Pam AM Systems

Pellet Additive Manufacturing Solution

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Pam AM Systems

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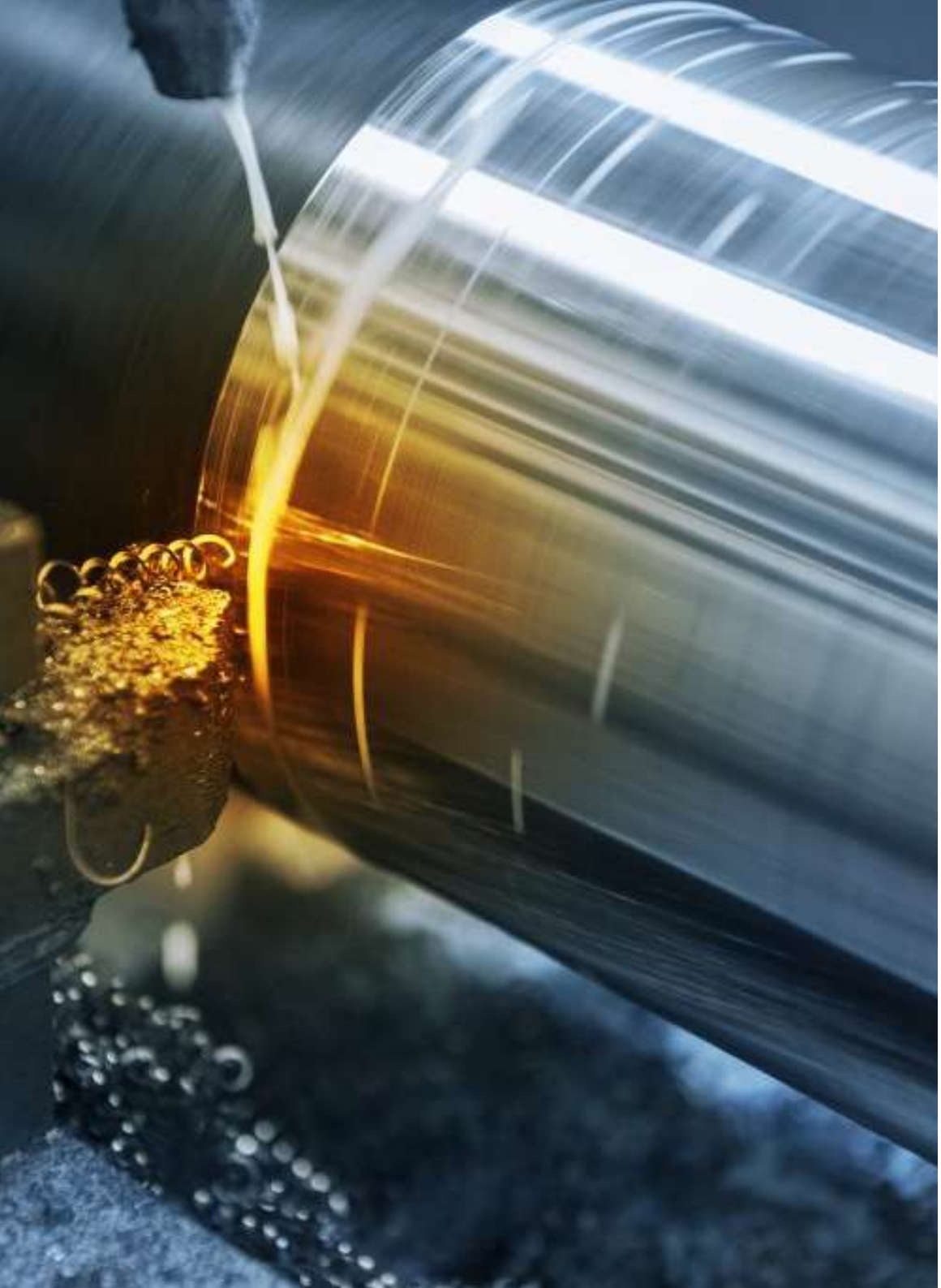
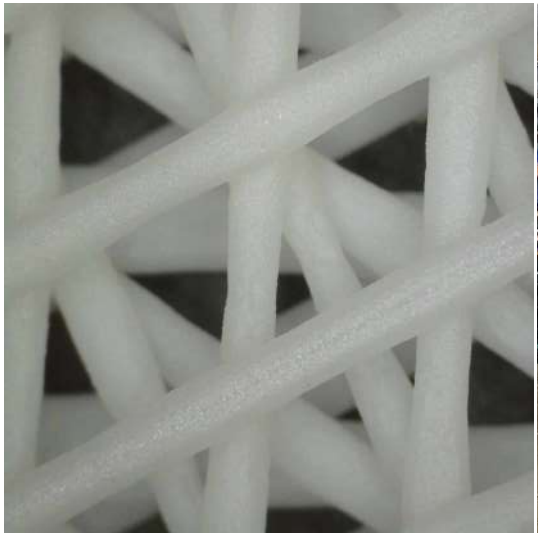


#01
General overview

- AM Benefits & Uses
- Pellet Additive Manufacturing
- Pollen AM Solution
- Pam Solution Overview

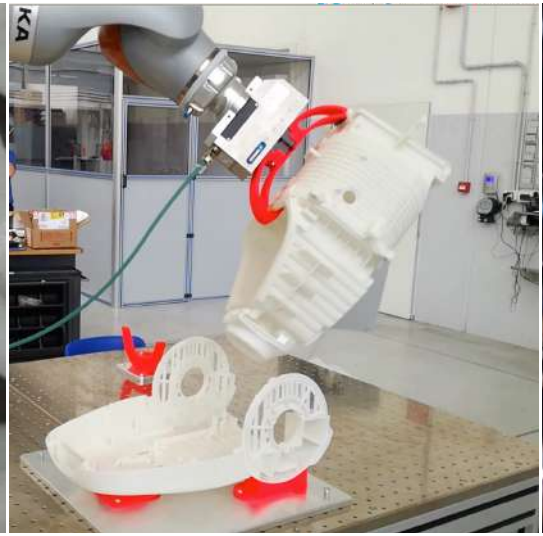
AM Benefits & Uses

A relevant complement to traditional manufacturing



#1

New design freedom with possible part inner structuring *(variation of part density gradients, etc.)*



#2

Shorter development cycle & faster reactivity for tooling production *(production aids factory autonomy)*

#3

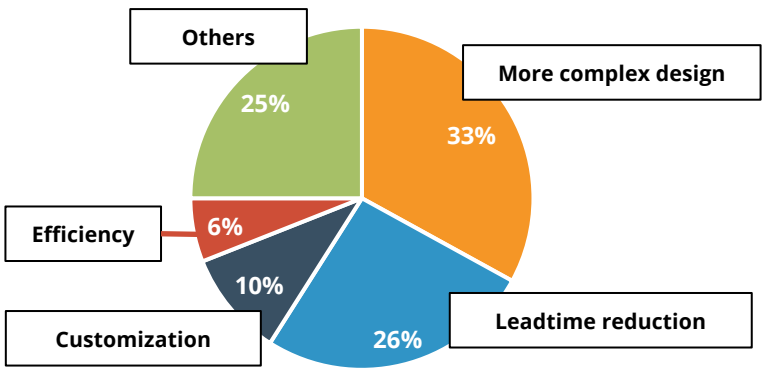
Waste reduction

(traditional manufacturing waste production account for 10% of annual GWP)

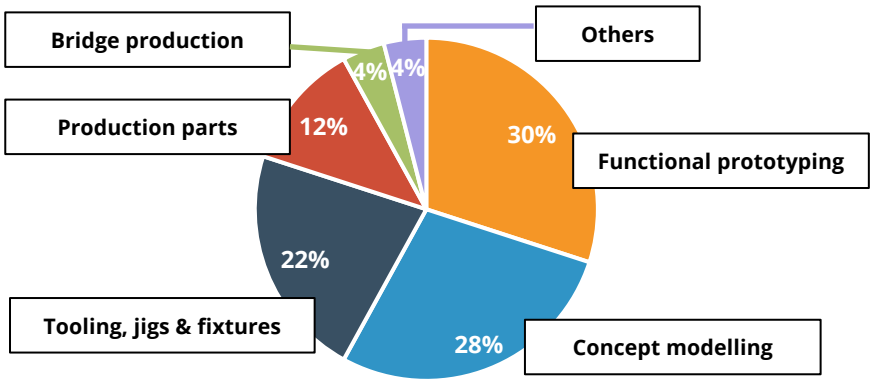
#4

Logistics rationalization with local production *(save from 5 to 10% of the product price)*

The most significant benefits of using AM



Top applications produced with AM



Source: Stratasys Direct Manufacturing; Looking ahead : AM in 2020.

Pellet Additive Manufacturing

Breaking the limits of AM specific formats

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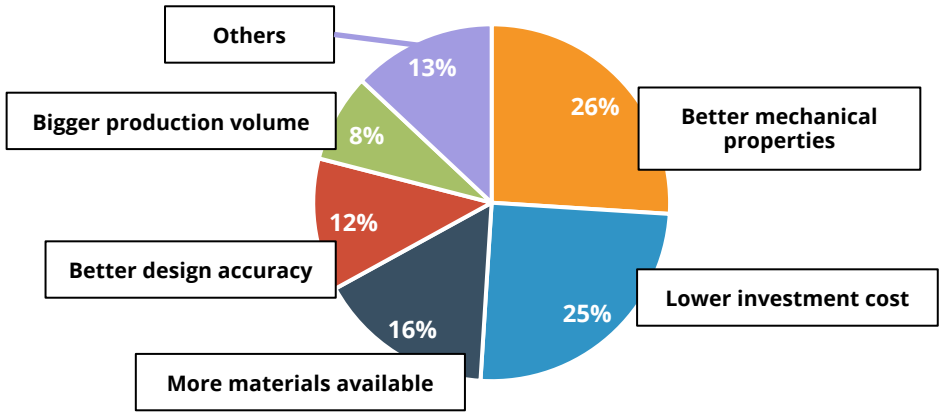
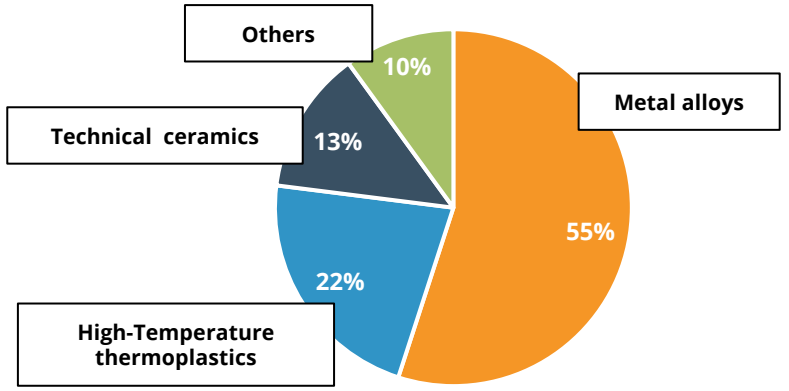
Top AM market needs



The use of pellets provides an immediate answer to two of the top AM market needs.

Top materials desired for AM



The use of pellets allows to **cover the whole top material desired for AM**.

Stop waiting for new materials, go to **Pellet Additive Manufacturing** and transform the **current materials you use** and that already fit your requirements, the **injection moulding materials**.

Source: Stratasys Direct Manufacturing; Looking ahead : AM in 2020.

Pollen AM Solution

Pellets, an advantage that meets the versatile needs of the market

benefit from a **production volume of +21L** or ask for a custom-made system

up to **100% of the mechanical properties** of injection molded parts

objective zero waste
No spool, no material waste, Refillable on the fly, no more incomplete jobs, **better quality ratio**.

Zero additional investment costs for operator safety, the safety and comfort of the operators are our priority *(no volatile powder)*.

Address more than

87%

of key AM market needs

modular system for **design accuracy** with to **30⁺ different configurations**

with an **equipment cost 3 to 10 times less expensive** than competition

access to the most innovative and **complete material portfolio**, thanks to the use of pellets

Pam Solution Overview

Produce parts with the right materials, the right properties and at the right cost

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A **direct micro-extrusion technology** specially developed for 3D printing, capable of combining up to 4 materials. **No proprietary materials.**

Full openness on printing parameters and Gcode available for custom edition.

Modular architecture to adapt configuration to the application (multi materials, high-temperature materials, abrasive filled material, etc.).

No proprietary materials, total freedom on injection molding or 3D printing grades.

Supply at your choice to guarantee material **specifications and profitability** for specific applications.

Access the **widest range of certified materials** on the market, to obtain the right properties (skin contact, food contact, EMI shielding, smoke fire, etc.) **No shore hardness limit** with soft materials.

The use of pellet materials is **5 to 100 times cheaper** than their 3D printing counterparts.

A **versatile and open solution** that is suitable for the production of functional prototypes, tooling jigs & fixtures, spare parts and production parts.

Cura Slicer, the most popular slicer in 3D printing, **available in ready to print or expert mode**.

HoneyPrint, easy-to-use web-based software, to **control the 3D printers remotely from any devices**.

Online training with **knowledge database available at any time** & dedicated support during your development

10⁺ systems ready to be mobilized to support you in your projects.

A tailored pathway to **qualify and setup system configuration** ready for your needs.

R&D as service – Ask Pollen AM to develop your 3D printing profiles for ready to use material.

#02
Pollen AM at a Glance

- Key Figures
- Value Proposition
- Markets & Applications

Key Figures

10 years of innovation in Additive Manufacturing

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2016

commercial launch of the first generation of Pam 3D printers, after 5 years of R&D.

AIRBUS SANOFI DECATHLON Electrolux

70% industrial customers, from consumer goods, healthcare to aerospace applications.

4th generation

of products integrating the latest innovations and a new range of accessories and options to meet performance applications.

3 products to cover the largest range of materials : thermoplastics, Metals & Ceramics.

10+ years of R&D & continuous improvements.

100% independent for autonomous decision making.

90+ qualified materials thermoplastics, metal alloys & technical ceramics.

21+ countries, mainly in Europe and Asia.

30+ different configurations, Pam systems modular architecture to offer the optimal setup for demanding materials.

100+ systems deployed and more than 30 % are operated outside Europe.

400+ 3D printing parameters, to get total freedom and determine the best compromise between productivity and quality.

7 distributors to cover international markets.

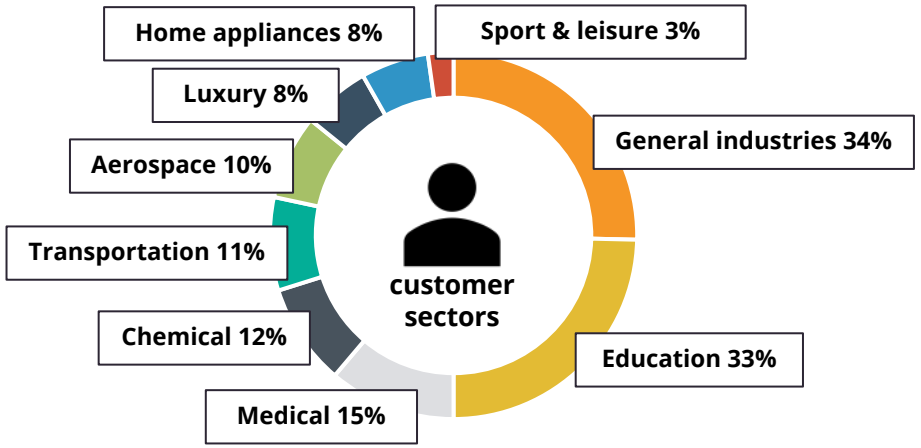
Value Proposition

Make profit with small and medium series - Your chemistry inside

Markets & Applications

Cover almost all market needs

Addressed markets



Industrial	Pam is used for **right material prototyping and small series production**.
Education	Mainly used for R&D applications on **new material development and processes**.
Medical	Use for prospective applications such as **new pills, orthopedic prosthesis and new materials**.
Chemical companies	Used on material demonstration to **develop new applications for their clients** and push Pam usage with their chemistry.
All other sectors	Used for right material prototyping, design, tooling, production and spare parts. **Time-to-market reduction is a key success factor**.

Key customers & applications

Key customers

Industry

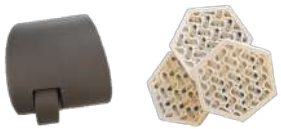
AIRBUS, Alliance-mim, BASF The Chemical Company, BIC, Chanel, Electrolux, essilor, KRAIBURG, Louis Vuitton, MICHELIN, ptt Global Chemical, SANOFI, SNCF, Valeo, WÜRTH

Education

cea, cnrs, CRIBC member of EMRA, DLR, INSA

Applications

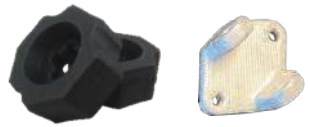
Prototyping



Spare parts

Tooling

Small series



Pollen AM has a strong multi-market expertise allowing to address the challenges of the industrial and education markets.

#03
Pam AM Solution

- Pam Systems Range
- Unique AM Solution
- Pam Software Ecosystem

Pam Systems Range

From commodity material to metal alloys & technical ceramics

Key differentiating elements

- ✓ **Unique** pellet additive manufacturing solution
- ✓ Full setup control for **agile manufacturing**
- ✓ **Same Material as Injection Moulding** *(thermoplastics, TPEs & PIM feedstocks)*
- ✓ A **no health hazards solution** *(no volatile powders)*
- ✓ **Largest elastomers compatibility** *(from Shore 00 to Shore D)*
- ✓ Multi-material applications **with up to 4 materials**
- ✓ Properties **combination** *(hard and soft materials)*
- ✓ **Most profitable** PiM-Like additive manufacturing solution

	New Pam Series P	New Pam Series P – HT	Pam Series MC
			
Number of extruders	From 2 to 4	2	From 2 to 4
Maximum extrusion temperature	350°C	450°C	450°C
Extruder	Standard	HT	Reinforced
Commodity materials	✓	✓	✓
TPEs materials	✓	✓	✓
Optimized materials	✓	✓	✓
Performance materials	✗	✓	✓
Metal alloys – [MIM feedstock]	✗	✗	✓
Technical ceramics – [CIM feedstock]	✗	✗	✓

Unique Additive Manufacturing Solution

Strengths of PAM technology based on different point of view

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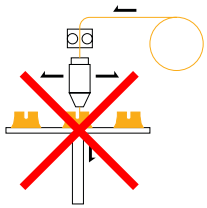
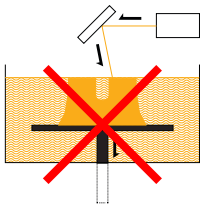
Using universal materials

- ✓ No filaments
- ✓ No powders
- ✓ No resins

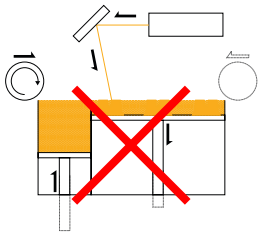
It is <u>not</u> FFF



It is <u>not</u> SLS



It is <u>not</u> SLA



We only use industrial grade materials in the shape of pellets.

Why?

Because we trust that the industry needs the **right chemistry** at its **right cost & compatible with traditional manufacturing** processes is key.

The most innovative and complete material portfolio

ALBIS · ARKEMA · BASF The Chemical Company · Celanese · covestro

DOW · EASTMAN · INEOS STYROLUTION · INMATEC Technologies GmbH · KRAIBURG

LATI · LEHVOSS Group · LOTTE CHEMICAL · mcpp Power to Perform · NatureWorks

POLYMIM · SOLVAY · TOTAL · Bring your own material ...

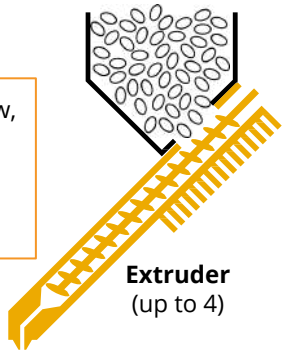
Pam extrusion process

Contains 1L of pellets

Material cartridge

The material cartridge is reusable and can be refilled on the fly. A feeder is integrated to **ensure good material flow.**

The extruder is composed of a **cylinder**, an Auger screw, **heating elements**, **fans** and **thermocouples**
Rotation of the Auger screw is controlled by the system:
- the material flow **is linked to the screw speed**
- retract function is assured by inverted screw rotation



Extruder (up to 4)

Material deposition

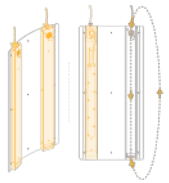
Throughout extrusion nozzles, controlled flow of fused material is **deposited layer** by **layer** on the build plate.

Modular 3D printers, focus on some accessories & options

Nozzles
7 sizes and 2 different alloys are available to fit application needs.

Heating radiant disc
to create a thermal boundary on the part being produce.

Heating build plate
Interchangeable to suit material specifications. A 250°C version is available.



Heating room chamber
control the temperature of the building room <70°C to enhance parts properties

Pam Software Ecosystem

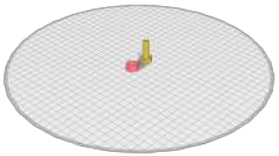
A global solution to meet all the stages of a project

Most popular slicing solution

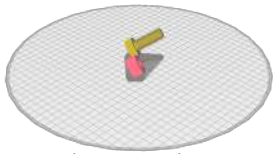
Cura powered by Pollen AM is the slicing software used to **prepare the 3D files** to be produced with Pam 3D printers.

3D file → Slicing software → G.Code file

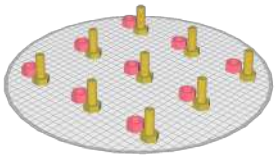
- ✓ **Flexible**, use standard 3D printing profile, adapt it or create new ones
- ✓ Expert mode gives access to up to 400 different settings for a **granular control**
- ✓ **Large range of compatible files** (STL, OBJ, X3D, 3MF, BMP, GIF, JPG, PNG)



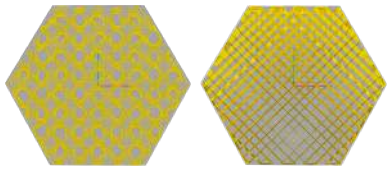
Import 3D files, select material & parameters



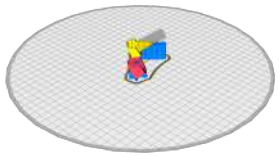
Scale, move, change orientation



Prepare production batch



Choose the infill density (from hollow to 100%) & the infill pattern (up to 13)



Slice, visualize & export file

Custom software for demanding industrials

HoneyPrint is the Pam 3D printers **control software, used to manage the production**, it is accessible by any connecting device.

G.Code file → HoneyPrint software → 3D printed part

- ✓ Specifically **engineered for Pam 3D printers**
- ✓ Allow **real-time & precise control** on the system
- ✓ A "**laboratory mode**" is accessible to allow the realization of R&D activities
- ✓ Access and retrieve **production data**

E-learning & interactive knowledge platform

PollenHive is an interactive tool for **self-service knowledge and project support solution**.

PollenHive

- ✓ Connect to the **installation & setup program**
- ✓ **Progress at the appropriate speed** with the knowledge data-base & maintenance program
- ✓ Stay up to date with all the **materials & product news**
- ✓ Download the **software updates**
- ✓ Access to the **3D printing profiles marketplace**

#04
Demonstrations

- Standard materials
- Performance materials
- TPE materials
- Metal alloys
- Technical ceramics
- Use cases

Standard thermoplastics

From prototyping to commodity applications

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Large valve actuator - PLA

This part is 25 cm large (9,8 inches) and is made of PLA. It was 3D printed as a prototype demonstrator to **ensure the product had the right fit**. And thanks to a 1,2 mm nozzle, the print went fast, lasting only 5 hours.

Nozzle size: Ø 1.2 mm

Layer height: 0.6 mm

Part weight: 606,80 g

Part size: Ø 250 x H 145 mm

Material cost: € 3.33

Material supplier: NatureWorks

Coupling Sleeve - ABS

This coupling sleeve is a part that is declined in a large number of references and is produced in small unit quantities.

The production of this part in 3D printing allows to avoid the tooling production, to produce locally and on demand while avoiding the storage with the **right properties at right prodcution** cost.

Nozzle size: Ø 0.4 mm

Layer height: 0.2 mm

Part weight: 62,22 g

Part size: Ø 60 x H 42 mm

Material cost: € 0.34

Material supplier: INEOS STYROLUTION

Sealable and watertight bottle - PP

This bottle has been 3D printed in PP. It represents a clear example of Pam's capacity to 3D print parts **with sealed function and functional threads**.

Ideal for food contact applications, PP also exhibits chemical resistance. Being the most widely used polymer.

Nozzle size: Ø 0.4 mm

Layer height: 0.2 mm

Part weight: 16.85 g

Part size: Ø 50 x H 80 mm

Material cost: € 0.08

Material supplier: TOTAL

Mechanical test results

Material information :
- Grade : ABS
- Supplier : Lotte
- Reference : Starex

3D printing parameters :
- Nozzle size : 0.4 mm
- Layer height : 0.2 mm
- Infill density : 100%
- Infill pattern : concentric

Properties	Injection Moulding	Pam	Pam performance
Flexural Modulus (ASTM D790) [Mpa]	2200	2540	111 %
Young's Modulus (ASTM D6381) [Mpa]	2450	2620	107 %
Stress at Yield (ASTM D6381) [Mpa]	44.9	48.9	109 %
Strain at Yield (ASTM D6381) [%]	2.5	2.8	112 %
Strain at Break (ASTM D6381) [%]	30	30	100 %

Concentric (CC)

Specimens 3D printed with Pam in the X/Y plane show better mechanical performances than IM.

Performance thermoplastics

Meet the demanding requirements of the market

Turbine - PESU

This turbine is made of PESU. Taking into consideration its concave and **convex elements**, the part was 3D printed to avoid supporting material, hence **reducing production time and ensuring maximal strength** for the material.

PESU is a **high-performance material** with a temperature profile that is unique among engineering thermoplastics, it can be a substitute for metal, and technical ceramics.

Nozzle size: Ø 0.4 mm

Layer height: 0.2 mm

Part weight: 22.36 g

Part size: Ø 60 x H30 mm

Material cost: € 1.12

Material supplier: BASF The Chemical Company

Gear - PC

This straightforward gear made of PC, a performance material used in **applications requiring good shock and temperature resistance**.
This **LED grade can achieve good light transmission**.

This material is very resistant to impacts, has excellent mechanical properties that are characterized by low expansion and low heat distortion.

Nozzle size: Ø 0.4 mm

Layer height: 0.2 mm

Part weight: 6,26 g

Part size: Ø 46 x H22 mm

Material cost: € 0.09

Material supplier: covestro

Bumper – PA 66 15CF

This bumper was printed in PA filled with 15% carbon fiber.
This part demonstrates the ability of Pam printers to **process both performance and filled materials**.
The part has **very good inter-layer adhesion, good surface finish and good dimensional accuracy**.

Nozzle size: Ø 0.4 mm

Layer height: 0.2 mm

Part weight: 16.85 g

Part size: L120 x W50 x H35 mm

Material cost: € 0.08

Material supplier: Lehmann&Voss&Co. LEHVOSS Group

Mechanical test results

Material information :
- Grade : PA 66 – 15% carbon fiber
- Supplier : Lehvoss
- Reference : LUVOCOM® 3F PAHT® CF 9742 BK

3D printing parameters :
- Nozzle size : 0.8 mm
- Layer height : 0.3 mm
- Infill density : 100%
- Infill pattern : 2

Lines (LI)

Lines (LI90)

Series	Tensile strength Injection moulding [Mpa]	Tensile strength Pam [Mpa]	Pam performance vs Injection moulding	Tensile strength FFF [Mpa]	Pam performance vs FFF
LI	183	151	82 %	146	103 %
LI90	90	97	107 %	82	118 %

Specimens 3D printed with a Pam system show better mechanical performances than those in FFF.

TPE materials

Producing flexible AM parts without hardness shore limits becomes possible

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Car light sealing – TPU 33 Shore D

This vintage car headlight bracket was no longer available and needed to be replaced.

After being redesigned, the part was produced in TPU with a hardness of 33 Shore D TPU **allowing a good holding of the headlight while ensuring the waterproof function**.

Nozzle size: Ø 0.4 mm

Layer height: 0.2 mm

Part weight: 77.03 g

Part size: L175 x W80 x H80 mm

Material cost: € 1.08

Material supplier: BASF The Chemical Company

Snorkel Mouthpiece – TPE 70 Shore A

This snorkel mouthpiece is 3D printed **in TPE 70 Shore A**.

With excellent mechanical properties, good inter-layer adhesion, and a very good surface finish, this material is a **good alternative to silicones**.

Recyclable and skin contact, this material meets a large number of **industrial needs**.

Nozzle size: Ø 0.4 mm

Layer height: 0.2 mm

Part weight: 9.20 g

Part size: L60 x W16 H64 mm

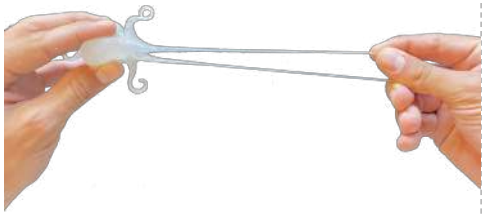
Material cost: € 0.13

Material supplier: KRAIBURG

Octopus toy – 30 Shore 00

This octopus toy is 3D printed with an **extremely flexible TPE** (30 Shore 00).This toy is a demonstration of the ability of Pam printers to transform flexible materials without hardness limits. This is **not possible with conventional 3D printers**.

This material is skin contact and meets the toy standard.



Nozzle size: Ø 0.8 mm

Layer height: 0.4 mm

Part weight: 10.35 g

Part size: L80 x W80 x H32 mm

Material cost: € 0.14

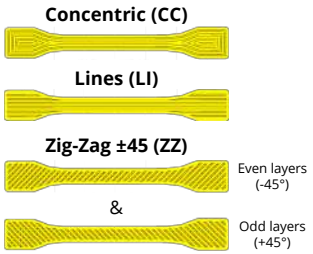
Material supplier: KRAIBURG

Mechanical test results

Material information :
- Grade : TPE
- Supplier : Kraiburg TPE
- Reference : TC6MLB

3D printing parameters :
- Nozzle size : 0.8 mm
- Layer height : 0.3 mm
- Infill density : 100%
- Infill pattern : 3

Properties	Injection Moulding	Pam (CC)	Pam (LI)	Pam (ZZ)
Tensile Strength (DIN 53504/ISO 37) [Mpa]	4.5	4.49	4.5	4.6
Elongation at Break (DIN 53504/ISO 37) [%]	550	497	540	584
Tensile Strength comparison		**99 %**	**100 %**	**102 %**
Elongation at Break comparison		**90 %**	**98 %**	**106 %**



A good 3D printing strategy allows to obtain mechanical properties equivalent or superior to IM.

Multi-material parts

Combining up to 4 different materials and properties is possible

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Bellows using support material – TPU 33 Shore A

Destined to the automotive market, this bellows has been manufactured using a **TPU 33 Shore D for the structure material** & **PVOH** (water-soluble material) **to support cantilever part elements**.

The removal of this support material is achieved by plunging the part into a tempered water tank. Once the support material is removed, the bellows is fully functional with the required flexibility.

Nozzle size: Ø 0.4 mm

Layer height: 0.2 mm

Part weight: 15.00 g

Part size: Ø 55 x H 75 mm

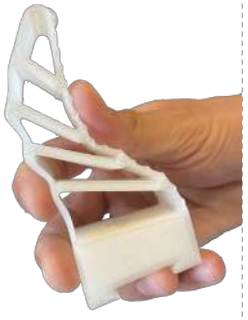
Material cost: € 0.43

Material suppliers: BASF The Chemical Company, kuraray

Robot multi-material griper – ABS & TPE 70 Shore A

With the increase of robots in manufacture and assembly lines, the production of grippers is on the rise. Pam 3D printers multi-material capability make it possible to **associate flexibility with rigid materials**.

In this example ABS and TPU 33 Shore D create a perfect combination for gripping effect.



Nozzle size: Ø 0.4 mm

Layer height: 0.2 mm

Part weight: 29.56 g

Part size: L 110 x W 45 x H22 mm

Material cost: € 0.59

Material suppliers: KRAIBURG, INEOS STYROLUTION

Automotive spare partS

This prototype required 2 TPEs (45 Shore A & 70 Shore A); a structural material was needed to allow the production of the cantilevered elements. A total of **3 materials were needed**.

It has good mechanical properties and good surface finish. The production of right material prototypes allows to **reduce iterations time** (±90 days), to **avoid the tooling production** (± 18 000 € / prototype), etc.

ADD LAB, DECATHLON

Nozzle size: Ø 0.4 mm

Layer height: 0.2 mm

Part weight: 16.85 g

Part size: L 275 x W 85 x H 45 mm

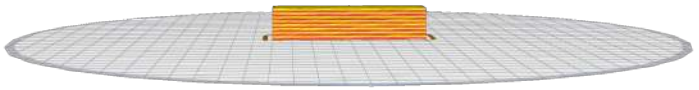
Material cost: € 0.08

Material suppliers: KRAIBURG, INEOS STYROLUTION

Mechanical test results

"Multimaterial PMMA/PLA parts produced with a Pam 3D printer were **successfully developed**. […] PMMA/PLA axisymmetric multilayers **exhibit interfacial properties situated between those of the PLA and PMMA monolayers**. […] Finally, the proposed workflow in the study can be used for manufacturing other 3D-printed multimaterials with different composition ratios and **different functional gradient properties** in view of numerous industrial applications."

Part presentation



Multilayers structure

PMMA
PLA
PMMA
PLA
PMMA
PLA

Properties	3D printed PLA	3D printed PMMA	Injection molding PLA	Injection molding PMMA	Injection molding PLA/PMMA	3D printed PLA/PMMA @Tr=55°C
Flexural Strength [Mpa]	11.4	8.1	11.6	14.6	13.3	9.0

Extract from " 3D printing of PLA and PMMA multilayered model polymers: an innovative approach for a better-controlled pellet multi-extrusion process." By Mohamed Yousfi, Ahmed Belhadj, Khalid Lamnawar and Abderrahim Maazouz

Metal alloys

3D print the widest range of metal alloys at unbeatable cost

pollen
your chemistry inside

Bracket – Stainless Steel 316L

This part is presented at the sintered stage, when the part is fully metallic, with **lowest porosity**.

When produce in small and medium series, brackets are **good candidates for 3D printing**, their geometry are adapted to the shaping process.

Nozzle size: Ø 0.4 mm

Layer height: 0.2 mm

Part weight: 109.12 g

Part size: L 65 x W 57 x H 36 mm

Material cost: € 8.73

Material supplier: BASF The Chemical Company

Bracket – Stainless Steel 17-4 PH

This gear is presented in the sintered state, it has a **porosity ratio of < 1%** and **mechanical properties very close to those of injection molded parts**.

The 3D printed parts with conventional MIM feedstock can be **integrated in conventional debinding and sintering cycles**. No need to change industrial processes.

Nozzle size: Ø 0.4 mm

Layer height: 0.2 mm

Part weight: 35.59 g

Part size: Ø 58 x H 5 mm

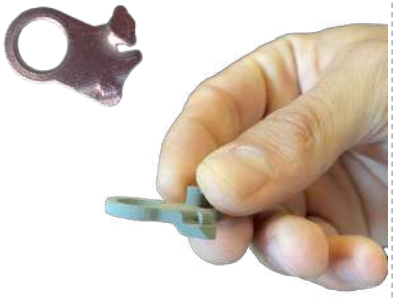
Material cost: € 2.85

Material supplier: POLYMIM

Ring Holder – Titanium Ti6Al4V

Producing titanium parts thanks to 3D printing allows to **create prototypes, but also parts in small and medium series**.

This allows, among other things, to use the **same raw material in 3D printing and injection molding**, thus simplifying the entire value chain and **avoiding material re-qualification** when it is necessary to switch from a forming technology to another one.



Nozzle size: Ø 0.25 mm

Layer height: 0.125 mm

Part weight: 4.30 g

Part size: L 30 x W 15 x H 4 mm

Material cost: € 0.65

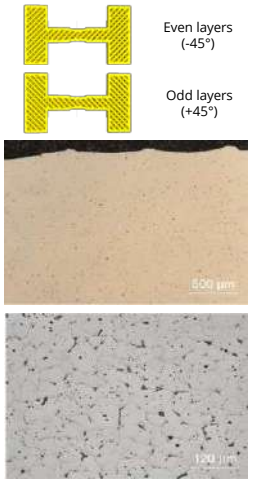
Material supplier: ELEMENT 22

Mechanical test results

Material information :
- Grade : Stainless Steel 316L
- Supplier : PolyMIM
- Reference : polyMIM® 316L D 170E

3D printing parameters :
- Nozzle size : 0.4 mm
- Layer height : 0.2 mm
- Infill density : 100%
- Infill pattern : Zig-Zag ±45°

Properties	Binder Jetting	FFF	Pam
Density [g/cm³]	7.82	7.55	**7.90**
Porosity ratio [%]	> 1	> 1	**< 1**
Tensile Strength (EN ISO 6892-1) - [Mpa]	558	416.76	**565.84**
Elongation at Break (EN ISO 6892-1) - [%]	19.8	13.74	**21.16**



Sintered parts 3D printed by a Pam system have better performance than those obtained by the BF and FFF processes (lower porosity & higher tensile strength).

Technical ceramics

From oxides to non-oxides, make the most technical applications accessible

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Laboratory cup – Aluminium Oxide

Producing ceramic parts from **industrial CIM feedstock** that meet specifications and projects reduces costs but also **right mechanical properties**.

This part presented in a green and dense state has mechanical properties similar to the injected parts.

Nozzle size: Ø 0.4 mm

Layer height: 0.15 mm

Part weight: 28.00 g *(as sintered)*

Part size: Ø 39 x H 7 mm

Material cost: € 0.87

Material supplier: INMATEC Technologies GmbH

Architectural cylinder - Zirconium oxide

Architectural cylinder was printed in black Zirconium oxide by the Belgian Ceramic Research Centre (BCRC). Presented in a dense, pourable state, this piece shows a very good level of resolution, a good surface finish

"**When ceramic micro-extrusion reaches the resolutions of stereolithography**" – *BCRC, Dr. Fabrice Petit, Program Manager Manufacturing Processes.*

Nozzle size: Ø 0.4 mm

Layer height: 0.2 mm

Part weight: 31.22 g *(as sintered)*

Part size: Ø 28 x H 35 mm

Material cost: € 4.06

Material supplier: INMATEC Technologies GmbH

Watch case - Silicon Nitride

3D printing **non-oxide ceramics is possible** with Pam, this watch case is shown in a dense green state.

This ceramic is particularly important because the combination of its properties is unique. Extremely hard, it is highly resistant to thermal shock, chemicals and wear even at high temperatures.

Nozzle size: Ø 0.6 mm

Layer height: 0.3 mm

Part weight: 5.6 g *(as sintered)*

Part size: L 38 x W 30 x H 4 mm

Material cost: € 0.85

Material supplier: Siceram

Mechanical test results

Material information :
- Grade : Alunimum oxyde
- Supplier : Inmatec GmbH
- Reference : Inmafeed K1008

3D printing parameters :
- Nozzle size : 0.4 mm
- Layer height : 0.2 mm
- Infill density : 100%
- Infill pattern : Zig-Zag ±45°

Properties	Data sheet	Pam	Pam performance
Density [g/cm³]	3.80	3.78	99.36 %
Open Porosity [%]	-	0.64	< 1 %
Flexural Strength (ASTM C1161-18) - [Mpa]	> 370	465,43	-

CRIBC member of EMRA

The 3D printed ceramic parts have a density superior to 99%.

Use cases

From tooling application to production

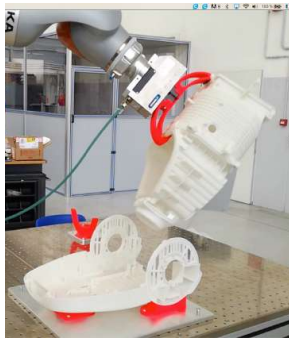
Tooling, jigs and fixtures

Using traditional 3D printers could save 50-75% of costs and reduce significantly lead time

Pam 3D printers saves 91% of the cost of production
and the part is available the same day.

CNC cost/part: **€ 49,58**

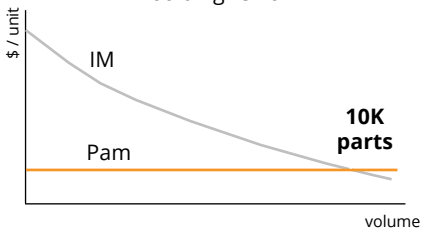
New Pam Series P cost / part: **€ 4,56**



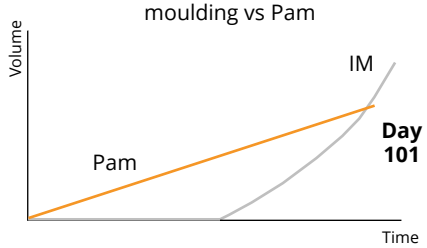
Injection Moulding vs Pam 3D printing

Pam 3D printers are :
- **more cost effective** than IM **up to 10K parts**;
- **more productive** than IM **up to 101 days** after design validation.

Cost per part comparison: injection moulding vs Pam



Production volume comparison: injection moulding vs Pam



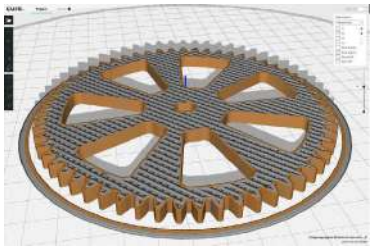
Multi-resolution

Using multi-resolution could save 30-80% of production time while maintaining the aesthetic qualities

using **one 3D printing resolution** with a 0.4 mm nozzle
=
6 hours production time

using **two 3D printing resolutions** combining 0.4 mm & 0.8 mm nozzles
=
3,5 hours production time

+1.7X faster



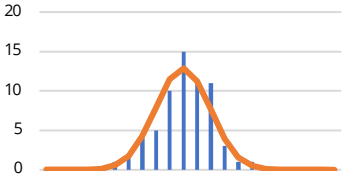
0.4mm nozzle for the outside perimeters (brown)
0.8mm nozzle for the infill (grey)

Production capacities measurements

100 parts produced, 25 per day, using a single Pam 3D printer working 12 hours a day (4 cycles/day, 1 cycle/night);

- Availability rate = 94%
- Performance rate = 99%
- Quality = 100%, no printing failure.

OEE = 93 %, a good setup machine gives outstanding results of productivity thanks to Pam's **reliability and robustness**.



Capability results: Cp = 1,42
Cpk = 1,34

#04
Going Further

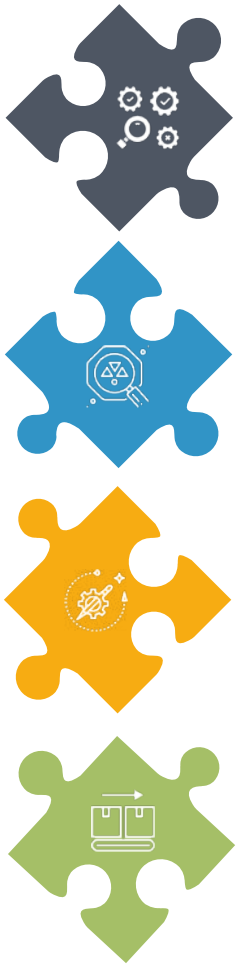
- AM Consulting Service
- Learn More

AM Consulting Service

A 360° service, from material qualification to industrial deployment

Service range

In the upstream phases of AM projects, take advantage of Pollen AM's expert teams and 10+ Pam systems fleet **to work on specific topics that are critical to your industry**.



Material testing & validation
From the qualification of a material to the development of machine parameters **allowing its optimal transformation**, Pollen AM offers services dedicated to materials.

Mechanical testing & characterization
Thanks to a network of laboratories and industrial partners Pollen AM is able to offer **a wide range of mechanical tests on 3D printed parts** for the whole range of printed materials (thermoplastics, metals and ceramics).

R&D & concept validation
Whether you are working on the development of a **new material, a new product or simply want to test innovative concepts**, our teams of experts are available to support you and move your projects forward.

Parts production
Whether it is for the production of **single parts or small and medium series**, it is possible to subcontract all or part of the production of parts to Pollen AM which will mobilize its fleet of Pam systems.

Get ready for industrial deployment

In a context where it is necessary to accelerate the modernization of the production tool, Pollen AM offers a **AM consulting service to cover the different needs of the industries**.

1 - Focus project
Determine the **essential needs and objectives** of the project.

2 - Define Scope & KPIs
Identify **3D printable parts and conduct a study on the benefits of AM** (ROI, logistics, lead times, etc.)

3 - Implementation roadmap
Detailed **roadmap of the solution** to be deployed (schedule, resources, operational objectives).

4 - Training program
According to KPIs and project scope, a **specific training course is carried out** to enable the teams to master the project.

5 - Use cases & demonstration
Produce **high-potential use cases and measure benefits and savings** to showcase project performance.

6 - Adapt, scale & duplicate
Capitalize on the results of the pilot program at the group level, the project can be duplicated in different business units.

Learn more

Request access to more content to become an expert on Pam ecosystem

- New Pam Series P - Specifications
- New Pam Series P – HT - Specifications
- Pam Series MC – Specifications
- Design for 3D printing
- Pollen AM training methodology
- Production ratio according to 3D printing speed & resolution
- 3D printing TPEs with no shore hardness limit with Pam
- 3D printing filled material with Pam
- 3D printing performance materials with Pam
- 3D printing metal feedstocks with Pam
- 3D printing technical ceramic feedstocks with Pam
- 3D printing exotic materials with Pam
- And many more…

Member of

Our contacts

Victor Roux
President
vr@pollen.am
+33 (0)6 64 11 94 71

Didier Fonta
General Manager
df@pollen.am
+33 (0)7 60 40 30 29

Thibaud Deshons
International Commercial Engineer
td@pollen.am
+33 (0)7 68 49 65 61

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