BioScaffolder Product Overview

3D Prototyping, Cell Printing, and More

- Four independent Z-axes for maximum flexibility
- Pressure-controlled 3D printing, heatable extruder optional
- Piezoelectric ink-jet printing e.g. for printing cells or matrix proteins
- Numerous accessories

Just another 3-D printer? Look again. The GeSiM BioScaffolder 3.1 is probably one of the most flexible systems of its kind, featuring four independent Z-drives and a host of accessories to suit your needs.

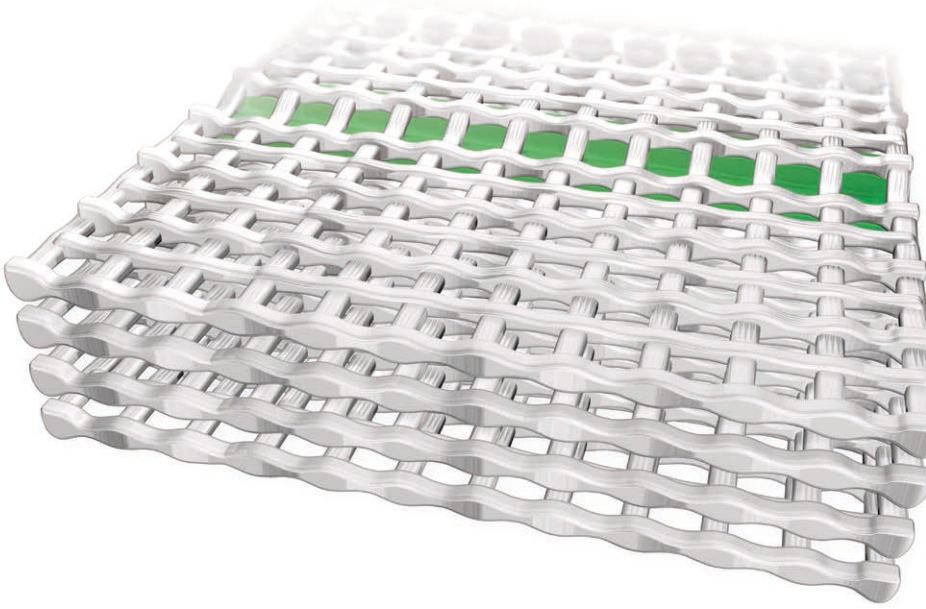
Three Z-axes exist for cartridges to print pastes such as hydrogels. Cartridges can be heated or used at room temperature. For even higher temperatures of up to 250 °C, a piston-based extruder is available.

What sets the BioScaffolder apart is the dosage of tiny droplets with GeSiM's piezoelectric ink-jet dispensers (again heatable and non-heatable), with which you can spot cells or proteins on top or between scaffolds. But other dispensers can be used as well, e.g. solenoid valve dispensers for adhesives.

Clever tools such as our easy-to-use Scaffold Generator to define simple geometries, substrate height measurement, tip alignment and tip cleaning complete the machine.

There is a long and growing list of accessories. To name a few: CAD import, cooling/heating of microplates and target holders, dispensing of core-shell structures and melt electrospinning.

Contents
BioScaffolder



BioScaffolder – Basic Configurations

Article Number	Description	Figure
	Main Units	
A053-104	BioScaffold Printer with 3 cartridges; 4-axes instrument for printing of bioscaffolds, no piezo	(●)
A053-105	BioScaffold Printer with 3 cartridges / Piezo-axis; 4-axes instrument for printing of bioscaffolds, with piezo pipetting unit	●

You can choose between systems with and without liquid dispensing, usually by a piezo-electric ink-jet print head. Other options can be a solenoid valve dispenser e.g. for glues, or a "passive" dispenser consisting of a steel capillary and actuated by a syringe pump.

The minimum scope of delivery is:

- XYZ precision robotic stage
- 3 Z-axes for head tools (–> total number of Z-axes: 4)
- 2-fold pneumatic/fluidic control (in Fluidic Box = F-Box)
- 3-axis light barrier for **automatic XYZ offset correction** for each dispensing tool
- Automatic cleaning brush for dispense needles ("tip cleaner")
- Additional Z-axis for a **Z-level sensor** and operation of an optional dispense tool
- Windows® 10 computer, pre-configured
- Software:
  - Graphical user interface for instrument control (manual/automatic)
  - **Scaffold Generator** for design of simple 2- and • 3-dimensional geometric bodies (circles, polygons, with tapering)
  - Option: **CAD import** of STL files with many choices: strand distance, patterns, automatic centring, strand editing etc.
- Manuals

The fourth Z-axis in the front is reserved for a sensor that measures the height of substrates to print on. A configuration with only three total Z-axes is not available because the price difference is insignificant and upgrading would not be possible.

The front axis can also hold a liquid dispenser. If a **piezo pipette** is present, additional fluidic components are needed:

- Syringe pump module with 3-way valve, in front panel of F-Box
- Teflon tubing for liquid transport to and from the dispenser
- Internal pumps and valves and silicone tubing for general liquid handling, e.g. washing
- Liquid level sensors, for maintaining the level in the PCV and safety stop when the reservoir is empty or the waste bottle full
- Piezo pipetting unit with stroboscope (for function test), wash bowl and dry pad

Two-fold pneumatic control means that two different pressures can be applied at the same time. This is important for simultaneous printing of two different materials, e.g. for core-shell strands. In normal operation (delivery of single pastes), the pressure is adjusted for the active cartridge before printing.

Prices are net prices; delivery is Ex Works (Incoterm: EXW), so shipping and import taxes must be taken care of by the customer. Installation and training are also charged extra. If you do not buy the piezo option, set-up can be done by you using the manual, as the software is pre-installed on the computer, described in the manual and easy to use. Installation of the delicate piezo dispenser and its accessories is more difficult and so this should be done by an expert.

A053-105 *BioScaffolder 3.1 with piezo dispenser, completely assembled (computer not shown) and connected to compressed air. A053-104 is similar, but without the piezo pipette on the front Z-axis and also lacking all fluidic periphery (tubes, bottles and level sensors) From left to right: main robotic unit, pressure compensation vessel (PCV), F-Box (containing electronic/pneumatic/fluidic controls), and rack for system fluid and waste bottles. Capacitive sensors to control the liquid level are placed beside each bottle; PTFE tubes go to the pipette and silicone tubes are for general liquid handling. Tubes for compressed air have outer diameters of 6 and 4 mm. An optional UV lamp sits on top of the F-Box.*

The Many Tools of the BioScaffolder

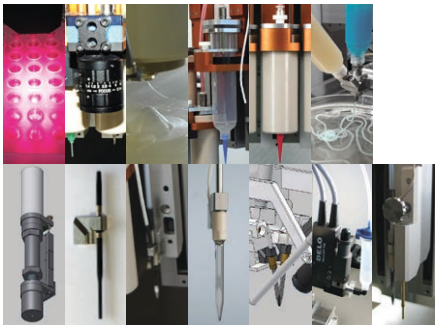
The uniqueness of the system becomes apparent when one lists all the available tools, be it on the print head or elsewhere in the machine.

The following sections will present the many tools and their accessories in detail, either to configure a new system, to upgrade an existing one, or as a list for spare parts.

Our other instruments based on the same platform (µCP, BSys) bear additional tools that may also be used on the BS3.1. Also watch for more tools in the future. We develop new tools for you; please inquire.

Tool Number	Head Tools
1	UV lamps
2	Camera
3	Melt electrospinning writing
4	Cartridge holders for pastes, not heated
5	Cartridge holders for pastes, heated
6	Core/shell dispenser
7	Cryo cartridge dispenser (4 °C)
8	High-temperature extruder (250 °C)
9	Dosage capillary (“passive” dispenser)
10	Non-contact liquid dispensers, heated
11	Non-contact liquid dispensers, not heated
12	Twin-tip piezo dispenser
13	Adhesive dispenser (PICOxMOD, DELO-DOT)
14	Z-sensor

Tool Number	Further Instrument Tools
1	Target holders (removable)
2	Source plate holder, heatable (60 °C)
3	Source plate holder, not heatable
4	STL import software



Various head tools

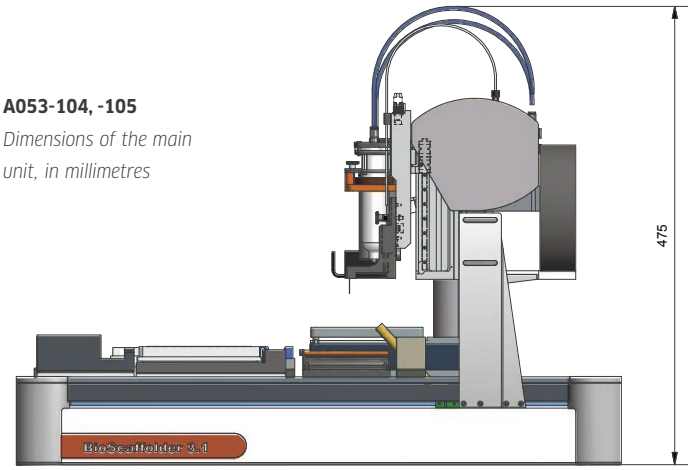
Set-up Requirements

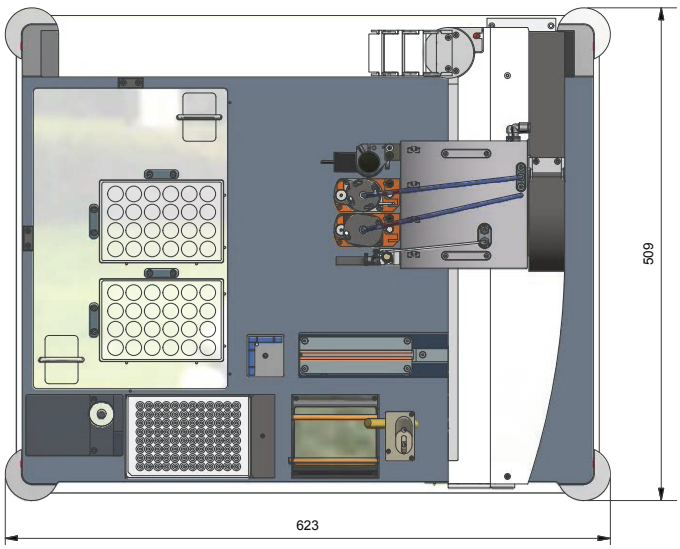
- Electrical power of 115 to 240 V AC, 50/60 Hz. If power outlets inside the biological safety cabinet (BSC; or laminar flow box) are used, make sure their amperage is high enough.
- Windows® computer connected via Ethernet and USB cables (included and **pre-configured**). WiFi or wire connection (please specify) to Internet required for remote software updates.
- Compressed nitrogen/air, either from house gas, a tank or a small compressor (to be ordered separately), filtered and adjusted to at least 7 and max. 10 bar (0.7 – 1 MPa or 100 – 150 psi) via pressure reducing valve.
- The connector on the air outlet must be of the same type as on the front of the F-Box, otherwise an adapter is needed.
- Before set-up, a BSC must be ready or a containment ordered. Allocate sufficient

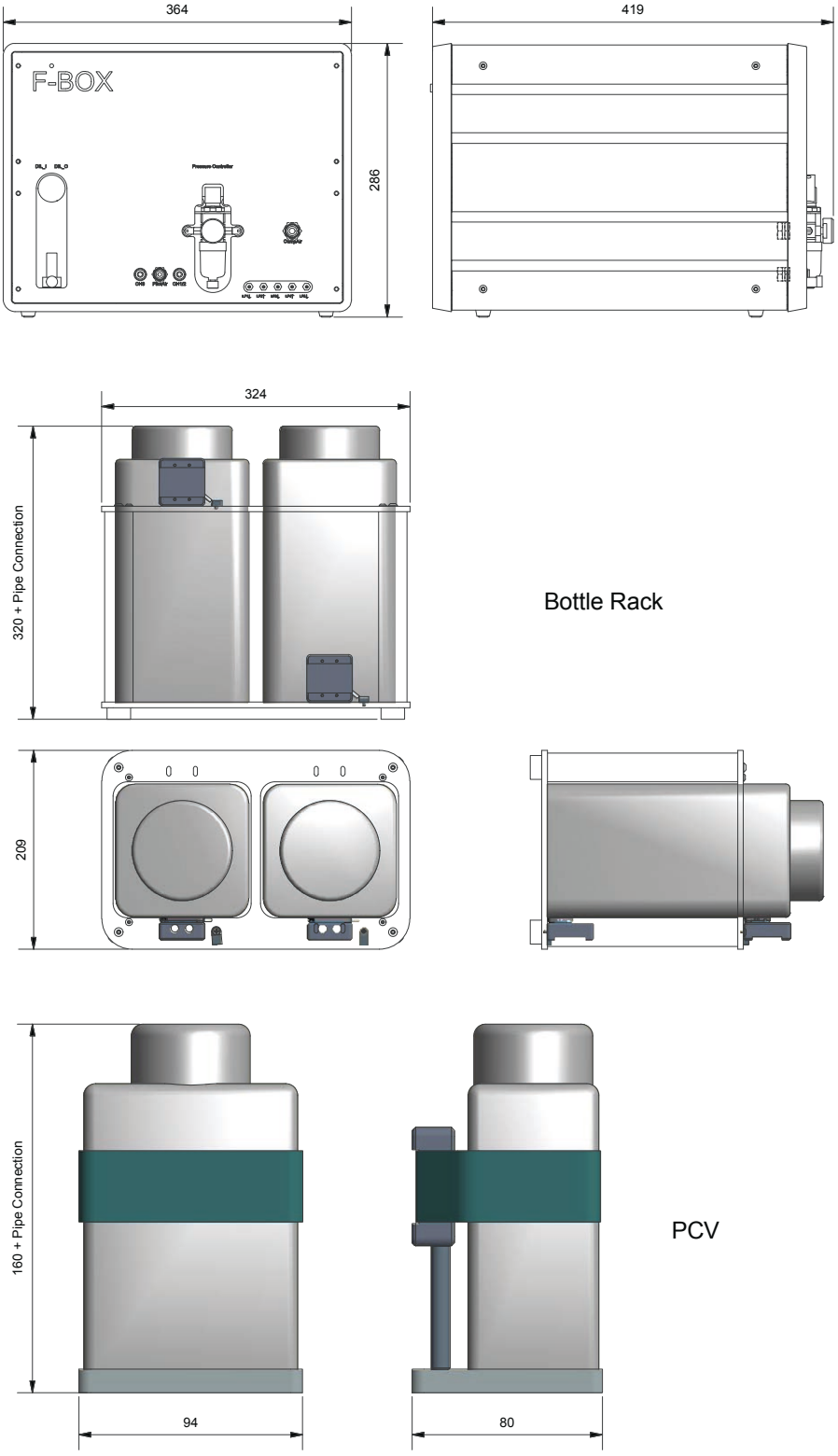
Connector for compressed air. An OD 6 mm tube (quarter inch = 6.4 mm is too thick!) is inserted into the blue opening. For release, press the ring.

A053-104, -105

Dimensions of the main unit, in millimetres







A053-104, -105 *Dimensions of F-Box and racks for 4-litre reservoir/waste bottles and PCV, in millimetres*

space for the main unit in the hood and for F-Box and computer. Please contact GeSiM early so that the configuration can be adapted to your lab conditions.

The system consists at least of main unit and F-Box. Because of tubes and cables, the depth of the BSC must be larger than the depth of the main unit (51 cm); an inner space of 60 cm (2 ft.) is found in many safety cabinets.

About 8 cm for plugs on the rear side of the F-Box and some space for the pneumatic/ fluidic connections on the front panel are needed, so its total depth is about the same as that of the robotic unit.

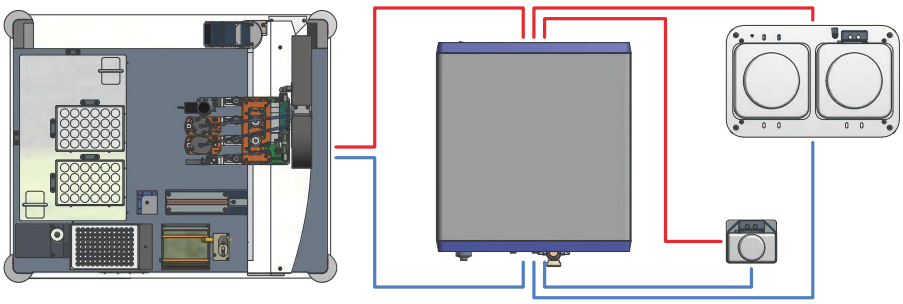
Main unit and F-Box can be inside the hood, but for small BSCs the F-Box can be placed outside. Plugs (> 5 cm long) are on the right side of the main unit, so the main unit is normally on the left and the F-Box on the right. If the F-Box is on the left (still inside flow box), the data cable must be two metres long.

For the piezo dispenser, racks with bottles (reservoir, waste, pressure compensation vessel = PCV), connecting tubes and sensor cables are added. Do not put bottles on the F-Box.

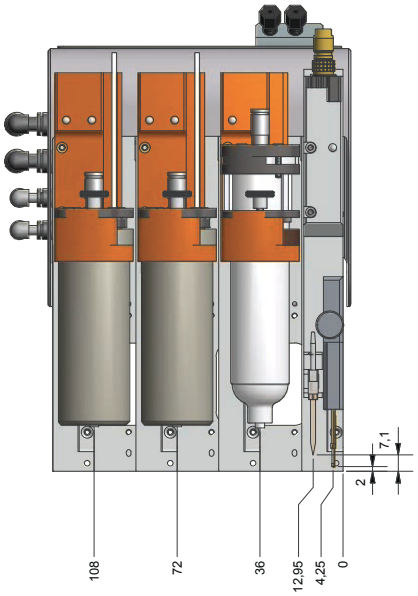
All units are placed in a row. Use a 4-foot or 5-foot cabinet (120/150 cm width without/ with bottles) to put everything inside.

If the F-Box is outside the hood, the cable port in the right window must be larger than the data cable plug (55 mm = 2.25”). The data cable between F-Box and main unit can be one or two meters long. Place computer on the same side or use extra-long cables; Ethernet and USB cables can be between one and five meters long.

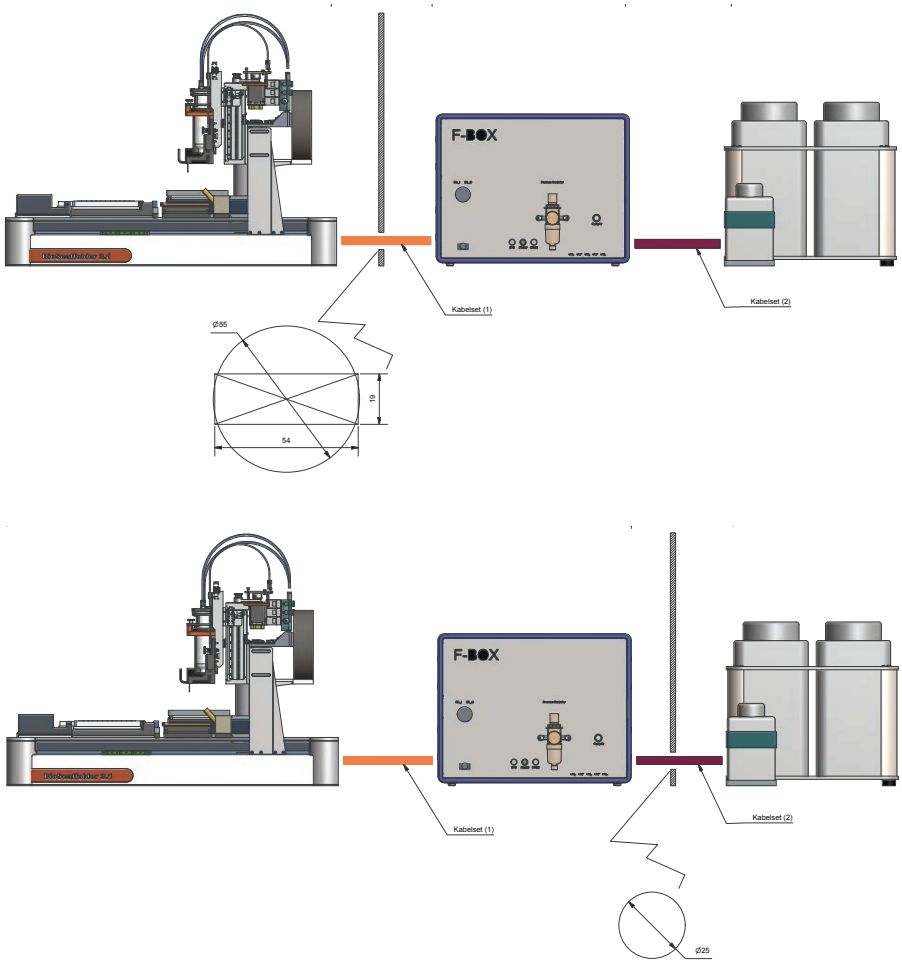
If the F-Box is outside the laminar flow box, but all bottles must be inside for sterility, the silicone tubes must be longer (important when ordering).



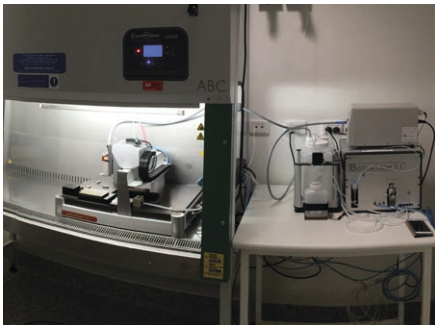
A053-104, -105 *Typical arrangement: main unit left, F-Box right, plus bottles. Blue: tubes; red: cables.*



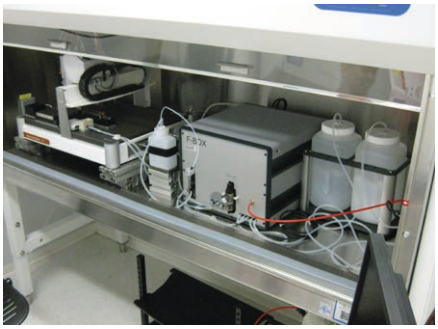
A053-104, -105 *Positions of dispensing tools on the print head, in millimetres*



A053-104, -105 *Two options to place the instrument in a BSC. Either F-Box and bottles are outside or only bottles. To put everything inside, the BSC must be quite large. The minimum diameter for the cable port is 55 or 25 mm, respectively.*



A053-105 *BSC with only main unit inside (typical configuration)*



A053-105 *BSC with everything inside*

Tools on the Print Head

Optical Systems

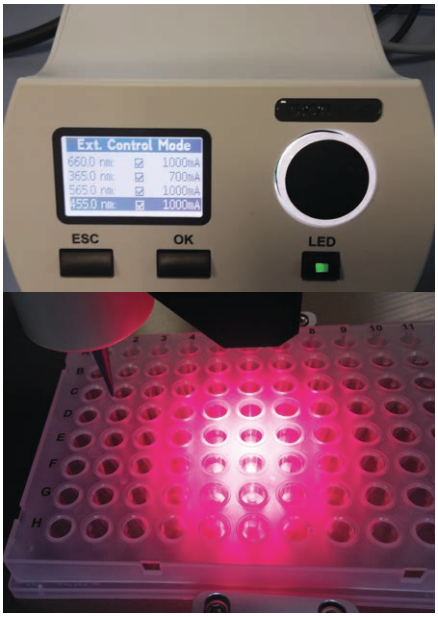
Ultraviolet light is used for the cross-linking of certain polymers. GeSiM offers different external UV lamps, e.g. the OmniCure 200 W mercury vapour lamp, with external control unit operating at different wavelengths and triggering via a cable plugged into the F-Box. The optical fibre from the lamp (included) is inserted in a holder/adapter on one of the cartridge holders (included), typically on the rear one.

You can also use your own lamp; this is then adapted to the system. In that case, we need the lamp for testing, otherwise correct function cannot be guaranteed.

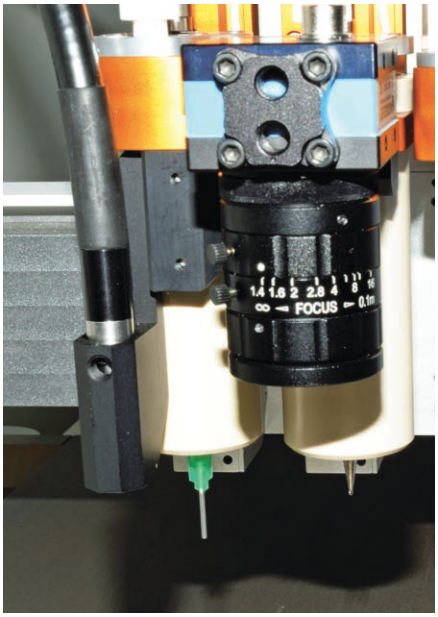
The software allows automatic positioning of the Z-axis holding the UV fibre above the specimen for a pre-set time.

Article Number	Description	Figure
	Optical Systems	
A051-124	Camera system for cartridge holder, without lens, for monitoring	●
A051-130	UV Source "Omnicure S1500"; delivery: external control unit, optical fibre on the print head of the BS3.1, selectable bandpass filter for adaptation to different wavelengths (please specify with your order)	●
A051-131	4-fold LED lamp (Thorlabs) 365/455/565/660 nm; delivery: four-wavelengths high-power LED lamp, holder to attach lamp head to BS3.1 cartridge frame	●
A051-132	Adapter Kit for UV Source for BS3.1; fits to cartridge axis: holder for light guide fibre, trigger cable for UV source OmniCure S1500 (UV source not included)	●
A051-133	Light fibre 3 m, D5 (for UV lamp OmniCUre S1500)	(●)

A051-130 *OmniCure 1500 UV lamp with optical fibre*



A051-131 *Thorlabs LED lamp, control unit (top) and UV light produced by it on a microtitre plate (bottom)*



A051-132, -133 *Optical tools in front of cartridge holders on two Z-axes: camera system for monitoring (right) and adapter for optical fibre (left)*

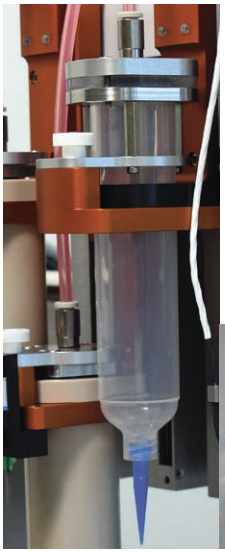
Dispensing Systems for Pastes: Cartridges, Extruders and More

Except when using an extruder, pastes are delivered from disposable plastic cartridges using **compressed air**. Cartridge holders with or without heaters are mounted on the Z-drives. Polycaprolactone (PCL), melting around 70 °C, can be easily delivered using compressed air and a cartridge with our standard heater. As the polypropylene material that is used for disposable cartridges flows at higher temperatures, an all-metal cartridge system (manufactured by GeSiM) is recommended for higher temperatures; this is then non-disposable.

For temperatures significantly above 100 °C, e.g. to melt biodegradable polymers such as poly-L-lactic acid (PLA/PLLA), we recommend GeSiM's new piston-based **extruder** for temperatures of up to 250 °C. A cooling cartridge holder is also available.

A nozzle for the dispensing of **core-shell** strands from two cartridges is available. As materials with different viscosity must be delivered, a special version of the software must allow simultaneous control of two different pressures. Hardware reconfiguration is not necessary, as all BioScaffolders come with two separate pressure systems.

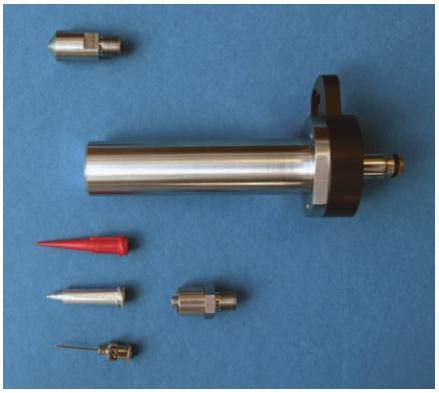
Article Number	Description	Figure
	Cartridge Holders and Accessories for Paste Delivery	
A051-205	Holder for 30 ml cartridges, without temperature control; air tube for print head, bayonet lock	●
A051-210	Cartridge heater for 10 ml cartridges, for BioScaffold Printer; temperature range: RT...120 °C	●
A051-212	Stainless steel cartridge 10 ml, for BS3.1; fits to cartridge heater, connector for pressurized air system	●
A051-213	Luer-Lock adapter for stainless steel cartridge, for A051-212 only; connects standard nozzles with Luer-Lock adapter to the GeSiM stainless steel cartridge (A051-212)	
A051-240	Heat insulation for heatable metal nozzles	●
	Cartridges and other Disposables	
A051-661	Cartridge with Piston 10 ml, 1 pc.; for Bioscaffold Printer BS2.1/BS3.1, manufacturer Nordson-EFD, white, opaque	●
A051-662	Cartridge with Piston 30 ml, 1 pc.; for Bioscaffold Printer BS2.1/BS3.1, manufacturer Nordson-EFD, white, opaque	●
A051-690	Dispense needle 0.25 mm, conical, aluminium; with Luer-Lock	(●)
A051-691	Dispense needle 0.3 mm, conical, aluminium; with Luer-Lock	(●)
A051-692	Dispense needle 0.4 mm, conical, aluminium; with Luer-Lock	(●)
A051-702	Dispense needle 0.25 mm, stainless steel; for steel cartridge A051-212 only	(●)
A051-704	Dispense needle 0.4 mm, stainless steel; for steel cartridge A051-212 only	(●)
	Accessories for Cartridges	
A051-870	Connection set for pressurized air, for 10 ml cartridges: clamping jaws for 10 ml cartridges, upper and lower part, fixation screws, 4 pcs., 10 ml cartridge with plunger	●
A051-875	Sealing ring for stainless steel cartridge	
A051-876	Stainless steel cartridge without clamping jaws – replacement part –	●
	Special Dispensing Tools for Pastes	
A051-230	Core/Shell Dispenser, pneumatic 2-channel extruder; accommodates 10 ml cartridges to dispense two different materials, requires pair of steel nozzles (not included)	●
A051-721	Pair of dispense nozzles, for core/shell extruder; pair of stainless steel nozzles with specific diameters	(●)
A051-235	Cryo Cartridge Dispenser 10 ml, with Peltier cooler, Tmin. 4 °C (4 °C, available 2017)	
A051-253	High Temperature Extruder, Tmax. 250 °C; worm-gear driven extruder system with piston (available 2017)	●



A051-205 *Holder (metal) for 30 ml cartridges without heater, including bayonet lock, built into the BS3.1 print head (left) and disassembled (bottom)*

A051-661, -870 *Disposable cartridge (on the right, shown without piston) and connector unit for compressed air (contains gasket)*

A051-210 *Holder for 10 ml cartridges with heater and cable; for up to 120 °C. Inset: heat shield for metal nozzles (A051-240), which is connected to the bottom of the heatable holder via four small screws.*

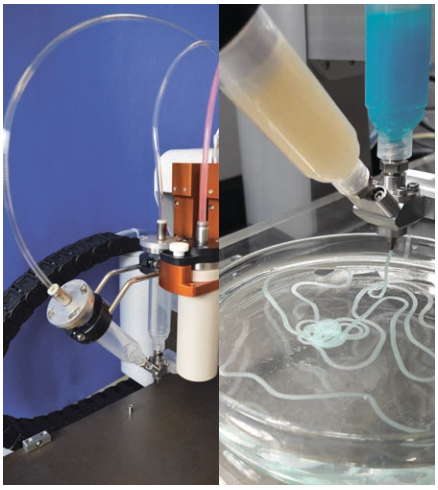


A051-212, -213, -876 *Stainless steel cartridge 10 ml, with connector and other suitable accessories such as heatable/non-heatable conical dispensers, needle and Luer-Lock adapter. Article no. without air connector: A051-876.*

A051-662 *Disposable cartridge 30 ml (without piston)*

The core/shell nozzles can have the following combinations:

- Large core/shell nozzle pair: 2500 µm core / 5000 µm shell
- Small nozzle pairs:
  - 800 µm shell: 100, 150, 200, 300 or 400 µm core
  - 610 µm shell: 100, 150, 200 or 300 µm core
  - 330 µm shell: 100 or 150 µm core



A051-230, -721 *Core-shell dispensing unit (non-heatable) with two 10 ml cartridges on the rear Z-axis (left) and during printing (right)*

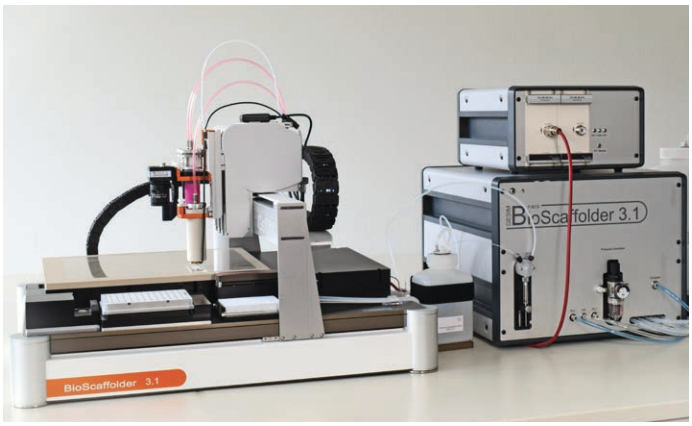
A051-253 *High-temperature extruder for up to 250 °C*

Melt Electrospinning Writing

Melt electrospinning (MES), i.e. dispensing of polymers at high voltage, produces very thin wires, much thinner than can be produced by normal delivery. Whereas normal (non-directed) MES is capable of delivering fibres in the nanometre range, melt electrospinning writing, i.e. the generation of geometric forms using an XYZ robotics, can go down to approx. 10 µm, which has been shown for the GeSiM BioScaffolder. This is a technique asked for by biologists, as the structures are very porous, which is cell-friendly, but due to the small thickness, the build-up of structures is very slow.

Prerequisite for melt electrospinning is a suitable polymer (e.g. long-chain polycaprolactone, PCL50; but others can be used too, check), compressed air at different (high/low) pressures, and a cartridge heater (around 80 °C for PCL50). Please note that the collector plate onto which the structure is printed is positively or negatively charged and the nozzle at the print head must be metallic and grounded. Due to the extremely low current, operation is generally safe. However, the electronics of delicate instruments may be damaged.

Article Number	Description	Figure
	Melt Electrospinning Writing	
A051-261	Melt Electrospinning Dispense Module	●



A051-261 *MES dispense module, consisting of high-voltage power supply on F-Box (controlled by software), insulated collector plate laid on the robotic unit, grounded counter electrode (metal tip) on cartridge holder and HV cable (red)*

A metallic cartridge must be used.

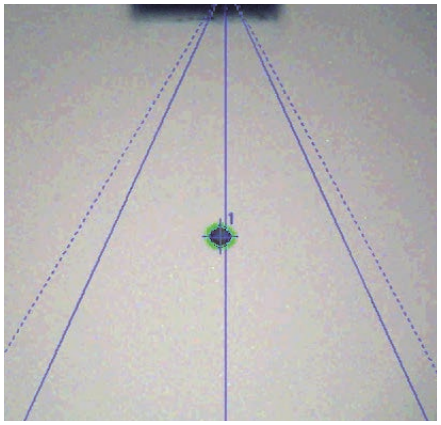
Scope of delivery:

- High-voltage power supply 2 channels (+30 kV/ -30 kV)
- Insulated target holder with ground electrode
- Counter electrode for one dispense cartridge
- Safety switch for assembly to the sterile work bench

(Non-Contact) Liquid Dispensers

Dispensers for liquids are usually mounted on the front Z-drive. Options are:

- A "passive" dosage capillary for displacement dispensing driven by a syringe pump. The tip is not disposable (no automatic throw-away, tip must be washed)
- "Active" piezo dispensers (heatable and non-heatable) delivering tiny droplets in the sub-nanolitre range; for cell suspensions, matrix or signal proteins etc.
- Adhesive print heads (see below)

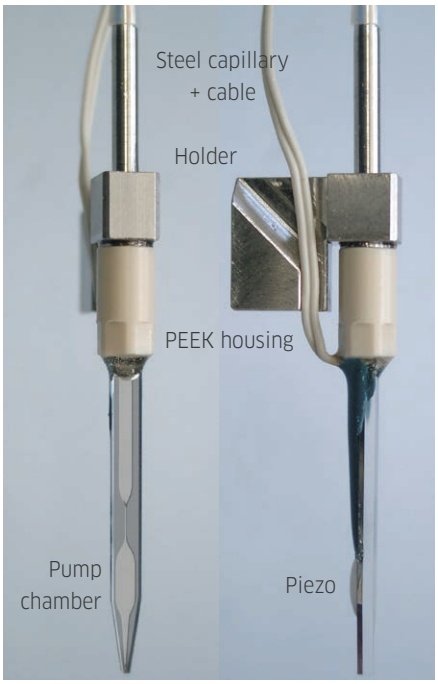


Stroboscope image of a flying droplet ejected by a piezo dispenser and identified by the software

with an cable adapter (see below), as long as they need not be heated.

Liquid dispensing needs a complete fluidic periphery filled with "system liquid" (MilliQ water), see drawing below:

- Syringe pump with 3-way valve for fluid aspiration and tip washing from inside
- A "pressure compensation vessel" (PCV) that is connected to the piezo tip during dispensing to protect the nozzle from running dry
- Bottles for system fluid and waste
- PTFE (Teflon) tubes from the pressure compensation vessel (PCV) via the syringe pump to the pipette on the print head
- Silicone tubes for fluidic system 1 for general liquid handling, e.g. pipette washing from outside and replenishing the PCV
- Capacitive sensors that help maintain the liquid level in the PCV as well as protecting system liquid and waste bottles from running dry and overflowing, resp.
- Filters protecting the pipette from particles: 2 µm frit mounted on print head, 20 µm frits inside reservoir and PCV
- Piezo pipetting unit with piezo controller, stroboscope (for function test; connected to computer via USB cable), wash bowl and dry pad



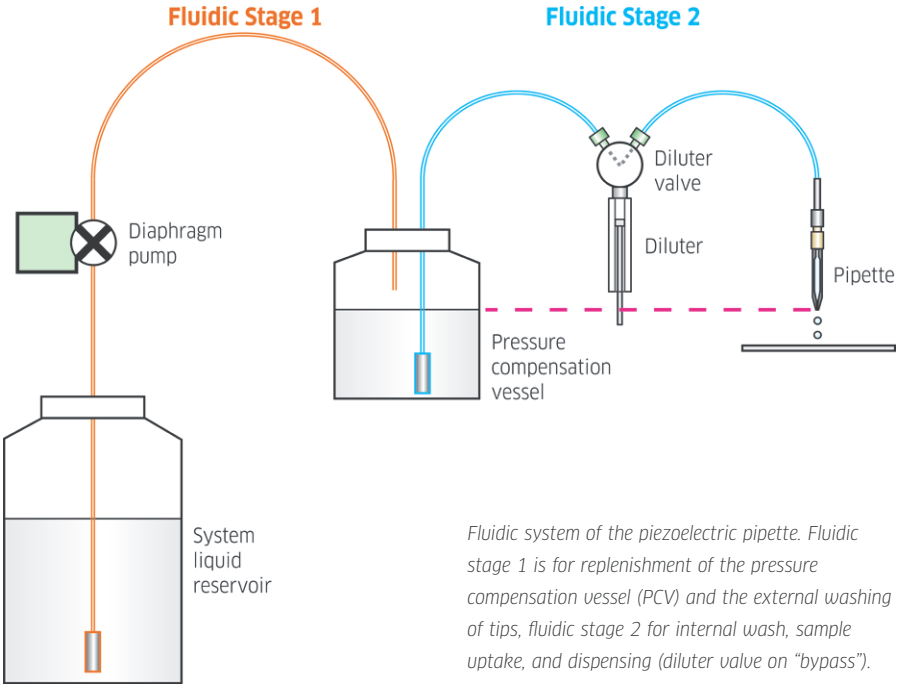
A070-401 *Nano-Tip, front and side view; silicon and glass layers and the silicone cover on the piezo actuator can be seen (overall size of Pico-Tip identical)*

Piezo dispensers, which have no internal valves, are available for two droplet sizes:

- **Nano-Tip** for droplets of ca. 350 pl (range: 300–650 pl; orifice size 50 µm)
- **Pico-Tip**, ca. 60 pl (range: 50–90 pl; orifice size 25 µm)

For larger volumes, more droplets per spot are dispensed at max. 1000 Hz and a dynamic viscosity of max. 5 mPa·s. For higher viscosities without heating (corresponding to ca. 50% glycerol), the **Nano-Tip HV** is available.

Piezo tips contain a high-precision mounting pad (type "J") with which they are quickly mounted using one screw, and they are delivered in a shipment box. Nano-Plotter dispensers (e.g. the **Nano-Tip A** with 250 pl droplets or extra thin tips type "R"; inquire for details) can be used in the BioScaffolder



Fluidic system of the piezoelectric pipette. Fluidic stage 1 is for replenishment of the pressure compensation vessel (PCV) and the external washing of tips, fluidic stage 2 for internal wash, sample uptake, and dispensing (diluter valve on "bypass").

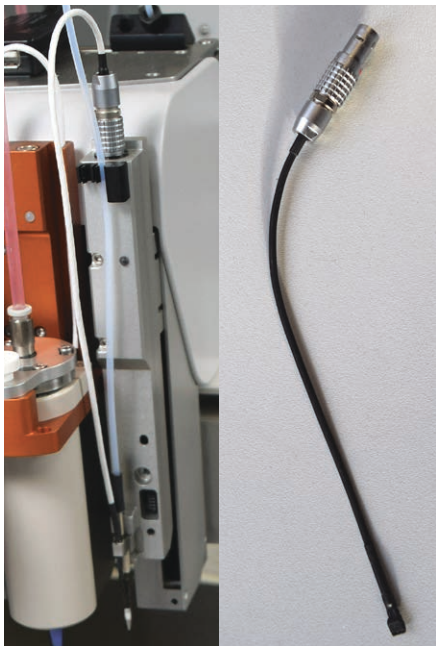
BioScaffolder
Product Overview

Parts can be ordered separately. Frits and some tubes should be replaced once a year (see below).

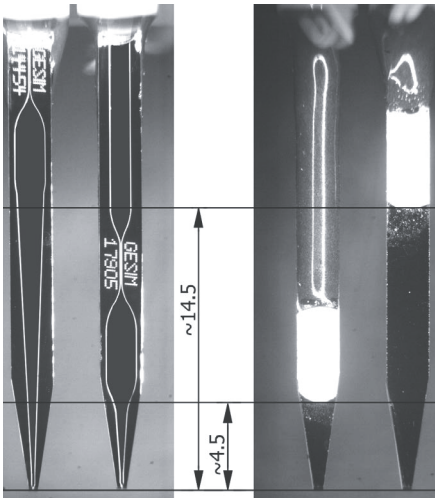
Typically BioScaffolder piezo dispensers are heated. If heating is not required, a piezo tip from the large collection from our microarrayer, Nano-Plotter, with shorter cable is available; for this an adapter to the socket on the Z-drive is required.

Article Number	Description	Figure
	Heatable Piezo Dispensers and Accessories	
A051-184	Dosage capillary ID 0.8 mm (stainless steel, PTFE-coated); inner diameter 0.8 mm, for displacement dispensing, , no disposable tip, no automatic throw-away, tip has to be washed	●
A051-271	Piezoelectric Pipetting Tip Nano-Tip J-H, heatable; drop volume about 300 pl	●
A051-272	Piezoelectric Pipetting Tip Pico-Tip J-H, heatable; drop volume about 60 pl	(●)
A051-274	Piezoelectric Pipetting Tip Nano-Tip HV-J-H, heatable; drop volume about 300 pl, for more viscous liquids	(●)
A051-750	Cable adapter for non-heated piezoelectric tips (not needed for heated piezo tips)	●
	Nano-Plotter Piezoelectric Tips (not Heatable)	
A070-301	Nano-Tip TGJ (ca. 400 pl; thin glass at the tip)	●
A070-401	Nano-Tip J (ca. 400 pl)	●
A070-402	Pico-Tip J (ca. 60 pl)	(●)
A070-403	Nano-Tip J, ground/sharpened tip	●
A070-404	Pico-Tip J, ground/sharpened tip	(●)
A070-502	Nano-Tip J, extra-long nozzle	●
A070-503	Nano-Tip A-J (ca. 250 pl)	(●)
A070-504	Nano-Tip A-J, ground/sharpened tip	
A070-505	Nano-Tip HV-J, high viscosity	
A070-506	Nano-Tip AR-J (bevelled, slim design for spotting into 96-well plates)	●
A070-507	Nano-Tip R-J (bevelled, slim design for spotting into 96-well plates)	(●)
A070-508	Pico-Tip R-J (bevelled, slim design for spotting into 96-well plates)	(●)
A070-509	Nano-Tip HV-R-J (high viscosity, slim design for spotting into 96-well plates)	(●)
A051-280	Twin-Tip Piezo Dispenser; without piezo tips, these have to be ordered additionally	●

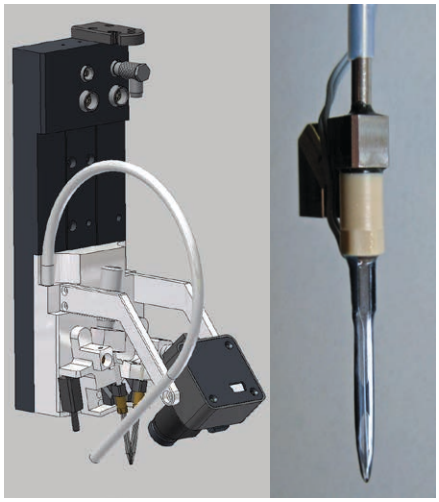
A051-184 *Dosage capillary ("passive" tip) for bulk volumes; it is no disposable and has to be washed between different samples*



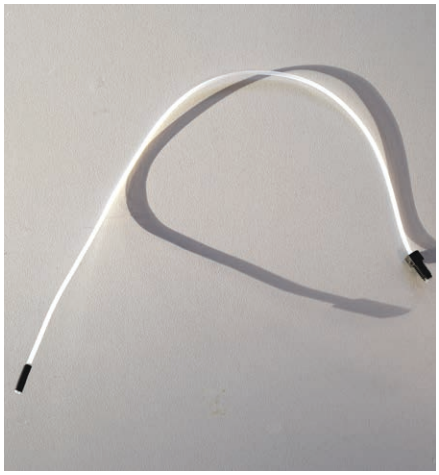
A051-271, -750 *Left, heatable Nano-Tip J-H on the front Z-axis of the BioScaffolder 3.1, with cable for piezo actuation, heating and heat measurement. A051-272 (Pico-Tip H-J) looks similar. Right, cable adapter for non-heatable piezo tips.*



A070-401, -502 *Normal Nano-Tip and Nano-Tip with extra long nozzle, dimensions in mm. The white silicone cover on the piezo actuator is seen on the back side. In A070-502, the piezo is farther away from the nozzle and does not dip into solvents.*

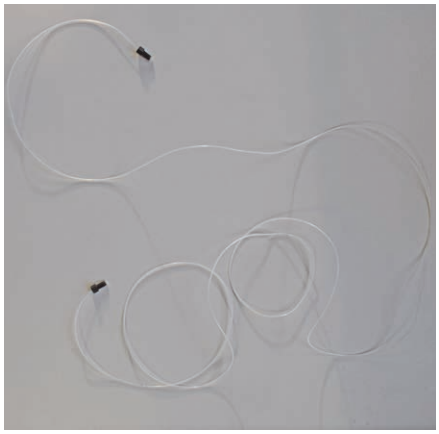


A051-280, A070-506 *Left, Twin-Tip Piezo Dispenser for mixing of droplets in flight, with control camera. Right, extra thin Nano-Tip AR-J (A070-507/508/509 similar).*

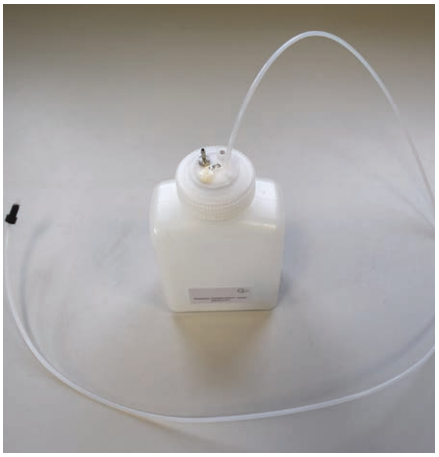


A051-802 *PTFE tube running from the print head to the pipette tip*

Article Number	Description	Figure
	Tubes and Bottles for Piezo Dispensers	
A051-802	Pipet tube for piezoelectric tips, PTFE	●
A051-803	Tube diluter -> main unit, for pipet tip connection, PTFE	●
A051-804	Tube PCV -> diluter, PTFE	●
A051-807	UNF connector 1/4-28, for PTFE tube (adapter to connect two male fittings)	●
A051-825	Silicone tubes complete set; delivery: silicone tube F-Box -> wash bowl, silicone tube wash bowl -> F-Box, silicone tube system liquid tank -> F-Box, silicone tube F-Box -> waste tank, silicone tube F-Box -> pressure compensation vessel (PCV)	●
A051-840	PC vessel complete, pressure compensation for piezoelectric tip	●
A051-845	System liquid reservoir complete, 4 litres	●
A051-850	Waste reservoir complete, 4 litres	●
	Dispensers for Adhesives	
A051-215	PICOxMOD Microdosage Head, for volumes from 0.003 mg; contains PICOxMOD microdosage head (Nordson), adapter for BS3.1 Z-axis	●
A051-217	DELO-DOT PN2 Dosage Head, for volumes from 0.02 mg; delivery: DELO-DOT PN2 dosage head (heatable up to 100 °C), adapter for BS3.1 Z-axis, nozzle with Luer-Lock adapter	●



A051-803 *PTFE tube between diluter and main unit*



A051-804, -840 *PTFE tube between PCV and diluter in pressure compensation vessel (complete)*

A051-807 *UNF connector 1/4-28, connects two male fittings between the BS3.1 robotic unit and A051-803*

A051-825 *Complete silicone tube set for fluidic stage 1*

A051-845, -850 *Wide-mouth reservoirs (complete) for system liquid and waste, 4 litres, in their rack (rack not included)*

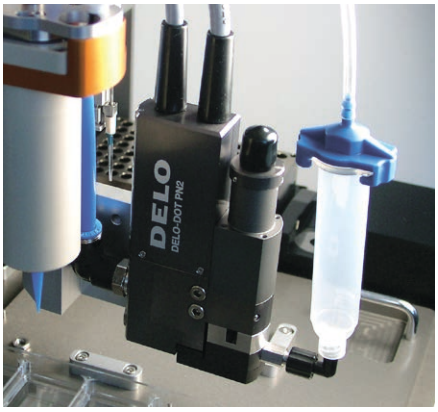
Another option for droplet delivery, albeit at volumes far exceeding 1 nanolitre, are adhesive dispensers for very viscous thixotropic fluids. They deliver liquids using compressed air and opening and closing a piezo or a solenoid valve. Please see more detailed information on the websites of the valve manufacturers.

Scope of delivery for the adhesive dispensers:

- Micro-dosage head
- Adapter for BS3.1 Z-axis (mount)
- Nozzle
- Control unit

For drops in the 100 nl range, we created a glass capillary dispenser with solenoid microvalve from The Lee Company that can aspirate samples from a microtitre plate. This dispenser needs extra pressure regulation, extra electronics and a modified PCV for dispensing. Please inquire if and when this becomes available for the BioScaffolder.

A051-215 *PICOxMOD microdosage head from Nordson*



A051-217 *DELO-DOT PN2 dosage head with solenoid valve, heatable, built into BS3.1*

Other Tools

Target and Microplate Holders

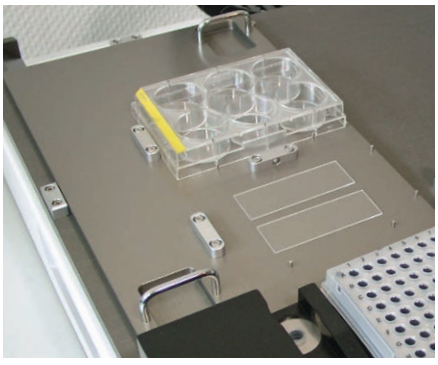
Detachable holders for printed specimens can be mounted. The standard configuration allows the spring-loaded mounting (snap-in fixation) of two microtitre plates, usually 6-well.

For special cases, a coolable holder for targets (A051-420) is available. It additionally requires a tray (A051-404), to which it is attached, and a recirculating water bath (A021-505), which comprises the following items:

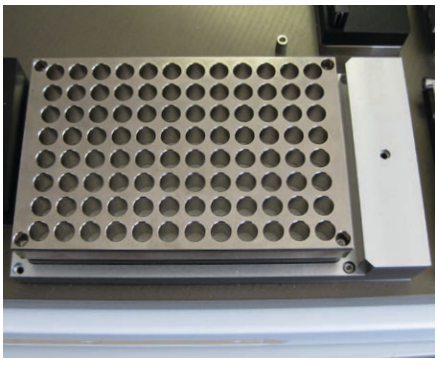
- Ministat 125 (manufacturer: Huber)
- Coolant Kryo 30 (-30 … 90 °C; can also be ordered separately)
- Tubing for micro-plate holder

Another option is a metal plate with resistive heater for 96-well source plates, as the standard holder has no temperature control. It can be easily added because cable and plug are already installed.

Article Number	Description	Figure
	Target and Microplate Holders	
A051-404	Tray for coolable MTP holder, for Bioscaffold Printer 3.1; accommodates 2-fold MTP holder (not included!), snap-in fixation and clamps	
A051-405	Tray for micro-well plates, for Bioscaffold Printer 3.1; snap-in pads for the fixation of two well plates w/o temp. control, snap-in fixation and clamps	●
A051-410	Heatable microplate holder 60 °C, for pipetting module	●
A051-411	Microplate holder without temperature control, for pipetting module	
on request	Cooled microtitre plate holder (for one MTP, chiller not included)	●
A051-420	2-fold holder for well plates, connects to chiller bath; hosts two standard microplates (no coolant or thermostat is included!)	
A051-505	Cooling Pump (without cooling object); shipment see text	
A070-095	Kryo 30 (ethyleneglycol-based coolant, 5 litres)	
on request	Cooling tube set (spare)	



A051-405 *Tray for micro-well plates (not cooled), in BS3.1, holding a 6-well plate*



A051-410 *Heatable microplate holder (max. 60 °C), for pipetting module, built into BS3.1*

A051-411 *Spring-loaded microplate holder without heater/temperature control, for pipetting module*

Cooled microtitre plate holder for one source MTP (this one is from the Nano-Plotter; the BS3.1 version is different)

A051-505 *Cooling pump (Huber Ministat 125). It contains coolant and tubes (not shown), but not the object to be cooled (e.g. a target holder).*

Special Software, Computers etc.

The BioScaffolder features a versatile import of CAD data using a proprietary slicer for external STL data:

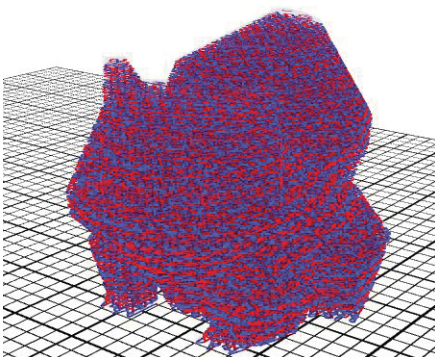
- Import of external CAD files by reading STL data in their native orientation
- 3D-modelling of the scaffold and 2D-visualisation of each layer
- Possible centring of CAD data when the starting point of the figure is far away from the print origin
- Deletion and redrawing of individual strands in a layer (e.g. to correct slicing errors)
- Design of the internal scaffold structure in a wide range:
  - Arbitrary print angles between layers
  - Change of strand porosity (distances), horizontally and vertically
  - Print patterns with up to 3 scaffold materials
  - UV cross-linking of layers
  - Piezo printing on the scaffold
- Generation of G-code and 3D printing of scaffold

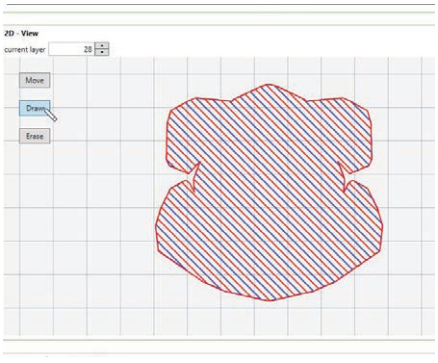
This STL importer comes at an extra cost and must thus be unlocked using a personal password.

A new computer with small footprint can be ordered from GeSiM. It will contain the current control software and the initial configuration at the time of shipment of the system. It is the customer's responsibility to make frequent backup of configurations and scaffold data to make a smooth transition to this new computer.

To ensure proper remote service, please indicate if you wish to connect to the internet via WiFi or Ethernet cable.

Article Number	Description	Figure
	Special Software, Computers etc.	
A051-600	STL Converter for BS3.1, version 2016; software for import of STL data	●
A070-090	Windows PC + 22" TFT monitor, control software pre-installed with initial settings for original computer	
A070-091	Windows Notebook, 17"	
A070-019	Computer keyboard, US layout	
A070-920	Computer keyboard, UK layout	





A051-600 *Representation of imported data in 3-D and 2-D, here with a pattern of two materials (with the possibility of line-by-line editing), from the STL slicing module*

BioScaffolder Spare Parts

The printer is basically maintenance-free, so many parts are only needed when defect after years of operation. Wear parts may be exchanged at the factory during refurbishing/ upgrading or repair.

The situation is different for the fluidic system of the piezo tip. As fouling can occur, an exchange of parts is recommended at regular intervals (see below).

Please keep the original wooden box for your BioScaffolder including all foam parts and metal clips for shipping the BioScaffolder, as in many cases a serious defect cannot be corrected on-site. GeSiM will charge for a new crate if the original one is lost.

Article Number	Description	Figure
	Tip Cleaner Accessories	
A051-655	Wipers for nozzle cleaning, for BS3.1; pair of metal brackets with rubbers	●
A051-656	Rubber pad for nozzle wipers, for BS3.1	(●)
	Spare Parts and Consumables for Piezo Dispensers	
on request	Z-level sensor for BioScaffolder 3.1	●
A072-015	Dummy tip type "J" (to test piezo printing runs)	●
A072-115	Water-sensitive test strips 76x26 mm (for piezo test)	●
A072-116	Dry fleece for Nano-Plotter and BioScaffolder	●
A072-120	Particle filter 2 µm for pipette tube (stainless steel)	●
A072-121	Particle filter 20 µm (for PCV)	●
A072-122	Air filter plug for pressure compensation vessel	●
A072-126	System liquid container 4 l without cap	(●)
A072-129	Pressure compensation vessel 0.5 l without cap and sensor	(●)
A072-132	System liquid container 10 l without cap (can also be used for waste)	
A072-146	Particle filter 20 µm for system fluid container	(●)
A072-509	Hexagon screw for pipette fixation	
A072-530	Tool set for Nano-Plotter and BS3.1	●
A072-531	Tweezers for glass slides	

Tip Cleaner Accessories

There are exchange parts for the tip cleaner. One can replace the entire metal parts (fixed by screws) including the rubber or only the rubber which must then be attached to the metal brackets.

A051-655 *Wipers for nozzle cleaning. The exchangeable rubber pads are made of red foamy material*

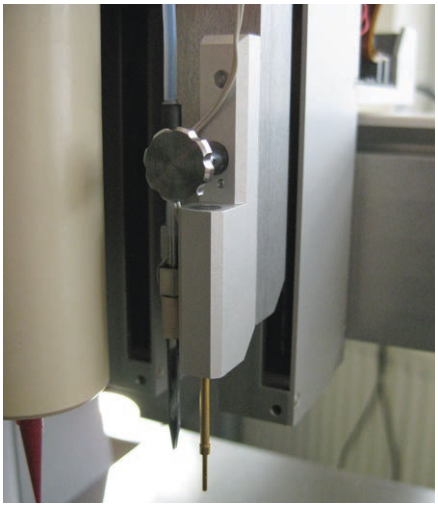
Spare Parts and Consumables for Piezo Dispensers

Replace tubing and filters on a regular basis. So put the following items on your shelf to quickly replacing worn-out or malfunctioning parts:

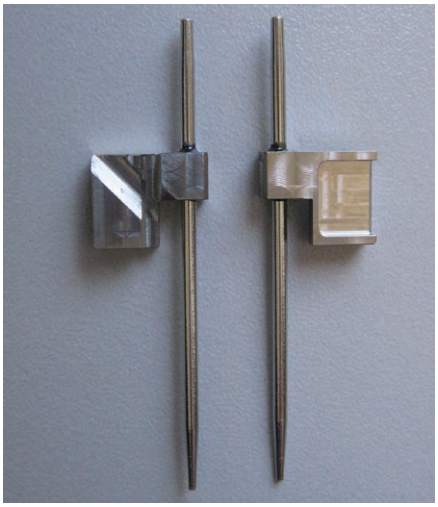
- Spare piezoelectric pipettes, and pipettes dispensing another volume, or special/ heated dispensers, also dummy tips
- Water-sensitive paper test strips and drying fleece (A072-115/116)
- Full set (better more) of green 2 µm particle filters (A072-120) that sit at the print head
- 20 µm particle filters for PCV and system fluid reservoir (A072-121/146)
- 250 µl dilutor syringes (A072-106) and dilutor valves (A072-111)
- PTFE tubes connecting pipettes with print head (A051-802), best also all other PTFE tubes of fluidic stage 2
- Z-level sensor and a few hexagon mounting screws (A072-509) for the pipette holders
- Set of silicone tubes (A051-815)
- Extra slide holder, either to load one while the other one is in the instrument or for other slide sizes

Replace filters (A072-120/121/146) once every year. Replace pipette PTFE tube (A051-802) when needed (every 1–2 years) and the other PTFE tubes and the silicone tubes (A051-815) when dirty, every 1–2 years. Replace dilutor syringes completely when the gasket gets leaky. Clean or replace bottles regularly, including the pressure compensation vessel (PCV).

Z-level sensor for BioScaffolder 3.1

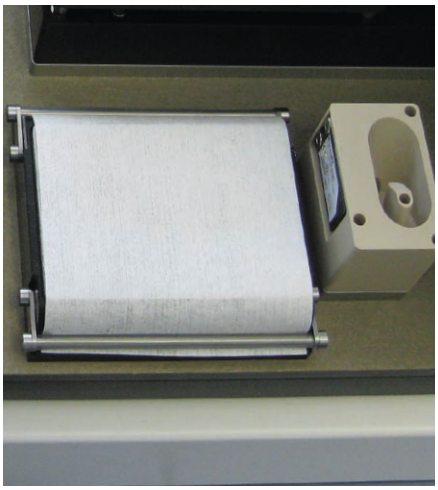


Z-level sensor mounted on front Z-axis



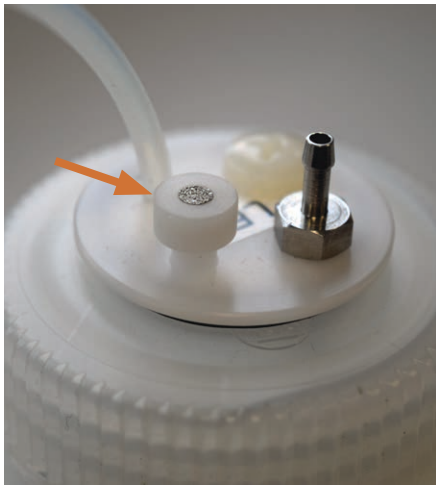
A072-015 *Dummy tips to test settings and pipetting programs*

A072-115 *Yellow paper that turns blue upon contact with water*



A072-116 *Dry fleece (to wipe off excess liquid from piezo tips) on the "soft pad" dry station*

A072-120, -121 *Green 2 µm particle filter for pipette tube and 20 µm filter for PCV (A072-146 is similar, but adapted to a thicker tube)*



A072-122 *Air filter plug in the cap of the pressure compensation vessel*

A072-530, -531 *Tool set; tweezers for slides on the right*

Spare Parts for Fluidic System 1

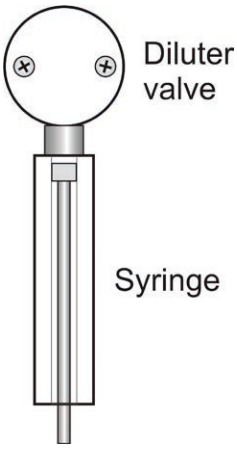
Many of the following items, e.g. the syringe pump module, will only be exchanged during a routine check/repair at the factory, not by the customer.

The standard syringe has a volume of 250 µl. In case of a leakage, it is recommended to replace the entire pump, not only the gasket. Replace also the valve on a regular basis.

BioScaffolder
Product Overview

Article Number	Description	Figure
	Spare Parts for Fluidic System 1	
A072-100	Dilutor module XCalibur (new version)	●
A072-177	Dilutor valve XCalibur (current version)	●
A072-162	Blind screw, black, 1/4"-28	●
A072-106	Dilutor syringe 250 µl	●
A072-401	Dilutor syringe 2.5 ml	●
A072-402	Dilutor syringe 50 µl	●
A072-409	Dilutor syringe 100 µl	●
A072-421	Dilutor syringe 5 ml	●
on request	Capacitive liquid level sensor for PCV, system liquid or waste	●
on request	Extension cable for the capacitive liquid level sensor	●
on request	Rack for the storage bottles (system liquid and waste), without sensors	(●)
on request	Holder for the PCV, without sensor	●
on request	Cable for BS3.1; please specify	●

A072-100 *Dilutor module XCalibur, naked, in antistatic bag*



A072-106, -111 *Schematic drawing of dilutor syringe and three-way valve*

A072-111, -177 *Dilutor valve for XCalibur (left) and blind screws (right)*

A072-402, -409, -106, -401, -421 *Dilutor syringes 50 µl, 100 µl, 250 µl, 2.5 ml, 5 ml; more sizes available*

Liquid level sensor built into the PCV holder (the latter without Velcro fastener)

Extension cable for the capacitive liquid level sensor

Cables for BS3.1 (top: data cable, can be longer), to be mounted between main unit and F-Box

Miscellaneous

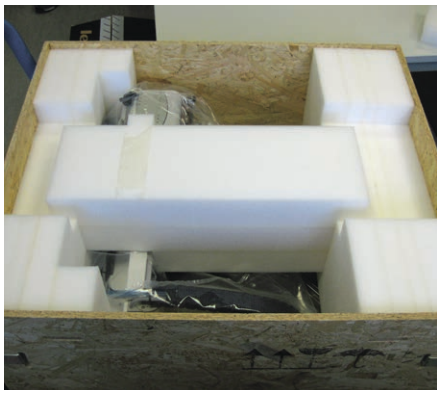
In case of a malfunction of your piezo dispenser, you can send it to GesiM without risk. Piezo pipette repair/cleaning is only charged for if successful. If not, the dispenser will be discarded, with your consent.

Please inquire if you need to see a GeSiM technician at your site, e.g. for training lessons, or for custom dispensing tests of your individual materials.

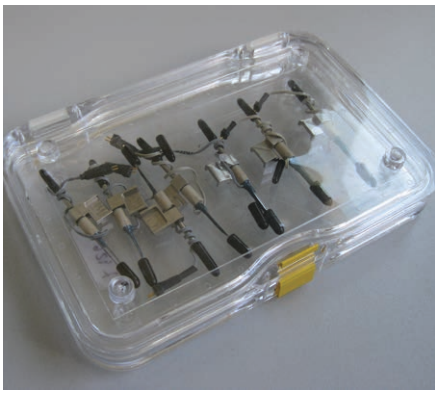
If you own a BioScaffolder without piezo dispenser or you wish to add an adhesive dispenser, please inquire for upgrade options. And note that for adding tubes, pumps and valves, both the main unit and the F-Box must be shipped to GeSiM for refurbishment. Usually also installation and training is required to operate the system with piezo.

Sorry, adding more piezo dispensers than one (except for the twin piezo) is not possible at the moment. If you need spotting with more than one dispenser, consider our microarray spotter, Nano-Plotter, which, however, has no cartridge printing function.

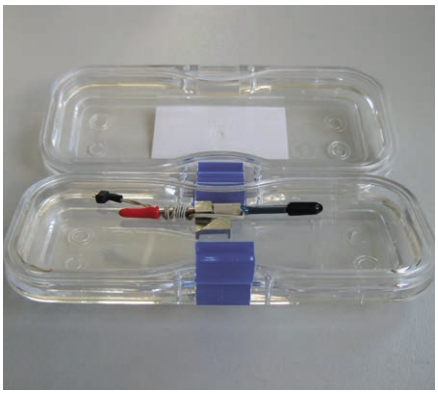
Article Number	Description	Figure
	Packaging Material	
on request	Foam pads for BioScaffolder 3.1 crate	(●)
on request	Packaging for F-Box	
on request	Crate with spring clips for BioScaffolder 3.1, complete	●
A076-038	Packaging for accessories (corrugated cardboard, 430 x 320 x 160 mm, VDW 2.4)	
A076-203	Membrane box 1605, for piezo dispensers (outside dimensions 300 x 150 x 50 mm)	
A076-204	Membrane box 147, for piezo dispensers (outside dimensions 150 x 100 x 16 mm)	●
A076-205	Membrane box 45, for piezo dispenser (outside dimensions 125 x 50 x 25 mm)	●
	Service	
A080-008	Travel expenses	
A080-009	Accommodation expenses per night	
A080-010	Installation, per hour	
A080-011	Repair (work), per hour (error tracking, repair, test)	
A080-012	Warranty extension (12 months)	
A080-013	Return shipment	
A080-017	Repair (spare parts)	
on request	Printing test for customers	
A070-700	Repair pipetting tip	
A700-701	Exchange of the electrical connector of the tip	
A700-702	Pipette cleaning	



BS3.1 packed in wooden crate, with spring clips and foam pads



A076-204 *Large membrane transport box 147 (piezo dispensers not included)*



A076-205 *Small membrane transport box 45 (piezo dispenser not included)*

More BioScaffolder spare parts on request

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Technical data subject to change without notice

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