

BOND 3D

PRINTING & DESIGN SERVICE

The added value of Bond3D's technology is a combination of the advantages of PEEK and additive manufacturing. To fully capture these benefits, the new technical possibilities should be taken into account as early as possible in the design phase. That's why Bond3D doesn't just deliver high quality prints, we can also support during the whole development process.

Bond3D can advise, develop and manufacture your high performance products.



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Bond3D High Performance 3D Technology BV, operating out of Enschede, the Netherlands, and founded in 2014, is driving innovation in the field of additive manufacturing. Bond3D's patented technology is unique in its ability to produce functional parts from high-performance polymers; polymers that are certified for use in critical applications.

A highly skilled growing team of international professionals develops a novel printing technology, including system mechatronics, software, slicing technology and process validation. The combination of high-performing polymers and the developed technology targets strategic markets such as medical, aerospace, energy, automotive manufacturing and engineering applications.



Bond3D is a world class brand in high performance polymer 3D technology and provides services in high performance polymer additive manufacturing solutions. Our game changing technology in 3D printing opens up a wide array of opportunities for our customers allowing for complex designs, improved functionalities and performance increases which were impossible to achieve with other 3D printing technologies. The combination of material and technology allow our customers to take a step ahead of competition, with strong

and voidless 3D high performance printed products usable as functional parts.

Bond3D technology programs are focused to adapt the printing process to the material instead of manipulating the material to make it printable. As a result the inherent material characteristics are maintained by using the Bond3D technology.

Creating critical high performance functional parts with AM technology is a fast growing market but still limited by low strength in z-direction and voids. Bond3D as a pioneer in this market, has managed to breakthrough the limitations of material and process with its complete end-to-end solution by combining technology, material, and a skilled and dedicated team of specialists.

High performance polymers which are printed with the Bond3D technology leads to functional products retaining its native material properties.

The Bond3D technology is capable of printing PEEK in a voidless way, which allows for leak tight applications such as fluid and gas manifolds.

The Bond3D technology is capable of printing parts with high isotropic strength, creating parts comparable to the strength of moulded or machined parts.

Characteristics of Bond3D:

- Unique patented High Performance Polymer printing technology e.g. The Bond3D technology)
- Adapt process to material to retain virgin material properties
- Printing certified and already approved high performance polymers
- Holistic approach, full system (hardware, system en software) in house developed
- Production & development in house
- Service provider

Victrex 450G PEEK is a high performance polymer certified for use in the medical, aerospace and food industry. Due to its excellent properties the material enables the development of light weight and strong products applicable in demanding environments.

Victrex is the world leader in the creation of PEEK and a shareholder of Bond3D. Together we deliver outstanding products in high performance polymers.



Bond3D technique

- Preservation of material properties
- Voidless printing
- Isotropic strength
- Ultra High vacuum applications
- Pressure tight
- Engineering services

+ Additive Manufacturing values (AM)

- Flexible design
- Design for 3D modelling
- Complex internal structures
- Cost saving
- Speed to market
- Capital efficiency



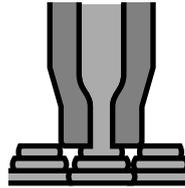


PEEK 450G

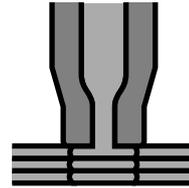
 Wear Property	 Electrical Property (Insulating or conductive)	 Easy Processing	 Extreme Temperature (-40°C to +250°C)
 Mechanical Strengths (TS 98 MPa)	 Chemical Resistance (also sterilization by Gamma)	 Bio inert (also radiolucent for X-ray, CT or MRI)	 High Purity

In standard flow controlled printing the extruded amount of material is based on perfect extrusion. In reality, perfect extrusion is not achievable due to small variations. Since overextrusion can disturb and even crash the printing process, most systems aim for underextrusion. With Bond3D's pressure controlled printing process, the correct amount of material is extruded in every situation. This creates voidless parts.

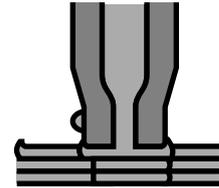
FLOW CONTROLLED PRINTING



Underextrusion



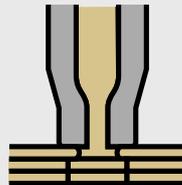
Perfect extrusion



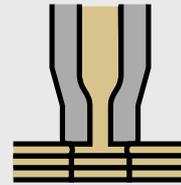
Overextrusion

PRESSURE CONTROLLED PRINTING

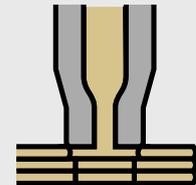
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Small gap



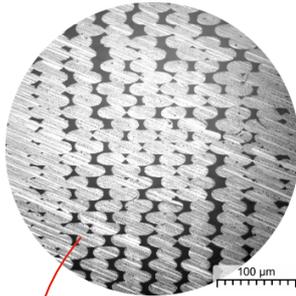
Moderate gap



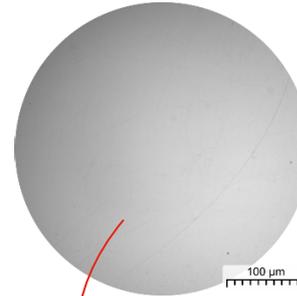
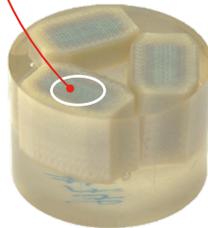
Large gap

Parts virtually free of voids

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Regular FDM

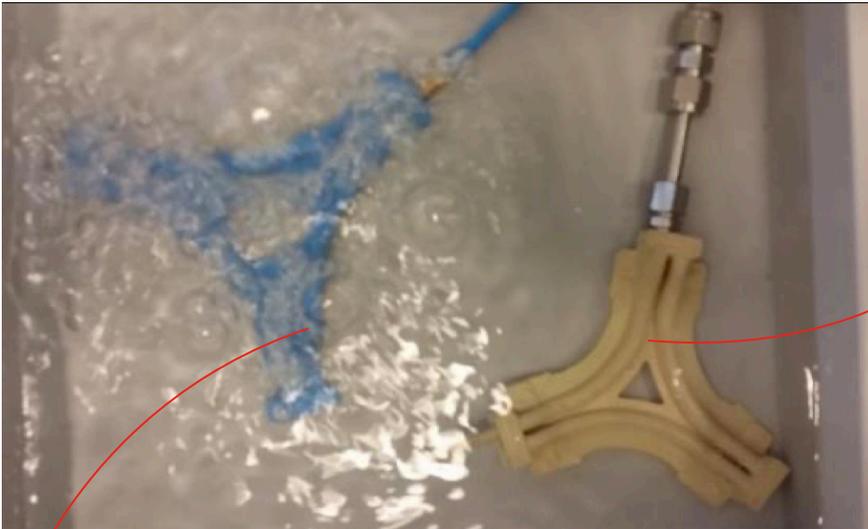


BOND 3D



Voidlessness

BOND 3D

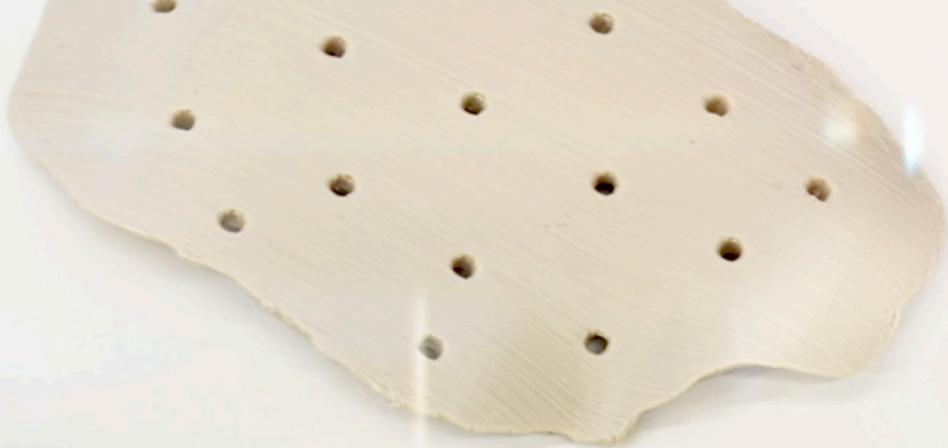


• Part printed with regular FDM technology



Part printed with Bond3D technology

- Pressurized to 100 bar without failure
- Leak rate $8 \cdot 10^{-6}$ mbar-l/s (@7.5bar(g))



Bond3D markets & applications

Aerospace

- Cable clamps
- Brackets
- Fluid transport
- Compliant mechanisms



Automotive

- Fasteners
- Interior parts
- Gas & liquid manifolds
- Housings



Electronics

- Gas & liquid manifolds
- Wafer handling
- Tooling



Energy

- Floating devices
- Seal- and backup rings
- Insulating components



Industrial

- Tooling
- Molds
- Static mixers
- Gas & liquid manifolds



Medical

- Non-implantable: medical tooling
- Implantable: spinal cages, CMF



APPLICATIONS: AEROSPACE

Cable clamp

Amphenol PCD has asked Bond3D to develop the P75D clamp for additive manufacturing. Various sizes and design iterations can be quickly done without large setup costs.

Advantages

-  Short lead time
-  No setup-costs
-  Freedom of design
-  Digital stock



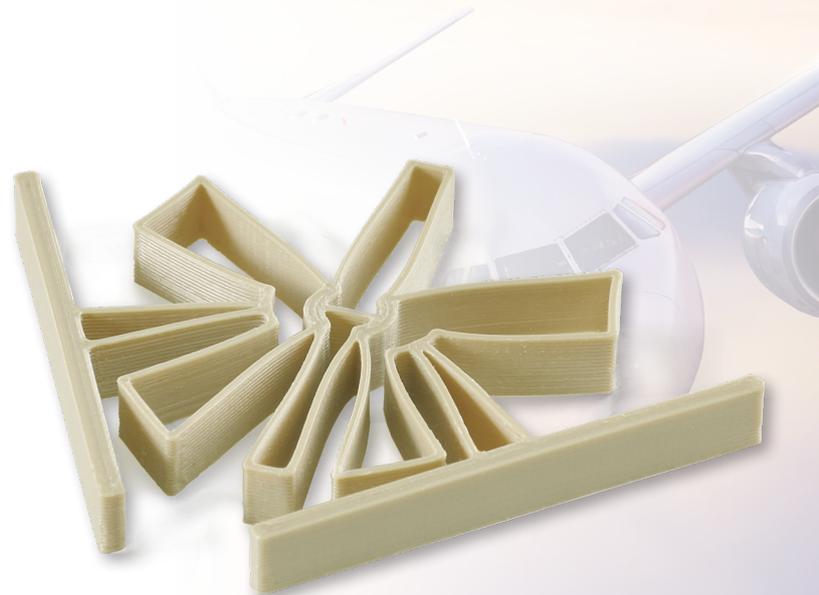
APPLICATIONS: AEROSPACE

Compliant mechanism

'Less is more' – using additive manufacturing, assemblies can be reduced to one integrated part.

Advantages

-  Complex structures possible
-  Low weight
-  High strength
-  Function integration



APPLICATIONS: AUTOMOTIVE

Bracket for high-voltage motor cables

Isolating the phase cables from a 700V electric motor to the inverter. 3d-printing allows our customer to make last-minute changes in the prototype phase.

Advantages

-  Electrical isolation
-  Short lead time
-  Digital stock
-  Optimized flow



APPLICATIONS: ELECTRONICS

Cooling manifold

Cooling fluid is distributed by this flow-optimized manifold, simultaneously saving weight and enhancing production output.

Advantages

- Leak-tight manufacturing
- 🏗️ Reduce parts
- ⚖️ Low weight
- 💧 Optimized flow



APPLICATIONS: ELECTRONICS

Manifold for semiconductor

The semiconductor industry uses a variety of fluid manifolds, which are perfect for the Bond3D leak-tight technology and PEEK material.

Advantages

- Leak-tight manufacturing
- 👁️ Material purity
- ⚖️ Low weight
- 👊 High wear resistance



APPLICATIONS: ENERGY

Back-up ring

On-demand manufacturing allows a diverse amount of sizes to be manufactured in a short timeframe, to minimize downtime.

Advantages

-  Chemical resistance
-  Minimal waste (no billet)
-  Digital stock & short TTM
-  Voidless printing



APPLICATIONS: ENERGY

Oil pump casing

3d-printing PEEK opens up new possibilities in the production of pump housings. Channels can be flow-optimized and no residue sticks in the channels due to the PEEK material.

Advantages

-  Chemical resistance
-  Optimized flow
-  Metal replacement
-  Digital stock & short TTM



APPLICATIONS: ENERGY

Labyrinth seal

3D-printing makes it possible to print seals near-shape and finish the product to tolerances using conventional machining methods.

Advantages

-  Chemical resistance
-  Minimal waste (no billet)
-  Digital stock & short TTM
-  Voidless printing



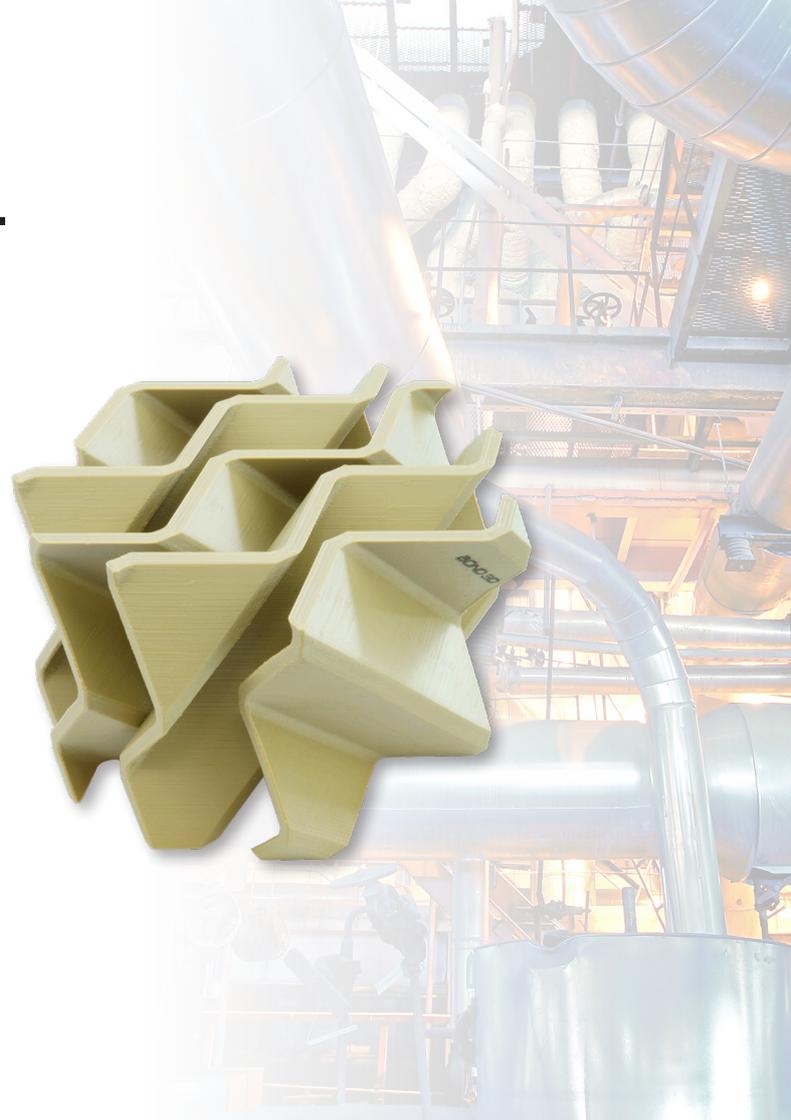
APPLICATIONS: INDUSTRIAL

Static mixer

The design freedom is large with 3D-printing. This static mixer uses the design freedom to optimize the mixing capabilities.

Advantages

-  Complex structures possible
-  Strong parts
-  Freedom of design
-  Function integration



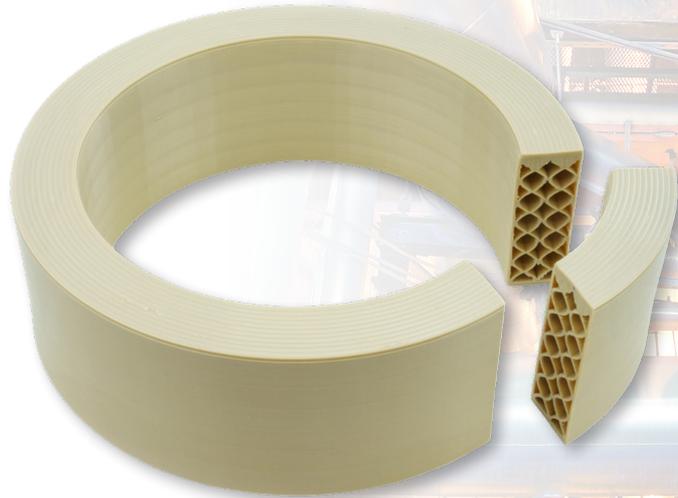
APPLICATIONS: INDUSTRIAL

Insulating ring for Bond3D GEN3 machine

The insulating ring of the Bond3D machine has been optimized using a special 3D-infill type to improve the insulating properties.

Advantages

-  Unique and complex designs
-  Reduced costs
-  Lower material usage
-  Enhanced insulating properties



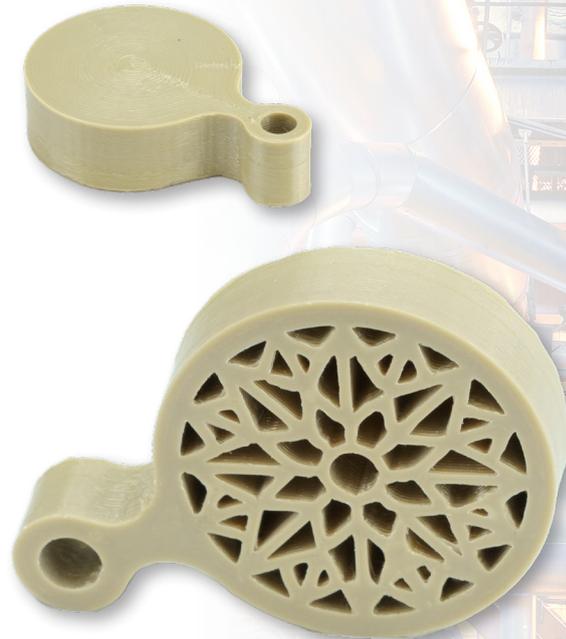
APPLICATIONS: INDUSTRIAL

Floatation device

A buoyant part has been designed that actuates based on liquid level. The density and maximum load are optimizable with design.

Advantages

- 🕒 Pressure resistance
- 🧪 Purity
- 🔬 Chemical resistance
- 🖨️ Freedom of design



APPLICATIONS: INDUSTRIAL

Gripper

To quickly respond to design changes, one of our customers uses Bond3D printed grippers to replace regular PEEK grippers.

Advantages

-  Short lead time
-  Strong parts
-  Freedom of design
-  No setup costs



APPLICATIONS: MEDICAL

Cranial implant (CMF)

Customized cranial implants can be produced using the Bond3D technology with less waste and faster lead times.

Advantages

- ① One part production possible
- 🏥 Medical-certified material
- 🚚 Short lead time
- 🔗 Flexural modulus comparable to bone



APPLICATIONS: MEDICAL

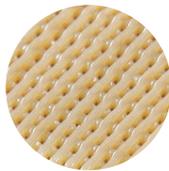
Spinal cage

The PEEK spinal cages printed by Bond3D offer superior properties compared to the Ti competitors.

Advantages

- ① One part production possible
- 🏥 Medical-certified material
- 🚚 Short lead time
- 🔲 Flexural modulus comparable to bone

Porous structure for faster bone growth



Surface roughness, Ra

Nozzle size	Top	Side straight	side sloped
0.6	6.0	12.7	27.5
0.3	9.4	8.3	12.4

Accuracy:

- Without optimization: ISO2768 coarse
- With optimization: ISO2768 medium (from 6mm)

	0.5 < L ≤ 3	3 < L ≤ 6	6 < L ≤ 30	30 < L ≤ 120	120 < L ≤ 400
Medium			±0.2	±0.3	±0.5
Coarse	±0.2	±0.3	±0.5	±0.8	±1.2

Tapped thread & inserts possible

Pull out force 1300 N

Fatigue

Similar to injection molded PEEK



- **Pressure burst tested**

120 bar

- **Tensile test (XYZ)**

95 MPa

- **Leak tight:**

8-10-6 mbar-l/s (@7.5bar(g))

- **Outgassing TOC**

1.0-1010 (molecules/cm2/s)

Tensile strength [MPa], Vitrex PEEK 450G

Data sheet

98

Typical value

X-bar

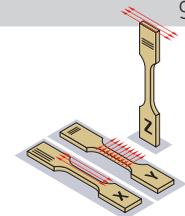
95

Y-bar

95

Z-bar

95



Mechanical properties	Value	Test Standard
Impact resistance Izod Notched; x,y,z	X: 5,4 kJ/m ² Y: 5,1 kJ/m ² Z: 2,5 kJ/m ²	ISO 180
Tensile strength at yield; x,y,z	95 MPa	ISO 527-2
Tensile modulus	± 4 GPa typical	
Strain at break; x,y,z	X: 20 % Y: 5 % Z: 5%	ISO 527-2
Flexural strength at yield; x,y,z	160 MPa	ISO 178
Flexural modulus	± 4 GPa typical	ISO 178
Compression yield stress	XY: 110 MPa Z: 105 MPa	ISO 604
Thermal properties	Value	Test Standard
Glass Transition (T _g)	143°C	ISO 11357
Continuous operating temperature (upto)	250°C	
Other properties		
Leak rate (@7.5 bar(g))	8e-6 mbar l/s	Internal standard
Outgassing TOC (TD-GC-MS)	1.0E+10 (molecules/cm ² /s)	Internal standard
Chemical resistance	Chemically resistant to aggressive environments, suitable for sterilisation for medical and food contact applications	

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Bond3D.com
Sales@Bond3D.com