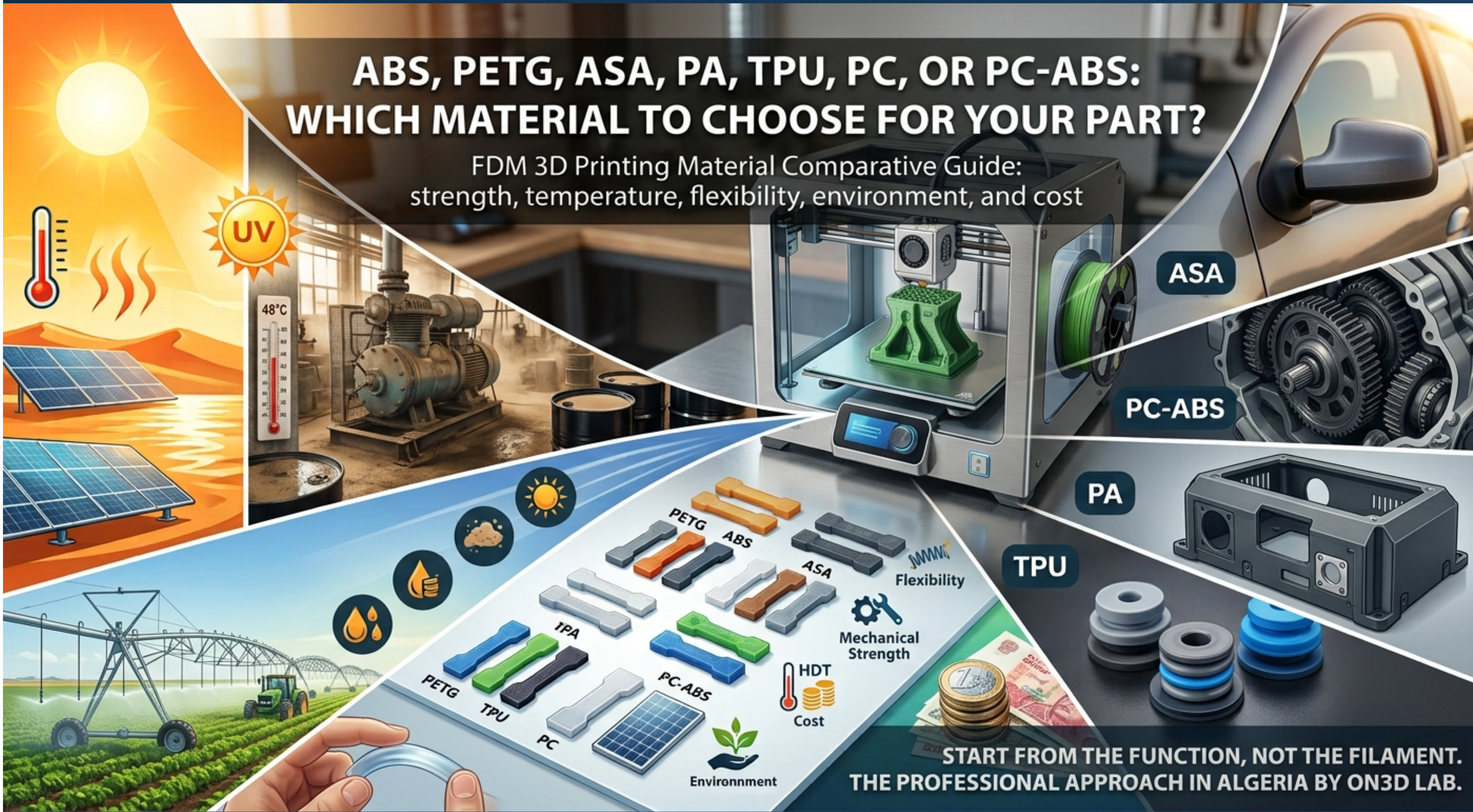

ON3D Lab — Oran, Algeria • Version 1.0 • September 2026

Contents

Choosing a 3D printing material is not simply a matter of looking for "the strongest plastic".

A sensor bracket installed in a factory, a gear, a housing placed in a vehicle, a part exposed to the sun or a bumper designed to absorb vibrations all face different constraints. The material must be chosen according to **the real function of the part and its operating environment**.

This question is particularly important in Algeria. A part may be exposed to high temperatures, solar radiation, dust, oils and vibrations, or operate close to an engine, a compressor or hot industrial equipment.

In maintenance, another factor must also be taken into account: **the availability of the original part**. When a spare part takes several weeks to source or is no longer manufactured, 3D printing can quickly produce a functional alternative. But you still need to select the right polymer.

Among the FDM materials that are particularly interesting for technical parts today are **PETG, ABS, ASA, PA/Nylon, TPU, polycarbonate (PC) and PC-ABS**.

At a glance: which material for which need?

Versatile, economical part	**PETG**
Indoor mechanical part, impact + moderate heat	**ABS**
Outdoor part, exposed to UV / sun	**ASA**
Friction, wear, repeated motion	**PA / Nylon**
Flexibility, vibration, damping	**TPU**
Stiffness + mechanical strength + high heat	**PC**
Impact + heat, industrial compromise	**PC-ABS**

Full details on each material in the following pages.

Quick glossary

FDM	Fused Deposition Modeling — the 3D printing technique used here.
HDT	Heat Deflection Temperature — an indication of heat resistance, not an absolute limit.
Tg	Glass transition temperature — the zone where the material's behavior changes sharply.
Vicat	Softening temperature, measured with a standardized test method.
Shore A	Hardness scale for soft materials (e.g. TPU) — the lower the number, the softer.
Warping	Part deformation/lifting during printing, caused by thermal shrinkage.

Materials comparison table

> ***Important:*** *the values below are* **orders of magnitude** *taken from technical data sheets of documented commercial grades. They should not be considered universal for all filaments sharing the same name.*

Property	PETG	ABS	ASA	PA / Nylon	TPU 95A	PC	PC-ABS
Ease of printing	★★★★☆	★★★☆☆	★★★☆☆	★★☆☆☆	★★★☆☆	★★☆☆☆	★★☆☆☆
Stiffness	Good	Good	Good to high	Good, varies by grade	Very low	**Very high**	Very high
Mechanical strength	Good	Good to very good	Good to very good	**Very good**	Good in tension, but soft material	**Excellent**	Very good to excellent
Impact resistance	Good	Very good	Good to very good	Very good	**Excellent**	**Excellent**	**Excellent**
Wear / friction	Medium	Medium	Medium	**Excellent**	Very good	Good	Good
Indicative HDT	≈ 64–78 °C	≈ 98–100 °C; up to ≈104 °C on some HT grades	≈ 100–103 °C	≈ 70–111 °C for some unfilled PA; up to ≈155 °C with some CF-reinforced PA	Highly grade-dependent; HDT less relevant for an elastomer	≈ 107–111 °C	≈ 106–112 °C
UV resistance	Medium	Low	**Excellent**	Low to medium	Varies by formulation	Low to medium	Low to medium
Moisture resistance	Good	Good	Good	**Low: highly hygroscopic**	Medium	Medium	Medium
Outdoor use	Possible	Not recommended long-term	**Excellent**	Suitable grade advised	UV-suitable grade advised	Stabilized grade advised	Stabilized grade advised
Oils / greases	Good on some grades	Good on some grades	Good	**Good**	Good depending on formulation	Good on some grades	Good on some grades
Flexibility	Low	Low	Low	Low to medium	**Very high**	Very low	Low
Warping	Low	High	Medium to high	Medium to high	Very low	**High**	**High**
Enclosed chamber	Not essential	Recommended	Recommended	Recommended	Generally not	**Strongly recommended**	**Strongly recommended**
Drying	Recommended if humid	Useful	Recommended	**Essential**	Recommended	**Strongly recommended**	**Strongly recommended**
Indicative nozzle	≈ 230–260 °C	≈ 240–265 °C	≈ 230–260 °C	≈ 250–300 °C depending on grade	≈ 210–250 °C	≈ 260–290 °C	≈ 250–270 °C

Property	PETG	ABS	ASA	PA / Nylon	TPU 95A	PC	PC-ABS
Indicative bed	≈ 70–90 °C	≈ 90–100 °C	≈ 75–95 °C	≈ 50–90 °C depending on grade	≈ 25–60 °C	≈ 90–110 °C	≈ 90–105 °C
Relative cost	€€	€€	€€–€€€	€€€	€€€	€€€€	€€€–€€€€
Typical applications	Brackets, flanges, housings, prototypes	Housings, mechanical supports	Outdoor, automotive, enclosures	Gears, guides, slides	Bumpers, guards, damping	Demanding mechanical and thermal parts	Technical housings, impact + heat

About HDT

HDT – Heat Deflection Temperature is the temperature at which a material deflects under load. It does not correspond to a guaranteed maximum service temperature.

Two grades of the same material can have significantly different values. Formulation, additives, moisture, print orientation, any annealing and the test method all influence the result.

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1. PETG: the versatile choice for functional parts

PETG – glycol-modified polyethylene terephthalate – is often an excellent starting point for a functional part.

It combines good mechanical strength, good layer adhesion, a low tendency to warp and relatively easy processing.

It is particularly interesting for **brackets, flanges, housings, guards, guides, functional prototypes and moderately stressed mechanical parts**.

Depending on the commercial grade, the HDT of PETG is generally around **64 to 78 °C**. This variation already shows that a material family name alone is not enough to characterize a part.

When to choose PETG?

PETG is particularly relevant when the part must be functional without being subjected to very high heat, heavy friction or severe mechanical loads.

In an Algerian industrial workshop, it can for example be perfectly suited to a sensor bracket, a connector guard, a flange or a static guide.

However, for a part in a closed vehicle in the sun, near an engine or in a machine producing a lot of heat, you should look at ABS, ASA, PC-ABS or PC.

Key takeaway: PETG = versatility, ease of printing and controlled cost.

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2. ABS: the classic for technical parts

ABS – acrylonitrile butadiene styrene – has long been used in industry and the automotive sector.

It offers a good balance between stiffness, toughness, impact resistance, heat resistance and cost.

On commercial technical grades, an HDT close to **98 to 100 °C** is commonly found, while some high-temperature formulations slightly exceed 100 °C.

eSUN, for example, states for its **ABS-HT** a measured heat deflection temperature of about **104.4 °C**, with a tensile strength of about **46 MPa in XY**. The manufacturer also recommends an enclosed chamber for this grade.

This illustrates an important point: **a standard ABS and a high-temperature ABS are not exactly the same product**.

ABS remains harder to print than PETG because of its thermal shrinkage. A long or massive part may warp if the temperature of the printing environment is not sufficiently stable.

Key takeaway: ABS = good compromise of strength + impact + heat, especially indoors.

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3. ASA: ABS designed for the outdoors

ASA – acrylonitrile styrene acrylate – is often compared to ABS, but it has a decisive advantage: its **resistance to UV and weathering**.

This makes it particularly relevant for parts intended to stay outdoors long-term.

Commercial ASA grades show an HDT of around **100 to 103 °C**, while offering good outdoor aging performance.

eSUN, for example, describes its **ASA+** as better suited than ABS to UV exposure and harsh weather conditions, with better retention of color and mechanical properties under prolonged sun exposure.

Why ASA is particularly interesting in Algeria

For a part permanently installed outdoors, UV resistance can become as important as its mechanical strength.

A sensor housing, a bracket installed on a roof, a piece of agricultural equipment, an exterior automotive accessory or a machine guard may be exposed to the sun daily for several years.

In these situations, **ASA is generally preferable to ABS**.

It remains, however, a material that benefits greatly from an enclosed printer to limit shrinkage and warping.

Key takeaway: ASA = heat + UV + outdoor environment.

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4. PA / Nylon: when the part must really work

"Nylon" or **PA – polyamide –** actually refers to a whole family of materials: PA6, PA66, PA11, PA12, PA6/66, carbon-reinforced PA, glass-fiber-reinforced PA, and so on.

It is therefore impossible to give a single value valid for all nylons.

Their main advantage generally lies in their combination of **toughness, wear resistance, low friction and fatigue resistance**.

This is what makes PA very interesting for components such as:

- gears;
- pinions;
- guides;
- slides;
- bushings;
- hinges;
- industrial replacement parts subjected to repeated motion.

On some documented unfilled PA, the HDT can vary around **70 to 111 °C** depending on the test load.

With fiber reinforcement, much higher levels can be reached. eSUN, for example, states for its **ePA-CF**, based on a carbon-fiber-reinforced PA6/66, an HDT of up to about **155 °C at 0.45 MPa**.

This shows why one should not simply write "Nylon: 100 °C". **The exact grade changes everything.**

The critical point: moisture

The main problem with polyamide is its **hygroscopic** nature.

It absorbs moisture from the air, which can severely degrade:

- extrusion quality;
- surface finish;
- accuracy;
- interlayer adhesion;
- mechanical properties.

Drying is therefore not a detail.

For an industrial PA part, managing the filament before and during printing is an integral part of the manufacturing process.

Key takeaway: PA = friction, wear, fatigue and demanding mechanical parts.

5. TPU: when deformation becomes a function

TPU – thermoplastic polyurethane – should not be compared directly to rigid materials.

Its value lies precisely in its ability to deform.

A TPU 95A can be used to produce:

- bumpers;
- guards;
- cable grommets;
- non-slip surfaces;
- wheels;
- damping elements;
- parts absorbing vibrations.

Commercial TPU 95A can show elongation at break of several hundred percent.

The **Polymaker PolyFlex TPU95**, for example, is given with a **Shore 95A** hardness and an elongation at break above **500%** under certain test conditions.

Why not give TPU a simple HDT?

For an elastomer, the notion of heat deflection temperature is less intuitive: **the material is already designed to flex**.

It is therefore more useful to look at:

- the exact grade;
- Shore hardness;
- chemical resistance;
- behavior with temperature;
- compression;
- wear.

You should also avoid concluding that a TPU is automatically suitable for diesel, gasoline or hydraulic oil. Compatibility must be checked for the specific fluid and grade used.

Key takeaway: TPU = flexibility, damping, vibration and shock absorption.

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6. PC: when strength and temperature become priorities

Polycarbonate – PC – is one of the highest-performing technical materials commonly available in FDM.

It offers a very good combination of:

- stiffness;

- mechanical strength;
- toughness;
- impact resistance;
- heat resistance.

The **Polymaker PolyLite PC**, for example, shows a tensile strength close to **69 MPa in XY**, a glass transition temperature of about **113 °C**, a Vicat temperature close to **120 °C** and an HDT around **107 to 111 °C** depending on the applied load.

These properties make it interesting for:

- structural brackets;
- tooling;
- housings exposed to heat;
- mechanical parts;
- components working in an environment where PETG and ABS become limiting.

Why not use PC everywhere?

Because performance comes at a manufacturing cost.

PC generally requires:

- a high extrusion temperature;
- a very hot bed;
- properly dry filament;
- a stable enclosure;
- good control of warping.

For a simple bracket working at room temperature, choosing PC when PETG perfectly meets the specification does not necessarily bring any benefit.

Key takeaway: PC = high stiffness + mechanical strength + high heat.

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7. PC-ABS: an excellent compromise between ABS and PC

PC-ABS is a blend of polycarbonate and ABS.

The goal is to combine part of the heat resistance and toughness of PC with some of the processing and finishing characteristics of ABS.

On the **Polymaker PC-ABS**, the HDT reaches approximately:

- **106 °C at 1.8 MPa**;
- **112 °C at 0.45 MPa**.

The glass transition temperature is around **109 °C**.

This material is particularly interesting when you want to combine:

- impact resistance;
- good heat resistance;
- stiffness;
- good finish;
- industrial behavior.

It can be summarized as follows:

ABS → when constraints remain reasonable.
PC-ABS → when heat and impacts increase.
PC → when stiffness and thermal performance become priorities.

Key takeaway: PC-ABS = excellent industrial compromise between impact, heat and stiffness.

Temperature: beware of the numbers

This is probably the most important part to understand when comparing materials.

The temperature indicated for the nozzle is **not** the temperature the part can withstand.

A PC printed at 280 °C obviously cannot operate at 280 °C.

Three data points are particularly interesting.

Tg – glass transition temperature

Tg indicates a zone in which the mechanical behavior of an amorphous polymer starts to change strongly.

Vicat

The **Vicat** temperature characterizes the softening of a material according to a standardized test method.

HDT – heat deflection temperature

HDT measures the temperature at which a test specimen deforms in a certain way under a standardized load.

For a 3D-printed mechanical part, HDT therefore gives a useful indication, but **it is not a universal maximum service temperature**.

The same material can show different values depending on the load applied during the test.

In Algeria, ambient temperature is not enough

When a customer says:

> *"The part operates at 40 °C maximum"*

this figure needs to be analyzed.

A black part installed in the sun, a component under a car hood, the inside of an industrial cabinet or an area near an engine can reach temperatures very different from the outdoor air temperature.

This is why an outdoor part in Algeria may justify using **ASA rather than ABS**, while a mechanical part located near a heat source may point the choice toward **PC-ABS or PC**.

The material must be selected based on **the real temperature of the part**, not just the weather.

The material is not everything

A part printed in PC can be weaker than a properly designed PETG part.

Why?

Because FDM printing is **anisotropic**: strength depends on layer orientation.

On FDM material data sheets, a significant difference between properties measured in XY and in Z is frequently observed.

Geometry, orientation, number of walls, print temperature, layer fusion, fillets, infill and drying can therefore matter as much as the choice of material.

For a mechanical part, asking only:

> *"Which filament should I use?"*

is not enough.

You must also ask:

> ***"How should this part be designed and printed so that the loads are properly carried?"***

Which material to choose? The quick method

Versatile, economical functional part

PETG

Indoor mechanical part with good heat and impact resistance

ABS

Outdoor part exposed to UV and sun

ASA

Friction, wear or repeated motion

PA / Nylon

Flexibility, vibration or damping

TPU

Stiffness, mechanical strength and high temperature

PC

Impact + heat with a good industrial compromise

PC-ABS

And the cost?

Price per kilogram should not be the only criterion.

For an industrial part, the real cost also includes:

- machine time;
- filament drying;
- risk of failure;
- print speed;
- post-processing;
- the lifespan of the part.

In Algeria, local availability and the import of technical materials can also greatly change the real cost of a PA, a PC or a PC-ABS compared to a more common PETG or ABS.

A cheap part that must be replaced every two months can end up costing much more than a better-suited part from the start.

The question is therefore not:

> ***"Which filament is the cheapest?"***

but:

> ***"What is the least expensive material capable of durably fulfilling the required function?"***

Conclusion: start from the function, not the filament

There is no universally best material.

The right choice depends on:

- temperature;
- load;
- duration of that load;
- impacts;
- friction;
- moisture;
- UV exposure;
- chemicals present;
- expected lifespan.

In professional 3D printing, **the choice of polymer is an integral part of part design**.

At **ON3D Lab**, the approach is therefore to analyze the real operating environment before choosing the material, then to adapt the geometry, print orientation and manufacturing parameters.

This approach is particularly important for **functional prototyping, tooling and industrial replacement parts**, where printing a part that "looks like the original" is not enough: it must above all be able to properly fulfill its function.

Technical references

Polymaker — China

Manufacturer of 3D printing materials based in Changshu, China.

- PolyLite PETG — Technical Data Sheet
- PolyLite ABS — Technical Data Sheet
- Polymaker ASA — Technical Data Sheet
- PolyMide CoPA — Technical Data Sheet
- PolyFlex TPU95
- PolyLite PC — Technical Data Sheet
- Polymaker PC-ABS

eSUN — China

Shenzhen Esun Industrial Co., Ltd.

- eSUN PETG
- eSUN ASA+
- eSUN ABS-HT
- eSUN Flexible Materials / TPU
- eSUN Engineering Filaments

Additional sources

- Prusa — Material Guide
- UltiMaker — Materials

Methodology note

The properties of a printed part can vary greatly depending on:

- the exact formulation of the filament;
- its moisture content;
- layer orientation;
- manufacturing parameters;
- geometry;
- infill density;
- wall thickness;
- the real operating environment.

For a critical or safety-related application, the data sheet of the **grade actually used** as well as tests on the final part remain necessary.

About ON3D Lab

ON3D Lab supports companies and professionals in Algeria in the design, modeling and additive manufacturing of functional parts, prototypes, tooling and replacement parts in technical polymers.

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