLP)	Neo (SL)
Ability to print color textures	Standard			●		
Build File Integrity Check	Standard	●	●	●	●	
Business Intelligence	Standard	●	●			
FIPS Compatible	Standard	●	●			
Full color (Pantone Validated )	Standard			●		
Graphics	Standard		●			
Measure	Standard	●	●	●	●	●
Mix material printing (Flex, Rigid, Color , etc.)	Standard			●		
Multi Printer Control	Standard	●	●	●	●	
Organize Print Queues	Standard	●		●		
Position	Standard	●	●	●	●	●
Real-time Notifications	Standard	●	●	●	●	
Section tool	Standard	●	●	●	●	●
Support Generation	Standard	●	●	●	●	●
Water soluble support material	Standard			●		
3D Array	Pro	●	●			
3rd Party Partner Plugins	Pro	●	●	●	●	
Accuracy Center	Pro	●				
Graphical Build Report	Pro		●			
Labeling	Pro	●	●	●		
Manufacturing Templates	Pro	●				
Orientation Analysis Tool	Pro		●			
Per-Part Estimation	Pro	●	●			
Costing Rates & Estimation	Pro	●	●	●		
Specify per part spacing	Pro		●	●		
Thickness & Gap Analysis	Pro	●	●	●		
Air as Material	Pro			●		
Element Insert	Pro			●		
High Speed Printing Mode	Pro			●		
Liquid Printing	Pro			●		
Print on 3D	Pro			●		
Voxel Print	Pro			●		

# Software

## Skalierbarkeit & Wertschöpfung durch Partnerschaften



SIEMENS

OQTON



SIEMENS



OQTON



riven



And More!

Enterprise  
Ecosystem

Digitale Rechte,  
Sicherheit,  
Rückverfolgbar-  
keit

Berichte &  
Dashboarding

DFAM und  
Druckvorberei-  
tung

CAD  
Integrationen

# Software

## Open AM - frei verfügbare FDM-Materialien

**Recycled ABS**  
FormFutura ReForm rTitan ABS in Black

ReForm rTitan ABS testing with CM-10250 chip

**Result**

- Lower extrusion temperature enabled - 260°C
- Results in photos after only 5 iterations
- Excellent surface finish and overhang quality
- Good adhesion to enabled SR-30 support material

Second attempt: CM-10250 profile



**Recycled PA12**  
Used PA12 MJF Powder

Second attempt: G-ABS profile


**Motivation for G-ABS profile:**


- Lower extrusion temperature

Flow factor increased from 0,92 to 1 to reduce under filled segments

**Results**

- Fundamental printability confirmed
- Inadequate adhesion to SR-30 at base
- Even lower extrusion temperature desired



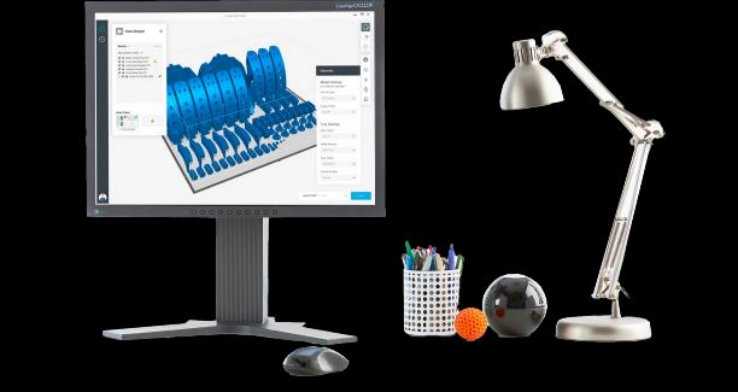
 **stratasys**

WHITE PAPER  
FDM

### From Waste to Resource: Transforming FDM Printing with Recycled Materials via OpenAM

**Introduction**

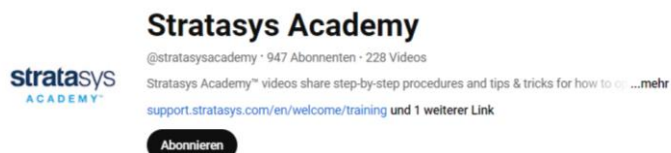
As the additive manufacturing (AM) industry continues to grow, so does its environmental footprint. Integrating recycled materials into 3D printing processes presents a critical opportunity to mitigate this impact, particularly in reducing carbon emissions and manufacturing waste. Utilizing a product like OpenAM™ to unlock third-party materials for select Stratasys fused deposition modeling (FDM®) printers represents a significant leap towards sustainability in additive manufacturing.



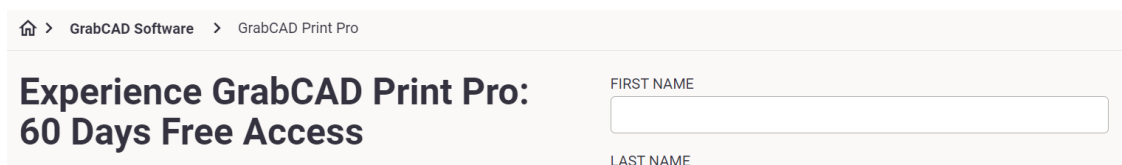
# Wissen & Erfahrung teilen



<https://support.stratasys.com/de>



<https://www.youtube.com/@stratasysacademy>



<https://www.stratasys.com/en/software/grabcad-print-pro-trial/>



DANKE