CARACOL

AT THE **FOREFRONT OF ADDITIVE MANUFACTURING**, **ENABLING** YOUR NEXT MOVE

OUR **MATERIALS**

ABS

It is a thermoplastic copolymer appreciated not only in 3D printing but also in traditional production techniques. It is a rigid, tenacious and light material. The pieces are both resistant and with a good aesthetic quality.

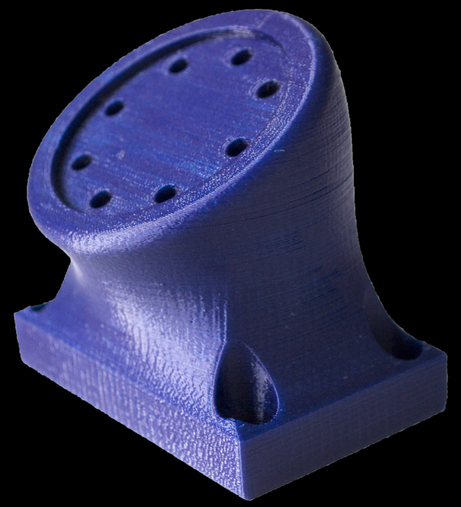
APPLICATIONS

- CONSUMER GOODS
- BIOMEDICAL
- PROTOTYPING
- MECHANICS
- ELECTRONICS
- TOOLING

CASE STUDY

ABS was used to produce this support for tools for industrial robot arms: its design is studied to customly adapt on our customer's robots. It is produced through additive manufacturing: the final result is a reliable and economical object and much lighter than the same object produced with other processes.

The lightness of the piece has increased the productivity of the robots, which can now work at higher speeds with less weight.



CHARACTERISTICS

ABS	VALUE	UNIT	STANDARD
Density	1.04	g/cm³	ISO 1183
Water Absorption	1	%	ISO 62
Izod notched impact strenght	29	kJ/m²	ISO 180/A
Tensile Strenght at yield	2.6	%	ISO 527
Tensile Modulus	2300	MPa	ISO 527
Flexural Strenght	65	%	ISO 178
Vicat Softening Temperature	90	°C	ISO 306
MFR	19	g/10 min	ISO 62

PETG

PETG is the glycolized form of PET, optimized for 3D printing. It is a thermoplastic polymer with good mechanical and chemical resistance, good stiffness and toughness. It also has a good translucency in its neutral form without dyes.

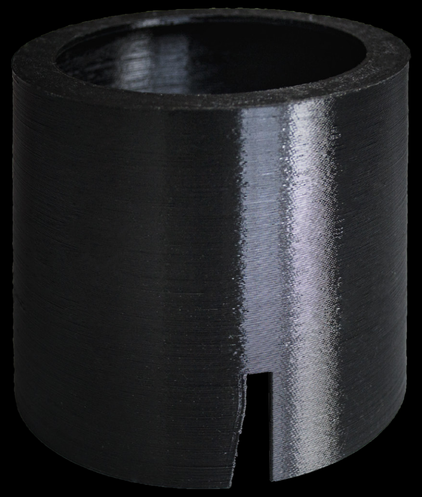
APPLICATIONS

- MECHANICS
- CONSUMER GOODS
- FOOD AND BEVERAGES
- PACKAGING
- ELECTRONICS
- PROTOTYPING

CASE STUDY

One of the most important applications of PETG is in the food sector, due to its chemical compatibility.
The displayed object is a deposit for cocoa powder, designed as a component for a cocoa-based beverage machine.
The PETG certified was chosen for being suitable for contact with food and has therefore been an economic and efficient response to customer needs.

The mass production of hundreds of units was possible using additive manufacturing: we were able to supply the customer with precise and standardized pieces.



CHARACTERISTICS

PETG	VALUE	UNIT	STANDARD
Specific Gravity	1.27	g/cm³	ISO 1183
Water Absorption	0.13	%	ISO 62
Tensile Strenght at Break	26	MPa	ISO 527
Charpy Impact at 23 °C	7.9	KJ/m²	ISO 180
Hardness	105	sh/R	ASTM D785
Melting Point	240	°C	ISO 11357
Heat Distorsion Temperature	70	°C	ISO 75
Vicat Softening Temperature	78	°C	ISO 306

PP

Polypropylene is a semi-crystalline thermoplastic polymer characterized by low density and high resistance to impact, abrasion and chemical agents. It has excellent electrical insulating properties.

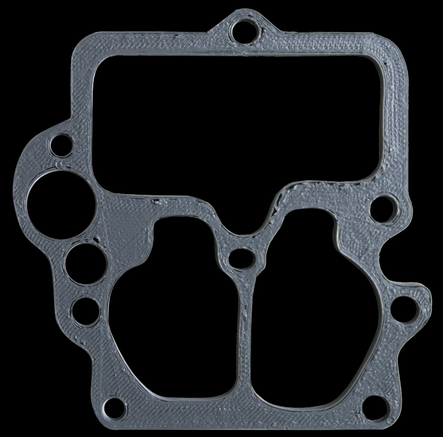
APPLICATIONS

- CONSUMER GOODS
- AUTOMOTIVE
- PACKAGING
- FOOD AND BEVERAGES
- BIOMEDICAL
- PROTOTYPING

CASE STUDY

This gasket of a carburetor was 3D printed using polypropylene, as a replacement for a same piece that is out of production.
3D printing has allowed a custom and on-demand realization of a single unit, without raising the costs of production or stock of the piece.

The choice of PP has therefore proved to be the most suitable both for fulfilling the customer's request for cost-effectiveness and for the insulating properties and resistance to abrasion or necessary impacts.



CHARACTERISTICS

PP	VALUE	UNIT	STANDARD
Density	0.89	g/cm³	ISO 1133-1
Flexural Modulus	950	MPa	ISO 178
Tensile stress at break	15	MPa	ISO 527-1,-2
Tensile stress at yield	17	MPa	ISO 527-1,-2
Tensile strain at break	500	%	ISO 527-1,-2
Tensile strain at yield	6	%	ISO 527-1,-2
Vicat Softening Temperature	135	°C	ISO 306
Heat deflection temp B (0.45MPa)	80	°C	ISO 75B -1,-2
DSC melting point	163	°C	IEC 11357-3
Charpy strenght notched (23°C)	65	kJ/m²	ISO 179
Charpy strenght notched (-20°C)	15	kJ/m²	ISO 179
Charpy strenght notched (-30°C)	10	kJ/m²	ISO 179

CARBON PP

A PP based filament, with 18% carbon fibers added, which provide extra performance in terms of tensile strength and stiffness. It can be used to produce recirculation pumps and turbines, components in contact with aggressive fluids or parts for the automotive engine. It is a valid but cheaper alternative to other technopolymers.

APPLICATIONS

- AUTOMOTIVE
- AEROSPACE
- NAUTICS
- MECHANICS
- TOOLING

CASE STUDY

The example shows a study prototype for a turbine. The production with additive manufacturing has proven to be a customized solution capable of containing production costs and guaranteeing the mechanical quality of the piece.

Carbon PP gives the piece a high mechanical and abrasion resistance, limiting production costs compared to the use of another technopolymer.

CHARACTERISTICS

CARBON PP	VALUE	UNIT	STANDARD
Density	1	g/cm³	ISO 1183
Water Absorption	< 0.3	%	23°C/24h
Linear Mould shrinkage	0.2-0.6	%	DIN 16901
Tensile strenght	54	MPa	ISO 527
Elongation at max. force	1.2	%	ISO 527
Modulus of elasticity	7	GPa	ISO 527
Flexural strenght	78	MPa	ISO 178
Flexural elongation	1.5	%	ISO 178
Flexural modulus	6	GPa	ISO 178
Charpy impact strenght	35	kJ/m²	ISO 179 IeU
Vicat Point softening	80	°C	DIN ISO 306
Continuous service Temperature	100	°C	UL 746B
Maximum (short term) use Temp.	130	°C	-
Insulation resistance	$<10^{3-7}$	Ω	DIN/IEC 60167
Surface Resistance	$<10^{7}$	Ω	DIN/IEC 60093

PA

Polyamide is a thermoplastic polymer characterized by relatively low specific weight, good resistance to impacts, moderate electrical insulation and resistance to solvents, oils, greases and fuels.
It is a self-extinguishing polymer and has a high water absorption: it is therefore not suitable for applications in contact with water or humidity.

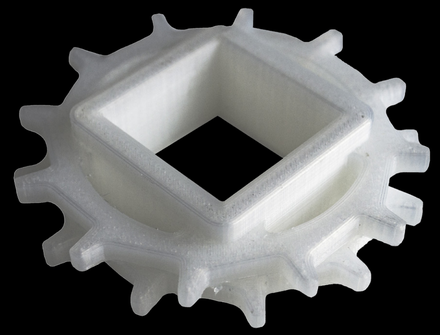
APPLICATIONS

- AUTOMOTIVE
- FASHION
- PROTOTYPING
- MECHANICS
- CONSUMER GOODS

CASE STUDY

This gear for conveyor rollers is an example of redesign, optimized for 3D printing.
The original gear was in fact composed of several parts, that are now integrated into a single product, avoiding assembly costs and risks of breakage.

PA, which is commonly used in industry, gives the piece a long durability, good mechanical characteristics and low cost.



CHARACTERISTICS

PA	VALUE	UNIT	STANDARD
Density	1.2	g/cm³	ISO 1183
Water Absorption	<0.3	%	23°C/24h
Linear Mould shrinkage	0.3-0.5	%	DIN 16901
Tensile strenght	85	MPa	ISO 527
Elongation	3.5	%	ISO 527
Modulus of elasticity	3	GPa	ISO 527
Heat distortion temp.	90	°C	ISO 75
Continuous service temp.	120	°C	UL 746B
Maximum (short term) use temp.	160	°C	-
Coefficient of thermal expansion	0.5	10^{-5}/K	DIN 52752
Thermal conductivity	0.3	W/mK	HOT/DISK
Insulation resistance	$<10^{12}$	Ω	DIN/IEC 60167
Surface resistance	$<10^{12}$	Ω	DIN/IEC 60093

PA12 CARBON

This is filament adds Carbon fiber to a Longchained PA: the result is a material which provides efficient solutons to a lot of industrial needs such as weight reduction through metal replacement, protection against flammability, long term resistance.

APPLICATIONS

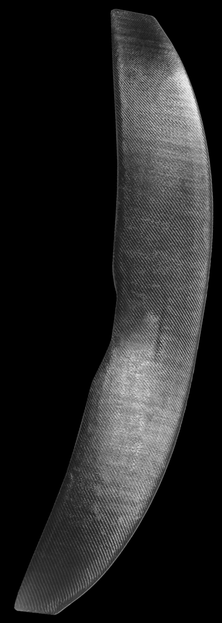
- AUTOMOTIVE
- AEROSPACE
- MECHANICS
- MOTORSPORT
- TOOLING

CASE STUDY

The automotive sector is always looking for more resistant, light, and reliable components, to up the performance of vehicles.

We worked on the spoiler for racing cars of one of the leading car manufacturers, applying our deep-knowledge in 3D printing: by re-designing the rear wing, we optimized it for our robotic system for additive manufacturing.

The piece was manufactured using carbon PA12. The resulting spoiler is lighter than the original by almost 1kg, greatly improving its performance.



CHARACTERISTICS

CARBON PA	VALUE	UNIT	STANDARD
Density	1.07	g/cm³	ISO 1183
Water Absorption	1.1	%	23°C/24h
Tensile strenght	8000	MPa	ISO 178
Flexural Modulus	6800	MPa	ISO 178
Volume resistivity	1.00 e^{+11}	ohm/cm	IEC 60093
Stress at break	110	MPa	ISO 572-2
Melting Point DSC	178	°C	ISO 3146

PA6 CARBON

This filament reinforced with fibers uses PA6 as polymeric base. It has an higher modulus of elasticity compared to Carbon PA12, which makes this material a perfect solution for high-end mechanical applications.

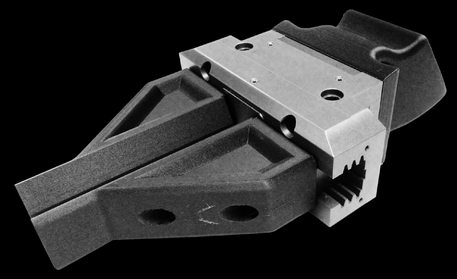
APPLICATIONS

- AUTOMOTIVE
- AEROSPACE
- MECHANICS
- MOTORSPORT
- TOOLING

CASE STUDY

The project is a redesign of a pair of grippers for Kuka Agilus and Kuka KR Cybertech.
The aim is to replace the metal with which the original tool was previously produced.

PA6 Carbon allowed to keep the mechanical characteristics of the piece, increasing its lightness by 50%, compared to the original version. Furthermore, the geometry of the grippes has been simplified, reducing the components to 3, compared to 5 for the original part.



CHARACTERISTICS

CARBON PA	**VALUE**	**UNIT**	**STANDARD**
Density	1.25	g/cm³	ISO 1183
Water Absorption	<0.3	%	23°C/24h
Tensile strenght	170	MPa	ISO 527
Elongation	2	%	ISO 527
Modulus of elasticity	15	GPa	ISO 527
Charpy impact strenght	47	kJ/m²	ISO 179 IeU
Heat distortion temp.	240	°C	ISO 75
Continuous service temp.	150	°C	UL 746B
Maximum (short term) use temp.	180	°C	-
Coefficient of thermal expansion	0.4	10^{-5}/K	DIN 52752
Thermal conductivity	1	W/mK	HOT/DISK
Insulation resistance	$<10^{12}$	Ω	DIN/IEC 60167
Surface resistance	$<10^{12}$	Ω	DIN/IEC 60093

TPU

TPE and TPU (Thermoplastic Polyurethane) is a thermoplastic elastomer with properties such as flexibility and abrasion resistance. Unlike other tires it is recyclable, as it is not thermosetting.

APPLICATIONS

- AUTOMOTIVE
- BIOMEDICAL
- ELECTRONICS
- MECHANICS
- FASHION

CASE STUDY

TPU can be used in the production of orthotics for shoes.

This project is developed for Vibram and involves the construction in small series of customized flexible shoe soles.

In this case the 3D printing of the material has allowed a distribution at different densities, making the sole even more flexible and optimized.

CHARACTERISTICS

TPU	VALUE	UNIT	STANDARD
Specific gravity	1.24	g/cm³	ISO 1183
Tensile Strain	55	MPa	ISO 37
Charpy Impact at 23°	no break	KJ/m²	ISO 179
Charpy Impact at -30°	no break	KJ/m²	ISO 179
Elongation at Break	600	%	ISO 37
Compression set at 70°	45	%	ISO 815
Abrasion Loss	30	mm³	ISO 4649
Hardness	93	sh/A	ISO 868

STIRON HIPS

It is a material cheap and easy to print, perfect for prototype evaluation. It is ideal as a support for prints as it is a material soluble with limonene. This characteristic makes it interesting to use it to make disposable cores in products with undercuts and complex geometries.

APPLICATIONS

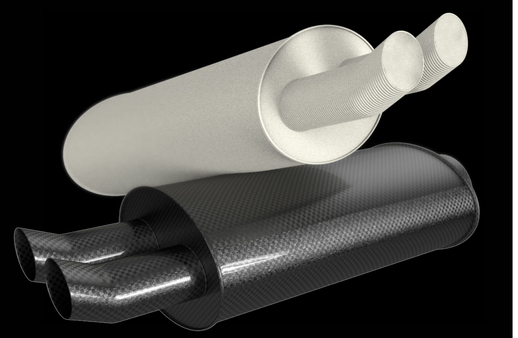
- PROTOTYPING
- PACKAGING
- MECHANICS
- CONSUMER'S GOOD
- ALIMENTARE

CASE STUDY

The project required the manufacturing of a car component in carbon fiber.

The Stiron HIPS was used to 3D print a disposable model of the object.
The fiber was then applied on this model, in order to obtain the desired geometry.

Despite the undercuts, the insert was easily removed through a solution of limonene, leaving the piece in carbon fiber as an end product.



CHARACTERISTICS

STIRON HIPS	**VALUE**	**UNIT**	**STANDARD**
Specific Gravity	1.04	g/cm³	ISO 1183
Water Absorption	0.1	%	ISO 62
Tensile Modulus	1800	MPa	ISO 527
Tensile Strain (Yeld)	1.5	%	ISO 527
Charpy impact at 23°C	12	kJ/m²	ISO 179
MFR	4	g/10min	ISO 62
Melting point	240	°C	ISO 11357
Vicat softening point	96	°C	ISO 306

PEEK

PEEK is an advanced semi-crystalline thermoplastic polymer, which is often used in engineering applications. It combines high mechanical performance with excellent chemical resistance, that remain unchanged at high temperatures. It is also considered an advanced biomaterial used in medical prostheses.

APPLICATIONS

- AUTOMOTIVE
- DEFENSE
- AEROSPACE
- BIOMEDICAL/CHEMICAL
- ELECTRONICS
- OIL & GAS

CASE STUDY

This print in PEEK is a unique custom component that acts as a wire conveyor for industrial textile machines.

This same component was originally obtained by CNC milling of a full block of PEEK. Depositing the material through additive manufacturing it was possible to avoid that resource's waste, eventually reducing the costs.

PEEK is in fact a rather expensive advanced technopolymer, due to its high mechanical, thermal and chemical performances which make it suitable for demanding engineering applications.

CHARACTERISTICS

PEEK	VALUE	UNIT	STANDARD
Specific Gravity	1.31	g/cm³	ISO 1183-3
Water Absorption	< 0.1	%	ISO 62
Tensile Strenght	97	MPa	ISO 527
Elongation at maximum force	5	%	ISO 527
Modulus of elasticity	3.8	GPa	ISO 527
Flexural strenght	145	MPa	ISO 178
Flexural elongation at max. force	7	%	ISO 178
Flexural modulus	3.4	GPa	ISO 178
Charpy impact strenght	185	kJ/m³	ISO 179 IeU
Charpy impact strenght, notched	7	kJ/m³	ISO 179 IeA
Heat distortion temperature	145	°C	ISO 75
Service temperature	260	°C	max. 200h
Insulation resistance strip electrode	< 10^{12}	Ω	DIN/IEC 60167
Surface Resistance	< 10^{12}	Ω	DIN/IEC 60093

PPS

PPS is a thermoplastic technopolymer, with remarkable properties of resistance to chemicals, oils, flame and water vapor. In addition to low water absorption, PPS has good dimensional stability and excellent electrical properties. These features make it a technopolymer suitable for the most demanding application sectors.

APPLICATIONS

- GAS & OIL
- ELECTRONICS
- AEROSPACE
- MECHANICS
- NAUTICS
- AUTOMOTIVE

CASE STUDY

This object is a special handle used in trains. The original shape has been redesigned to best suit the 3D printing technology.

In this case, PPS was used as a substitute material for aluminum: using a technopolymer for additive manufacturing was possible to avoid the production of this same object with a metal casting.

The piece results light but at the same time rigid, with an excellent resistance and dimensional stability.

CHARACTERISTICS

PPS	VALUE	UNIT	STANDARD
Specific Gravity	1.45	g/cm³	ISO 1183-3
Water Absorption	< 0.05	%	ISO 62
Flammability behaviour	V-0	-	UL 94
Tensile Strenght	75	MPa	ISO 527
Elongation at maximum force	2.9	%	ISO 527
Modulus of elasticity	4	GPa	ISO 527
Flexural strenght	95	MPa	ISO 178
Flexural elongation at max. force	2.8	%	ISO 178
Flexural modulus	3	GPa	ISO 178
Charpy impact strenght	20	kJ/m³	ISO 179 IeU
Continuous service temperature	220	°C	IEC 60216
Service temperature	240	°C	during lifetime
Insulation resistance strip electrode	< 10^9	Ω	DIN/IEC 60167
Surface Resistance	< 10^9	Ω	DIN/IEC 60093

CARBON PPS

This material is composed by a base of PPS additivated with 15% carbon fiber.
The fiber increases the mechanical performance of the PPS making it a hard, rigid and light material, in compliance with ISO standards.

APPLICATIONS

- GAS & OIL
- ELECTRONICS
- AEROSPACE
- MECHANICS
- NAUTICS
- AUTOMOTIVE

CASE STUDY

The piece is a structural carter that works as the central body of an extruder.
Thanks to the combination of 3D printing and the use of PPS carbon it was possible to produce a complex geometry in a single piece, able to resiste up to 220 ° C: the PPS carbon has replaced metal for the manufacturing of the piece, producing a lighter carter.

The piece integrates several functions, such as the extruder supply tank, the structural interface of the extruder body itself, assembly assembly flange.

CHARACTERISTICS

CARBON PPS	VALUE	UNIT	STANDARD
Specific Gravity	1.49	g/cm³	ISO 1183-3
Water Absorption	< 0.05	%	23°C/24h
Tensile Strenght	125	MPa	ISO 527
Elongation at maximum force	1.2	%	ISO 527
Modulus of elasticity	13	GPa	ISO 527
Flexural strenght	175	MPa	ISO 178
Flexural elongation	1.5	%	ISO 178
Flexural modulus	10	GPa	ISO 178
Charpy impact strenght	19	kJ/m³	ISO 179 I fu
Heat distortion temperature	220	°C	ISO 75
Continuous service temperature	220	°C	UL 746B
Maximum (short term) use temp.	240	°C	-
Coefficient of thermal expansion	3	10^{-5}/K	DIN 53752
Insulation resistance strip electrode	< 10^{5}	Ω	DIN/IEC 60167
Surface Resistance	< 10^{3}	Ω	DIN/IEC 60093

BEYOND PLASTIC

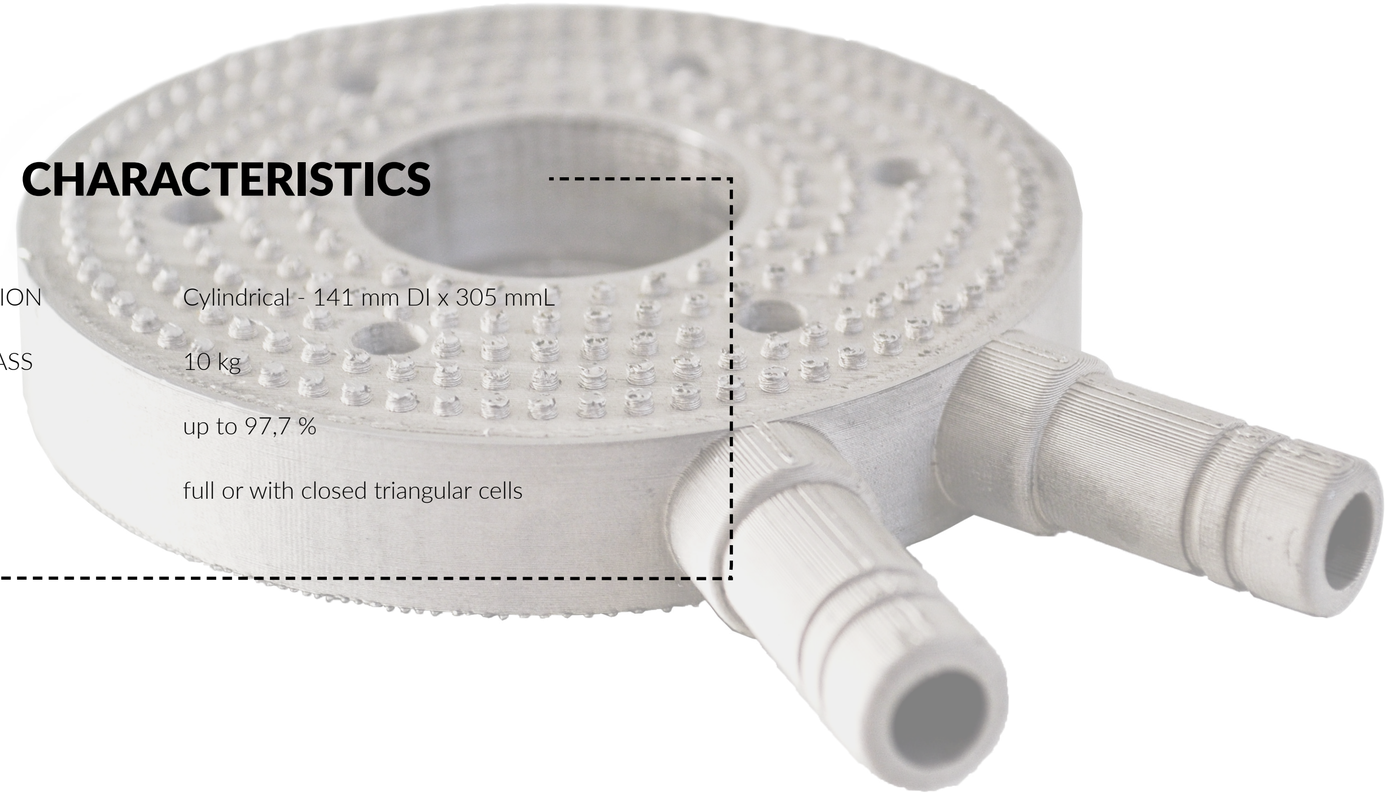
METAL PRINT

The potential of 3D printing goes beyond polymeric materials.

Technological innovation allows us to print metal pieces, with geometries that cannot be produced with other technologies.

Our solution differs from traditional SLS metal powder printing, resulting up to 10 times cheaper than this technology and 100 times cheaper than traditional metal processing.

Discover the possibility of having a fully functional metal piece in less than 24 hours and without molds!



CHARACTERISTICS

MAXIMUM DIMENSION	Cylindrical - 141 mm DI x 305 mmL
MAXIMUM PART MASS	10 kg
DENSITY	up to 97,7 %
INFILL	full or with closed triangular cells

SOON AVAILABLE:

TITANIUM 6AI4V

ALUMINUM 6061

ALUMINUM 7075

INCONEL 625

STEEL A-2

STEEL D-2

17-4 PH STAINLESS STEEL

Stainless steel Cr-Ni-Cu (AISI 630) is one of the most widely used PH-type stainless steels.
It has an excellent combination of mechanical characteristics and corrosion and acid resistance, that are comparable to the 304 series steel ones.

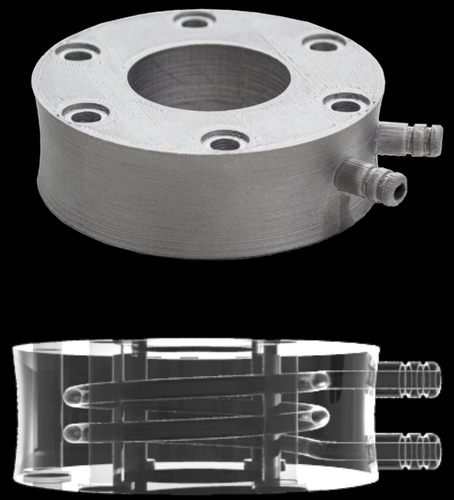
APPLICATIONS

- AUTOMOTIVE
- ELECTRONICS
- AEROSPACE
- MECHANICS
- NAUTICS
- GAS & OIL

CASE STUDY

We 3D printed this custom joint for a particular extruder. The joint also works as a heat dissipator, reason why a material with high resistance and the thermal conductivity was needed.

The image in transparency shows a spiral channel manufactured inside the joint: this channel is necessary to let a coolant flow, in order to facilitate heat dissipation.
3D printing has allowed the production of these internal canals that cannot be reproduced neither with mold, nor through mechanical asportation.



CHARACTERISTICS

17-4 PH ACCIAIO INOX	**VALUE**	**UNIT**	**STANDARD**
Ultimate Tensile Strenght	1250	MPa	ASTM E8
0.2% Yield Strenght	1100	MPa	ASTM E8
Elongation at Break	6	%	ASTM E8
Tensile Modulus	170	GPa	ASTM E8
Hardness	36	HRC	ASTM E8
Corrosion	Pass	-	ASTM F1089
Relative Density	≥ 96	%	-