History

11 August 2025

17:10

Concept of 3d printing: additive manufacturing

1981- Hideo Kodama (Japan) develops early rapid auto typing using photo polymer

1984- Charles Hull invents SLA, found 3d systems

1990s- FDM & SLS patented, used mainly for industrial prototyping

2000s- patent expiration lead to open source (RepRap) and affordable printers

2010s to present- growth in speed, materials, and industrial adoption.

Theory Behind

11 August 2025

17:22

1. Additive manufacturing: Objects built layer by layer from digital 3D models (CAD)
2. Process

* 3D model. In CAD or 3d scanning
* Slicing. Using slicing software
* Printing. Printer deposits layer by layer
* Post processing. Cleaning. Finishing

3. Advantage: Less waste than subtractive manufacturing

Subtractive manufacturing: make something by cutting material form bigger pieces.

Ex: craving wood, drilling, milling, grinding etc.

Additive manufacturing: building something by adding material layer by layer

Limitations

13 August 2025

11:38

* + **Speed** — Large or detailed prints can take many hours.
  + **Strength vs. traditional manufacturing** — Not always as strong as injection moulding unless using reinforced materials.
  + **Surface finish** — Often requires post-processing to be smooth.
  + **Material constraints** — Not all materials are printable on all machines.
  + **Cost of materials** — Specialty filaments like carbon fiber nylon can be expensive

Types Present

11 August 2025

18:11

## 

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Technology** | **How It Works** | **Common Materials** | **Pros** | **Cons** |
| **FDM/FFF** | Melts and extrudes filament layer-by-layer | PLA, ABS, PETG, Nylon, Carbon Fiber composites | Affordable, wide material range | Visible layer lines, slower for complex shapes |
| **SLA** | Uses UV light to cure liquid resin layer-by-layer | Photopolymer resin | Very high detail, smooth surface | Resin is messy, more expensive |
| **SLS** | Laser sinters powdered material | Nylon, TPU | Strong functional parts, no supports needed | Industrial, expensive |
| **CFF** (Continuous Fiber Fabrication) | Similar to FDM but lays continuous fiber strands | Carbon fiber, Kevlar, fiberglass | Very high strength | Higher cost, fewer models |

1. FDM – Fused Deposition Modelling

* Melts and extrudes plastic filament through a nozzle, building objects layer-by-layer.
* Thermoplastics (PLA, ABS, PETG, TPU).
* Prototypes, hobby projects, educational models, low-cost manufacturing.

1. SLA – Stereolithography

* Uses a UV laser to cure liquid resin into solid layers
* Photopolymer resins
* Dental models, jewellery, detailed prototypes, art pieces.

1. SLS – Selective Laser Sintering

* Laser fuses powdered material to form solid layers
* Nylon, PA, composites
* Functional prototypes, low-volume production, industrial parts.

1. DMLS / SLM – Direct Metal Laser Sintering / Selective Laser Melting

* High-powered laser melts or sinters metal powder into solid parts
* Titanium, stainless steel, aluminum, cobalt-chrome
* Aerospace components, medical implants, high-strength tooling

* What it is
* Materials used
* Uses

.

14 August 2025

22:00

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Process** | **Typical Materials** | **Strength** | **Hardness** | **Cost** | **Speed** | **Key Limitations** |
| **FFF / FDM** | PLA, ABS, PETG, Nylon | Low–Moderate; anisotropic | 60–120 MPa (tensile) | Low | Moderate | Layer adhesion weak along Z-axis; rough surfaces; limited feature detail; requires supports for overhangs |
| **CFF (Continuous Fiber FDM)** | Nylon + Carbon/Glass Fiber | High along fiber direction; directional | 150–250 MPa (tensile) | Medium–High | Moderate | Strength directional; complex slicing; limited material combinations; expensive filaments |
| **SLA / DLP** | Photopolymer resins | Moderate–High | 50–90 MPa (tensile), Shore D 80–95 | Medium | Slow | Brittle; small build volumes; post-processing required; resin handling hazardous |
| **SLS** | Nylon, PA12, composites | Moderate; isotropic | 50–75 MPa (tensile), Shore D 70–85 | High | Moderate | Rough surfaces; expensive powder; part packing critical; limited to polymer powders |
| **DMLS / SLM** | Metals (steel, Ti, Al) | Very High; near or above forged | 200–600 HB, HRC 30–55 | Very High | Slow | Expensive machines & materials; residual stress; post-processing (supports, heat treatment) required; limited build size |

Types of CF printing

16 August 2025

16:09

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Type** | **How it Works** | **Strength** | **Cost** | **Pros** | **Cons** | **Applications** |
| **Chopped CF Filament (FDM/FFF)** | Thermoplastic filament mixed with short chopped CF strands, extruded layer by layer | Moderate – stiffer than normal plastic, weaker than continuous CF | Low | Easy to print, affordable, reduces warping | Fibers too short for major load, surface roughness | Prototypes, jigs, fixtures |
| **Continuous CF Reinforced (CFRP / CFF)** | Continuous carbon fiber strands are laid inside a thermoplastic matrix during printing | Very High – close to aluminum in strength-to-weight | High | Very strong and stiff, fiber alignment possible for stress paths | Expensive printers and materials, slower printing | Aerospace brackets, automotive load-bearing parts, robotics |
| **CF Powder Printing (SLS / MJF)** | Nylon (PA11/PA12) powders mixed with chopped CF, fused layer by layer in a powder bed | High – stronger and more stable than chopped CF filament | Medium to High | Good isotropy, accurate, complex shapes possible | Requires industrial machines, expensive | Drone frames, functional housings, end-use parts |
| **Hybrid / Pre-preg CF Filament** | Filament pre-impregnated with continuous carbon fiber tow, may need post-curing | High – between chopped and true continuous | High | Combines filament printing with long fiber reinforcement | Processing challenges, niche availability | High-performance prototypes, sports gear |
| **3D Printed Mold + CF Layup** | A mold is 3D printed, then carbon fiber sheets with resin are laid and cured | Very High – true composite (aerospace grade) | Medium | Produces real composite parts, ultimate strength | Manual labor, time-intensive, curing equipment needed | Automotive panels, aircraft parts, sports equipment |

Price of filaments

16 August 2025

17:00

|  |  |  |  |
| --- | --- | --- | --- |
| **Type of CF Filament** | **Base Material** | **Price Range (per 1 kg spool, INR)** | **Notes** |
| **PLA-CF** | PLA + 10–20% chopped CF | ₹2,000 – ₹3,500 | Cheapest CF option, stiff but brittle, easy to print |
| **PETG-CF** | PETG + chopped CF | ₹2,500 – ₹4,000 | More toughness than PLA-CF, good balance of ease and strength |
| **ABS-CF** | ABS + chopped CF | ₹3,000 – ₹4,500 | Stronger than PLA/PETG-CF, requires enclosed printer |
| **Nylon-CF (PA-CF)** | Nylon (PA6, PA12) + chopped CF | ₹4,500 – ₹8,000 | High strength, wear resistance, needs drying before print |
| **Nylon blends (PA-CF + others)** | Nylon with Kevlar/Glass + CF | ₹5,000 – ₹10,000 | Engineering grade, durable, industrial use |
| **PEEK/PEKK-CF** | High-performance polymers + CF | ₹15,000 – ₹30,000+ | Aerospace/medical grade, requires very high-temp printer |
| **Continuous CF (CFRP filaments)** | Continuous fiber + thermoplastic | Not sold as normal spools; proprietary materials (much higher, often ₹20,000+) | Used only with specialized printers like Markforged, Anisoprint |

Types of CF filament

16 August 2025

17:00

# Types of Carbon Fiber (CF) Filaments

* 1. **PLA-CF**
  2. PLA mixed with chopped carbon fibers (10–20%).
  3. Stiffer than normal PLA, less warping, but brittle.
  4. Easiest to print.

* 1. **PETG-CF**
  2. PETG blended with chopped CF.
  3. Better toughness than PLA-CF, more flexible, stronger.
  4. Prints at slightly higher temps.

* 1. **ABS-CF**
  2. ABS reinforced with chopped CF.
  3. Stronger and more heat resistant than PLA/PETG blends.
  4. Requires enclosed printer to prevent warping.

* 1. **Nylon-CF (PA-CF)**
  2. Nylon (PA6, PA12, etc.) reinforced with chopped CF.
  3. High strength, wear resistance, good heat stability.
  4. Must be kept dry during storage/printing.

* 1. **Nylon Blends (e.g., PA-CF + Glass/Kevlar)**
  2. Hybrid blends for extra toughness or flexibility.
  3. Used in industrial/engineering applications.

* 1. **High-Performance CF (PEEK/PEKK-CF)**
  2. Aerospace-grade polymers reinforced with CF.
  3. Extremely strong, heat and chemical resistant.
  4. Requires very high-temperature printers.

* 1. **Continuous Fiber Reinforcement (CFRP Filaments)**
  2. Continuous carbon fibers embedded in thermoplastic matrix.
  3. Provides strength close to metals (aluminum).
  4. Works only on specialized printers (Markforged, Anisoprint).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Type** | **Strength** | **Printability** | **Price (per kg)** |  |
| **PLA-CF** | Moderate | Easy | ₹2,000 – ₹3,500 | Good for beginners, brittle |
| **PETG-CF** | Moderate–High | Easy–Medium | ₹2,500 – ₹4,000 | Balanced strength + flexibility |
| **ABS-CF** | High | Medium (needs enclosure) | ₹3,000 – ₹4,500 | Tougher, heat resistant |
| **Nylon-CF (PA-CF)** | Very High | Medium–Hard (needs drying) | ₹4,500 – ₹8,000 | Engineering grade, strong & durable |
| **Nylon Blends (PA-CF + Kevlar/Glass)** | Very High | Hard (special conditions) | ₹5,000 – ₹10,000 | Extra durability, industrial parts |
| **PEEK/PEKK-CF** | Extremely High | Very Hard (high temp printer) | ₹15,000 – ₹30,000+ | Aerospace/medical use |
| **Continuous CF Filaments** | Extremely High (close to aluminum) | Proprietary systems | Often ₹20,000+ per material set | Only for specialized printers |

Thermo-setting plastic

14 August 2025

21:36

|  |  |  |
| --- | --- | --- |
| **Process** | **Thermoset Usable?** | **Notes** |
| FFF / FDM | Rare / experimental | Needs post-cure; not standard |
| CFF | No | Only thermoplastic matrix works |
| SLA / DLP | Yes | Standard photopolymer resins are thermosetting |
| SLS | No | Requires meltable powder |
| DMLS / SLM | N/A | Metal-based |

Capabilities

11 August 2025

20:31

* + Rapid prototyping
  + Creation of complex geometries
  + Custom manufacturing
  + Multimmaterial print
  + On demand production
  + Medical innovations prosthetics, implants, surgical models

* + **FFF/FDM:** Affordable, versatile, simple parts; good for prototyping.
  + **CFF:** Strength-focused polymer printing; best when mechanical performance matters.
  + **SLA/DLP:** Fine detail and smooth finish; small-to-medium precision parts.
  + **SLS:** Functional polymer parts with complex geometries; isotropic strength.
  + **DMLS/SLM:** High-performance metal parts; fully functional end-use components; supports complex designs unachievable with traditional machining.

Uses

11 August 2025

20:33

Industrial: Aerospace, automotive tooling, jigs, fixtures.

Healthcare: Prosthetics, dental crowns, surgical models, implants.

Architecture: Scale models, 3D-printed houses.

Consumer Goods: Custom accessories, jewelry, household tools.

Education: STEM learning, engineering projects.

Art & Fashion: Sculptures, wearable designs.

Software Used

12 August 2025

12:41

3D Printer Software & Linux Interface:

* 3D Modeling: Blender (design models)
* Slicing: Cura, PrusaSlicer (convert models to G-code)
* Printer Firmware: Marlin, Klipper (runs on printer hardware)
* Host Software: OctoPrint, Pronterface (control printer from Linux via USB/network)

Workflow:

Design (Blender) → Slice (Cura) → Send G-code (OctoPrint/Linux) → Printer firmware executes

Linux Interface:

* Communicates via USB serial or network
* OctoPrint is popular for Linux-based printer control

|  |  |  |
| --- | --- | --- |
| Step | Software example | Function |
| 3d Modeling | Blender, Fusion 360 | Creates 3D desing |
| Slicing | Cura, PrusaSlicer | Convert models to G-code |
| Host/Printer control | OctoPrint, Pronterface | Send commands, monitor prints |
| Firmware (Printer) | Marlin. Klipper | Controls printer hardware, runs G- code |

Model Selection

12 August 2025

23:56

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Printer | Price | Features | CF compatibility | Build volume |
| Creality K1C/K1 Max | 65-85k | Core XY:  300`C hotend:  Direct drive  Enclosed chamber  Auto-level  AI camera  High-speed printing | Supports  PLA-CF  PA-CF  PET-CF | 220 \*220 \*250mm |
| QIDI Tech Q1 pro | 2.0-2.2L | Heated chamber(~30`C)  350`C hotend  Auto-level  Direct drive  Fast speeds | Designed for  Nylon-CF  PET-CF  etc | 245 \*245 \*200mm |
| FlashForge creator 3 | 1.94L | Fully enclosed  Dual extruder  HEPA filtered  Heated bed 120`C  Ventilation fans | Nylon(PA)  PLA  ABS  PC  PETG  Also supports CF composites | 300 \*250 \*200mm |
| Fusion3 | >2L | Industrial FFF  Interchangeable heads  High-temp (320`C)  Large build volume | Certified for carbon fiber filaments | F306:  306 \*306 \*306mm  F400:  355 \*355 \*315mm  EDGE:  368 \*368 \*343mm |
| Bambu Lab X1 Carbon | 1.45-2.37L | Lightweight Core XY with 7 µm lidar,  hardened steel nozzle,  300 °C hotend, | PA  PC  CF | 256 \*256 \*256mm |
| Raise3D E2CF | 3.2-3.5L | Direct drive dual extruder  Hardened steel nozzles and abrasion-resistant components  Fully enclosed chamber  Auto bed levelling + flexible build plate  Independent dual extrusion (IDEX) — can print mirror mode or duplicate mode. | PA12 CF  PA CF+  PETG CF  PLA CF  PC CF. | Single extruder:  330\*240\*240mm  Dual extruder:  295\*240\*240mm |
|  |  |  |  |  |

Printing speed

19 August 2025

15:51

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Model | Printing speed | Max speed | Travel speed |  |
| Creality K1C | **300 mm/s** in normal use. | **600 mm/s** under ideal lab conditions | --------------------------------- | Quick results, high real-world reliability at ~300 mm/s; faster modes require care |
| Creality K1 Max | **300 mm/s**. | Up to **600 mm/s** | **800 mm/s**. | Feature-rich and fast, but quality may drop at highest speeds |
| QIDI Tech Q1 pro | ~200–300 mm/s |  |  |  |
|  |  |  |  |  |

travel speed is the speed at which the print head (or build plate, depending on the printer) moves while not extruding filament.

* + **Printing speed** → How fast the nozzle moves **while extruding plastic** (actually laying down filament).
  + **Travel speed** → How fast the nozzle moves **between printed sections** (moving through air, no extrusion).

Slicing configuration

14 August 2025

20:11

|  |  |  |  |
| --- | --- | --- | --- |
| **Process** | **Common Slicers** | **Key Configurations** |  |
| **FFF / FDM** | Cura, PrusaSlicer, FlashPrint, Bambu Studio, IdeaMaker | Layer height (0.05–0.4 mm), Infill density/pattern (0–100%), Shell thickness (1–3 walls), Print speed (30–150 mm/s), Nozzle/Bed Temp, Supports | Smaller layer height → higher detail; higher infill & shell → stronger; supports for overhangs; speed vs quality trade-off |
| **CFF (Continuous Fiber FDM)** | Markforged Eiger, Bambu Studio (fiber module) | * + Fiber orientation: Align fibers with stress for max strength   + Layer height**:** 0.1–0.3 mm   + Infill: Standard FFF infill; fiber added selectively   + Matrix material settings**:** Temp, speed, flow for proper fiber bonding | Fiber orientation critical for strength; selective fiber placement maximizes stiffness; matrix extrusion similar to FFF |
| **SLA / DLP** | Chitubox, Bambu Studio, PreForm | Layer height (0.025–0.1 mm), Exposure time, Lift/retract speed, Support placement, Anti-aliasing / XY resolution | Exposure time affects hardness & cure depth; supports crucial for overhangs; fine layer height improves surface finish |
| **SLS** | Materialise Magics, 3D Sprint | Layer thickness (50–150 µm), Laser power & scan speed, Part orientation & nesting | Powder acts as support; scan parameters affect density & surface quality; packing impacts thermal consistency |
| **DMLS / SLM** | Materialise Magics, 3DXpert, Siemens NX | Layer thickness (20–60 µm), Laser power & scan speed, Hatch distance, Part orientation, Support structures | Settings critical for density, mechanical properties, and stress control; supports needed for overhangs & heat management |

Hardness comparison

14 August 2025

20:11

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Technology** | **Common Materials** | **Typical Hardness Range** |  | **Overall Strength** |
| **FFF / FDM** | PLA, ABS, PETG, Nylon, CF-filled | 60–120 MPa (Tensile), Rockwell R ~70–100 | Thermoplastics; hardness is lower, reinforced filaments like CF or CFF increase stiffness  Strength depends on layer adhesion; anisotropic (weaker along Z-axis) | Low - moderate |
| **CFF (Continuous Fiber FDM)** | Nylon + Carbon/Glass Fiber | 150–250 MPa (Tensile), Rockwell R ~120–150 | Fibers significantly improve hardness & stiffness  Fibers greatly improve tensile and flexural strength; strength is directional along fiber | High (polymers) |
| **SLA / DLP** | Photopolymer resins | 50–90 MPa (Tensile), Shore D 80–95 | Rigid resins can reach higher hardness; brittle compared to FDM  Can be brittle; good surface finish, but lower impact resistance | Moderate – high (rigid resins) |
| **SLS** | Nylon, PA12, composites | 50–75 MPa (Tensile), Shore D 70–85 | Sintered powders; decent hardness, isotropic after sintering  Stronger than FDM due to isotropic sintering; still less than fiber-reinforced or metal prints | Moderate |
| **DMLS / SLM** | Stainless steel, Titanium, Aluminum | 200–600 HB (Brinell), HRC 30–55 | Metal prints; hardness can exceed cast/forged parts with heat treatment  Comparable or superior to machined/forged metal; excellent tensile, compressive, and impact strength | Very high |

* + **FFF/FDM:** Focus on layer height, infill, and shell; simple but can be strengthened with fiber (CFF).
  + **SLA/DLP:** Exposure & supports dominate; very high resolution possible.
  + **SLS:** Laser parameters and part layout more important than supports.
  + **DMLS/SLM:** Most complex; laser settings, orientation, and supports crucial for metal parts’ strength and hardness.

Tool chain

14 August 2025

20:11

## 1. CAD / Design Tools

* + **Purpose:** Create a 3D model of the part.
  + **Common Tools:**
  + **Fusion 360, SolidWorks, Tinkercad, Blender, Rhino**
  + **Notes:**
  + CAD model is the starting point for all additive processes.
  + Must be **manifold (“watertight”)** for successful printing.

## 2. Slicing Software

* + **Purpose:** Converts CAD (STL/OBJ/3MF) into printer instructions (G-code for FFF/CFF, machine code for others).
  + **Key Tasks:**
  + Layering
  + Infill patterns
  + Supports & brims
  + Temperature, speed, laser power (depending on process)
  + **Examples:**
  + **FFF/FDM:** Cura, PrusaSlicer, FlashPrint, Bambu Studio, IdeaMaker
  + **CFF:** Markforged Eiger, Bambu Studio (fiber module)
  + **SLA/DLP:** Chitubox, PreForm, Bambu Studio
  + **SLS / DMLS / SLM:** Materialise Magics, 3DXpert, Siemens NX
  + **Notes:** Proper slicing configuration is critical for strength, resolution, and surface quality.

## 3. Printer Firmware / Control

* + **Purpose:** Interpret G-code / machine instructions and control motors, heaters, lasers, or curing systems.
  + **Key Functions:**
  + Motor control (X, Y, Z axes, extruder, recoater)
  + Temperature / laser power regulation
  + Monitoring sensors (bed leveling, filament detection)
  + Safety interlocks
  + **Examples:** Marlin (FFF), proprietary firmware for DMLS/SLM, Bambu Lab firmware for X1 Carbon

## 4. Post-Processing Tools

* + **Purpose:** Improve mechanical properties, surface finish, or part accuracy.
  + **Methods:**
  + **FFF / CFF:** Sanding, annealing, acetone vapor smoothing (for ABS)
  + **SLA/DLP:** UV curing, washing in isopropyl alcohol
  + **SLS:** Powder removal, bead blasting, infiltration with resins
  + **DMLS / SLM:** Heat treatment, support removal, machining, surface finishing

## 5. Monitoring & Cloud Tools

* + **Purpose:** Track print progress, manage queues, and optimize workflow.
  + **Examples:**
  + **Bambu Handy / Bambu Cloud** (Bambu Lab)
  + **RaiseCloud** (Raise3D)
  + OctoPrint, AstroPrint (FFF/FDM)
  + **Notes:** Allows remote control, analytics, and sometimes slicing integration.

* + **Design CAD Model →**
  + **Slice with appropriate slicer**
  + **Send instructions to printer (Firmware interprets G-code / machine code)**

**Print part**

* + **Post-process for strength, surface, and functionality**
  + **Monitor and optimize workflow with cloud/software tools**

Features

13 August 2025

11:55

* 1. Core XY :

CoreXY is a design that lets a 3D printer’s head move fast and smooth by using two motors and special belts. It makes printing quicker, steadier, and more accurate

* 1. Hotend:

The part of a 3D printer that melts the filament so it can be squeezed out through the nozzle to make print.

* 1. Direct drive:

The filament feeder is placed right on top of the hotend, so it pushes the filament into the nozzle directly.

Better control of flexible or special filaments (like carbon fiber blends).

Faster retractions (pulling filament back to avoid stringing).

Downside: the print head is a bit heavier, so very high-speed printing can cause more vibration compared to other systems.

* 1. Enclosed chamber:
  2. Keeps heat in → important for materials like carbon fiber nylon that warp if they cool too fast.
  3. Protects the print from dust or wind.
  4. Quieter and sometimes safer, since hot parts are harder to touch by accident.

* 1. Auto-level:

the 3D printer checks and adjusts the print bed’s height automatically before printing.

It uses a small sensor or probe to measure the bed at different points and then adjusts the nozzle’s movement so the first layer sticks evenly.

* 1. AI camera:

An AI camera in a 3D printer is a built-in camera that uses software to watch your print and spot problems automatically.

It can:

* 1. Detect failed prints or spaghetti-like messes.
  2. Pause the print or send you an alert.
  3. Let you monitor remotely from your phone or computer.

* 1. High-speed printing
  2. Stronger, lighter moving parts
  3. Stable designs (like CoreXY)
  4. Smart software that controls acceleration

* 1. Heated chamber
  2. Prevents warping and cracking in materials like carbon fiber nylon, ABS, or polycarbonate.
  3. Keeps the entire print at a steady temperature.
  4. Improves layer bonding, making parts stronger.

* 1. Dual extruder:

A dual extruder 3D printer has two nozzles (or two filament feeds) instead of one.

Print two different materials in one object (e.g., carbon fiber nylon + support material).

Print in two colors without swapping filament.

Use special dissolvable supports for complex shapes.

* 1. HEPA filtered

A HEPA filter in a 3D printer is a special air filter that traps tiny particles released while printing, especially with materials like carbon fiber, ABS, or nylon.

* 1. Removes ultrafine particles that can be harmful if inhaled.
  2. Keeps the air cleaner in your workspace.
  3. Often paired with an activated carbon filter to also remove odors.

* 1. Industrial FFF

Industrial FFF (Fused Filament Fabrication) is basically the heavy-duty, big-league version of regular desktop 3D printing, built for factories, engineering labs, and high-volume production rather than hobbyists.

* 1. FFF means printing objects by melting plastic filament and laying it down layer by layer.
  2. Industrial FFF is the same process, but with larger machines, higher precision, stronger materials, and full environmental control for consistent results.

* 1. Core XY with 7micrometer lidar
  2. CoreXY already gives speed and positional precision.

LiDAR with 7 µm precision adds **micron-level quality control** — making it possible to print parts with much tighter tolerances and catch print failures early.

This combo is often seen in **high-end or industrial printers** where dimensional accuracy is critical.

* 1. **LiDAR (Light Detection and Ranging):** Uses laser pulses to measure distances with extreme accuracy.
  2. **7 µm resolution:** This means the sensor can detect surface height changes as small as 0.007 mm — about 1/10th the thickness of a human hair.
  3. **In a 3D printer, LiDAR could be used for:**
  4. **Bed leveling** with ultra-high precision.
  5. **Live layer inspection** to detect defects or uneven extrusion.
  6. **Automatic model dimension verification** during printing.

* 1. Independent dual extrusion (IDEX)

**Independent Dual Extrusion (IDEX)** means the 3D printer has **two separate print heads (extruders)**, each mounted on its own carriage, that can move **independently** along the same axis.

* 1. Printing a model with **different colors**.
  2. Combining **flexible and rigid materials** in one print.
  3. **No cross-contamination** between filaments (e.g., no PLA dripping into PETG print).
  4. **Two-material printing** (e.g., rigid material + dissolvable support).
  5. **Two-color printing** without purge towers (because one nozzle is idle and parked).
  6. **Duplication mode:** Both heads print the same part at the same time for double output.
  7. **Mirror mode:** They print mirrored versions simultaneously.

Mobile app of QIDI Tech Q1 pro

### Key Features

* 1. **Remote Monitoring**: View real-time print progress and camera feed.
  2. **Remote Control**: Start, pause, or stop prints remotely.
  3. **Preheating**: Prepare the printer for printing from a distance.
  4. **Time-Lapse Photography**: Capture time-lapse videos of your prints.
  5. **Print History**: Access records of past prints.
  6. **Firmware Updates**: Update printer firmware directly through the app

19 August 2025

17:05

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Model** | **Price** | **Printing speed** | **Travel speed** | **Type of material supported** | **Dimensions** | **Software toolchain** | **IDEX** | **Special features** | **Extra points** | **Reviews & ratings** |
| Creality K1C | ₹65k – ₹85k | 600 mm/s (typical ~300 mm/s) | 500 mm/s observed | PLA, ABS, PETG, TPU, ASA, PA (Nylon), PC; plus carbon-fiber-enhanced options such as PLA-CF, PA-CF, PET-CF. | K1C:220 \*220 \*250mm | Creality Print, Creality Cloud (Open-source) | No | High-speed CoreXY printing at consumer price point | • Great balance of price & speed  • K1 Max has AI features for automation  • Consumer-friendly setup |  |
| Creality K1 Max |  | 600 mm/s (typical ~300 mm/s) | 800 mm/s |  | K1 MAX: 300\* 300 \*300mm |  | No |  |  |  |
| QIDI Tech Q1 pro | ₹2.0L – ₹2.2L | ~200–300 mm/s usable; up to 400 mm/s | Up to 600 mm/s | PLA, PETG, TPU, PVA, HIPS; high-temp/engineering materials like ABS, ASA, PC, PA (Nylon), plus CF/GF composites like PA-CF, PET-CF, PA12-CF. | 245 \*245 \*240mm | QIDI Studio, QIDI-Link (Proprietary) | No | Affordable enclosed printer with high-temp capability | • Strong customer support reputation  • Good for engineering-grade materials  • Lower price compared to similar enclosed printers |  |
| FlashForge creator 3 | ₹1.94L | ~50–60 mm/s (common default) | (some models up to 200 mm/s) | PLA, ABS, Nylon, PC, PA-CF (carbon-fiber composites), engineering composites. | 300 \*250 \*200mm | FlashPrint, Simplify3D support ( Proprietary) | Yes | Reliable IDEX system for true dual-material printing | • Widely used in schools & businesses  • Reliable for continuous dual-material jobs  • Slightly bulky but very durable |  |
| Fusion3 | ₹2L | Max 250 mm/s; default around 100 mm/s | Max 500 mm/s | Common: PLA, ABS, TPU, PETG, ASA; Uncommon: HIPS, PC, TPE, Nylon; with approval: PP, PVA, composite materials including carbon-fiber reinforced. | F306:  306 \*306 \*306mm  F400:  355 \*355 \*315mm  EDGE:  368 \*368 \*343mm | Reactor slicer, Simplify3D support (Proprietary) | No | Industrial reliability & large build volume | • Made in USA, focused on professional use  • Long-term reliability and uptime prioritized  • Higher cost, but great ROI for industries |  |
| Bambu Lab X1 Carbon | ₹1.45L – ₹2.37L | Capable of 500 mm/s | — (not specified) | Primarily PLA and PLA-compatible filaments; also supports dissolvable breakaway and AMS-assisted advanced composites such as PET-CF, PA-CF. | 256 \*256 \*256mm | Bambu Studio, Bambu Farm Manager (Proprietary) | No IDEX but Yes (AMS supports multi-material via single nozzle) | Ultra-fast printing with AI + AMS multi-material system | • One of the fastest consumer printers available  • AMS makes multi-color/material very easy  • Strong online community & ecosystem |  |
| Raise3D E2CF | ₹3.2L – ₹3.5L | 30–150 mm/s | 30–150 mm/s | Broad engineering-grade support: fiber-reinforced PLA, ABS, Nylon, PET, PPS, PET-GF, PETG, ASA, PC, PA12 CF and PA12 CF support materials. | Single extruder:  330\*240\*240mm  Dual extruder:  295\*240\*240mm | ideaMaker, RaiseCloud (Proprietary) | Yes | Specialized for carbon-fiber & composite materials | • Specifically tuned for fiber-reinforced filaments  • Excellent build quality & industrial support  • Higher learning curve, more pro-oriented |  |
| Snapmaker J1 IDEX | ₹1.7L – ₹1.8L | Up to 350 mm/s | ~350 mm/s | PLA, ABS, HIPS, PC, TPU (≥90 Shore A), TPE, PETG, ASA, PP, PVA, PA, PA-GF, PA-CF; also supports dissolvable/breakaway support materials. | 300 × 200 × 200 mm. | Snapmaker Luban  (Open-source) | Yes | Versatile IDEX with mirror & duplicate modes | • Also integrates with Snapmaker modular ecosystem (laser, CNC)  • Compact design with creative IDEX modes  • Great for hobbyists who want versatility |  |

* + **Breakaway support:** Extra material printed to hold up your model. You **break it off by hand** when done.
  + **Good:** Cheap, easy
  + **Bad:** Can leave rough spots
  + **Dissolvable support:** Extra material printed to hold up your model. You **put it in water or special liquid**, and it **melts away**.
  + **Good:** Leaves smooth surfaces, good for tricky shapes
  + **Bad:** More expensive, must keep filament dry

Stores available in

19 August 2025

18:22

|  |  |  |
| --- | --- | --- |
| **Printer** | **Store & Price (₹)** | **EMI Options & Notes** |
| **Creality K1C / K1 Max** | WOL3D via Amazon.in – ₹59,999 (with No Cost EMI from ₹2,895/month) ([Amazon](https://www.amazon.in/Creality-K1C-Printer-Anti-Vibration-Pre-Assembled/dp/B0CX544Z4V?utm_source=chatgpt.com)) | EMI clearly offered—helps spread cost over time. |
|  | Robu.in – ₹57,999 (no EMI info on page) ([Robu](https://robu.in/product/creality-k1c-3d-printer/?utm_source=chatgpt.com)) | Lowest price, but EMI not explicitly mentioned. |
| **QIDI Tech Q1 Pro** | Official Qidi Tech site – global purchase, no EMI for India ([Qidi Tech Online Store](https://qidi3d.com/products/q1-pro-3d-printer?srsltid=AfmBOoqPfiOHTy3RmCNnzI_bcR1qLfD1nc_Al50A82lehb-HRQ15WdgV&utm_source=chatgpt.com)) | Clear payment methods listed, but no EMI arrangements visible. |
| **FlashForge Creator 3** | Flipkart – ₹4,40,043 (Pro model) with EMI starting from ₹15,471/month ([Flipkart](https://www.flipkart.com/flashforge-creator-3-pro-industrial-independent-dual-extruder-3d-printer/p/itm4550a4e3d01e6?utm_source=chatgpt.com)) | EMI available with specific bank offers and tenure options. |
| **Fusion3 (F410 / EDGE)** | No Indian site found with stock or EMI info — likely available via import only. | EMI details not available; would require inquiry with importers or resellers. |
| **Bambu Lab X1 Carbon** | IndustryBuying – EMI available starting at ₹20,968/month (MRP ₹264,527) ([Industry Buying](https://www.industrybuying.com/3d-printers-bambu-lab-IND.3DP.927411728?utm_source=chatgpt.com)) | Clear EMI option for high upfront cost; good for managing budget. |
|  | WOL3D / Flipkart – ₹2,11,115 (combo) but EMI not shown ([Flipkart](https://www.flipkart.com/wol3d-bambu-lab-x1-carbon-combo-3d-printer/p/itmb5d429264a91e?utm_source=chatgpt.com)) | Out-of-stock currently; EMI unclear despite discount listing. |
| **Raise3D E2CF** | Robu.in and Desertcart list it, but without EMI details ([Robu](https://robu.in/product/raise3d-e2cf-idex-3d-printer-for-carbon-fiber-printing/?utm_source=chatgpt.com), [Desertcart](https://www.desertcart.in/products/422734337-raise3d-e2cf-carbon-fiber-idex-3d-printer?utm_source=chatgpt.com)) | No explicit EMI options mentioned; would likely require contact with seller or finance partner. |
| **Snapmaker J1 IDEX** | Amazon.in – ₹99,999 (with No Cost EMI) ([Amazon](https://www.amazon.in/3idea-Snapmaker-3D-Printer-Extruder-Structure%EF%BC%88J1s%EF%BC%89/dp/B0CTMVCKJ9?utm_source=chatgpt.com)) | EMI clearly offered on Amazon. |
|  | Flipkart – ₹1,92,556 with EMI from ₹6,770/month ([Flipkart](https://www.flipkart.com/snapmaker-j1s-idex-3d-printer-350mm-s-5x-faster-high-speed/p/itm490427c68a2fa?utm_source=chatgpt.com)) | Good EMI plan over long tenure (e.g. 36 months with specific bank). |
|  | Moglix – ₹145,999 (no EMI details) ([Moglix](https://www.moglix.com/snapmaker-j1-high-speed-idex-upgraded-2023-3d-printer-with-enclosure-reliable-print-size-300x300x200-mm/mp/msn858082e0l92?srsltid=AfmBOoqlcWDk3gJrnkbuCB9lAiu1I-gNKxmKcQ9BpgAoNb_nO2xBflqg&utm_source=chatgpt.com)) | Cheaper listed price, but EMI not shown; may need inquiry. |
|  | Desertcart – EMI available (unspecified) ([Desertcart](https://www.desertcart.in/products/539306653-snapmaker-j1-idex-3d-printer?utm_source=chatgpt.com)) | General mention that “Easy EMI available” – details may depend on checkout experience. |

Component Selection

12 August 2025

23:57