PrograPrint®

The 3D printing system for dental applications

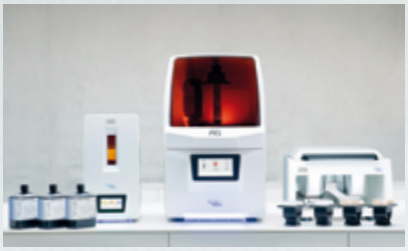
ENGINEERED TO MEET DENTAL NEEDS

Tips & Tricks

ivoclar digital®

Table of Contents

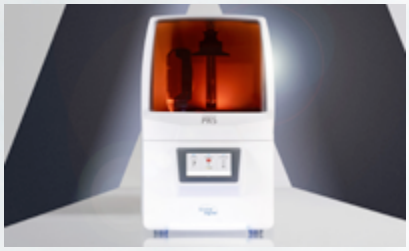
4 PrograPrint® System



PrograPrint Accessories

- PrograPrint Pool material tank
- PrograPrint Cartridge
- PrograPrint Stage build platform

9 PrograPrint® PR5



Curing procedure

Light Engine

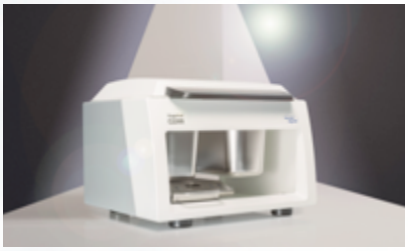
Printing quality of 3D printers

Printing speed / build times

The printing process with RFID

Software

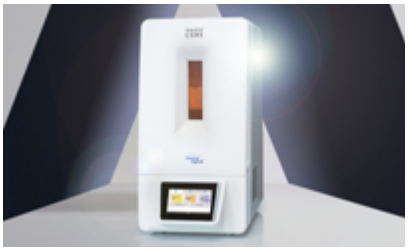
14 PrograPrint® Clean



Isopropanol

Compatibility with materials and devices from third-party manufacturers

16 PrograPrint® Cure



Compatibility with materials and devices from third-party manufacturers

18 PrograPrint® Materials

ProArt Print Splint

ProArt Print Wax

ProArt Print Model

Handling the materials

Compatibility with materials and devices from third-party manufacturers

25 Advantages

A comprehensive system for the entire workflow

Advantages of each individual component within the system

Please see the Workflow document for an overview of the components used and further information. Furthermore, please follow the respective operating instructions of the devices and instructions for use of the materials.

see instructions

The PrograPrint® System

What are the essential components of the PrograPrint® System?

The PrograPrint System consists of high-quality materials (ProArt Print) and devices for printing (PrograPrint PR5), cleaning (PrograPrint Clean*) and post-curing (ProgaPrint Cure).

The material tank (PrograPrint Pool), material cartridge (PrograPrint Cartridge) and build platform (PrograPrint Stage) are accessories. The print data is created with the 3Shape software "CAMbridge", processed using the specially developed software "PrograPrint Manager" and then transferred to the printer.

All system components are optimally coordinated with one another and form a validated overall process.

Which languages is the PrograPrint® System available in?

The user interface of the PrograPrint PR5 and the PrograPrint Cure are available in the following six languages: English, French, German, Italian, Spanish and Portuguese.
The CAMbridge software is available in German, English, Spanish, French, Japanese, Chinese, Italian, Korean, Portuguese and Russian.

* Only use PrograPrint Clean in an extraction cabinet. The instructions and notices in the Operating Instructions must be observed.

How much space is needed and what are the requirements of the PrograPrint® system and its components for installation?

	PrograPrint® PR5	PrograPrint® Clean	PrograPrint® Cure
Dimensions (mm, W x H x D)	455 x 758 x 550	450 x 320 x 360	245 x 440 x 490
Weight (kg)	54	18.5	17
Connections	100–240 V (50–60 Hz) LAN optional	100–240 V (50–60 Hz)	100–240V (50–60 Hz)
Additional equipment required	None	Extraction cabinet (observe the Instructions for Use) Recommendation: BDT Type ASEX420	None

Note: The augmented reality online application from Ivoclar Vivadent helps with general space planning by using a virtual image of the PrograPrint PR5 printer in real-life surroundings.

What should be taken into consideration when installing the PrograPrint printer?

The PrograPrint PR5 must not be placed near other devices that generate electro-magnetic waves. The PrograPrint PR5 must be protected from moisture, heat (such as radiators or similar) and direct sunlight.
The device must be operated in an environment which is as dust-free and vibration-free as possible as this could be detrimental to the quality of the material, which subsequently affects the success of the build. The device must not be installed inside cabinets or shelves. It should be placed on a stable, flat, non-slip working surface with a load capacity of at least 60 kilograms.

PrograPrint® Accessories

Which components of the PrograPrint® system are consumables?

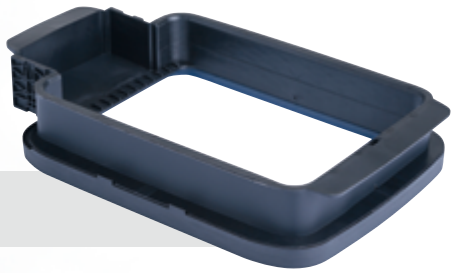
Apart from the ProArt Print materials, only the PrograPrint Pool material tank needs to be replaced. When used correctly, the service life of a PrograPrint material tank is at least 1000 milliliters of printing material. A built-in RFID label allows the PrograPrint PR5 printer to display a message when the material tank needs to be checked or replaced.
The material bottle valve is supplied along with every refill. The PrograPrint cartridge and the PrograPrint Stage build platform only need to be replaced if there is mechanical damage or extreme wear.

Note: Each type of material (Wax, Model, Splint) requires its own PrograPrint cartridge to prevent cross-contamination or accidental mixing of materials.

PrograPrint® Pool material tank

Can the same PrograPrint Pool be used for multiple materials?

When a material tank is used for the first time, it is assigned to the respective material. This means that the material assignment is saved and in future the material tank can only be used with this specific material type. This helps to prevent cross-contamination or accidental material mixing.



Note: When a material bottle is empty, a new bottle of the same material type can be assigned to the tank for further use.

How long can a PrograPrint Pool be used?
How can a damaged material tank be recognised?

When used correctly, the service life of a PrograPrint Pool material tank is at least 1000 milliliters of printing material. In general, once 1000 milliliters have been processed, the device itself will release a message, based on the data determined by the RFID chip, to exchange the tank.

If a material tank is already severely damaged, i.e. if it has deep cracks, scratches, punctures or creases, it is essential to replace it before the message is released in order to prevent misprints. Slight damage, resulting from normal wear and tear, must be checked carefully.

Can still be used:

Superficial scratches

The material tank only needs to be replaced if there are deep scratches or holes, so that a completely flat tank surface is guaranteed. Superficial, light scratches in the film will not affect the printed result and the tank can be reused.

Contaminated foil

Prints or grease residues on the tank foil can be cleaned using isopropanol. The tank can then be used again.

Must be exchanged:

Indentations / distortion

Raised surfaces or creases will change the surface tension of the foil. This can lead to problems in removing the object from the build platform and subsequently cause inaccurate results or misprints. Therefore, in this case, the tank should be exchanged. In addition, if there are deep cracks or perforations, the printing material can leak through the damaged area and contaminate the glass screen.

PrograPrint® Cartridge

How long can a PrograPrint® Cartridge be used?

The PrograPrint Cartridge is not a consumable item, the upper part of the cartridge can therefore be used indefinitely.

How is the material from the cartridge filled into the material tank?

The material bottle has a valve, which only allows the material to flow out when the cartridge is opened. This enables clean and easy use.

PrograPrint® Stage build platform

How long can the PrograPrint® Stage be used?

The build platform is not a consumable item and therefore only needs to be renewed in case of severe signs of wear and tear such as noticeable scratches. In case of scratches or other damage to the build platform, it is the depth of the damage which is decisive. Noticeable scratches have a significant impact on the adhesion of the printed objects to the build platform, which affects the printing job.

Can still be used:

Superficial scratches

Minimal, insignificant scratches have no effect on the printing job and the build platform can still be used.

Must be exchanged:

Deep scratches

Deep scratches on the surface of the build platform make its surface rough. This can lead to damage to the tank foil when the build platform is immersed in the material tank at the beginning of the printing process. For this reason, if the build platform has deep scratches, it must be exchanged.

How is the PrograPrint® Stage cleaned?

The build platform does not need to be specially cleaned, as it is immersed in the PrograPrint Clean container as part of the cleaning procedure together with the printed object and is therefore cleaned automatically. If the build platform shows signs of grease residues, from having been touched with bare hands without gloves, it can also be cleaned with isopropanol.

The objects are either partially attached or not attached at all to the build platform. What should I do?

During use, resin deposits can occur on the build platform and on the shaft. When hardened, these deposits can alter the parallelism of the build platform surface and cause adhesion problems. Check the condition of the build platform and shaft at the connection to the device for contamination. Ensure that these areas are kept clean at all times.

PrograPrint® PR5

Is the PrograPrint® PR5 a proprietary development of Ivoclar Vivadent?

Yes, the PrograPrint system was specifically designed for the validated and coordinated PrograPrint workflow by Ivoclar Vivadent.

Can the printer also be used for the 3D printing of objects outside of the dental field?

The PrograPrint PR5 was specially developed for the production of printed objects in the dental field and is therefore not suitable for 3D printing outside of the dental sector.

What are the technical features of the PrograPrint® PR5?

Build platform dimensions (mm, B x T)	125.44 x 78.4
Layer thickness	50–100 µm
Pixel resolution	49 µm
Wavelength	388 nm
Light intensity (max.)	16 mW/cm²
Control	Integrated touchscreen
Connections	USB and LAN
Weight (kg)	54
Dimensions (mm, W x H x D)	455 x 758 x 550
Energy supply	100–240 V / 50–60 Hz

Curing procedure

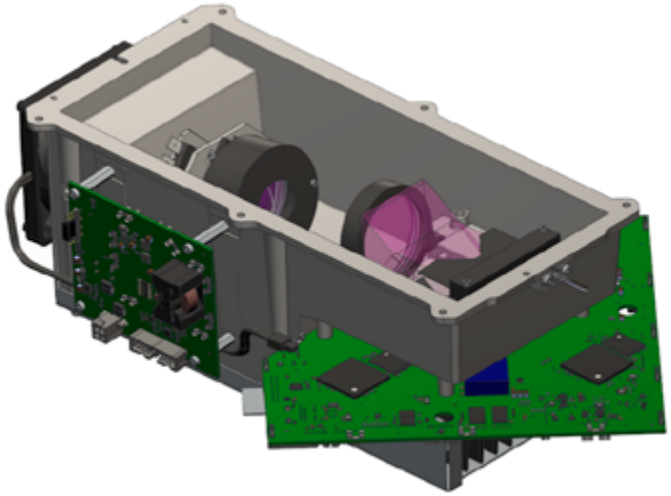
- **DLP process**
  In the "Digital Light Processing" (DLP) printing method, a UV beam of light is fragmented into pixels by a rectangular arrangement of movable micro-mirrors, and then reflected pixel-by-pixel. The smaller the pixels, the finer the printed structures. The micro-mirrors of the DLP chip control the light. They are either inclined so that the light source hits the material or adjusted at an angle so that the light cannot reach the material. The advantage of this method is the excellent printing quality. In comparison to the LCD process, the DLP method has a better black-and-white contrast, which subsequently achieves a higher precision.

- **LCD method**
  As with the DLP process, the LCD method projects a beam of light onto the liquid material to cure it layer by layer. The mask is an LCD screen. If an LCD screen is used, LCD technology does not completely prevent the light from reaching the material. Even black pixels – which are not to be printed – still let through residual light. This results in a poorer quality of the printed object. The advantage of the LCD method lies in the low costs.

- **SLA method**
  The SLA method uses a laser to project the individual layers of the 3D model onto the surface of the liquid material. The laser projects one layer after the other and cures them one by one. Technically, this method is easy to implement and therefore tends to be less expensive than DLP. The disadvantage is the printing speed as the laser cannot work on a large scale. Due to the minimum diameter of the laser point, it is not possible to print very fine structures.

Light Engine

The specially developed Light Engine is based on DLP technology and is fundamental for the precision and quality of the printed result. Due to its high resolution of 4 million pixels and a particularly high light intensity, it ensures consistently high precision and light energy on the entire build platform. The Light Engine is equipped with a LED light source. The materials are cured using UV light at a wavelength of 388 nanometres. This light curing achieves reliable printing results. The high precision and the consistent light intensity are made possible due to continual automatic calibration.

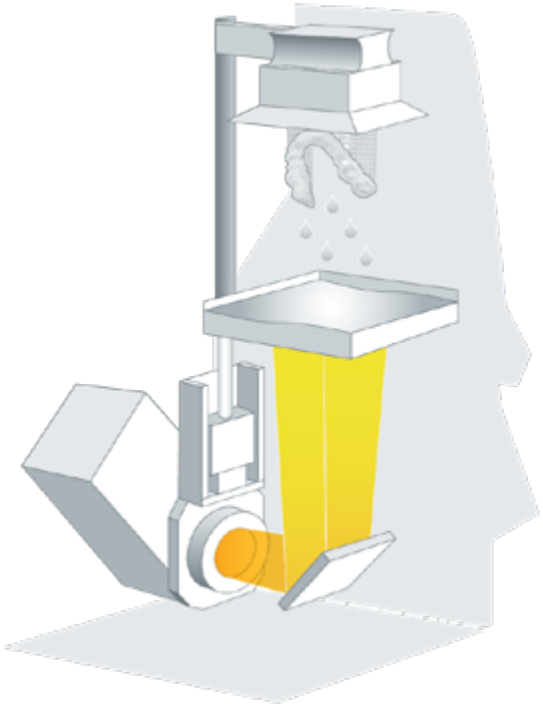


What is the advantage of the Light Engine compared to other technologies?

The DLP method has proven great precision and speed advantages over other technologies. Precise and fast polymerization depends on: consistent and maximum brightness along with a razor-sharp image. The developed software starts here and calculates the optimal light performance for each individual print layer.
This means that each individual print layer is printed in an ideal quality. At the same time, consistent precision is maintained – regardless of whether the objects are placed in the middle or in the margin area of the build platform.

Printing quality of 3D printers

The printing quality of 3D printers is determined by the resolution in the X, Y, and Z directions. Often, however, manufacturers only specify the layer height (Z axis). This is misleading, because layer heights are not sufficient for determining precision. The XY resolution is also important, the so-called build area resolution, as it specifies the minimum structure size. The level of detail depends on this value, a smaller value results in enhanced accuracy. The PrograPrint PR5 has a high level of precision due to its build area resolution of 49 microns per layer.



Can the accuracy of an object printed with the 3D printer be compared to an object manufactured by the PrograMill® milling machine?

Yes, the detailed precision of the objects printed with the PrograPrint PR5 is in no way inferior to the milled results from the PrograMill PM7.

Printing speed / build times

How fast does the PrograPrint® PR5 print?

2 models (upper and lower) horizontal	< 70 minutes
3 splints horizontal	~ 40 minutes
40 wax crowns horizontal	< 80 minutes
4 aligner models (upper and lower) horizontal	< 45 minutes

Does the alignment of the printed objects on the build platform (horizontal / vertical) affect the precision of the printing result?

The precision of the printed objects is the same, regardless of whether they are placed vertically or horizontally on the platform. However, the objects aligned vertically on the platform will take longer to print, depending on the height of the printed object.

The printing process with RFID

What is RFID technology?

RFID technology is used for the contactless identification of objects by means of radio waves. The encoded information on the label is transmitted to the reader without contact.

Which information is read via RFID?

The PrograPrint PR5 reads the RFID data about the material used, such as material type, remaining quantities, shelf life, start date or production batch. This enables the automatic mixing process to be activated for material that has been stored in the tank for a long period of time before the start of the printing process. In addition, the RFID label stores the state of the PrograPrint material tank including its calculated condition.

Software

Which software is required to operate the PrograPrint® PR5?

The following components are required to operate the PrograPrint PR5:

- 3Shape CAMbridge PrograPrint license
- Ivoclar Vivadent PrograPrint Manager

How is the software for the PrograPrint® PR5 provided?

The latest version of the CAMbridge software, including the build styles and the PrograPrint Manager, is available in the download area of the Ivoclar Vivadent website. Alternatively, it can be loaded and installed via the PrograPrint Manager. Build styles are material-specific parameters for the operation of the software and define, for example, the layer thickness or exposure time of each layer to be printed. These build styles are preconfigured for the PrograPrint PR5 and are validated according to the system.
The current CAMbridge software installation file can be downloaded here:

www.ivoclarvivadent.com/de/cad-cam-download-center/

How is the software controlled and sent to the printer?

The print jobs designed using the CAMbridge software are processed via Ivoclar Vivadent's PrograPrint Manager and transferred to the printer via LAN or USB flash drive.

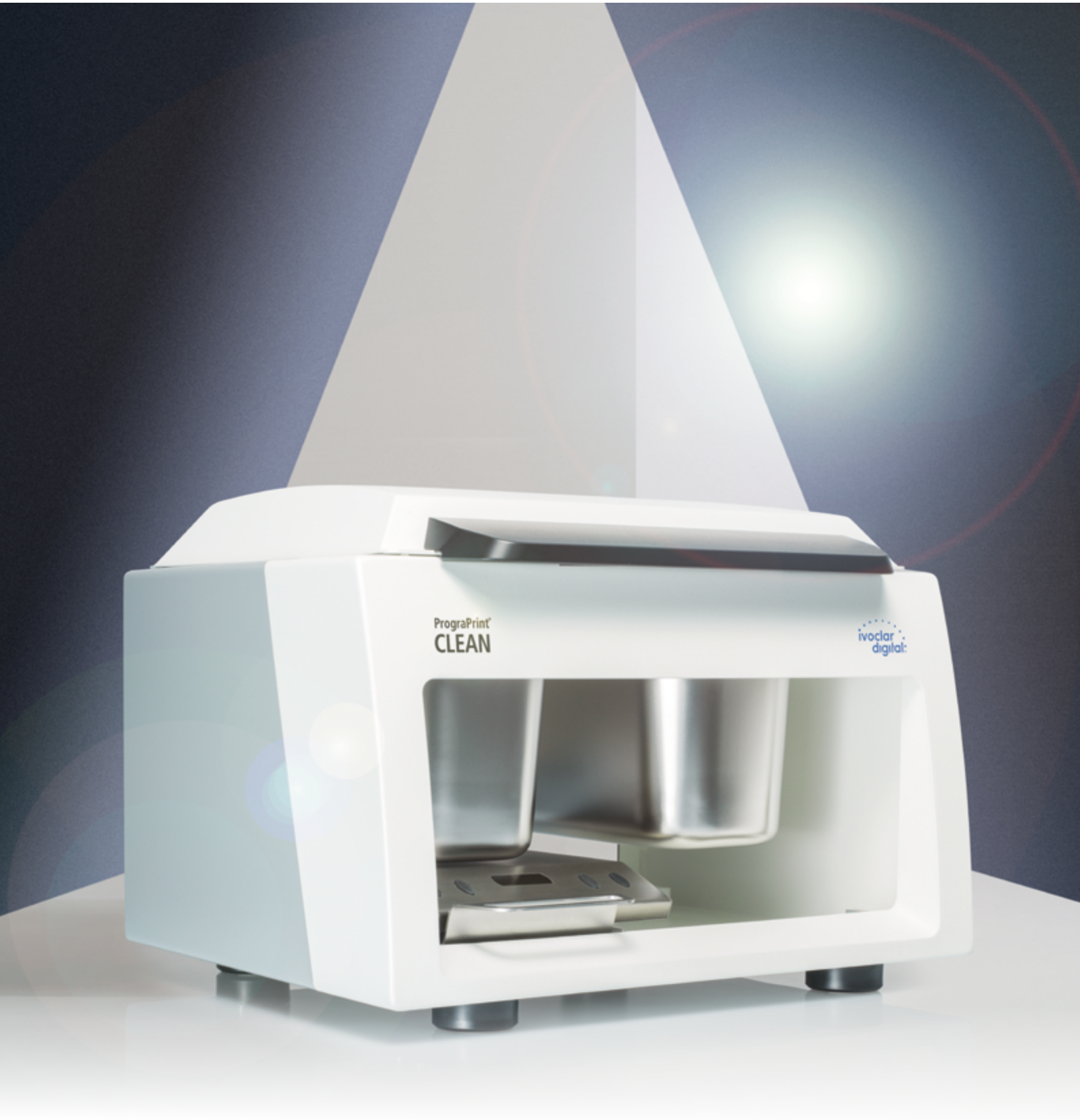
How is the 3D print data created?

The print data is created with the 3Shape software CAMbridge. This software is capable of processing STL files created with conventional CAD softwares (e.g. 3Shape Dental System).

When labeling the models / splints in the CAD design, is it possible to display the letters in a convex form?

Lettering must always be created in the CAD design in a concave form. This applies for all indications. Convex lettering generates local minimas, which in turn must be supplied with support structures.

PrograPrint® Clean



How long does it take to clean the 3D printed objects?

	ProArt Print Wax	ProArt Print Model	ProArt Print Splint
General cleaning	2 minutes	5 minutes	10 minutes
Detailed cleaning	2 minutes	5 minutes	5 minutes
Cleaning agent	Isopropanol / Isopropyl alcohol (IPA) >99,8%		

Isopropanol

Which cleaning liquid is used?

Isopropanol is used for cleaning with the PrograPrint Clean. Isopropanol has excellent cleaning qualities. It enables effective cleaning in a short time, which allows the efficient laboratory processes to be maintained and consistent material properties to be sustained.

What should be taken into consideration when using isopropanol?

PrograPrint Clean must be used in an extraction cabinet due to the fire hazard with isopropanol. The instructions and notices in the Operating Instructions must be observed.

Compatibility with materials and devices from third-party manufacturers

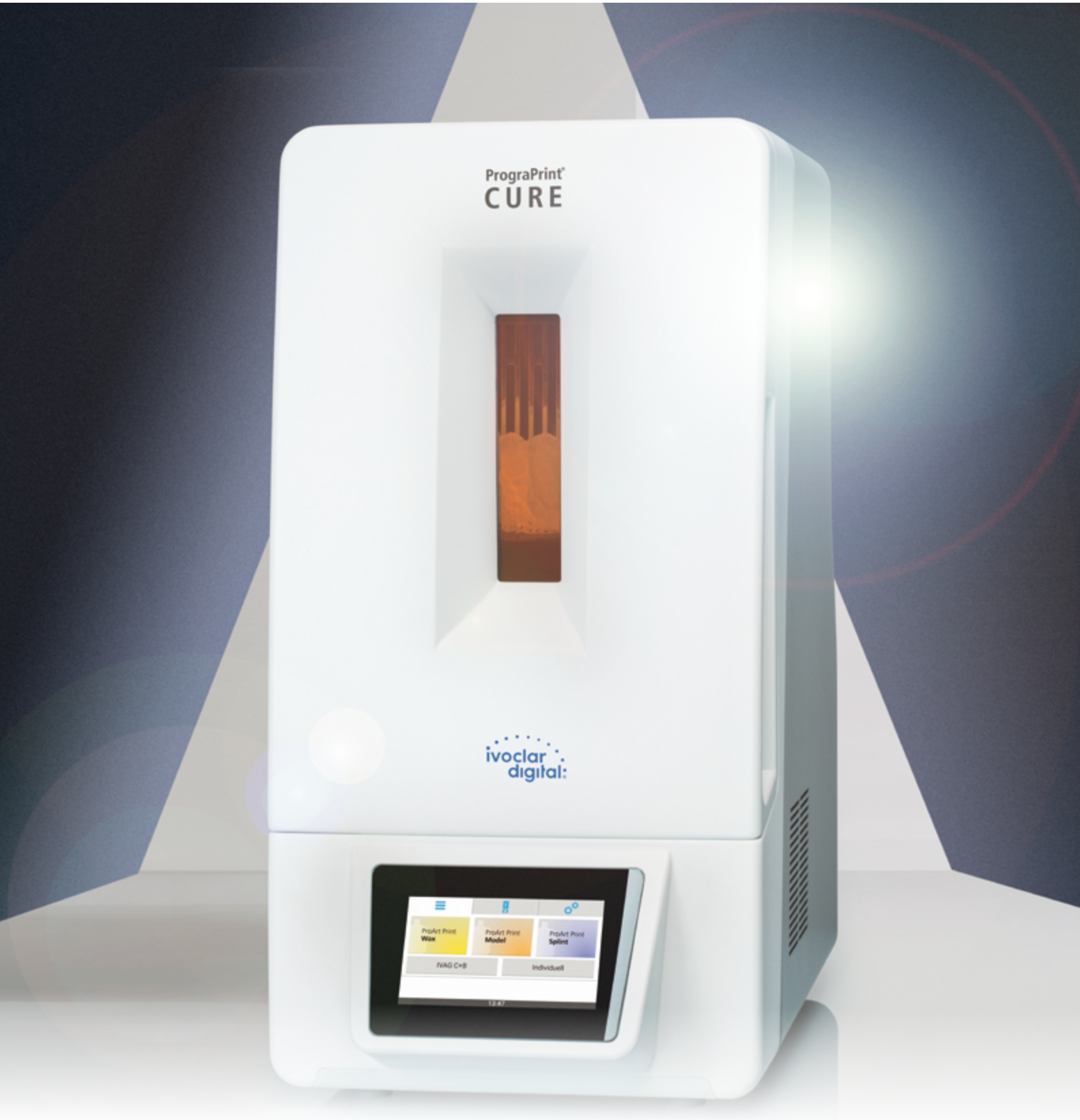
Can the PrograPrint Clean also clean 3D printed objects that were not produced with the PrograPrint system?

Third-party 3D printed objects created using the DLP or SLA methods can be cleaned in the PrograPrint Clean in accordance with the respective manufacturer's specifications.

Can the objects printed with the PrograPrint® PR5 also be cleaned in a third-party cleaning device?

No, because if a third-party cleaning device is used, the accuracy and biocompatibility achieved by the PrograPrint device cannot be guaranteed.

PrograPrint® Cure



Which light intensity does PrograPrint® Cure use?

274 mW/cm² ± 10 %

What wavelengths does the PrograPrint Cure work with?

405 nm / 460 nm

How long does it take to cure the 3D printed objects?

	Curing time
ProArt Print Model	120 seconds
ProArt Print Splint	90 seconds
ProArt Print Wax	60 seconds

Note: These times are pre-installed so that during use, only the type of material needs to be selected.

Is it possible to remove the object from the build platform and/or adjust the object before curing?

It is possible to remove the object from the build platform before curing. However, it is not intended for this purpose. The best method is to carry out the entire workflow with the object on the build platform, so that there is as little material contact as possible. If the printed objects, which are not yet completely cured, are left on the build platform, they are additionally protected against distortion or deformation.

Compatibility with materials and devices from third-party manufacturers

Can the objects printed with ProArt Print materials also be post-cured using third-party curing devices?

ProArt Print materials are coordinated with the PrograPrint system and a higher light intensity is required to cure them than that provided by conventional light curing devices. These could not guarantee sufficient curing of the objects or that the biocompatible properties of the printed objects are sustained.

Is PrograPrint Cure compatible with Ivoclar Vivadent lab composites?

The consistently high light intensity provided by PrograPrint Cure means it is also possible to cure light-curing laboratory composites from Ivoclar Vivadent, such as SR Nexco®. You can also create your own custom programs for other materials.

Can third-party printed objects be cured with the PrograPrint® Cure?

PrograPrint Cure is a universal light curing device and can also be used to cure conventional third-party C&B veneering composites.

PrograPrint® Materials

Currently, the PrograPrint PR5 can process three different materials to cover a wide range of applications:

- **ProArt Print Wax**
- **ProArt Print Splint**
- **ProArt Print Model**

Which areas of application are covered by the ProArt materials?

	ProArt Print Wax	ProArt Print Model	ProArt Print Splint
Veneers	✓		
Occlusal veneers	✓		
Inlays	✓		
Onlays	✓		
Partial crowns	✓		
Crowns	✓		
3-unit bridges	✓		
Occlusal splints			✓
Drilling templates			✓
Models		✓	
Aligner models		✓	

How many restorations can be made with 1000 milliliters of material?

ProArt Print Model	~ 60 hollow models
ProArt Print Splint	~ 120 splints
ProArt Print Wax	~ 250 objects

Note: 1000 milliliters are equivalent to one bottle of ProArt Print material.

ProArt Print Splint

Is it possible to sterilize ProArt Print Splint?

No. The printed ProArt Print splint objects are resistant to disinfectants such as an immersion bath with Dürr MD 520.

How long can a printed ProArt Print splint be worn before potential deformation or discolouration, etc. occurs?

The service life of a printed ProArt Print splint is unlimited and individually determined by the degree of wear and tear it is subjected to.

Can printed ProArt Print splints be extended?

Printed ProArt Print splints can be selectively extended using the light-curing composite Tetric® EvoCeram in combination with Adhese® Universal. The processing parameters can be found in the respective Instructions for Use.

Here you can find video tutorials on how to produce objects using ProArt Print Splint in CAMbridge:

www.ivoclarvivadent.com/ProArtPrintSplint

Note: ProArt Print Splint is a CE-marked medical device, unlike the other materials ProArt Print Wax and ProArt Print Model.

ProArt Print Wax

Is it possible to wax-up further on objects printed with ProArt Print Wax?

Yes, ProArt Print Wax printed objects can be waxed-up with conventional modelling waxes.

Can ProArt Print Wax also be burned-out using the speed heating method for the pressing technique with the investment material IPS® PressVest Premium?

Yes, the speed heating method can be used with IPS PressVest Premium to burn-out ProArt Print Wax in the press technique. Information can be found in the IPS PressVest Premium Instructions for Use.

How do I store ProArt Print Wax restorations if I do not invest and press the restorations immediately after curing them?

Place your restoration in a plastic bag from which you have removed as much air as possible. This way, you can store your restorations for up to 8 hours before you continue to process them.

How do I prepare ProArt Print Wax for use?

Vigorously shake ProArt Print Wax in the bottle for 2 minutes to prepare the resin for the printing process.

ProArt Print Model

What should be taken into consideration when printing hollow models?

Hollow models should be aligned at an angle of approximately 60 to 75 degrees, otherwise non-polymerized material can become trapped under the model during the manufacturing process, which makes the cleaning procedure more difficult.

Can I also print aligner models?

Yes, you can also print aligner models if you use the software update V1.41 for the PrograPrint PR5 printer and the software update V1.18.3.1645 for the PrograPrint Manager.

What is the difference between an aligner model and a conventional printed model?

The build style for aligner models is set to print in layers of a thickness of 100 µm at a time. This results in an adequate surface accuracy and reduces the time required for the horizontal printing of aligner models to less than 45 minutes.

Here you can find video tutorials on how to use ProArt Print Model and CAMbridge:

www.ivoclarvivadent.com/ProArtPrintModel

Handling the materials

How can the materials be stored?

Unopened material can be stored in a cool, dark and well-ventilated place between 2 and 28 °C (36 and 82 °F). Liquid or opened material must not be exposed to daylight to avoid premature curing.
Information on the expiry date can be found on the labels of the material bottles. Once the bottle has been opened, the material should be used up within six months.

Note: Opened material bottles can remain in the PrograPrint Cartridge. The cartridge protects the material against UV light. Due to the special structure of the cartridge, the materials can be stored in daylight. In order to protect the material and the tank foil, the foil protection cover must always be placed under the cartridge and the cartridge must be closed.

How often and in which intervals does the material need to be mixed?

Shake the material bottle briefly before inserting it for the first time. Then it is ready for use. Competitor products often have to be prepared for several hours with special blenders.
After inserting the PrograPrint Cartridge, the automatic mixing function ensures ideal printing conditions.
If the material is already in the material tank and has not been used for several weeks, it must be briefly mixed manually before use using the silicone spatula supplied with the cartridge in order to loosen possible sedimentation.

Note: The mixing process of the material in the cartridge is activated automatically. The RFID technology recognizes the necessity as well as the corresponding duration of the mixing process. ProArt Print Splint does not require mixing.

How can I filter out residue in the resin material?

Stainless steel tea strainers can be used for filtering contaminated printing material. Choose a strainer that allows you to pour the resin without difficulty. Ideally, use a strainer with a pore size between 0.4 and 0.55 mm.
Carry out the filtering process in a dark room in one go, without interruption.
Strainers can be cleaned in the PrograPrint Clean unit.

Materials that are not used in the oral cavity (ProArt Print Model and ProArt Print Wax) can be filtered using a paint filter.

Compatibility with materials and devices from third-party manufacturers

Can ProArt Print materials be used on third-party 3D printers?

Due to the fact that several processing and device parameters cannot be adjusted in third-party systems, compliant processing is not validated and therefore cannot be approved.

Can third-party materials be processed with the PrograPrint system?

In general, the PrograPrint PR5 has the technical requirements to process third-party materials. But the PrograPrint system and its components are coordinated. That also includes the ProArt materials. This coordination is not guaranteed with third-party materials. Therefore, only the use of validated ProArt Print materials is possible.

Can the ProArt Print Model material be isolated?

An isolation agent can be applied to the ProArt Print Model when using layering ceramics and Telio LAB.
When working with composites, there is no isolation effect on the ProArt Print Model material.

Advantages of the PrograPrint® System

A comprehensive system for the entire workflow

The PrograPrint System, designed by Ivoclar Vivadent, covers the complete workflow for 3D printing with perfectly coordinated individual components and offers a high level of processing reliability. Only by using Ivoclar Vivadent products and devices for the entire printing process, including the light-curing device and cleaning, the high quality and precision of the printed objects can be ensured.

Advantages of each individual component within the system

- **Light Engine**
  The specially developed Light Engine is part of the PrograPrint PR5 and is responsible for the highly precise printing results. The DLP technology used ensures high precision throughout the entire platform. The Light Engine is characterized by a high resolution of 4 million pixels and a high light intensity of 16 milliwatts per square centimetre.

- **PrograPrint Cartridge**
  The cartridge system provides a clean, easy and almost contactless handling of the material. This means it is quick and easy to exchange the materials. The RFID technology enables automatic material recognition and therefore intuitive device operation, which results in reliable printing results. In addition, the cartridge is also used for easy storage of the materials.

- **PrograPrint Stage**
  The printed objects can be left on the build platform throughout the entire workflow. This makes the respective processing steps easier to manage. Another advantage is the fact that the build platform is cleaned together with the printed objects in one sequence in the PrograPrint Clean, which eliminates an extra cleaning step.

- **PrograPrint Pool**
  The automatic exchange of information via RFID means the operation of the system is simple and intuitive. A PrograPrint Pool is always assigned to the respective martial type and can then only be used for this material type. In this way, material confusion and cross-contamination can be avoided. The condition of the materials in the tank is also registered automatically. This means, for example, that an automatic mixing process can be started if necessary.

- **ProArt Print Materials**

  ProArt Print Model is a particularly dimensionally stable material, it has a good surface finish and is opaque-beige in colour. This allows precise work with excellent surfaces to be achieved.

  ProArt Print Wax is characterized by good burn-out properties, which allows accurately fitting pressed objects to be achieved.

  ProArt Print Splint is a material with a low fracture risk and can therefore be used to produce transparent [1] and dimensionally stable [2] printed objects.

  In addition, the cartridge system makes material handling much easier. The necessary information, such as the material type, the filling quantity or the condition of the materials is automatically read via RFID. Based on this information, an intuitive and clean operation is possible.

[1] Scherrer P., Use Validation Report SL-G2 System V1, *Test Report*, Ivoclar Vivadent, 2020.

[2] Rist K., Entwicklungsbericht SL-G2 Splint, *Test Report*, Ivoclar Vivadent, 2019.

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