חידושים בהדפסה תלת ממדית תעשייתית

תקינה/חומרי גלם ועמידות בדרישות פיזיקליות **,טכנולוגיות** הדפסה

לשכת המהנדסים -2020

SU-PAD
Solutions You Can Trust

זיו שדה

סמנכ"ל שיווק ומכירות

שי אינגבר

מנהל מכירות מדפסות תלת מימד

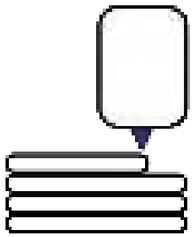
Who we are

30 YEARS OF EXPERIENCE

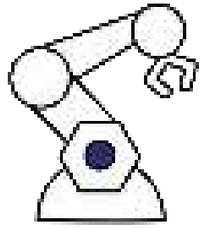
PROVIDING SOLUTIONS, NOT MACHINERY

TRUSTED BY THE LEADING BRAND

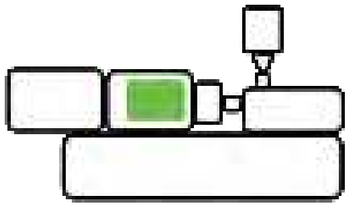
OUR DIVISIONS



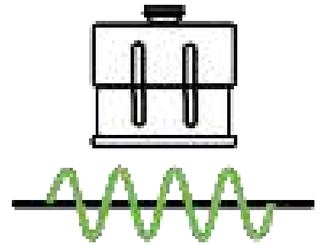
3D
PRINTERS



ROBOTICS &
AUTOMATION



INJECTION MACHINES &
EQUIPMENT



PLASTIC
WELDING

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Solutions You Can Trust

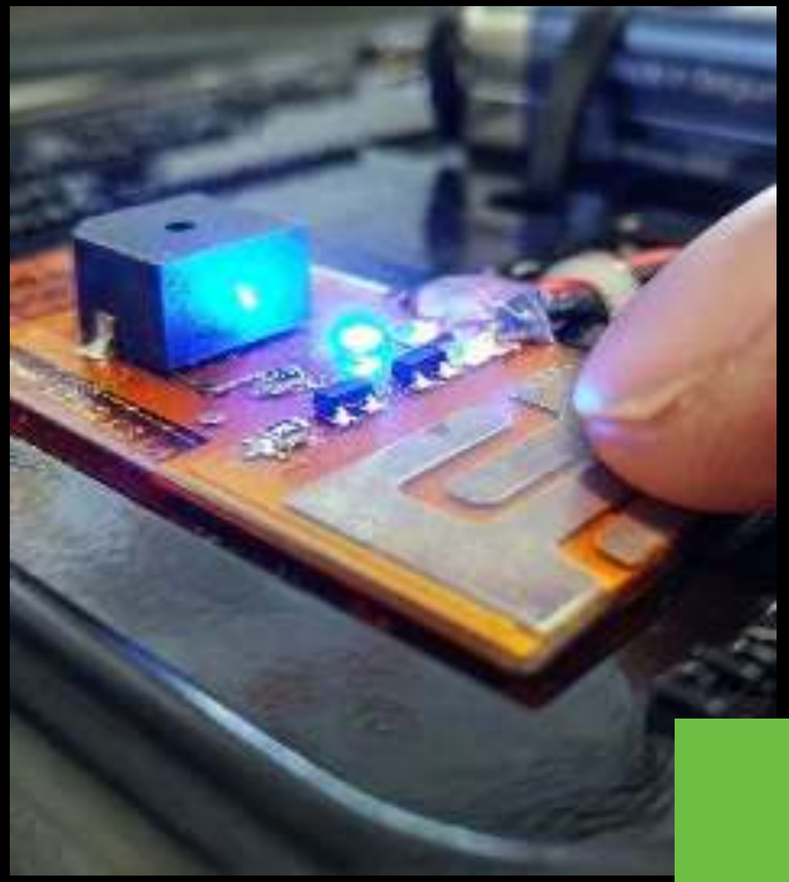
OUR RAPID MANUFACTURING SOLUTIONS

stratasys POLYMER

Desktop Metal METAL

XACT METAL

NANODIMENSION PCB



AGENDA:

- Polyemers – multi material printing
- Polymers – engineering applications & Material portfolio.
- Metal
- DesktopMetal BMD - Studio System
- Desktopmetal Binderjeting – Shop System
- NanoDimension- AMEW
- Q&A

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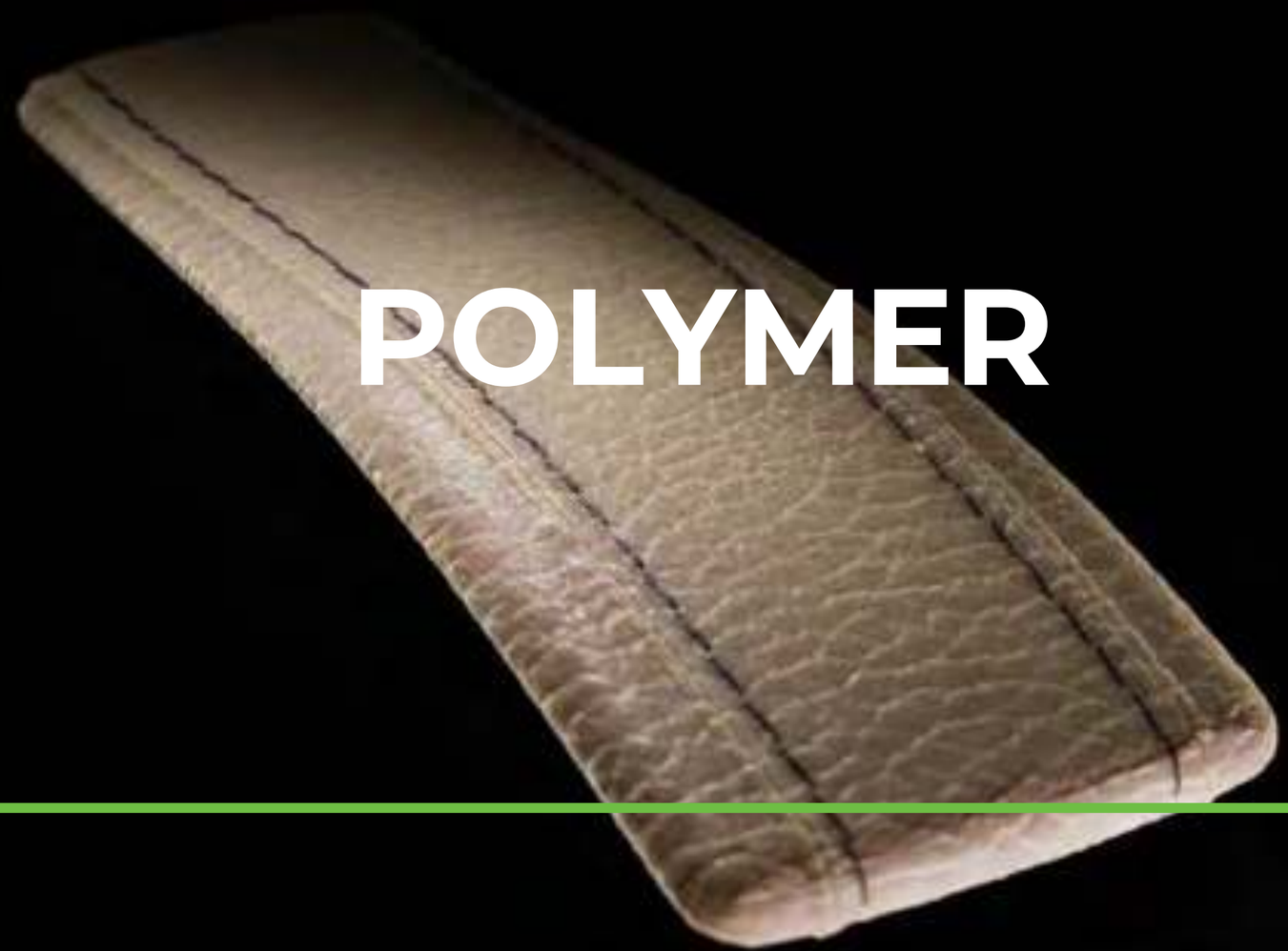
POLYMER



stratasys

The most widely used Polymer 3D printer in the world

Stratasys, an additive manufacturing pioneer who leeds the AM world wide industry. AN Israeli pride

Your paragraph text

Always innovating.

Always inventing.

Most widely-used 3D printer

SU-PAD

***Represents Stratasys in Israel Since 1995**

stratasys

ISRAELI BASED

(SU-PAD) *Represents Stratasys in Israel Since 1995

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ADDITIVE MANUFACTURING POLYMERS

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ADDITIVE MANUFACTURING FOR POLYMERS

Für alle Verfahren gilt: Durch das schichtweisen selektiven Abtrag entstehen dreidimensionale Strukturen.
It applies to all processes: three-dimensional structures are created by the selective layer-by-layer process.

STRATSYS TECHNOLOGIES

FDM

- Thermoplastics
- Functional Prototypes, Tools and Final Parts

SLA

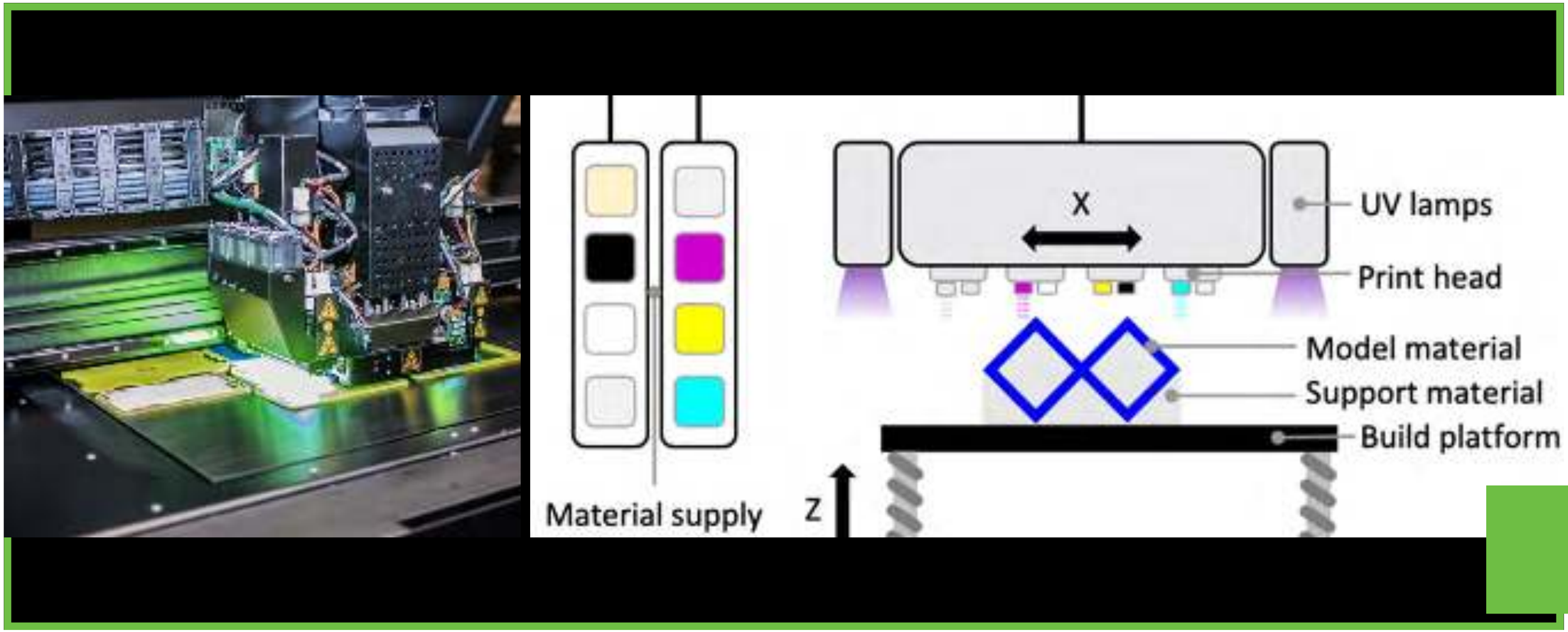
- UV Cured Resin
- Transperent/ hollow geometries
- part cost

POLYJET

- Photopolymers
- Material versatility including colors, different shores and clear materials on the same part/tray
- High resolution

COMING SOON: HSS, LPM

PJ – Polyjet Technology



Polyjet Material Groups

GENERAL RIGID

- VERO FAMIL
- VIVID COLORS FAMILY
- RGD720
- RIGUR·DURUS

GENERAL FLEXIBLE

- TANGO FAMILY
- AGILUS30 FAMILY

ENGINEERING MATERIALS

- DIGITAL ABS PLUS FAMILY
- HIGH TEMPERATURE

SPECIALTY/ DENTAL

- BIOCOMPATIBLE MED610
- DENTAL MATERIALS
- VEROGLAZEMED620
- VERODENTMED670
- VERODENTPLUSMED690
- VEROFLEXFAMILY
- HEARING AID MATERIALS

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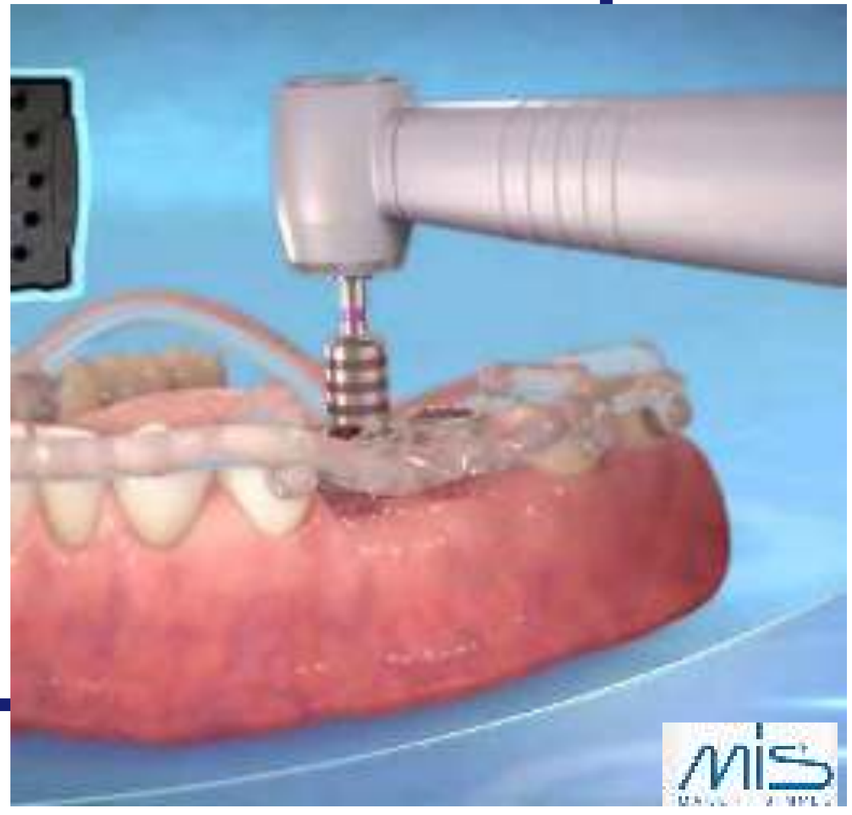
Nelson Labs™
A Sotera Health company

Biocompatibility of MED610 as a Component in Gas Path Devices

Prepared For: Stratasys

30 March, 2020



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MULTI MATERIAL PRINTING

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REDUCING TIME TO MARKET

"..50 % Reduction in Lead Time."

Audi

stratasys

PANTONE VALIDATION

stratasys

WORKFLOW PROCESS

3D PRINT DESIGN ITERATIONS FROM
CONCEPT TO FINAL DESIGN

stratasys Printed by J850

CMF Design Challenges

THERAGUN

The Mission of PolyJet

Stratasys J55

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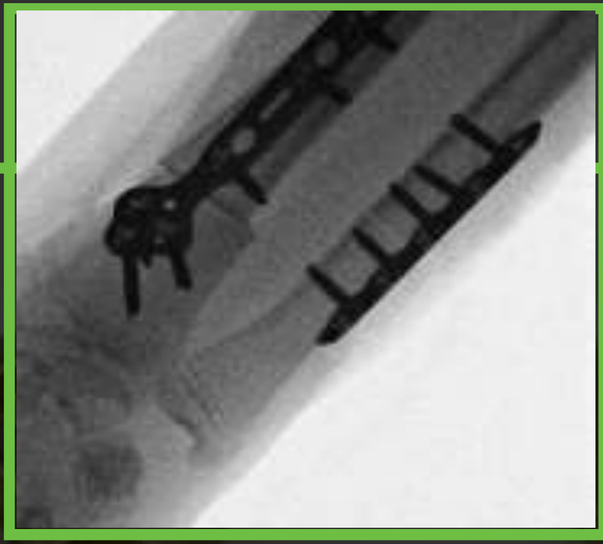
DIGITAL ANATOMY PRINTING

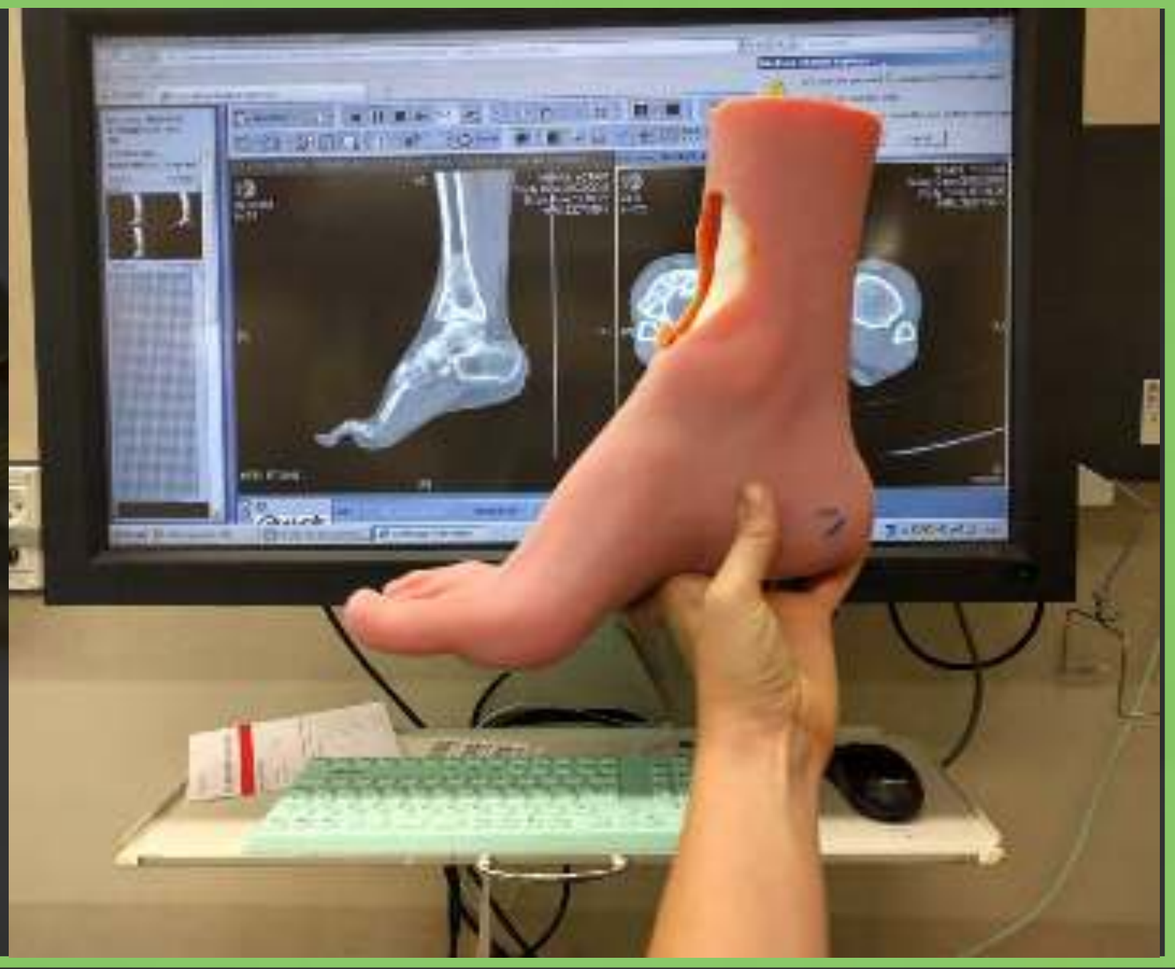


לראשונה בהדסה: טכנולוגיה של הדפסת תלת ממד הצילה את היד של בת 13

לראשונה ביחידה לכירורגיה של היד בהדסה נותחו בני נוער עם שברים מורכבים באמות היד בטכנולוגיה הכוללת הדפסת דגם תלת מימד של האזור הפגוע. ד"ר שי לוריא: "על הדגמים הללו יכולנו לתכנן את מהלך הניתוח עד לרמת מילימטרים"

[illegible]

מאת: מערכת "כל העיר"



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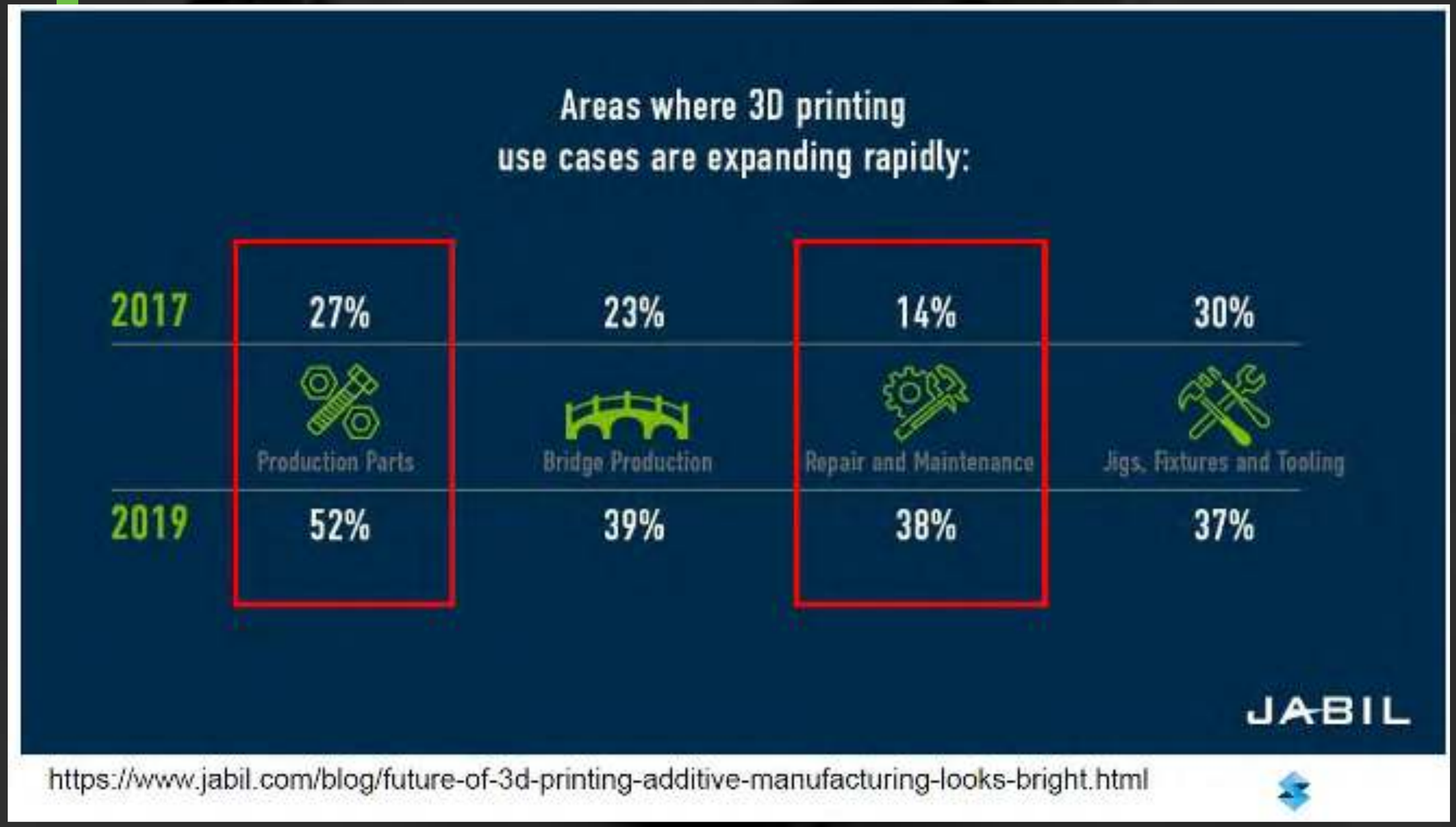
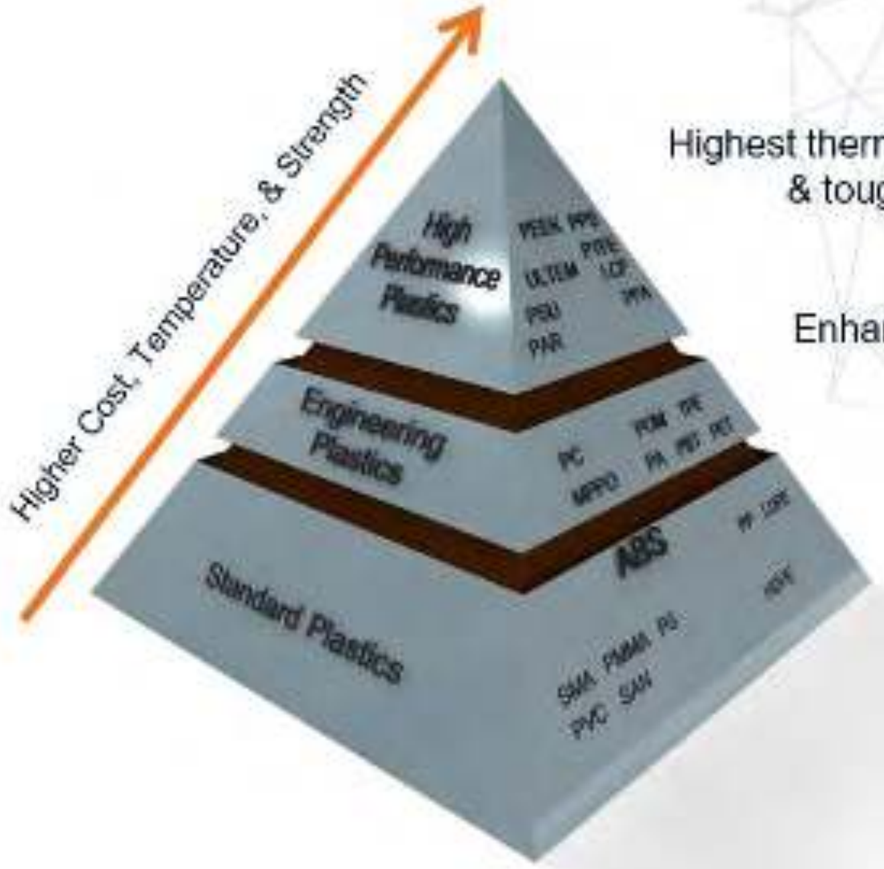
FDM



https://www.jabil.com/blog/future-of-3d-printing-additive-manufacturing-looks-bright.html

Materials / World of Plastics

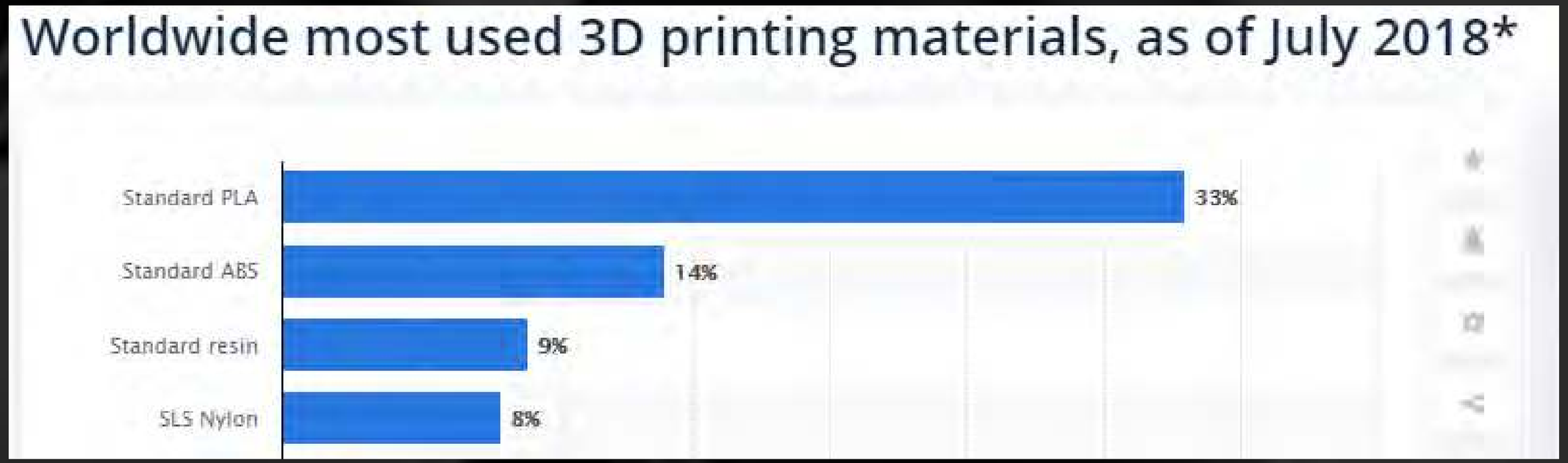


Highest thermal resistance & toughness

Enhanced thermal resistance & toughness

Average thermal resistance & toughness

According to a survey of STATISTA from 2018 the scope of use of the materials is:



FDM MATERIAL GROUPS

GENERAL

- ABSPLUS
- ABS-M30
- ABS-M30I
- ABS-ESD7
- ABSI
- ASA
- PLA
- TPU

ENGINEERING -GRADE

- PC
- PC-ABS
- PC-ISO
- FDM NYLON 12
- FDM NYLON 6

HIGH PERFORMANC

- ULTEM™ 1010 RESIN – FOOD GRADE
- ULTEM™ 9085 RESIN
- PPSF / PPSU
- FDM NYLON 12CF
- ANTERO800NA (PEKK)

SPECIALTY PRODUCTS

- ST-130

*ULTEM™ IS A REGISTERED TRADEMARK OF SABIC OR AFFILIATES.

ULTEM™ 9085 Resin
High-performance FDM PEI thermoplastic.

Fire Protection of Railway Vehicles

EN-45545-2

ULTEM™ 9085 resin was printed with a T16A tip on the Stratasys F900 and tested per EN 45545-2. The testing establishes that this material meets requirements for:

- **R1 HL1/2/3 at 25 mm thick in XY and XZ orientations and 5 mm in XZ orientation**
- **R2 HL1/2/3 at 5 mm thick in XY orientation.**

Table 9. ULTEM™ 9085 Resin Fire Protection of Railway Vehicles Test Results

Test	Results	5mm XY	5mm XZ	25mm XY	25mm
ISO 5659-2	Ds(4)	-	-	68	57
	VOF4	-	-	612	384
	Dm	-	-	226	251
ISO 5659-2 – EN 45545-2 Appendix C	ITC 4 minutes	-	-	0.02	0.01
	ITC 8 minutes			0.06	0.05
ISO 5660-1	MAHRE (kW/m2)	-	-	24.1	19.9
ISO 5658-2	CFE (kW/m2)	16.2	12.5	29.9	28.6

Outgassing

ULTEM™ 9085 resin, natural and black, was printed with a T20 and T16 tip on the Stratasys F900 and tested per ASTM E595. Full report available upon request.

Table 8. ULTEM™ 9085 Resin Outgassing Test Results

Sample	TML (%)	CVCM (%)	WVR (%)
ULTEM™ 9085 Resin, Natural, T20 Tip	0.34	0.06	0.35
ULTEM™ 9085 Resin, Natural, T16A Tip	0.37	<0.01	0.38
ULTEM™ 9085 Resin, Black, T16 Tip	0.33	< 0.01	0.22

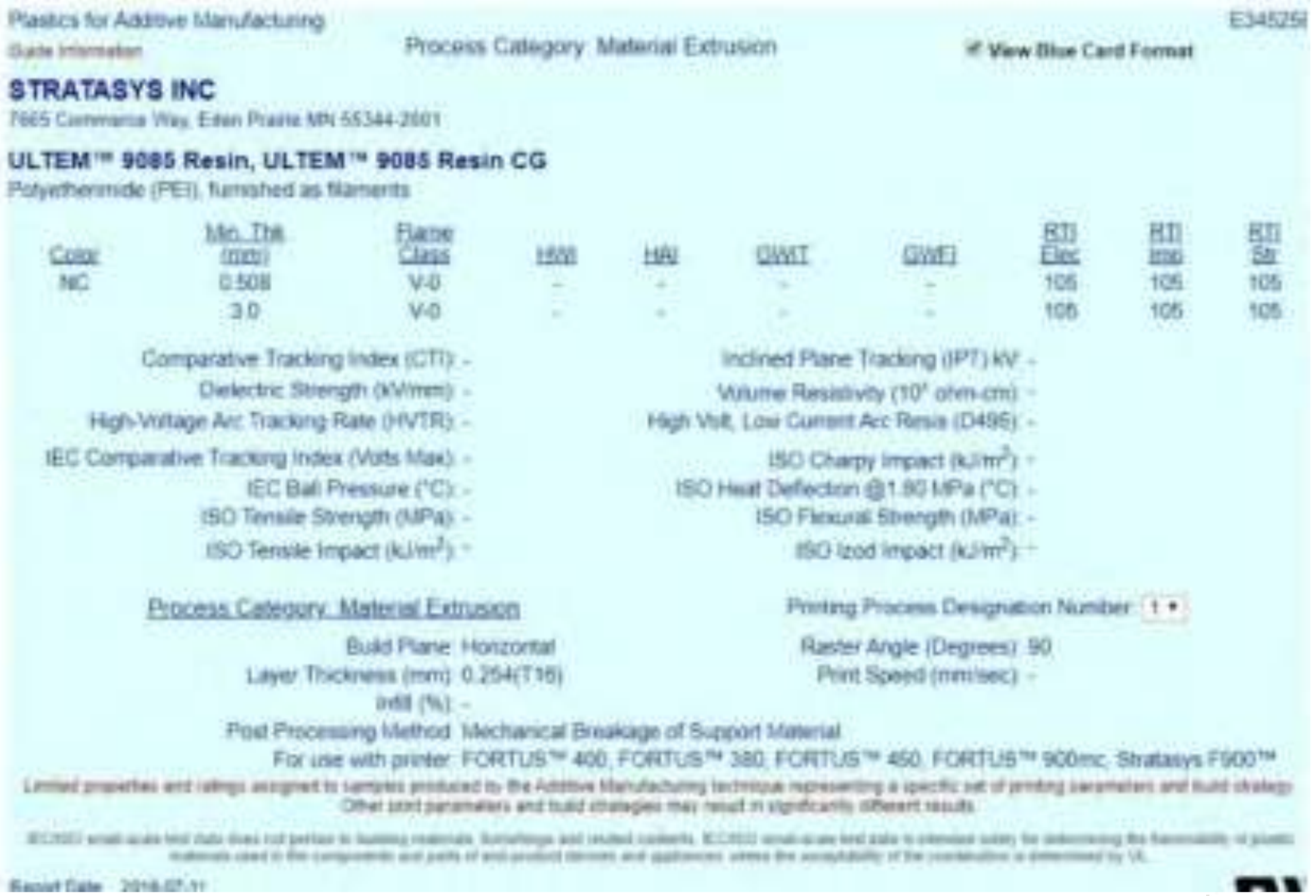
Testing Observations[1]			
Visible Condensate	No	Opaque	N/A
Percent Covered	0%	Interference Fringes	N/A
Thin	N/A	Colored Fringes	N/A
Heavy	N/A	Sample appearance after test	No change
Transparent	N/A		

[1] Observations apply to all tested samples

CERTIFIED AND VALIDATED MATERIAL

Certified ULTEM 9085 Resin

stratasys



Plastics for Additive Manufacturing

Guide Information

Process Category: Material Extrusion

View Blue Card Format

E345259

STRATASYS INC

7665 Commerce Way, Eden Prairie MN 55344-2001

ULTEM™ 9085 Resin, ULTEM™ 9085 Resin CG

Polyetherimide (PEI), furnished as filaments

Color	Min. Thk (mm)	Flame Class	HWI	HAI	GWIT	GWFI	RTI Elec	RTI Imp	RTI Str
NC	0.508	V-0	-	-	-	-	105	105	105
	3.0	V-0	-	-	-	-	105	105	105

Comparative Tracking Index (CTI): -

Dielectric Strength (kV/mm): -

High-Voltage Arc Tracking Rate (HVTR): -

IEC Comparative Tracking Index (Volts Max): -

IEC Ball Pressure (°C): -

ISO Tensile Strength (MPa): -

ISO Tensile Impact (kJ/m²): -

Inclined Plane Tracking (IPT) kV: -

Volume Resistivity (10¹⁴ ohm-cm): -

High Volt, Low Current Arc Resis (D495): -

ISO Charpy Impact (kJ/m²): -

ISO Heat Deflection @1.80 MPa (°C): -

ISO Flexural Strength (MPa): -

ISO Izod Impact (kJ/m²): -

Process Category: Material Extrusion

Printing Process Designation Number: 1

Build Plane: Horizontal

Layer Thickness (mm): 0.254(T16)

Infill (%): -

Raster Angle (Degrees): 90

Print Speed (mm/sec): -

Post Processing Method: Mechanical Breakage of Support Material

For use with printer: FORTUS™ 400, FORTUS™ 380, FORTUS™ 450, FORTUS™ 900mc, Stratasys F900™

Limited properties and ratings assigned to samples produced by the Additive Manufacturing technique representing a specific set of printing parameters and build strategy. Other print parameters and build strategies may result in significantly different results.

IEC60332 small-scale test data does not pertain to building materials, furnishings and related contents. IEC60332 small-scale test data is intended solely for determining the flammability of plastic materials used in the components and parts of end-product devices and appliances, where the acceptability of the combination is determined by UL.

Report Date: 2018-07-31

STRATASYS STRATEGIC INITIATIVES FOR AEROSPACE

- Simplify the path to part certification, a must for additively manufactured parts for certified aircraft
- Establish collaborative partnerships to develop materials, systems and processes for aerospace

First 3D printed parts
on British passenger trains

94% lead time 50% cost

SHEET METAL FORMING

CYCLE TEST

400 cycles with no signs of wear
7075-O Aluminum
0.090in (2.29mm)

SHEET THICKNESSES

ü0.016in to 0.100in (0.41mm to 2.54mm)

METALS FORMED

üAluminum alloys
üSteels
üStainless steels
üTitanium
üInconel

PRINTING SPARE PART

PRINTER:

Fortus900

MATERIAL

ULTEM9085

ULTEM 1010

3D Print with the Strongest FDM Material.

ULTEM™ 1010 resin offers superior tensile strength and excellent chemical and thermal resistance for an FDM thermoplastic. Available in general-purpose and certified grades. ULTEM™ 1010 resin uses breakaway support. Certified grade is biocompatible and approved for food contact with NSF 51 and ISO 10993/USP Class VI certifications.

BEHAVIOR AND USE

TENSILE STRENGTH, YIELD

64 MPa (XZ Axis) and 42 MPa (ZX Axis)

TENSILE MODULUS

2770 MPa (XZ Axis) and 2200 MPa (ZX Axis)

HDT

216 °C

IZOD IMPACT, NOTCHED

41 J/m (XZ Axis) and 24 J/m (ZX Axis)

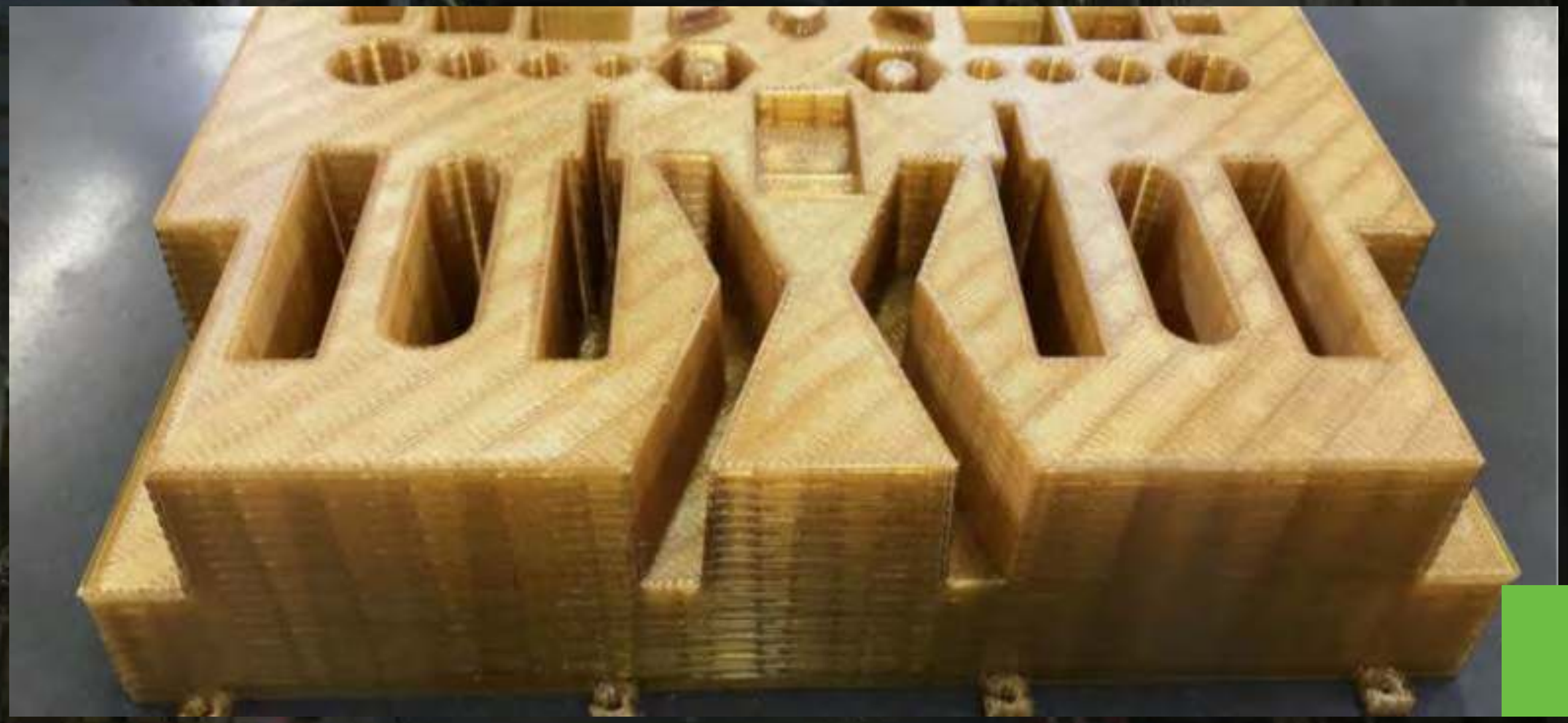
SU-PAD
Solutions You Can Trust

“

Not only do we enjoy a cost saving, but thanks to the ability to 3D print a customized part on-demand, there is no minimum order requirement. On certain orders we are witnessing cost savings of up to 55%.”

Alex Karetny
Pack Line Ltd.

SU-PAD
Solutions You Can Trust



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ANTERO PEKK

SU-PAD
Solutions You Can Trust

High-performance PEKK-based material

Antero 800NA PEKK-based thermoplastic possesses excellent mechanical properties that include high strength, high heat resistance, toughness and wear-resistance. These superior qualities make it a lighter alternative to aluminum and steel. Chemical resistance and minimal outgassing provide suitability for aerospace applications.

BEHAVIOR AND USE

TENSILE STRENGTH, YIELD

93 MPa (XZ Axis) 46 MPa (ZX Axis)

TENSILE MODULUS

3095 MPa (XZ Axis) 34,834 MPa (ZX Axis)

HDT @66 PSI

150 °C

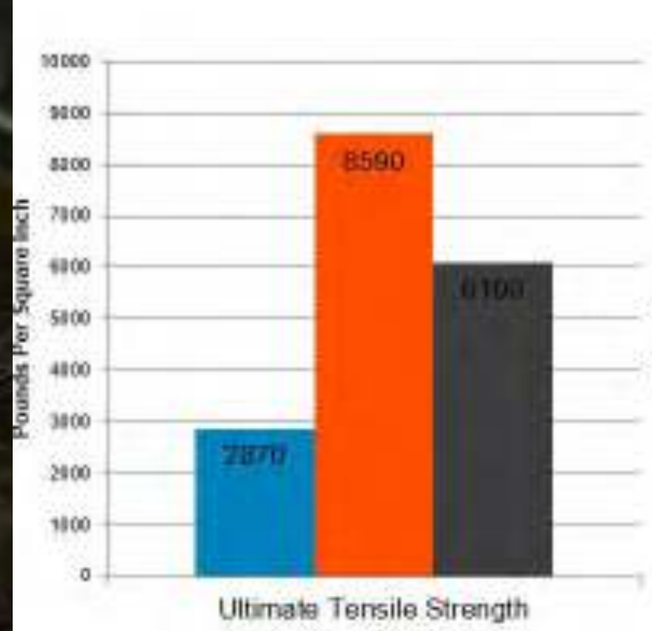
NOTCHED IMPACT

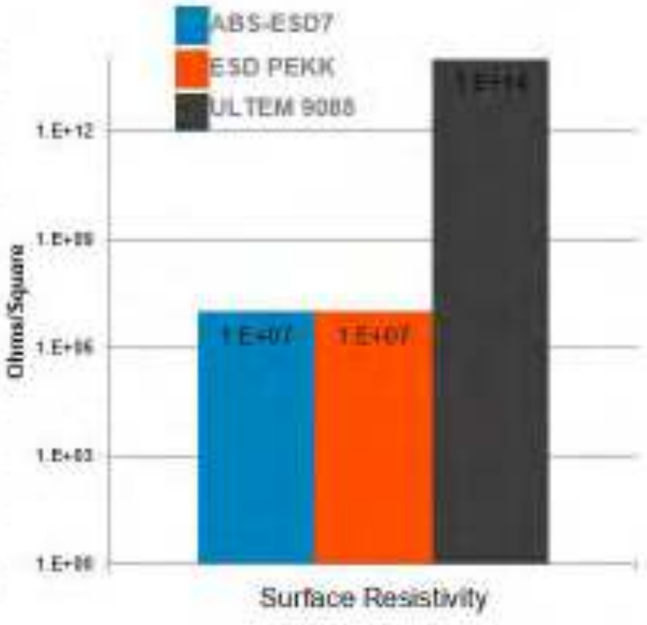
37 J/m (XZ Axis) 27 J/m (ZX Axis)

SU-PAD
Solutions You Can Trust

Electrically Static Dissipative (ESD) PEKK

- Sensitive electronics applications requiring ESD properties
  - Electrical resistivity <10^9 ohm
- Inherent flame resistance and high temperature capabilities





Three piece electronics enclosure printed in ESD PEKK

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DOCUMENT NAME	FILE TYPE	
Antero 840CN03 data sheet	PDF	
Antero 840CN03 safety sheet	PDF	
Antero 840CN03 material guide	PDF	
Chemical Resistance of Antero 840CN03	PDF	
Electrical Properties of Antero 840CN03	PDF	
Materials Testing Procedure	PDF	

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Solutions You Can Trust

Nylon12 CF

Lightweight Strength, Carbon Fiber Reinforced

The combination of high strength, stiffness and light weight lets you use FDM Nylon 12CF to replace metal components, for lighter tools, functional prototyping and select end-use parts.

BEHAVIOR AND USE

TENSILE STRENGTH	TENSILE MODULUS	HDT @ 264 PSI	IZOD IMPACT, NOTCHED
63.4 MPa (XZ Axis) 28.9 MPa (ZX Axis)	7515 MPa (XZ Axis) 2300 MPa (ZX Axis)	143 °C	85 J/m (XZ Axis) 21.4 J/m (ZX Axis)

SU-PAD
Solutions You Can Trust

End of Arm

- Weight savings:
  45 kg (61.25%)
- Cycle time savings:
  19.3%
- Cost savings:
  $1,642 (29.8%)

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Solutions You Can Trust

CNC Tooling & Fixtures

- 3 to 7 times lighter with Nylon12CF than aluminum or steel
- Over 900 bars compressive strength
- Cost saving 50 to 60%
- Fixtures printed in hours not days

SU-PAD
Solutions You Can Trust

GKN Driveline – Greasing Tool

GKN DRIVELINE

Application

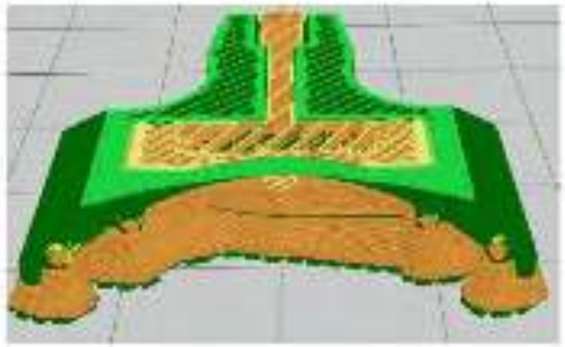
Greasing of a half shaft during production

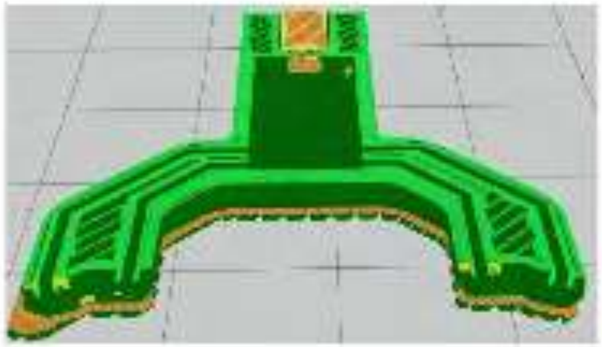
Challenge

Previously implemented as a bendable tube, where a high volume of oil was forced out a singular point of exit

This often lead to spills, requiring time to clean up

AM optimized redesign





Result

- **No support material generated** for internal structures in optimized segments (even if green flagged)
- **Tube connector utilizes traditional design** for demonstrative purposes, could also be redesigned
- **Lean tool** that requires less material and time to be produced (in any case)

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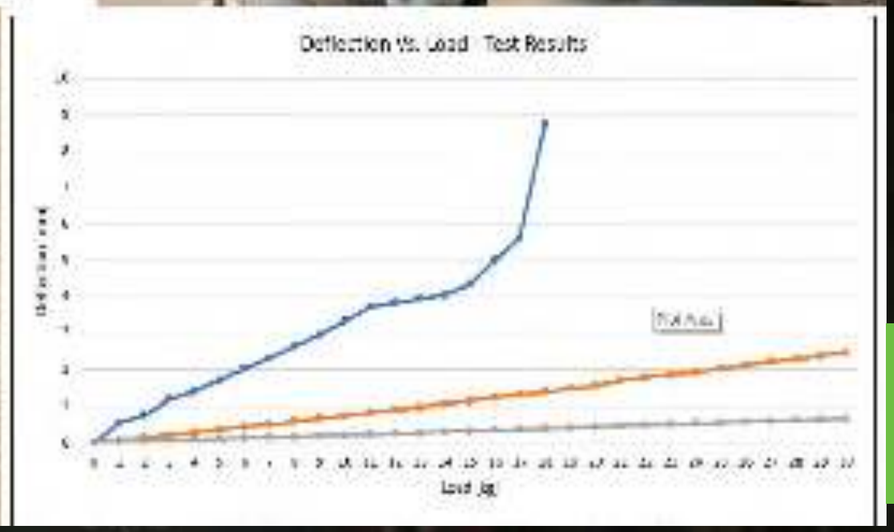
What about mechanical properties?



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TPU

LEADING USE CASES

F123 TPU 92A

Making the complex easy…with Stratasys soluble support

Competitors' subpar support makes their part production cost **1.8X MORE**

Stratasys' hands-free soluble support decreases labor time by 76%

Build large elastomer parts

Build the parts you need, and not just the parts your prototyping system makes

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standard engineering portfolio

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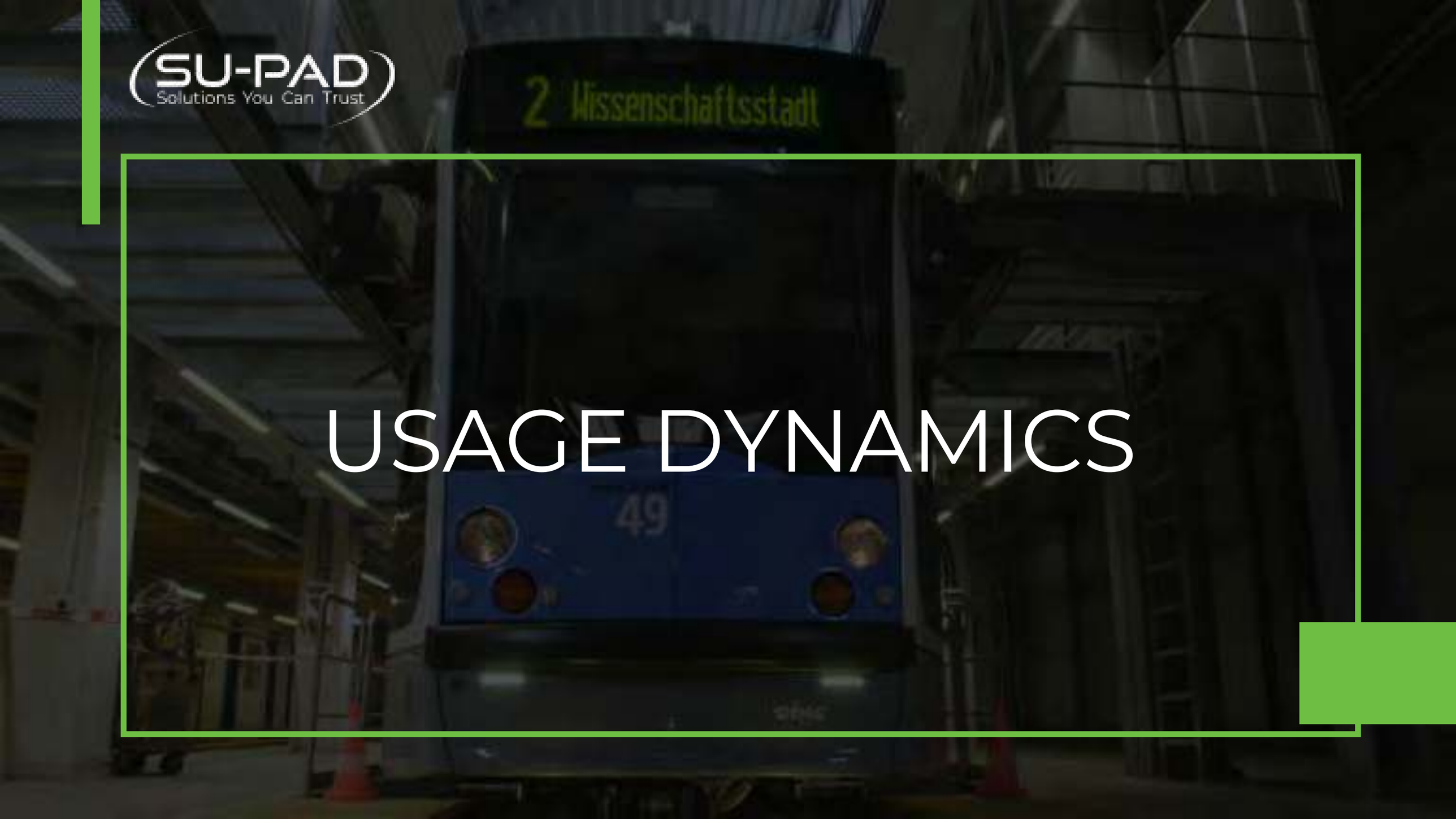

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USAGE DYNAMICS

REDUCTION OF LEAD TIME AND COST

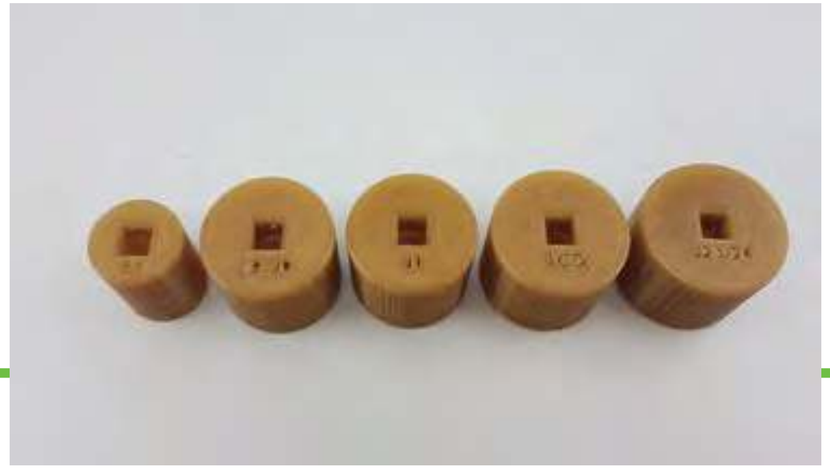
Printer: Fortus 450MC – STRATASYS
Material: ASA

Printer: Fortus 450MC STRATASYS
Material: ABS M30i

Printer: Fortus 450MC STRATASYS
Material: Nylon12 CF

Printer: Fortus 450MC – STRATASYS
Material: Antero800NA

Printer: Fortus 450MC – STRATASYS
Material: ASA

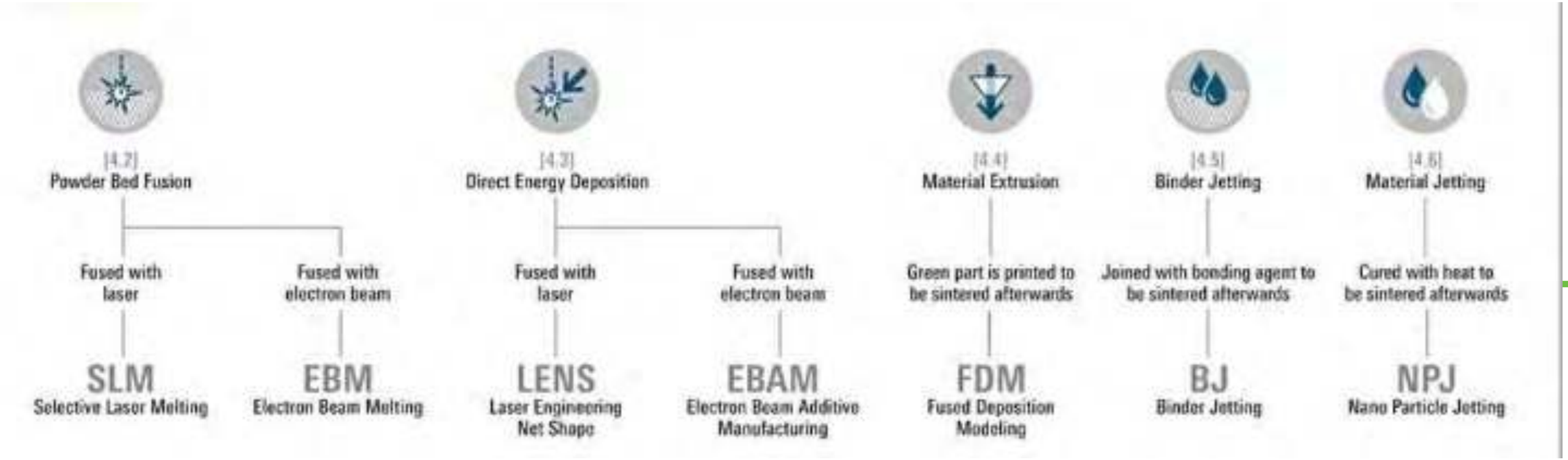


Printer: Fortus 450MC – STRATASYS
Material: ULTEM9085

Printer: Fortus 450MC – STRATASYS
Material: 1.ULTEM 9085 .2 ABS 3.Nylo


stratasys | F120
stratasys
Finally. Affordable
industrial-grade 3D printing.

ADDITIVE MANUFACTURING FOR **METAL**



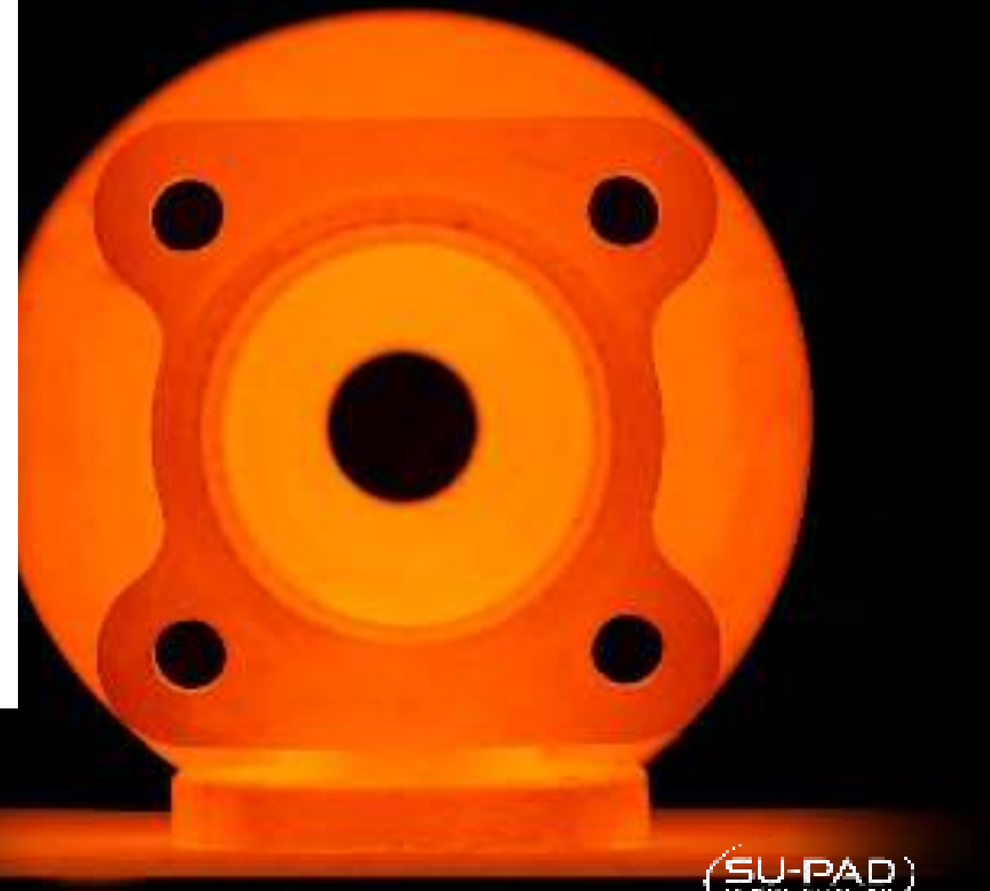
Desktop Metal™

Desktop Metal is reinventing the way engineering and manufacturing teams produce metal parts - from prototyping through mass production.

>$500M investment to bring metal AM into mass market

+180 engineers / 15 PhDs (including 4 MIT professors)

+200 patents in process



Google KPCB NEA

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DesktopMetal Studio system

Today’s metal 3D printers are like 1970s punchcard computers

Centralized facilities, raised floors, punchcards, mag tapes, very expensive

Explosion proof room, large outdoor argon gas tanks, 480V 3 phase, respirators, specialized operators, $600k printer + $200k post processing equip. + $200k facility

Today’s metal 3D printers are like 1970s punchcard computers

Safe for the office

No hazardous powders

No respirators

No external ventilation

No 480V 3-phase power

No stress relief

No dangerous lasers

No 3rd party equipment

No dedicated operators

No welded supports

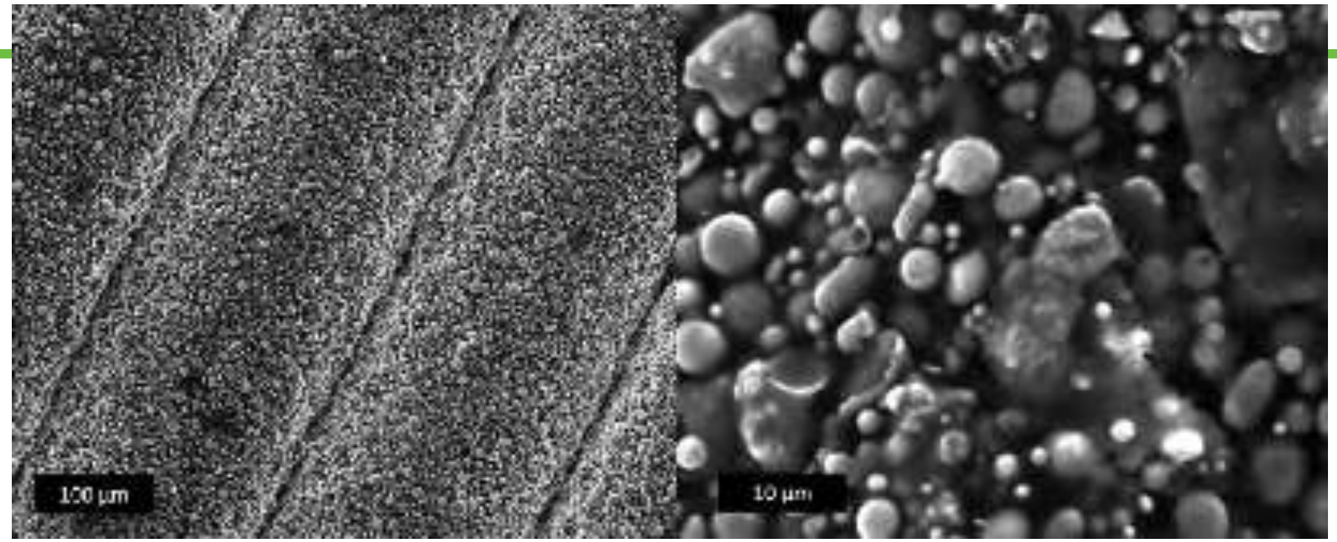
No special facilities

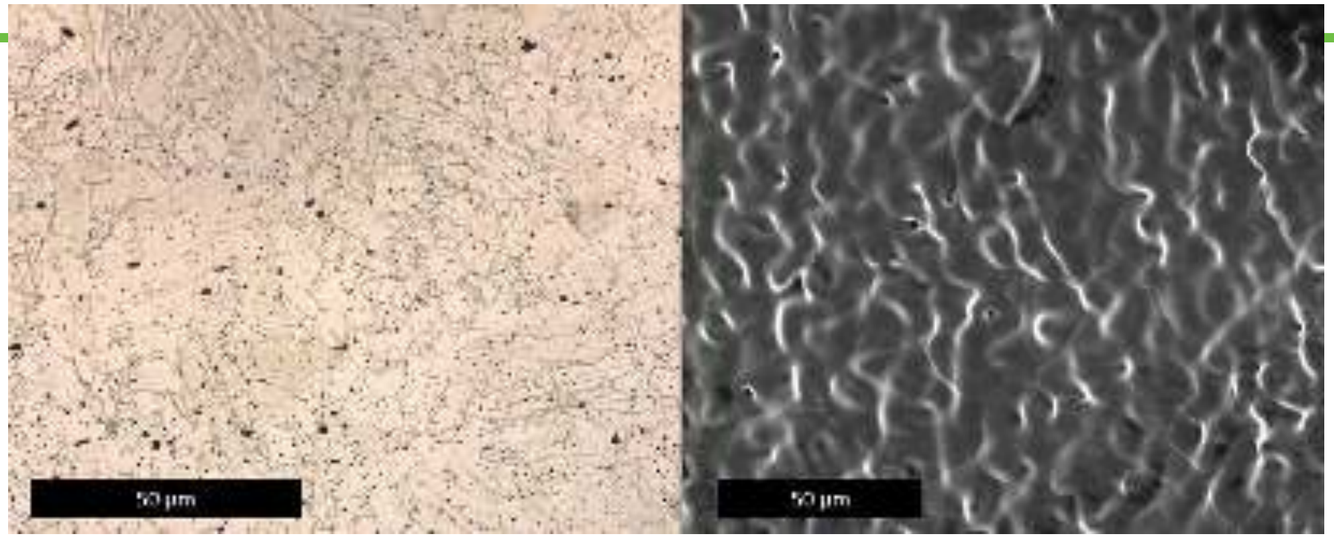
The world’s first office-friendly metal 3D printing system

Desktop Metal

MIM VS. STUDIO SYSTEM PROCESS

Green parts are composed of powders fully bound in a polymer





Sintered parts are composed of dense, polymer-free metal

Wide range of materials

- Designed around the Metal Injection Molding (MIM) powder supply chain
- Over 30 alloys under development
- Six alloys available

CORE ALLOYS

- 17-4 PH STAINLESS
- 316L STAINLESS
- H13 TOOL STEEL
- 4140 CHROME MOLY
- COPPER
- INCONEL 625

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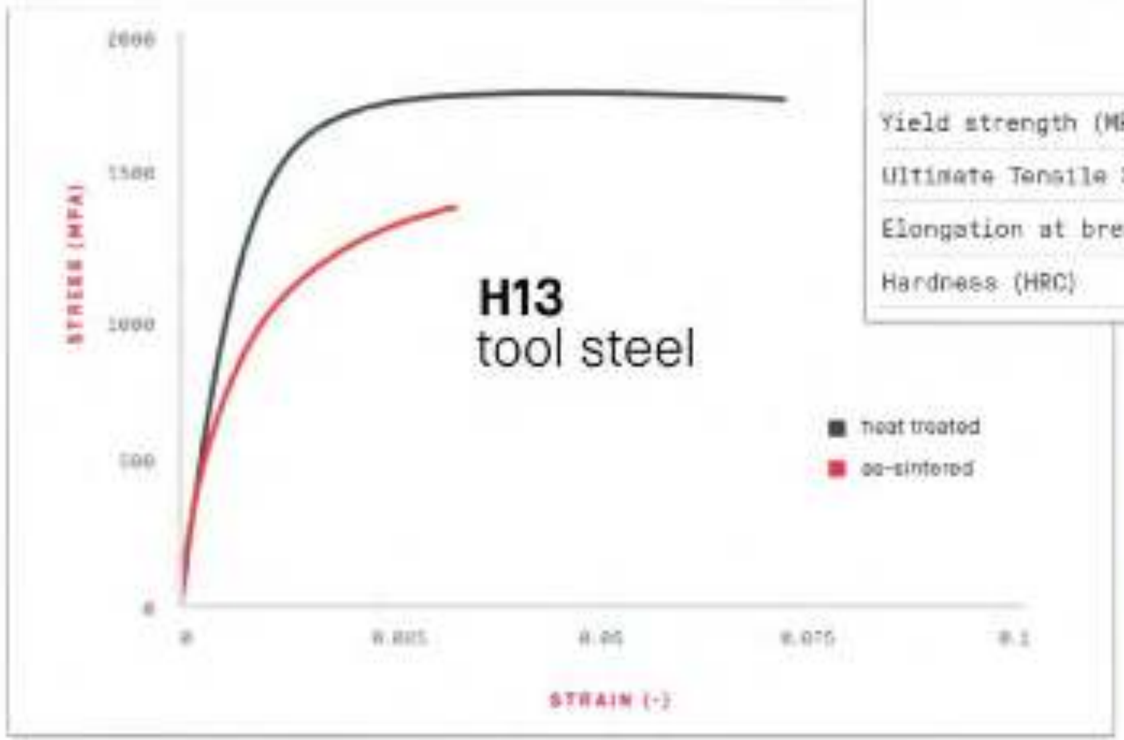
Material Properties meet or exceed material standards from ASTM/MPIF



Mechanical properties[1]

	Standard	Studio System as-sintered	Studio System heat treated[2]
Yield strength (MPa)	ASTM B9[1]	650	1250
Ultimate Tensile Strength (MPa)	ASTM B9[1]	1325	1720
Elongation at break	ASTM B9[1]	2.3%	5.8%
Hardness (HRC)	ASTM E18	35	45

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17-4 PH
Stainless Steel

316L
Stainless Steel

Alloy 625
Nickel Based Superalloy

H13
Tool Steel

4140
Low Alloy Steel

Copper
High Purity Copper

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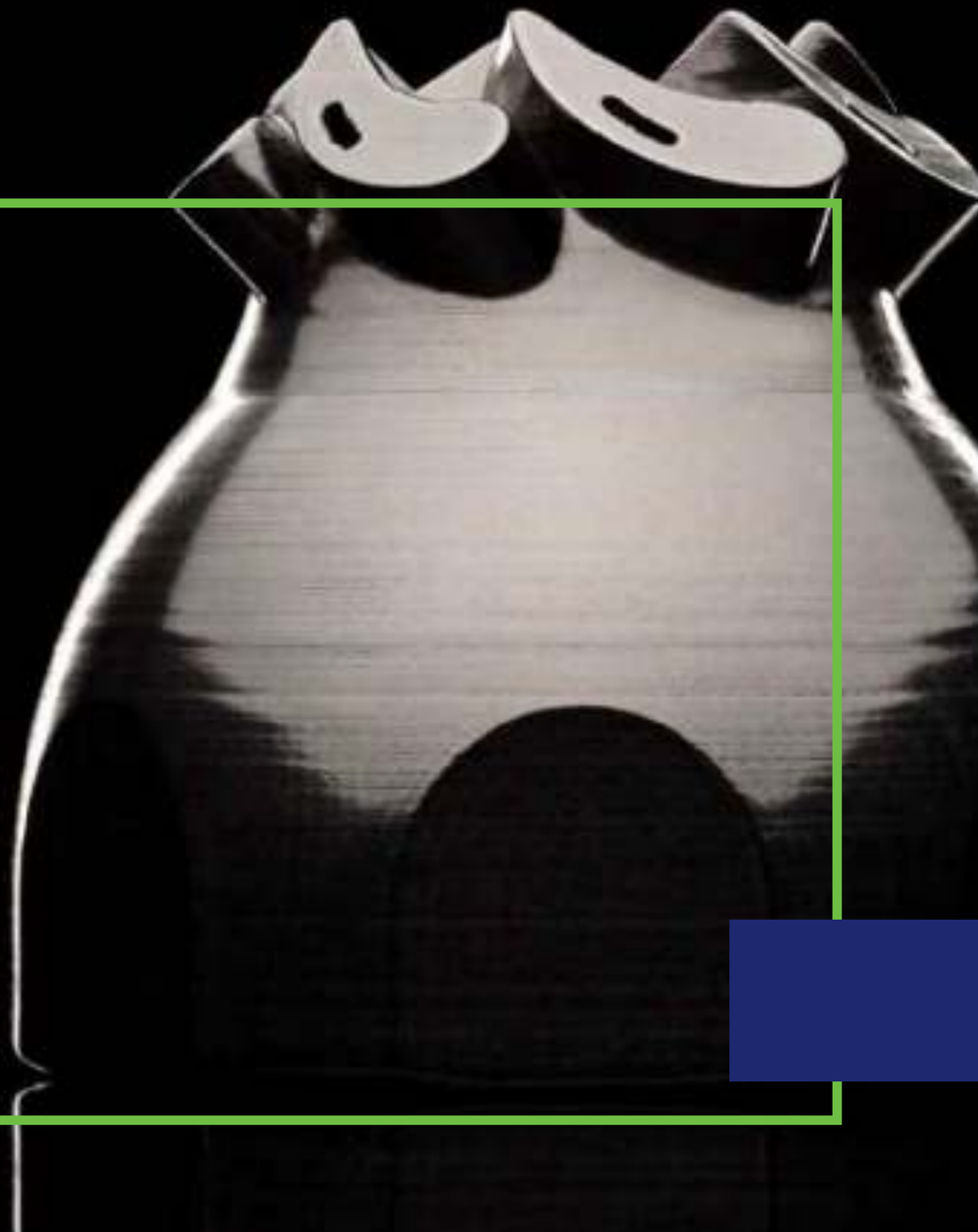

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האוניברסיטה העברית בירושלים
THE HEBREW UNIVERSITY OF JERUSALEM

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Shop and Production System

_Accessible to all

Affordable, turnkey solution

The Shop System contains all pieces of equipment your machine shop needs to begin binder jetting — from print through sintering. And with a range of build volume configurations (4L, 8L, 12L, and 16L), the Shop System is designed to scale to your shop's throughput.

- End-to-end system (print through sinter)
- Range of models: 4L, 8L, 12L,16L build boxes
- Printer starting at $150,000; turnkey solutions starting at just over $300,000

PRODUCTIVITY

➔ Fast

➔ Effortless

➔ Flexible

QUALITY

➔ High resolution parts

➔ Fine feature detail

➔ 5x redundancy

COST & THROUGHPUT COMPARISON | PART EXAMPLE #1

Output pulley

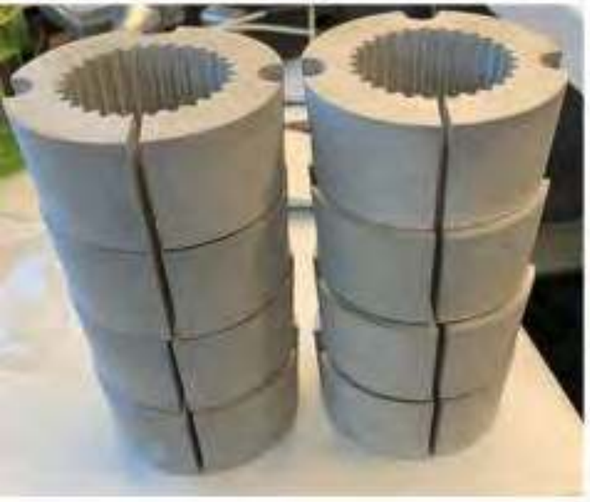
- Part volume: 3,627 mm3 (0.22 in3)
- Dimensions: 41 x 26 x 8 mm (1.6 x 1.0 x 0.3 in)
- Time to market via binder jetting significantly faster than traditional manufacturing
- Traditional manufacturing tooling requires side actions / sliders - impact to part cost

	Studio System	Shop System - 8L	Production System
Parts / year	3,120	144,199	3,423,420
Cost / part	$33.80	$6.75	$0.79
Cost / cc	$6.54	$1.86	$0.22





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XACT METAL

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Introduction to Metal Powder Bed Fusion and Xact Metal

FEATURE CAPABILITIES OF XACT METAL PRINTERS

- Fast enough for most applications
- User friendly intuitive modern graphical user interface (GUI)
- Fast change-over between builds
- Open powder and open architecture
- Recognized build software and powder metal suppliers

ALL FOR

$99,000\140,000 Bundle

METAL POWDER BED FUSION CAPABILITIES

Typical Metals:
Must Have Good Weldability

- Stainless Steels: 316L, 17-4 PH, 15-5 & 400 series
- Super Alloys: 625, 718, Cobalt Chrome F75, and other Nickel, Chromium & Molybdenum based alloys
- Tooling Steels: Maraging M300
- Bronze and Copper
- Precious Metals (Gold and Silver)
- Aluminum AlSi10Mg and Titanium Ti-64

Mechanical Properties

Tensile value, elongation, modulus of elasticity, and hardness properties comparable to as-forged or cast properties.

Build Tolerance

- Part Dimensions <30 mm (1.18 in.): +/- 60 microns (+/- 0.0024 in.)
- Part Dimensions >30 mm (1.18 in.): +/-0.2%

*Tolerances of 20 to 50 microns (0.001 to 0.002 in.) achievable after process optimization for a given geometry.

Minimum Dimensions

- Minimum practical wall thickness: 100 microns (0.004 in.)
- Minimum practical hole size: 200 microns ?(0.008 in.)

TYPICAL BENCHMARKS

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NANODIMENSION
Electrifying Additive Manufacturing®

NANODIMENSION

Electrifying Additive Manufacturing®

Nano Dimension is the world's leading additive electronics provider, targeting the growing demand for sophisticated electronic devices that rely on sensors, antennas, PCBs, capacitors and IC packaging

Our additive manufacturing solutions are mission critical and economical for our customers

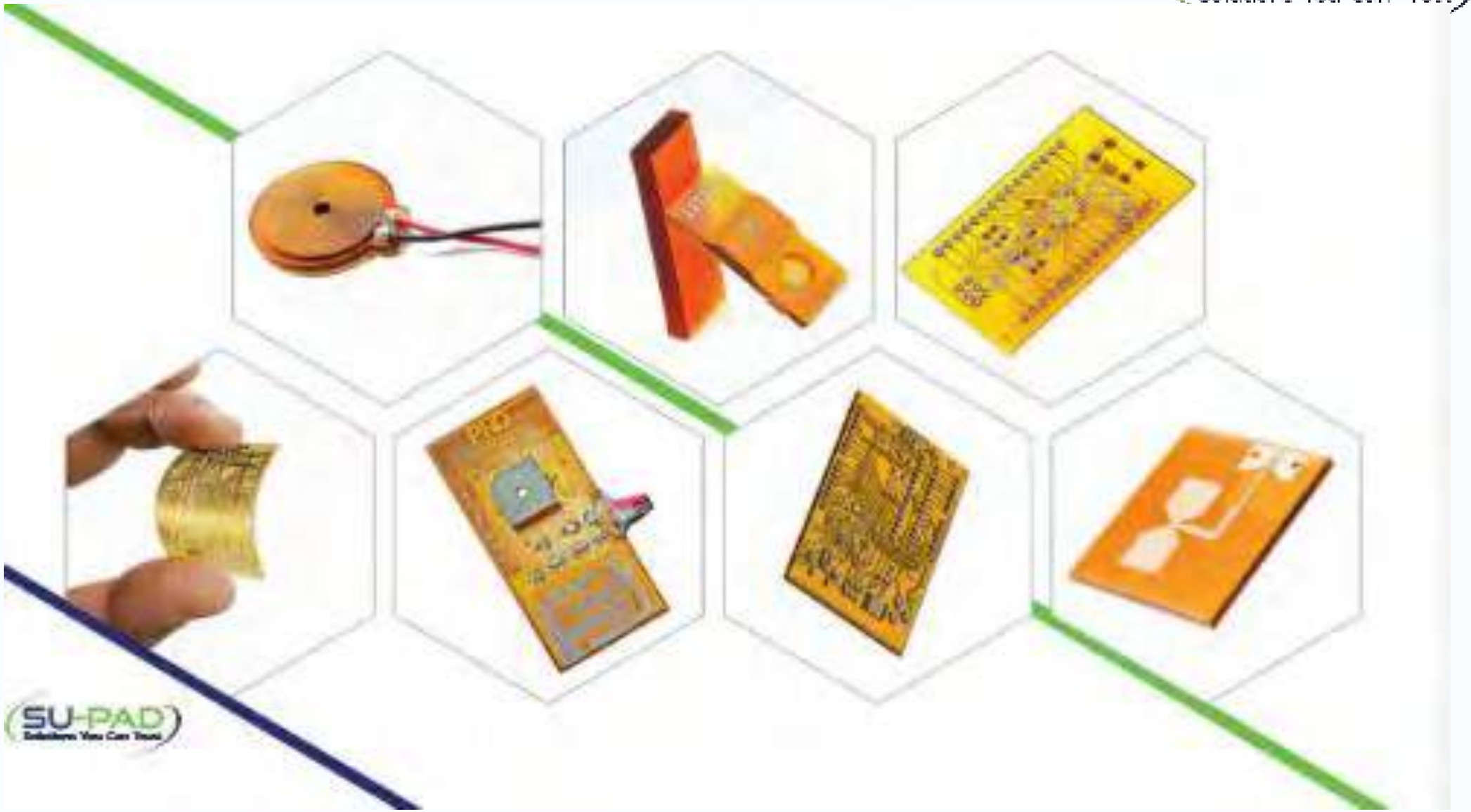
KEY TECHNOLOGIES

- Multi-layer Rigid PCB
- Side contacts
- Vertically integrated ICs
- Printed Capacitors
- RF: Antennas up to 6Ghz,
  Transmission line up to 20Ghz
- Battery Socket
- BGA/SMT mounting
- Inductor: Coils
- Sensors: torque, touch, strain gauge
- Transformers: AC2AC, AC2DC, DC2DC

2 printheads inkjet both materials simultaneously:

- Both conductor & substrate are printed
- 100% fully additive process!

Applications:



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Desktop Metal

XACT METAL

stratasys
PLATINUM PARTNER

THANK YOU

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