The 3D-Bioplotter® Process

Unique to the 3D-Bioplotter®

4th Generation 3D-Bioplotter® Manufacturer Series

4th Generation 3D-Bioplotter® Developer Series

Key Features of the 3D-Bioplotter®

Application: Bone Regeneration

Application: Drug Release

Application: Cell/Organ Printing & Soft Tissue Fabrication

Other Applications
3D Bioprinting - The Future Is Now!

The EnvisionTEC 3D-Bioplotter® system has been used since 2000 for a variety of medical applications. Most research done to date using our machines has been in the pre-clinical setting, yielding many publications by pre-eminent scientists from the materials science, neuroimaging, and toxicology disciplines. In the clinical setting, patient CT or MRI scans are used to create STL files to print solid 3D models which can then be used as templates for implants.

Tissue Engineering and Controlled Drug Release require 3D scaffolds with well-defined external and internal structures. The 3D-Bioplotter® has the capacity of fabricating scaffolds using the widest range of materials of any singular Rapid Prototyping machine, from soft hydrogels over polymer melts up to hard ceramics and metals. Complex inner patterns can easily be designed using the 3D-Bioplotter® software to both control the mechanical properties, increase cell adhesion, as well as improve the flow of nutrient media throughout the interconnecting pores of the printed implants.

Al Siblani - CEO EnvisionTEC
The **3D-BIOPLOTTER®** Process

**A simple process:**
A liquid, melt, paste or gel is dispensed from a material cartridge through a needle tip from a 3-axis system to create a 3D object.

**One single requirement:**
The material to be used must, through a physical or chemical reaction, solidify.

**A world of possibilities:**
The widest range of materials of any 3D printing technology can be processed.
Unique to the 3D-BIOHOPLOTTER® Process

- Uses raw materials (powder, pellets, etc.) without requiring a preprocessed filament.

- Medical-grade materials can be used.

- Designed for use in a sterile biosafety cabinet with built-in sterile and particle filters for the input compressed air.

- Materials are kept in sterilizable cartridges, thus avoiding touching the machine: easier to clean and sterilize.

- Each customer can create their own processing parameters.

- Not locked to any proprietary materials, customers can choose their preferred vendors, as well as required medical grades, mixture compositions and concentrations, additives, etc.
4th Generation 3D-BIOPLOTTER®
MANUFACTURER SERIES

- Designed both as a tool for advanced Tissue Engineering research, as well as for use in a production environment.

- Capable of using all hardware and software options of the 3D-Bioplotter Series.

- Includes heated platform and sterile filter, recommended for Cell Printing / Organ Printing.
<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Axis Resolution (XYZ)</td>
<td>0.001 mm (0.00004”)</td>
</tr>
<tr>
<td>Speed</td>
<td>0.1 - 150 mm/s (0.004” - 5.91”/s)</td>
</tr>
<tr>
<td>Pressure</td>
<td>0.1-9.0 bar (1.45 - 130 psi)</td>
</tr>
<tr>
<td>Build Volume (XYZ)</td>
<td>150 x 150 x 140 mm (5.91” x 5.91” x 5.51”)</td>
</tr>
<tr>
<td>Needle Position Control</td>
<td>Z-Sensor + High Resolution Camera</td>
</tr>
<tr>
<td>Camera Resolution (XY)</td>
<td>0.009 mm (0.00035”) per Pixel</td>
</tr>
<tr>
<td>Needle Sensor Resolution (Z)</td>
<td>0.001 mm (0.00004”)</td>
</tr>
<tr>
<td>Minimum Strand Diameter</td>
<td>0.100 mm (0.004”) - Material Dependent</td>
</tr>
<tr>
<td>Number of Materials per Scaffold</td>
<td>Maximum 5 Materials Using 5 Print Heads</td>
</tr>
<tr>
<td>Print Heads Included</td>
<td>1x Low and 1x High Temperature Head</td>
</tr>
<tr>
<td>Filters Included</td>
<td>Particle and Sterile Filters</td>
</tr>
<tr>
<td>Platform Temperature Control</td>
<td>Heating and cooling capable (-10°C to 80°C)</td>
</tr>
<tr>
<td>Platform Height Control</td>
<td>Automatic z-height controlling system</td>
</tr>
<tr>
<td>Material Calibration</td>
<td>Semi-Automatic Material Calibration</td>
</tr>
<tr>
<td>Additional Features</td>
<td>Automated nozzle cleaning process</td>
</tr>
<tr>
<td></td>
<td>4 external temperature sensor ports</td>
</tr>
<tr>
<td></td>
<td>Layer by Layer Photographic Log</td>
</tr>
</tbody>
</table>
4th Generation 3D-BIOPLOTTER®
DEVELOPER SERIES

- Designed for research groups new to the field of Tissue Engineering, as well as for specialized use, where the limited capability may still meet requirements.

- Consisting of the same basic hardware and software as the Manufacturer Series, but with reduced functionality regarding camera, build platform and park positions.

- Not upgradable to the same capability of the Manufacturer Series.
## Machine Specification

### Developer Series

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<tr>
<td>Pressure</td>
<td>0.1 - 9.0 bar (1.45 - 130 psi)</td>
</tr>
<tr>
<td>Build Volume (XYZ)</td>
<td>150 x 150 x 140 mm (5.91” x 5.91” x 5.51”)</td>
</tr>
<tr>
<td>Needle Position Control</td>
<td>Photo Sensor</td>
</tr>
<tr>
<td>Camera Resolution (XY)</td>
<td>-</td>
</tr>
<tr>
<td>Needle Sensor Resolution (Z)</td>
<td>0.001 mm (0.00004”)</td>
</tr>
<tr>
<td>Minimum Strand Diameter</td>
<td>0.100 mm (0.004”) - Material Dependent</td>
</tr>
<tr>
<td>Number of Materials per Scaffold</td>
<td>Maximum 2 Materials Using 2 Print Heads</td>
</tr>
<tr>
<td>Print Heads Included</td>
<td>1x Low Temperature Head</td>
</tr>
<tr>
<td>Filters Included</td>
<td>Particle Filter</td>
</tr>
<tr>
<td>Platform Temperature Control</td>
<td>-</td>
</tr>
<tr>
<td>Platform Height Control</td>
<td>Automatic z-height controlling system</td>
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</table>
Key Features **3D-BIOPLOTTER®**

- Input of outer shapes through STL files.

- Multi-part and multi-material capable through the use of an automatic tool changer and multiple print heads.

- Database of inner patterns (user-editable) in the controlling software, avoiding requiring patterns in the STL files.

- Database of materials (user-editable) with all process parameters.

- Individual temperature control of each printing head, both in the parking positions, as well as during printing.

- 2D Dot-Printing (Biopatterning) capability.

- Complete control of all printing parameters (temperature, pressure, speed, etc) through the software.

- Temperature curves with up to 5 set points and waiting times.
Low Temperature Print Head (0°C to 70°C) with disposable PE cartridges.

High Temperature Print Head (30°C to 250°C) with reusable stainless steel cartridges.

Automatic Platform Height Control for Petri Dishes, Well Plates, as well as other printing surfaces.

UV Curing Head (365 nm).

Needle cleaning station, with automatic cleaning before and during the print project available.

Luer Lock needle tips, 0.1mm to 1.0mm inner diameter available.

LOG file creation after project completion with all relevant data.

Footprint (L x W x H): 976 x 623 x 773 mm (38.4” x 24.5” x 30.4”)
Weight: 130 kg (286.6 lb)
Electrical Requirements: 100-240 V AC, 50/60 Hz
Compressed Air Requirements: 6 - 10 bar (85 - 145 psi)
**Application: Bone Regeneration**

- **Ceramic/Metal Pastes**
  - Hydroxyapatite
  - Titanium
  - Tricalcium Phosphate

- **Thermoplasts**
  - PCL
  - PLLA
  - PLGA

- **Sintering**
  - **Phase Transition**

**Sample Papers:**


Application: Drug Release

- Thermoplasts
  - PCL
  - PLLA
  - PLGA

Phase Transition

Sample Papers:
Application: Soft Tissue Fabrication
Cell Printing & Organ Printing

Hydrogels

- Agar
- Soy
- Alginate
- Chitosan
- Gelatin
- Hyaluronic Acid
- Fibrin
- Collagen

Phase Transition
2 Component System
Precipitation

Sample Papers:

### Other Applications

#### Other Materials

<table>
<thead>
<tr>
<th>Polyurethane</th>
<th>Silicone</th>
<th>Acrylates</th>
<th>Graphene</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase Transition</td>
<td>RTV 1</td>
<td>UV Curing</td>
<td>Evaporation</td>
</tr>
</tbody>
</table>

### Sample Papers:


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