Visible Light Photopolymerisation of Elastomer

Photocentric

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ADDITIVE MANUFACTURING FOR ELASTOMERS

About us

Elastomer Printing

Photopolymers and materials

Macro Scale: Mass Manufacturing

Photocentric

Formed in 2002
to manufacture patented
package of photopolymer

UK owned
company with 2
US subsidiaries

Invented concept of using LCD
screens in 3D printing

30+
scientists

Winner of 3 Queens Awards
Innovation 2020
International Trade 2018
Innovation 2016

8 Granted patents
23 applications on LCD
3D printing

Leading 3 grants
researching 3D printed
batteries

2020 revenue
Growth 200%

Employ 190 people in
Peterborough and
45 in Phoenix

Start 3D printing with an
Innovate grant in 2014
to develop a prototype

R&D target >15% of
revenues

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OUR BUSINESS IN NUMBERS

Formed in 2002

Manufacture in UK and US

Revenues of $28m

175 customers in 30 countries

210 employees in US and UK

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Our business strengths
INNOVATION

Invented LCD 3D printing- the disruptive scalable method

Invented imagepac- packaged polymer to make stamps

Winner of 3 Queens Awards,12 granted patents, 25 pending

30 Research scientists 15% revenue invested in R&D

Research program to 3D batteries for cars

Photocentric

Photopolymer running through our core

Specialist manufacturer of photopolymer
Primary in process- react oligomers
World leader in visible light polymerisation
Approach 3D Printing from perspective of chemical manufacturer
Expert formulator >100 3D formulations
Delivering functional materials for automotive applications
Research partnership with BASF

Dr Robert Young
Lead Chemist

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Photocentric + BASF We create chemistry

Strategic Partnership

Photocentric are working in partnership with BASF to enable custom mass manufacture of industrial parts. We are developing a combined solution of software, hardware and chemistry to overcome the problems that still exist in industrial printing today.

Printing problems we are addressing together

Parts are not functionals

Limitations in material properties have hindered the ability of 3D prints to be used as functional end-use parts

Parts are too expensive

Printers, software, maintenance and resin cost are all much too high. Fully costed finished AM parts come out a about 150 times those of injection moulded items, scale can never be achieved at these pricing levels.

No scale or volume

DLP´s and Lasers can only make small parts and make them very slowly

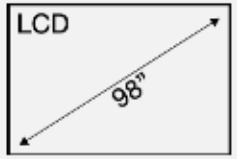
The Solution

Functional End-use parts

New chemistries jointly developed by BASF and Photocentric. Mechanical properties of printable materials which are stable against UV, humidity, aggressive chemicals and perform even under heavy mechanical duress

Affordable End-User Prices

Photocentric and BASF mutually agreed at the outset to provide value to our industrial customers. Our aim is to offer prices on bulk resin that are low enough to be nearer to injection moulding costs that current SLA prices.



Large Scale Printing for Manufacturing

Large format screens (up to 98") allow large part or multiple small part production at high resolution and fast speeds. LCD´s unlocked the AM productivity problem.

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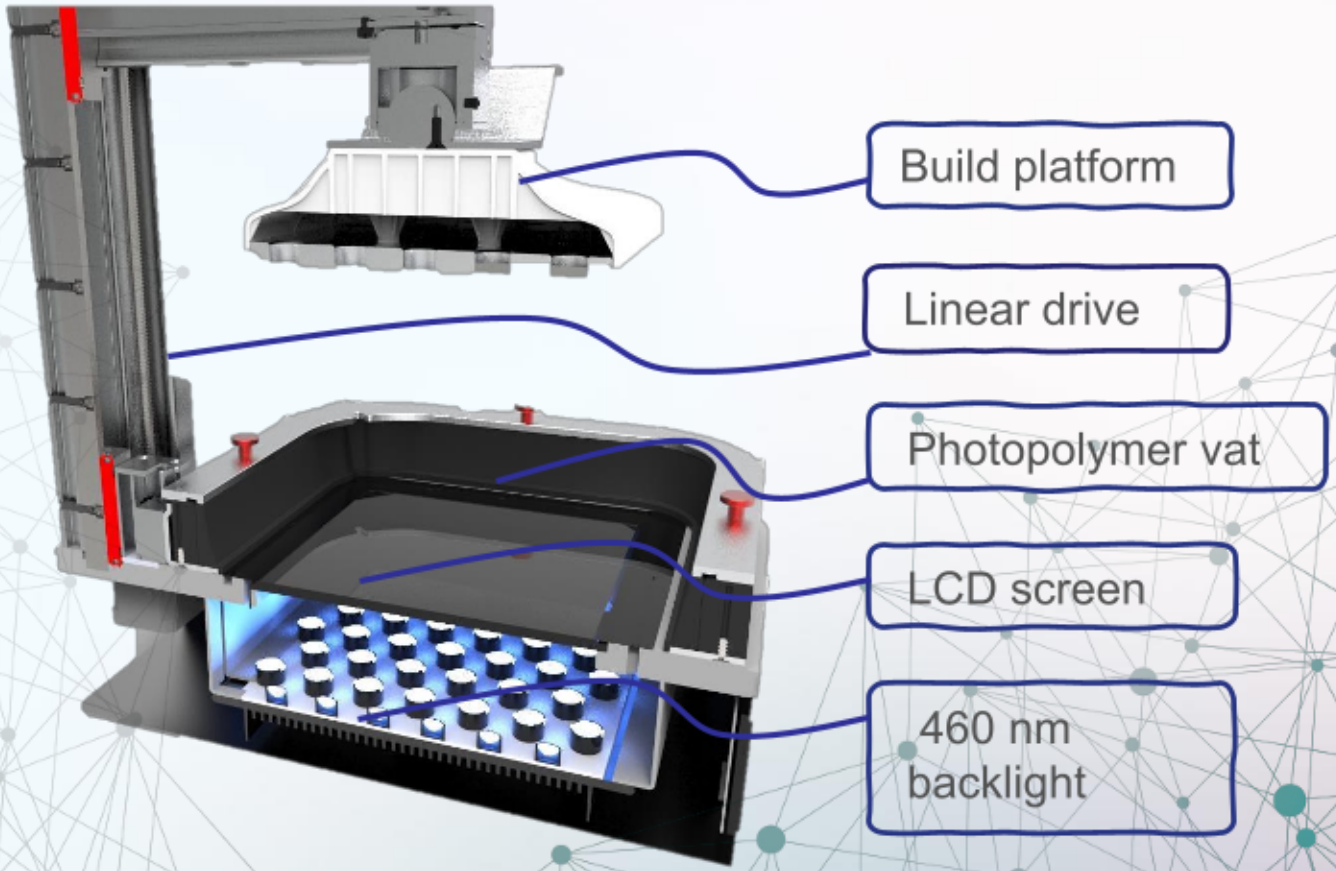
3D Printing with LCD screens

mSLA / LCD Printing



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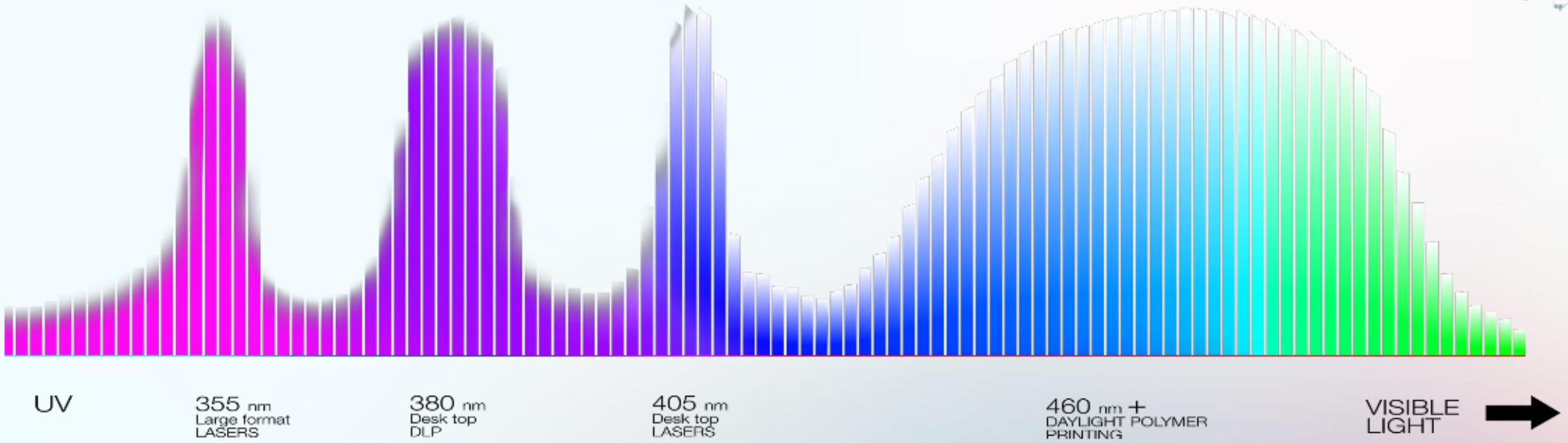
Photopolymer Operating across the Spectrum

We create chemistry across the spectrum to deliver functional properties

- 355nm cationic for large format lasers
- 380nm free radical for DLP
- 405nm free radical for Laser and LCD
- 460nm daylight for LCD printers



Conventional 3D Printing

Visible LCD Printing

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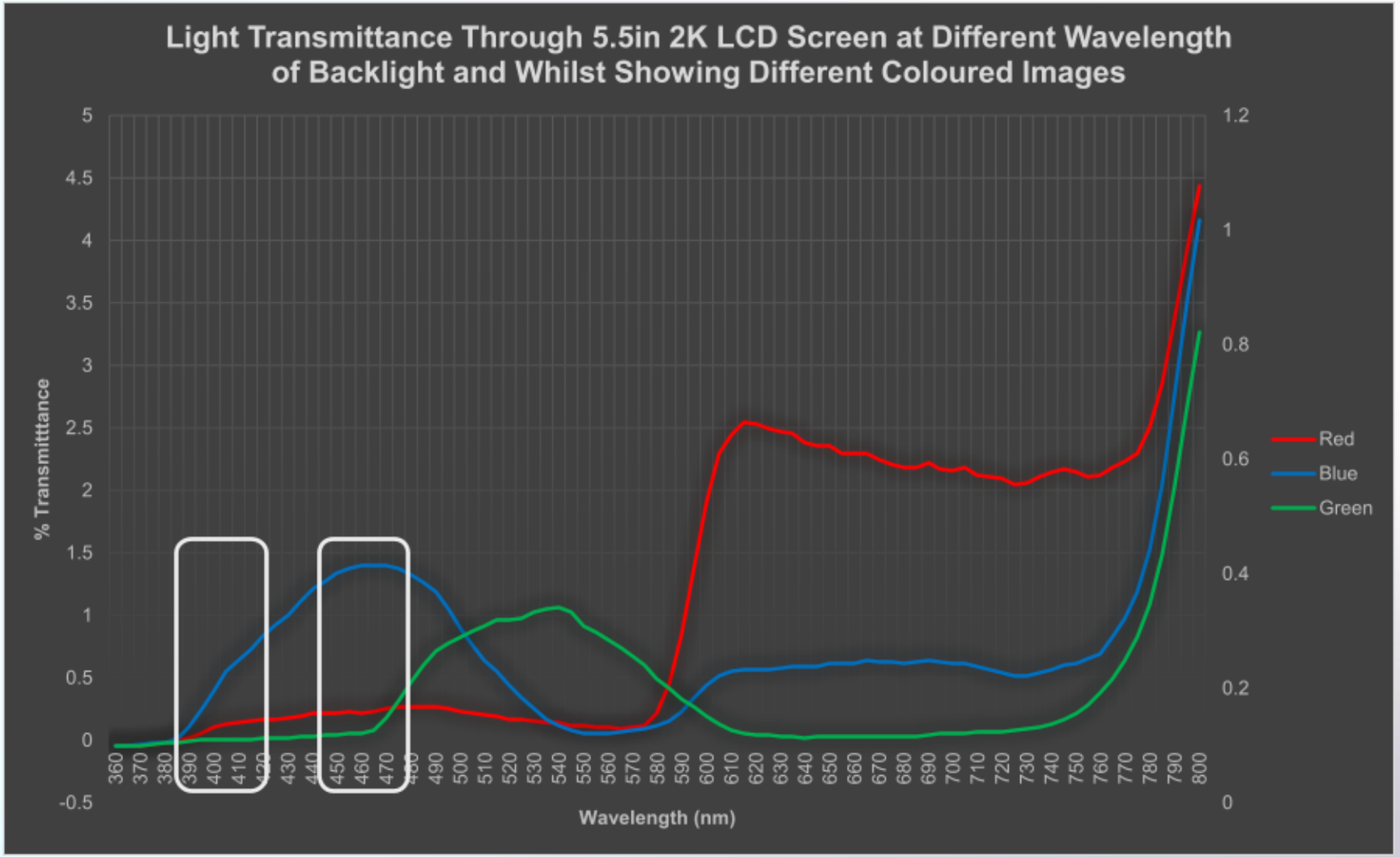
Why Visible light?



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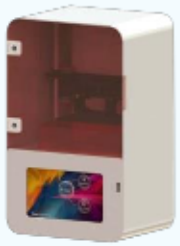
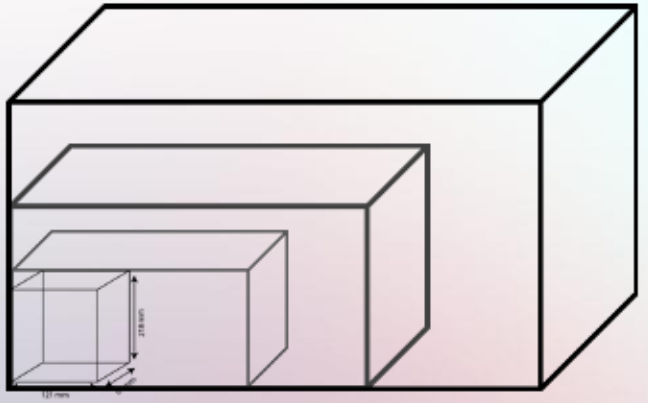
CHOICE OF LCD SCREEN

Depends on the accuracy and size required



	4K	4K Monochrome	4K	4K
Screen size	LCD 5.5”	LCD 14”	LCD 23.8”	LCD 43.7”
Pixel pitch size	32 µm	81 µm	137 µm	245 µm

Build volume comparison



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Liquid Crystal

MAGNA

One of the largest LCD 3D printers in the world

Enabling custom mass manufacture and large component printing. From dentistry to industrial product design and manufacture, the LC Magna´s 23.8" LCD screen and 510x280x350mm build volume manages to create both very large objects and incredible detail on small ones. Delivering print results previously impossible using traditional manufacturing techniques

TECH SPECS

510 x 280 x 350
Build Volume

13.3mm per hour 100 µm
Print Speed

3840 x 2160px
4k Screen

100 µm 3-8s sec / layer
Cure Speed

*Depending on resin

137 µm pixel size
XY Pixel Size

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Newly Launched Resins

Durable DL110 H

Ductile yet rigid

60 MPa, 15%, 2.1 GPa

High HDT (80 C)

High impact strength (110 J/m)

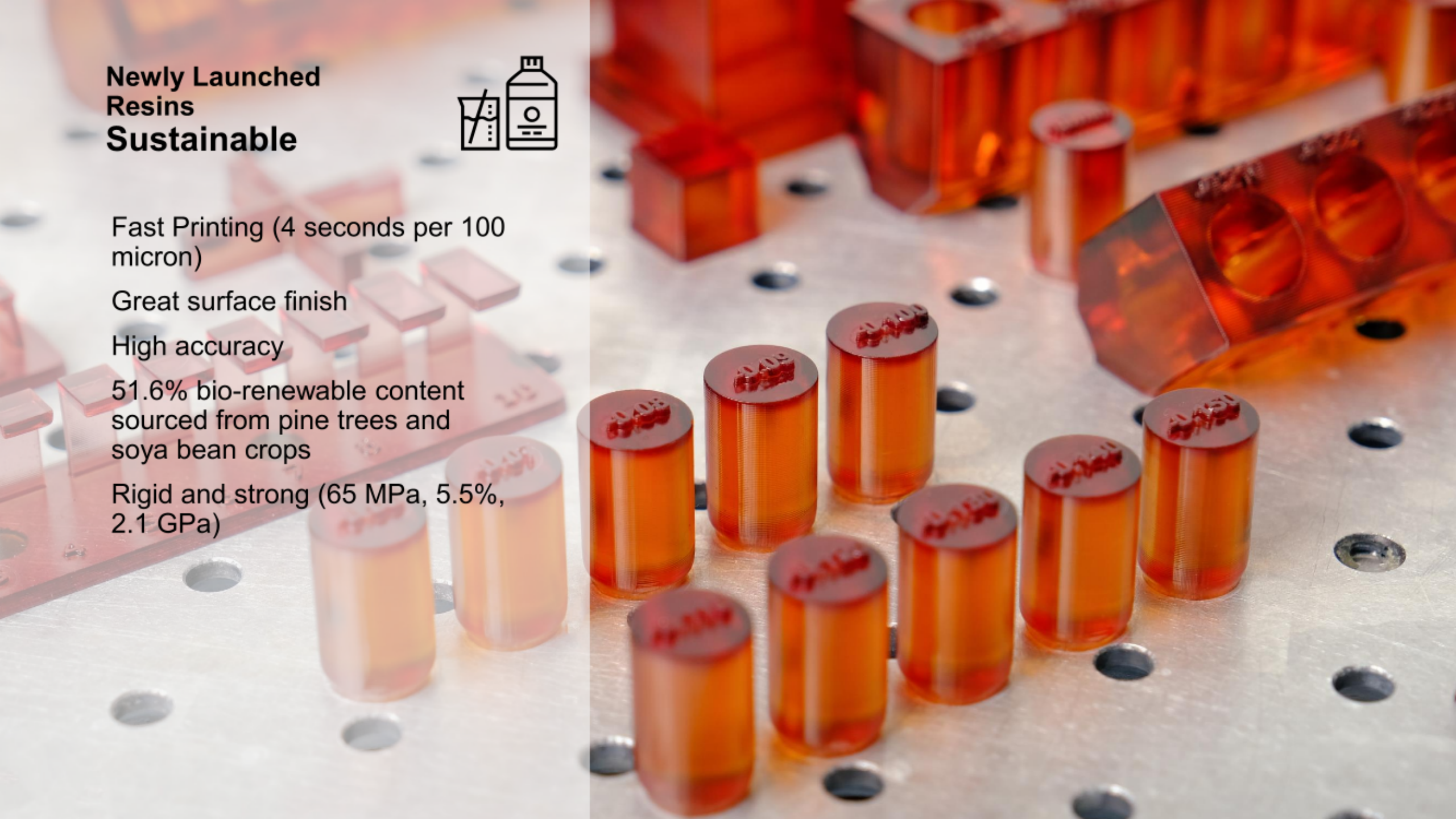
Potential replacement for ABS

Great surface finish

Newly Launched Resins

Sustainable

- Fast Printing (4 seconds per 100 micron)
- Great surface finish
- High accuracy
- 51.6% bio-renewable content sourced from pine trees and soya bean crops
- Rigid and strong (65 MPa, 5.5%, 2.1 GPa)



PHOTOPOLYMERISATION

the chemistry behind Daylight 3D printing

OUR PROCESS

Image displayed by LCD screen: 2D

Photopolymer in vat cures: 3D

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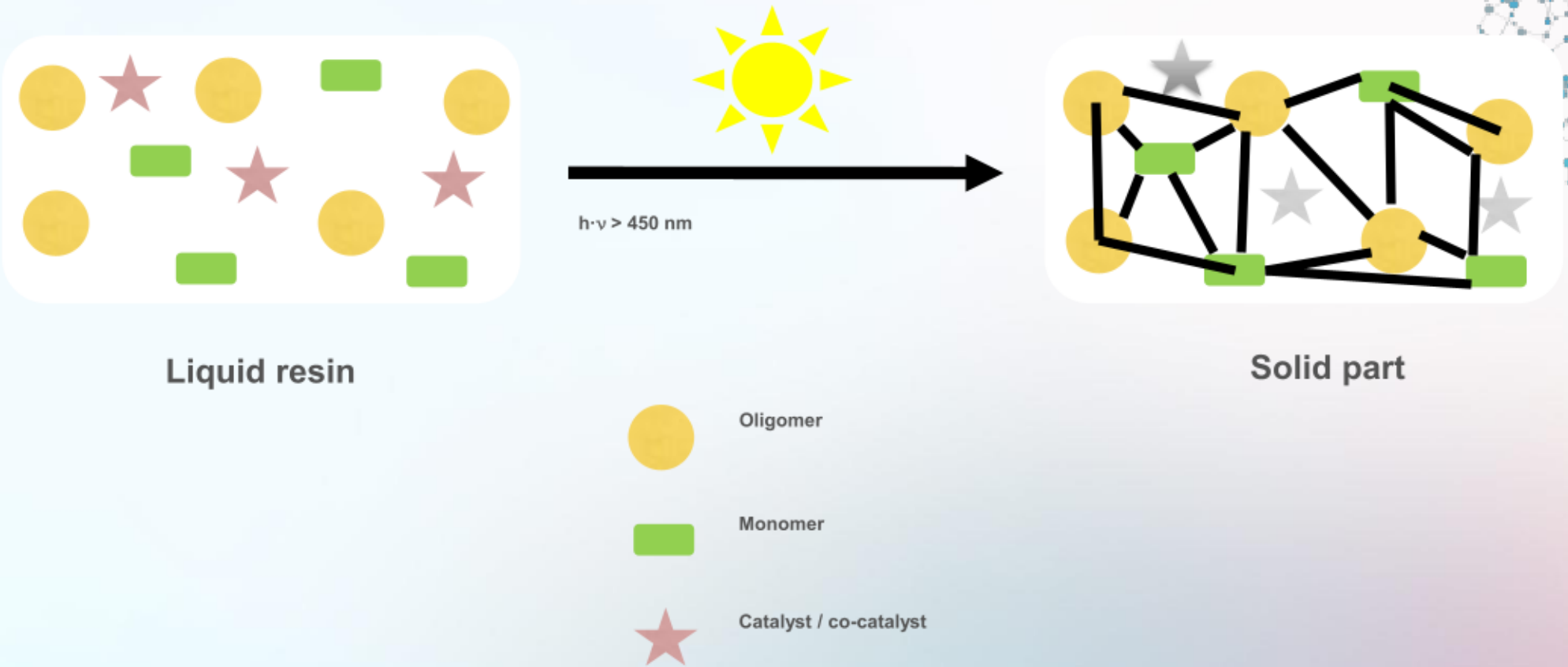
Photopolymerisation – the chemistry behind Daylight 3D printing



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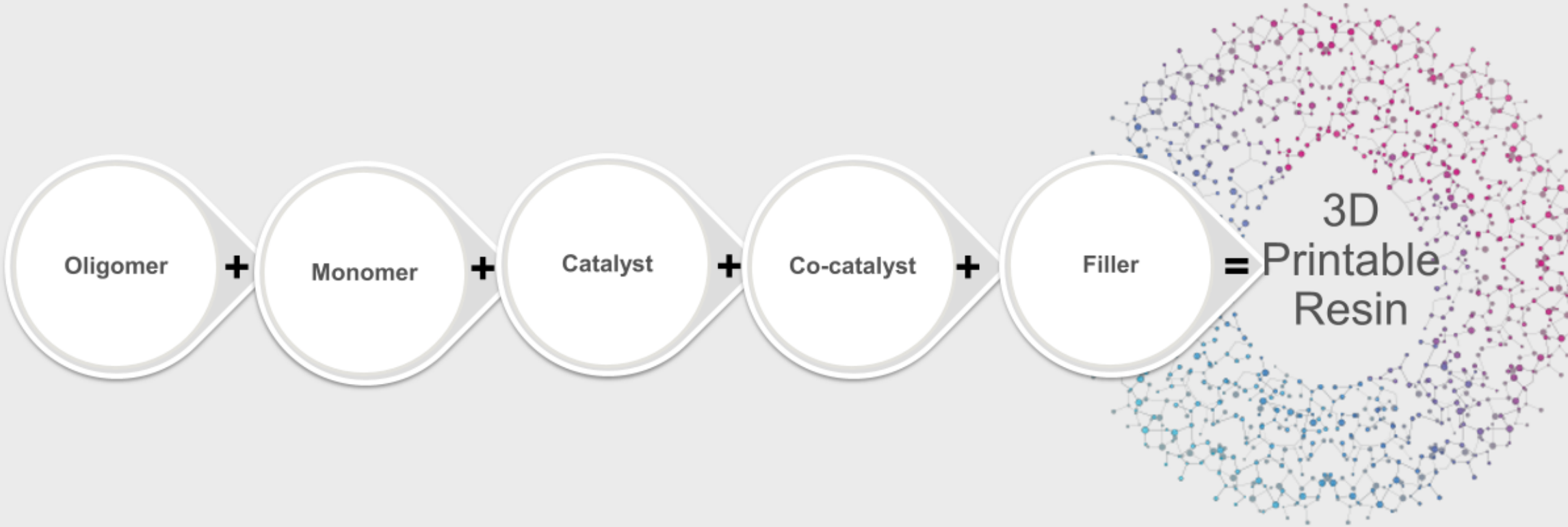
RESIN REQUIREMENTS



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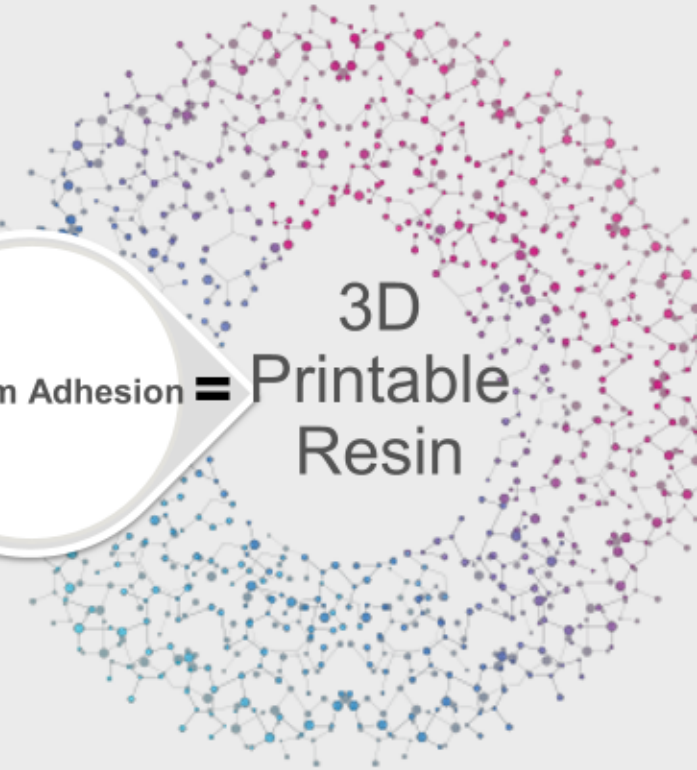
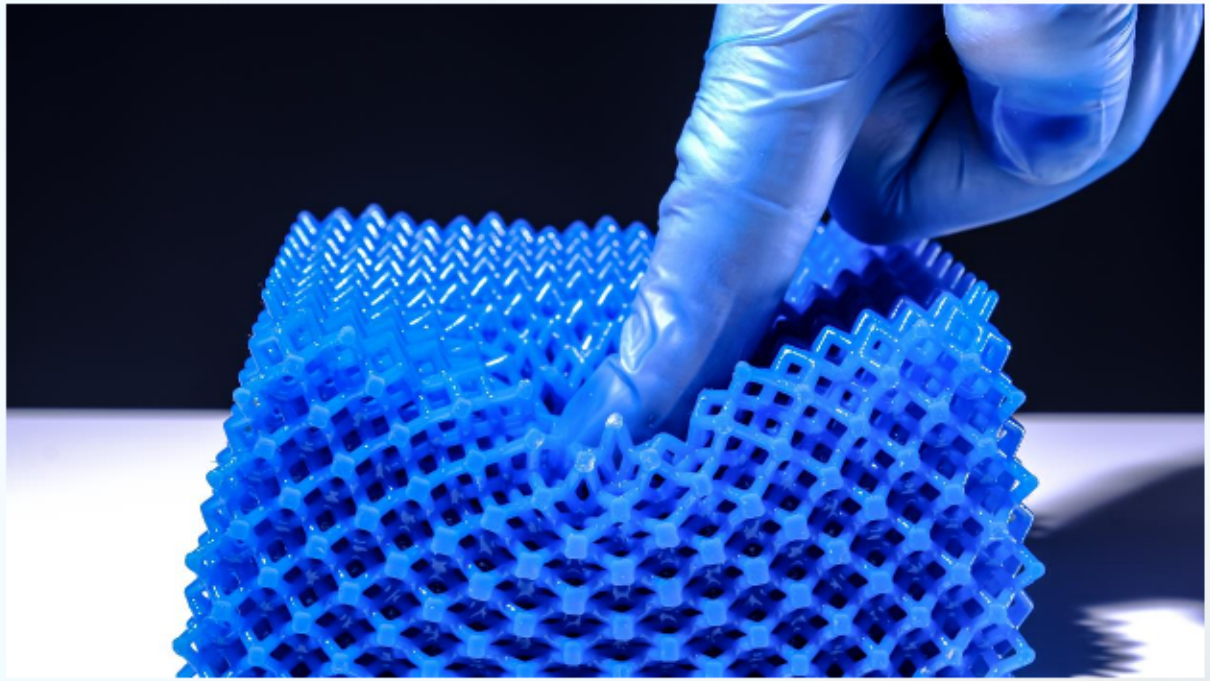
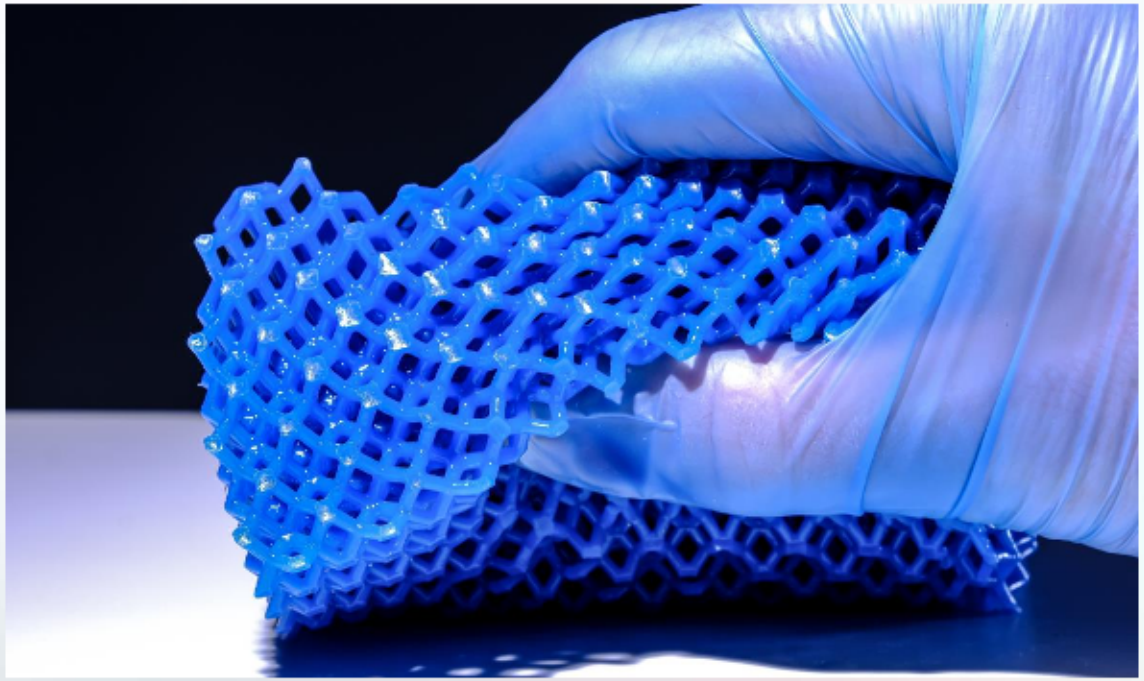
RESIN REQUIREMENTS

Tensile properties + Flexural properties + Rheology + Print Speed + Interlayer Adhesion + Platform Adhesion = 3D Printable Resin



3D printing of elastomeric materials





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3D printing of elastomeric materials

- Application in shoe industry: customization

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3D printing of elastomeric materials

- Challenges:

  1) Mechanical properties

  2) Chemical Stability

  3) Rebound

  4) Reactivity

  5) Rheology

3D printing of elastomeric materials

- Tensile strength
- Elongation
- Young's Modulus
- Hardness
- Rebound

Test via tensile testing

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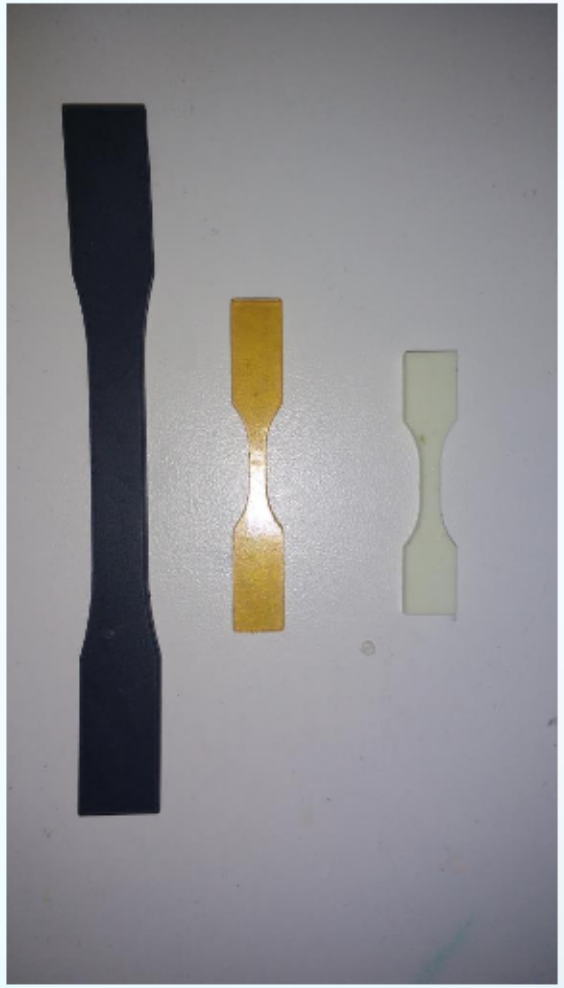
3D printing of elastomeric materials

- Tensile tests



ASTM 638

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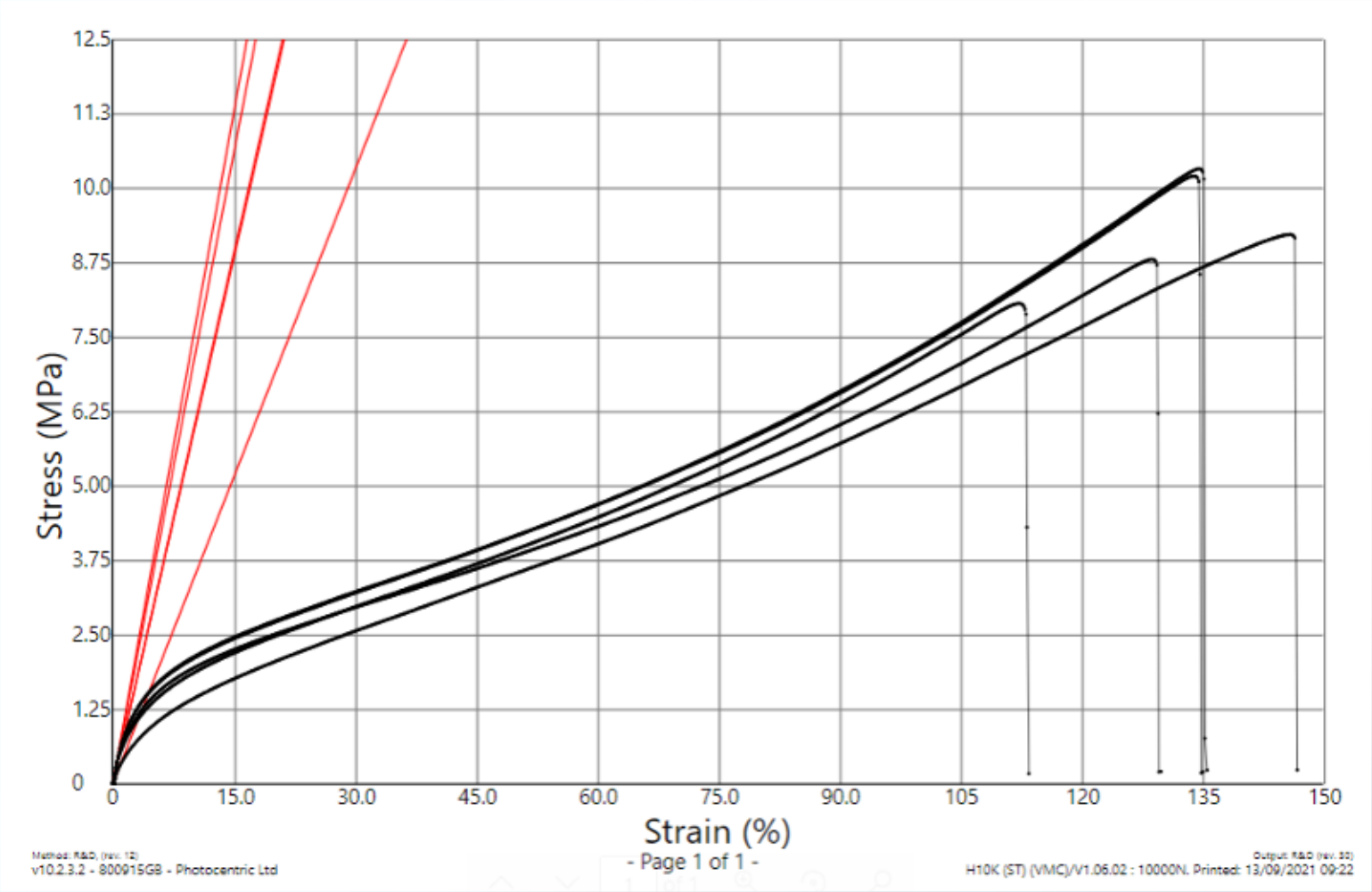
3D printing of elastomeric materials



Oligomer Custom Synthesised

- Low viscosity
- High reactivity (>2 reactive groups)
- Highly flexible
- Low cost

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3D printing of elastomeric materials

- Tensile strength
- Elongation
- Young's Modulus
- Hardness
- Rebound

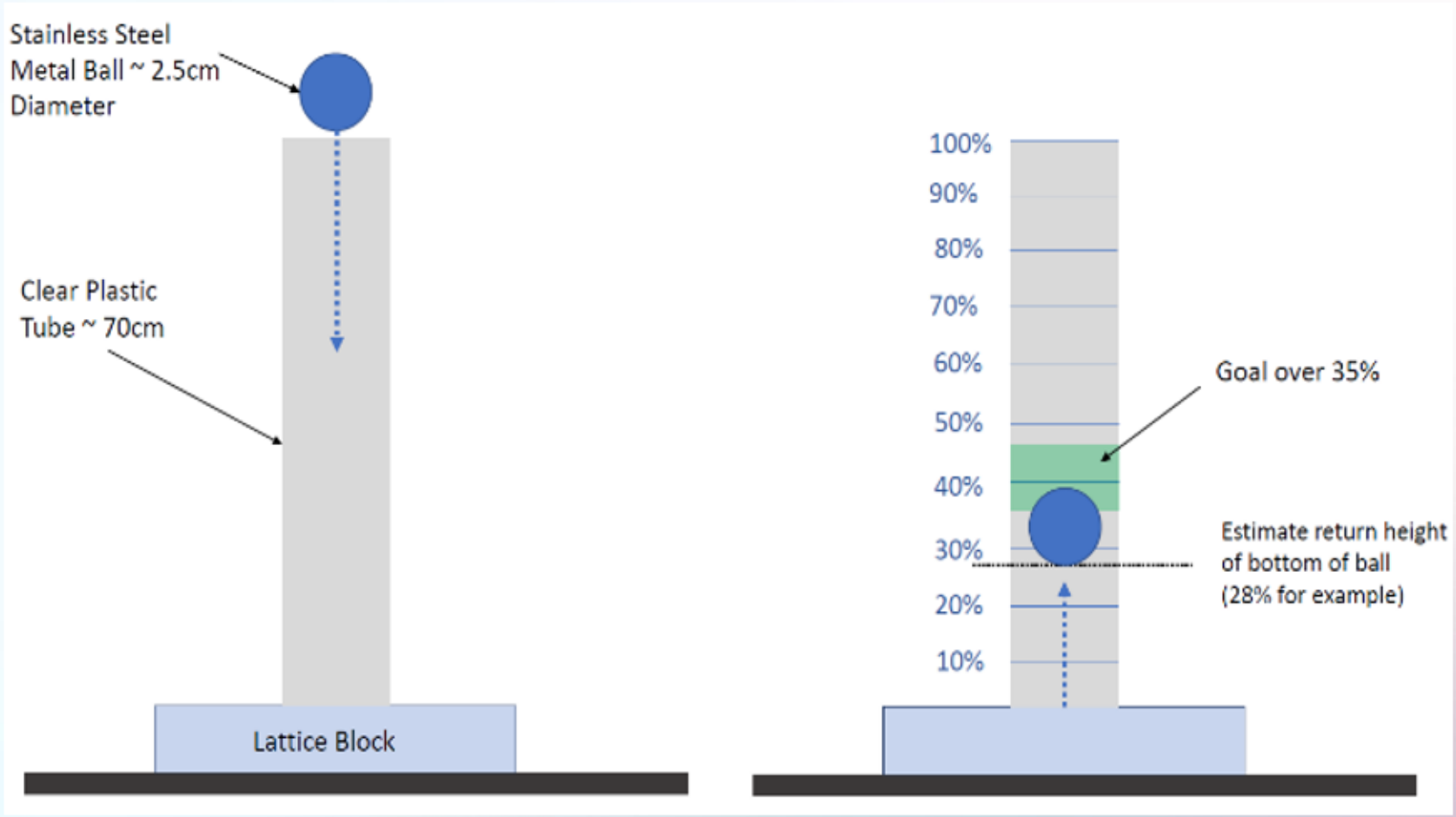
Test via Durometer

3D printing of elastomeric materials

- Tensile strength
- Elongation
- Young’s Modulus
- Hardness
- Rebound

Test via Steel Ball Rebound

3D printing of elastomeric materials



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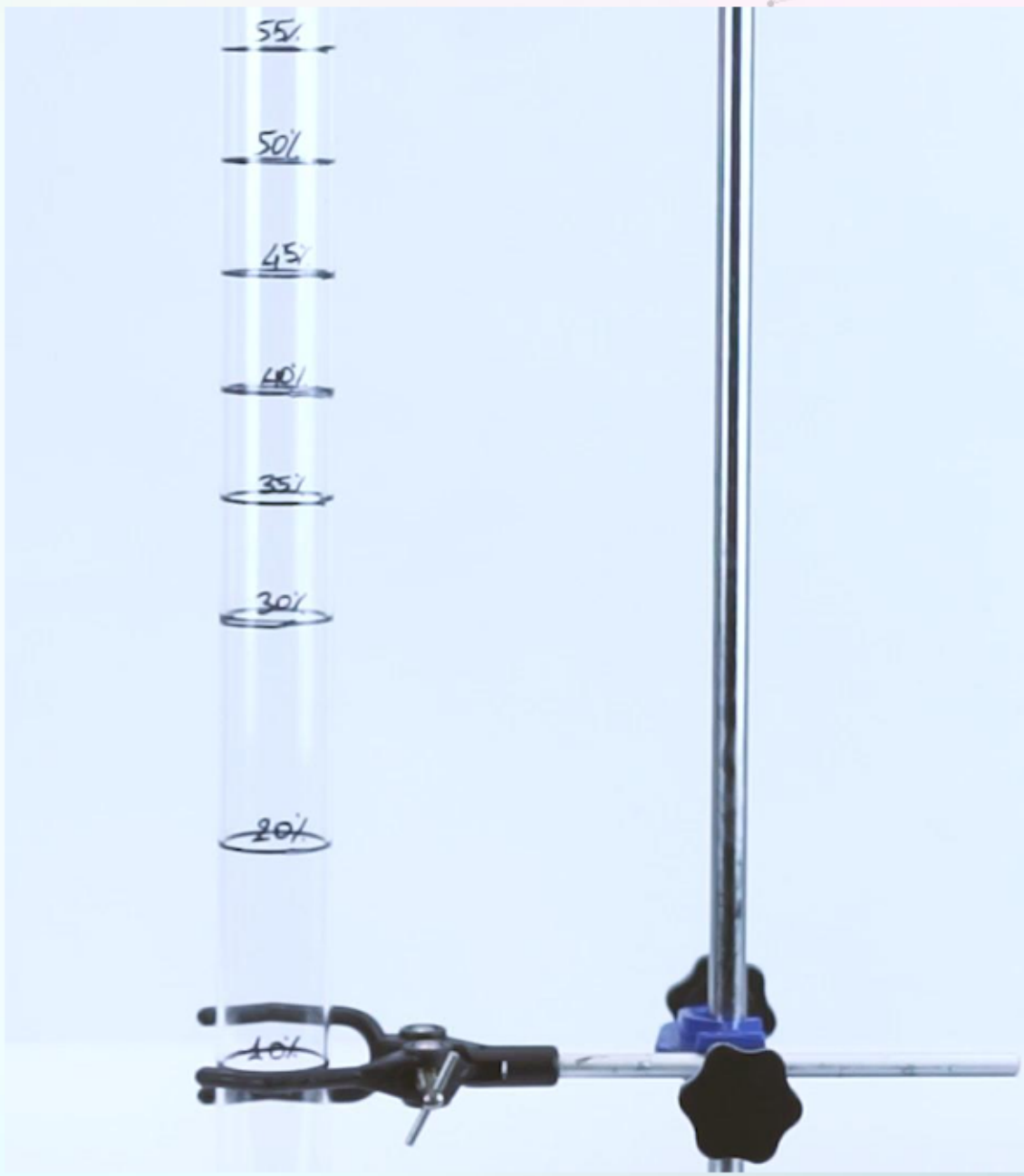

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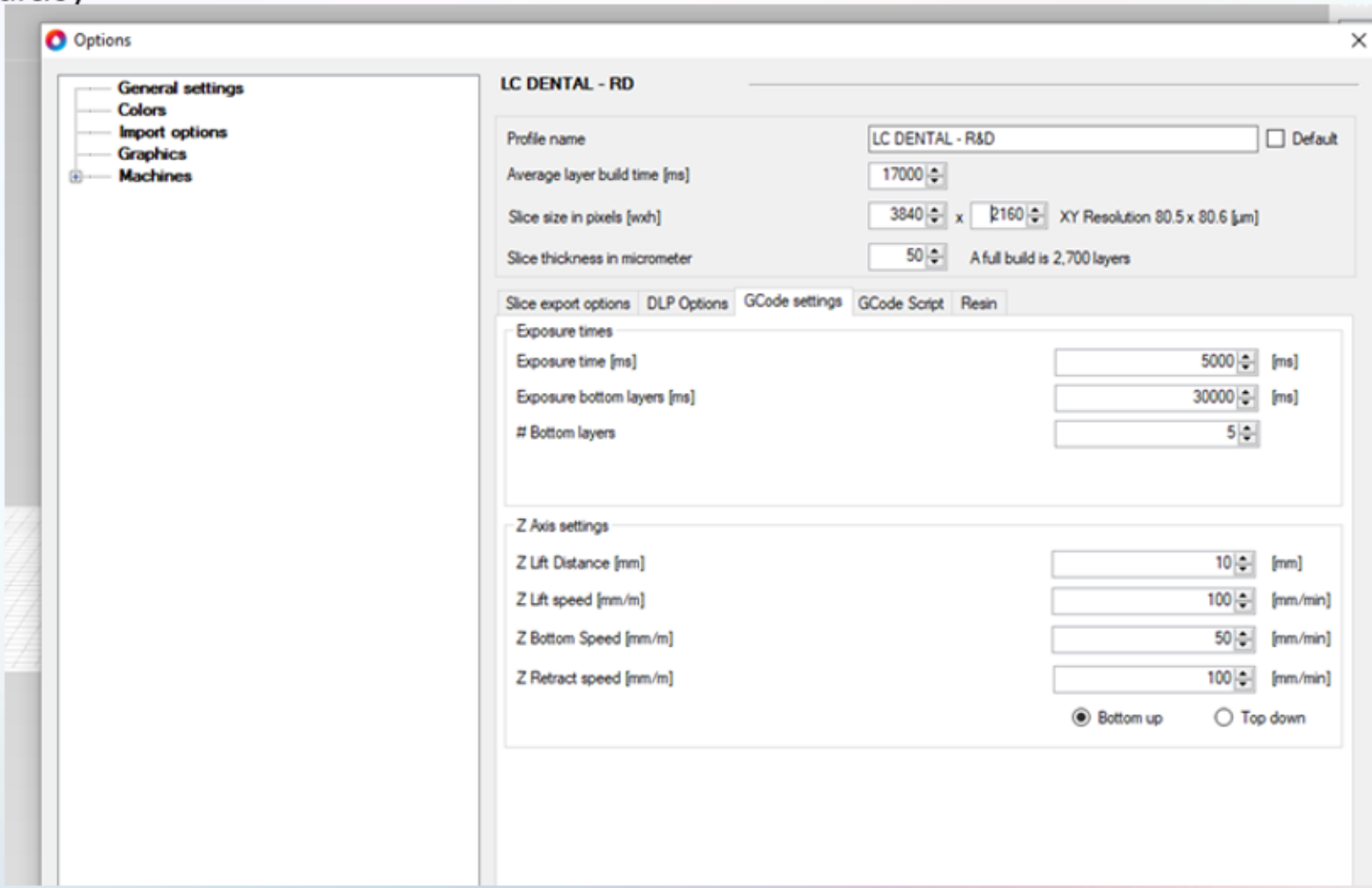
3D printing of elastomeric materials

- Optimization of print parameters and accuracy
  - Exposure times
  - No^{0} and exposure of bottom layers
  - Interlayer adhesion
  - Accuracy
  - Z-bleed
  - Cleaning of parts
  - Postexposure



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3D printing of elastomeric materials

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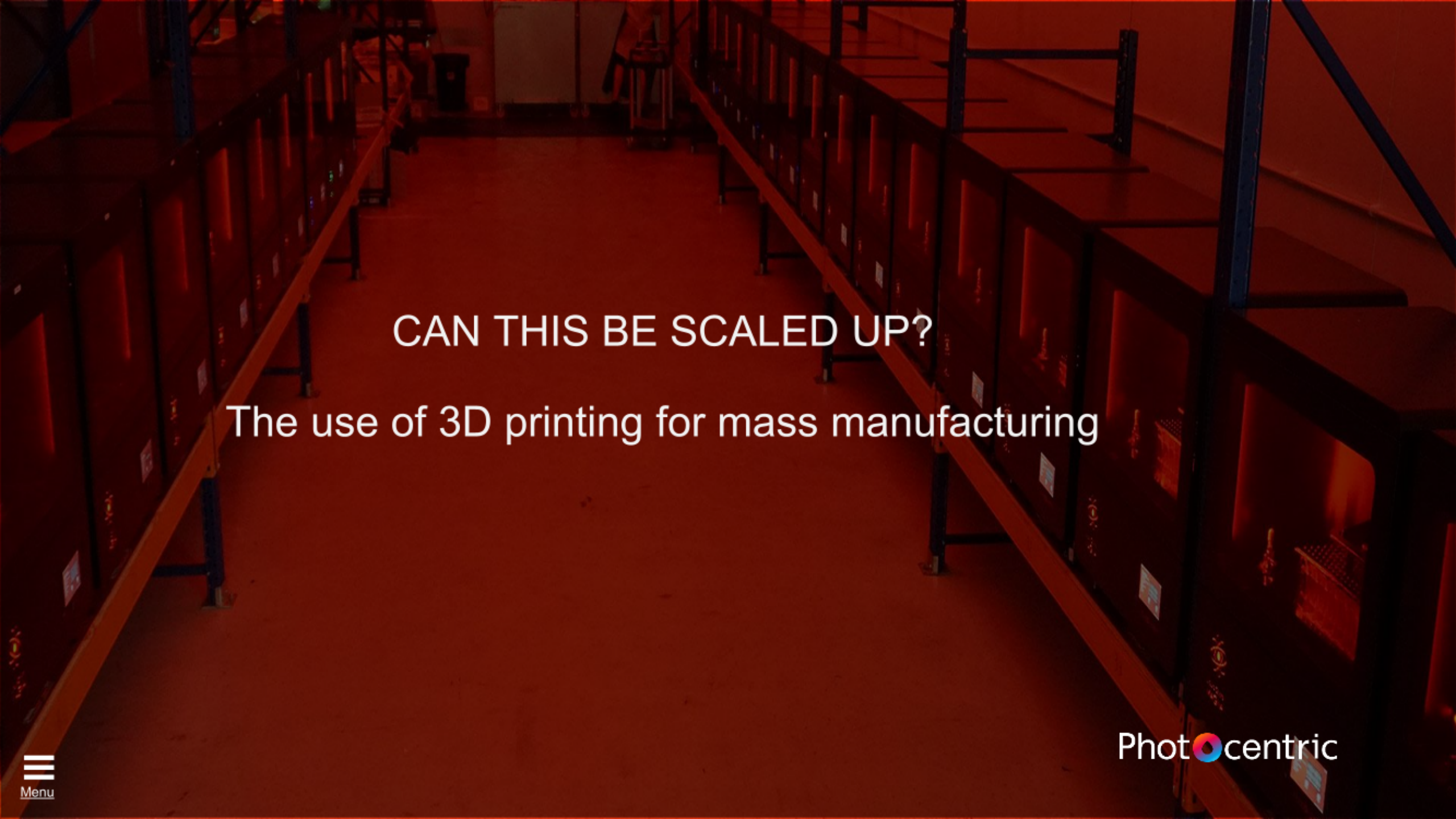
CAN THIS BE SCALED UP?
The use of 3D printing for mass manufacturing
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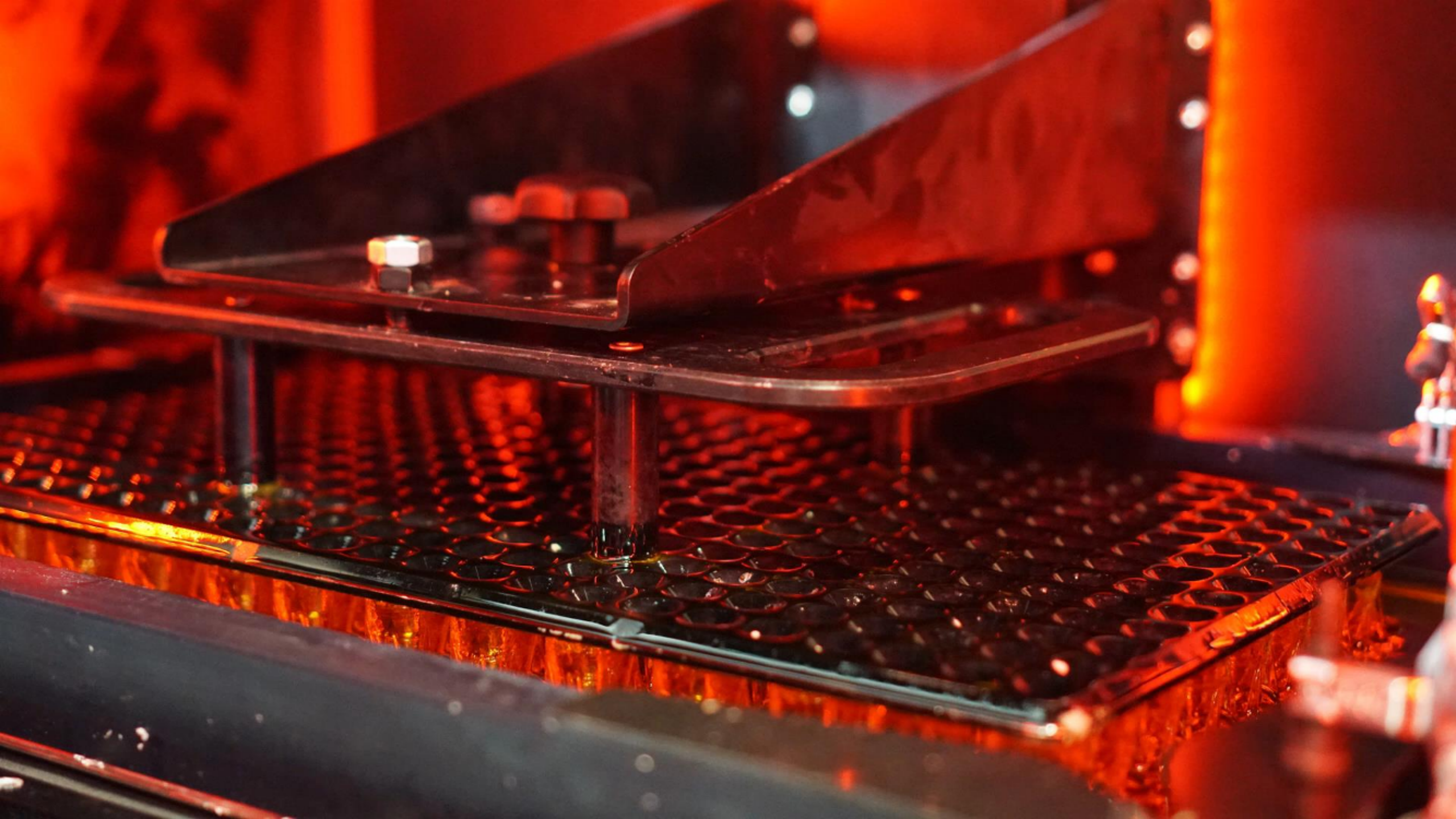
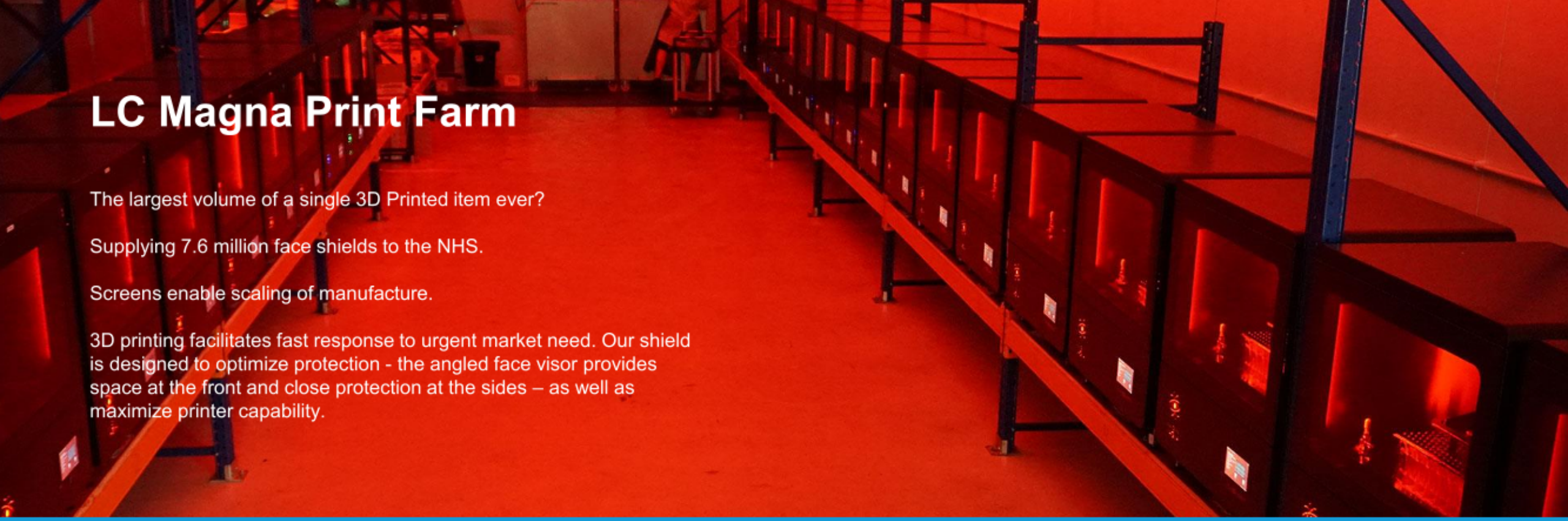




LC Magna Print Farm

The largest volume of a single 3D Printed item ever?

Supplying 7.6 million face shields to the NHS.

Screens enable scaling of manufacture.

3D printing facilitates fast response to urgent market need. Our shield is designed to optimize protection - the angled face visor provides space at the front and close protection at the sides – as well as maximize printer capability.

CREATED OPTIMISED WASH AND CURE PROCESS

60 NEW MEMBERS OF STAFF

WAREHOUSING CONVERTED TO MANUFACTURING

OVER 50 NEW 3D PRINTERS MANUFACTURED AND INSTALLED AS A 'PRINT FARM'

OPTIMISED A DESIGN PRINT WITHOUT SUPPORTS

WRITTEN SOFTWARE TO CONTROL A FARM OF PRINTERS

IMPROVED SPEED OF PRINTERS

DEVELOPED THE CHEMISTRY TO IMPROVE THE PLASTIC PROPERTIES

How we make materials into products in scale

- Large scale
- Low cost
- Functional items
- Smooth appearance
- Rapid manufacturing

Menu

pod
parts on demand

1 step

We discuss your CAD and work with you to Design for Additive.

2 step

We select resin properties even offering customisation, and we print the first offs, then iterate the design and make it perform better, print better and look better. We use our 4D software to texture your surfaces.

3 step

We agree on an optimised process with you, you sign off and we run your quantity required and test to the QC procedures you specify, all delivered from the pod!

4 step

We select resin properties even offering customisation, and we print the first offs, then iterate the design and make it perform better, print better and look better. We use our 4D software to texture your surfaces.

Menu

parts on demand

What do the costs look?

Digital manufacturing

Plastic part weighs	10g	
Resin costs		$45.00/kg
Cost of part- materials	$0.45	
consumables		$0.03
ancillary		$0.05
direct labour		$0.11
Total cost	**$0.64**	

Materialise (100 off) price comparison quote is $16.50

Injection moulding

Cost of tooling		$34,000
Cost of part	$0.45	

CASE STUDY

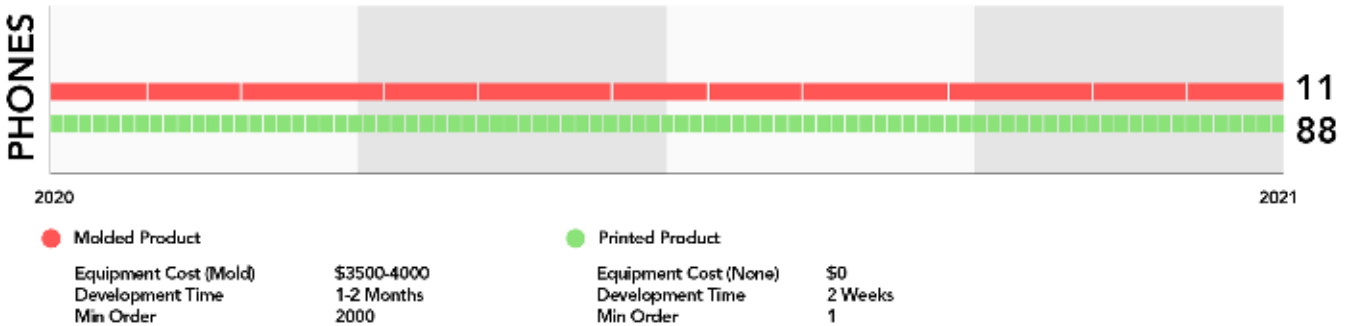
Merit3D

PHONE SKOPE

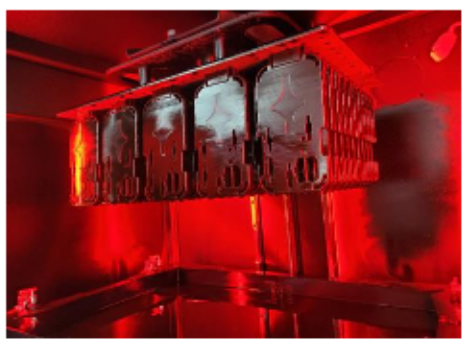
Becoming a part of the 3D printing future.

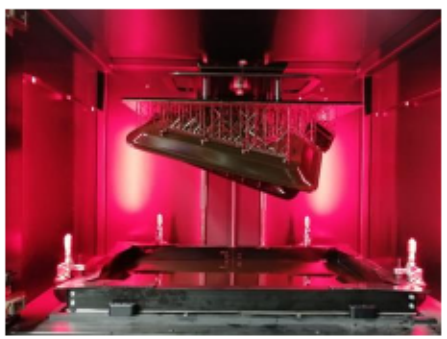
Dustless Technologies supported by Merit3D

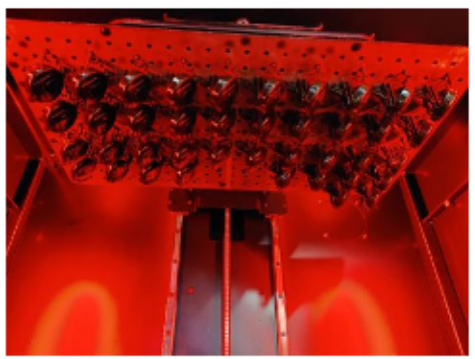
DEVELOPMENT TIME

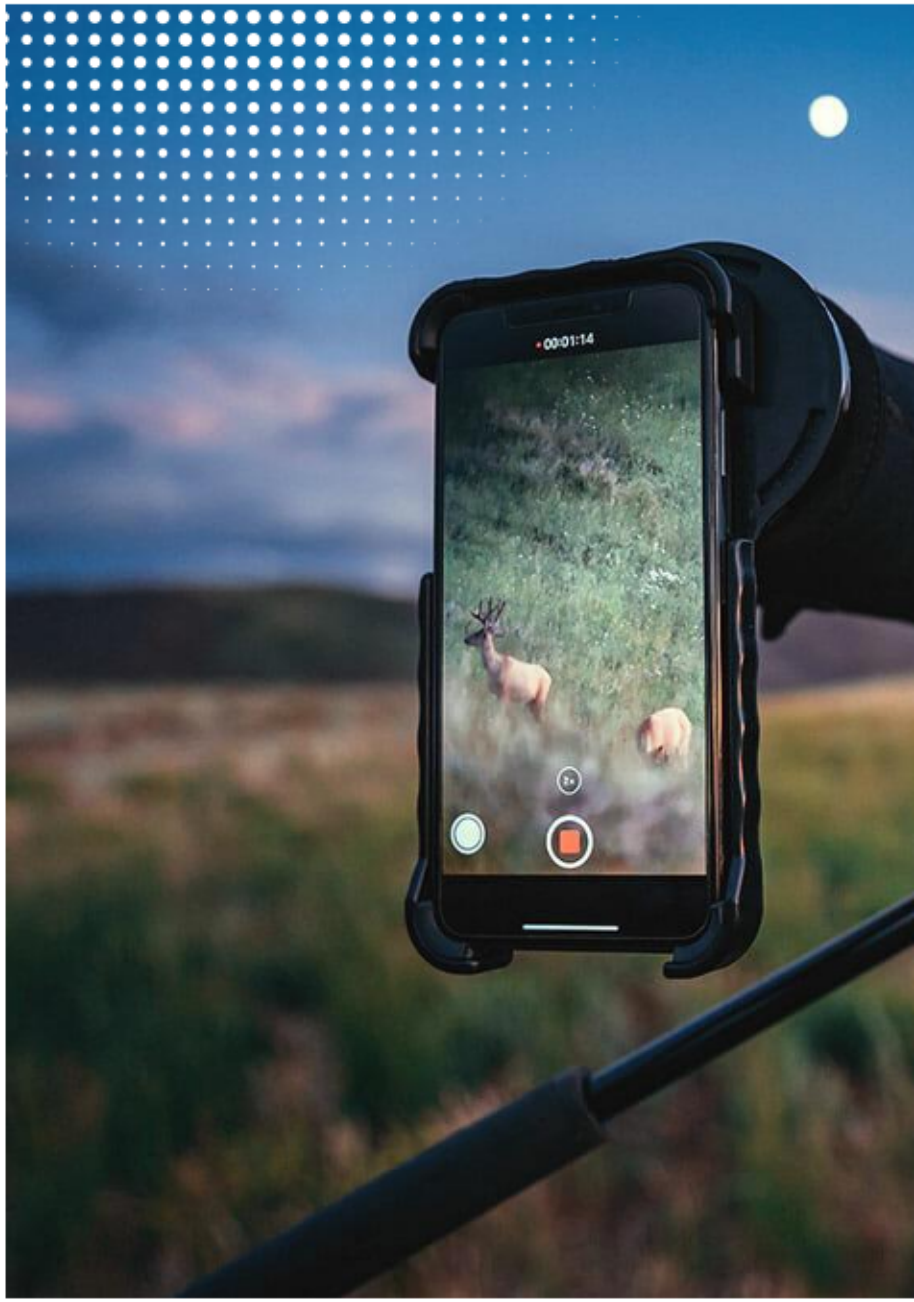


Molded Product		Printed Product	
Equipment Cost (Mold)	$3500-4000	Equipment Cost (None)	$0
Development Time	1-2 Months	Development Time	2 Weeks
Min Order	2000	Min Order	1









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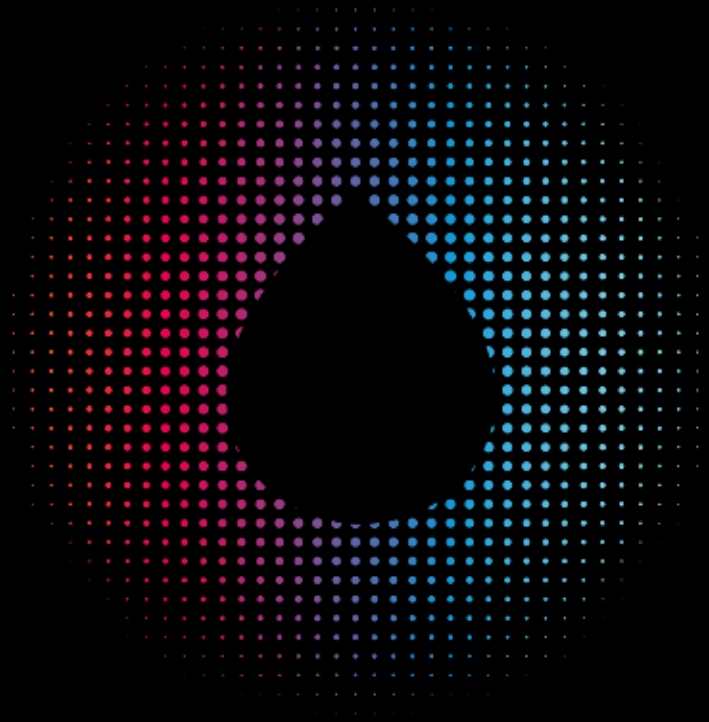

Thank you for listening

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