PERFACTORY®

Rapid Manufacturing System
Rapid Prototyping System

Buyers´ Guide

envisionTEC

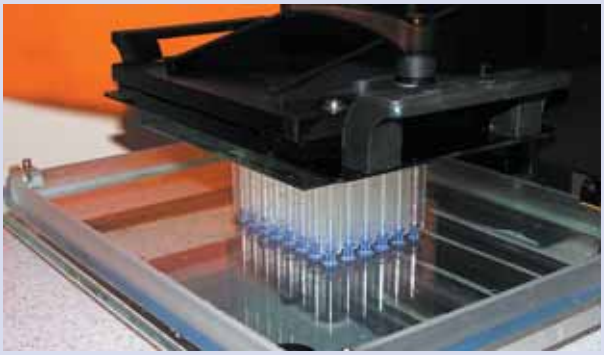
Perfactory® Buyers´ Guide

There are a wealth of Rapid Prototyping and 3D Printing technologies available, almost all of which use lasers or inkjet heads. The Perfactory® system from **envisionTEC** is different.

Introduction to the Perfactory® System

The Perfactory® system builds 3D objects from liquid resin, like stereolithography, but using a projector rather than a laser. This projector is almost identical to those found in high quality presentation and commercial theatre systems, known as Digital Light Processor or 'DLP®' projectors.

'Perfactory®' is the short form of 'Personal Factory' and a registrated trade mark of **envisionTEC**, Germany. On page 13 you can read in detail how the Perfactory® system works. For now, here's the



simplified version! The Perfactory® system works like a copy station. It builds solid 3D objects by using the DLP® projector to project sequential voxel planes into liquid resin, which then causes the resin to cure from liquid to solid. Each voxel plane made up of tiny Voxels (volume pixels), with dimensions as small as 16 µm x 16 µm x 15 µm in X, Y and Z direction. It's like building your part from very small Lego blocks!

With the Perfactory® system you can choose the balance between feature resolution and build speed. Dynamic Voxel Thickness gives you control over z build thicknesses from 15 µm to 150 µm and the Projector Optics give you control over X and Y resolution from 16 µm to 68 µm.

If your requirement is for a 3D printer which is

- flexible,
- easy-to-use,
- low cost to buy and run,
- and which produces parts combining,
- excellent surface finish, and
- superb detail and accuracy,

then you should consider purchasing a Perfactory® system.

Coming to the Right Decision

Why Choose the Perfactory® System

There are some convincing arguments for choosing the Perfactory® system for your 3D printing application.

Very High Quality of Parts

The resolution of fine detail is unmatched by any other Rapid Prototyping system, regardless of price. The dynamic voxel thickness can be as low as 15 µm.

Very High Speed

By exposing the whole voxel plane in one go, the system build speed is very fast. This high speed is independent of the number of parts in the build, or their complexity, further improving productivity.

Proven Reliability

- No jets to block.
- No lasers to fail.
- Very few moving parts.
- DLP® technology is proven in over 13,000,000 projectors!
- The projector bulb lasts up to 1,000 hours of operation.

Highly Versatile

Wide range of materials, for prototyping, casting, ceramic-filled, and more. The biocompatible parts can be post-finished if required – fully dense cured resin, suitable for vacuum casting master patterns also, biocompatible parts for direct manufacturing

in mass customization applications such as hearing aids and digital dental manufacturing, such as crowns, bridges, and drill guides.

Very Low Cost of Ownership

- No inkjet heads to replace.
- No expensive lasers to replace.
- Minimal supports needed.
- No material wasted during build process.
- The projector bulb does not costs the world.

Very Easy to Use

- Out of the box and ready to build parts in less than 10 minutes.
- Easy to change materials, it only takes a few minutes.
- Straightforward to use – simple to maintain. Predictable build times.
- Easy-to-install and requires only simple facilities, less than 0.3 m² floor space!

Application Advantages

Key Application Advantages

Here are the key application advantages of the Perfactory® system:

Upside Down Building

The inverted build platform improves part quality and speed by

- eliminating the need for levelling and recoating
- minimising the need for support structures
- allowing quick change of materials.
- minimal material stockage

No Laser and No Printhead Jetting

The light source is an economical reliable projector light bulb.

Mask Projection with DLP® Optical Semiconductor Technology

- Accuracy and resolution beyond Laser technology.
- High build speeds, regardless of part number or complexity. DMD® chips have a life time of about 6 years, when operating the Perfactory® machine on average for 10 hours a day.
- DLP® technology development is driven by the consumer industry.

Built-in PC and Hard Drive

- Having an embedded PC allows for reliable data communication.
- The hard drive can store up to 40 jobs in a queue.

Very Few Moving Parts

- Less wear and tear, and greater reliability
- Easy to position voxel planes for excellent registration of high detail.

Application Areas

Different Application Areas

Four main application areas are the Perfactory® systems predestinated for:
Jewellery Industry, Hearing Aid Industry, Dental Industry, and Toy Industry.

Jewellery Industry

envisionTEC Perfactory® is the number one choice for jewellery due to the precision and castable materials offered straight from the machine. Highly detailed filigree and accurate settings are routinely produced with little or no adjustment to the machine.

The throughput of the machine is proven to be unparalleled in the industry. For instance a set of 15 rings can be produced in a castable material within 5 hours! The accuracy achievable is beyond laser or printing alternative technologies with 15 micron resolution capability as standard. This makes it the perfect choice for micro pave or invisible settings.

Hearing Aid Industry

envisionTEC Perfactory® offers a perfect solution for the Hearing Aid Industry with over eight biomedically approved materials to offer with various skin tone colors along with Red, Blue, Clear and Rose clear, for application ranging from Ear Molds to Shells with integrated face plates the Perfactory® DLP® process can supply high quality parts in bespoke materials. The economics of running a perfactory make it the preferred choice for the Hearing Aid Industry with a throughput of over 30 shells every 90 minutes!

Application Areas

Dental Industry

The speed, accuracy and choice of materials from the Perfactory® DLP® process makes it an ideal choice for the Dental Industry. Multiple parts can be processed simultaneously on the Perfactory® DLP® process. Up to 80 caps and copings can be produced in under two hours in a castable material compared to being individually produced by hand or CNC. Accuracy from the Perfactory® machine exactly replicates input data resulting in a perfect fit of parts.

A range of materials can also be used with the same machine to produce either wax up components for casting or ceramic filled resins that will produce direct manufactured cap, copings, crowns etc.

Toy Industry and Animation

The requirement of the Toy, Film and Animation Industry is for highly detailed models with good surface finish so that models can be used for visual mock ups, photo/film shoots and master patterns for molding.

The Perfactory® DLP® process makes it an ideal choice for this industry as the surface finish

of models from the machine means little or no hand finishing of the parts are required, which is essential on free form textured models.

Materials - Everything is Possible...

Materials for the Perfactory® System

There is a growing range of materials available for the Perfactory® systems. As material developments are ongoing please contact us with your requirements to get the most up-to-date information. However the summary below gives an idea of the variety of materials which can be easily and quickly swapped in and out of the Perfactory®.

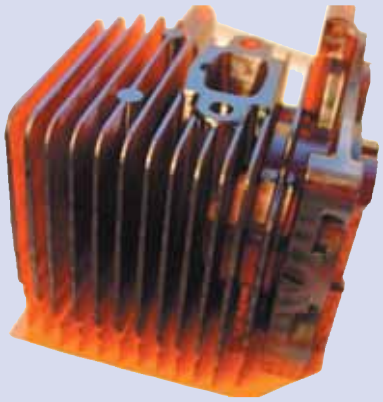
envisionTEC PIC 100/300 Series

The envisionTEC PIC 100/300 series is developed for investment casting, mostly for jewellery and dental markets. It provides highest quality details without sacrificing on toughness and ease of handling.

While there are other wax-based materials out there used in model making, they tend to be far more brittle and harder to handle and finish when compared to the models built on the Perfactory® systems using the PIC 100 resin. Image building, e.g. up to 40 rings with different designs in less than eight hours, that is the speed of Perfactory® with envisionTEC PIC 100.

envisionTEC R 05 and R 11

The envisionTEC R 05 and envisionTEC R 11 are liquid, photoactive resins that produce robust, accurate, and functional parts.



The material offers superior chemical resistance, a wide processing latitude, and excellent tolerance to a broad temperature and humidity range during and after build. Parts created from envisionTEC R 05 and envisionTEC R 11 exhibit superior fatigue properties, strong memory retention, and high quality up-facing and down-facing surfaces. It also offers a good balance of properties between rigidity and functionality. envisionTEC R 05 and envisionTEC R 11 are used for general prototyping, visualisation and vacuum casting master patterns.

envisionTEC e-Shell 200/300 Series

The envisionTEC e-Shell series is a durable, opaque skin tone colored resin for use in Perfactory® and Perfactory Xede / Xtreme® systems. It is developed for adoption in Hearing Aids and otoplastics.

The parts are CE certified for use as hearing aid products and Class-IIa biocompatible according to

Materials - Everything is Possible...

ISO 10993 (Medical Product Law). The material is available in different skin tone colors such as pink, tan, mocca, beige (envisionTEC e-Shell 200 series) and water clear, rosé clear, red and blue (envisionTEC e-Shell 300 series). envisionTEC e-Shell series mimics traditional engineering plastic ABS, which makes it usable in many other non-hearing-aid applications.

envisionTEC RC 25 (NanoCure)

The envisionTEC RC 25 is a ceramic filled resin for use in Perfactory® and PerfactoryXede / Xtreme® systems. Parts created with envisionTEC RC 25 have an opaque peach color appearance. It is developed for applications requiring good temperature resistance, toughness, and stiffness, e.g. automotive components, pump housings, wind tunnel test parts, pump impellers, light reflectors, injection molds, hard chrome plating.

envisionTEC SI 500

The envisionTEC SI 500 is a high-speed, liquid resin that produces flexible, high-impact-strength, and accurate parts using Perfactory® systems.

envisionTEC SI 500 has a wide processing latitude and excellent tolerance to a wide temperature and humidity range during and after build. This material is especially useful in functional applications where extreme flexibility and impact-strength are critical requirements, e.g. automobile panels, electronic enclosures, medical products, snap-fit parts, packaging, and plastic bottles.

You Have the Choice – It´s Quite Easy!

Choosing the Right Perfactory® Model

The Perfactory® consists of two main models, the Perfactory® Standard and the Perfactory® Mini Multi Lens system. Both models look identical from the outside and share many common components. The difference is in the optics and in the size of usable build envelope.

Perfactory® Standard

The Perfactory® Standard system with ERM fitted with a zoom lens, this model is capable of making the largest parts. The build envelope can vary from 120 x 90 x 230 mm to 190 x 142 x 230 mm (XYZ direction) with a dynamic voxel thickness from 25 µm to 150 µm and a build speed up to 20 mm per hour.

Perfactory® Mini Multi Lens

The Perfactory® Mini Multi Lens system with ERM is available with a choice of 3 lenses, this model is ideal for making the finest detailed models. The build envelope varies according to the selected lens (45 mm x 34 mm to 84 mm x 63 mm), as does the Voxel resolution in x and y direction.

- Lens f=60 mm
  30 µm Pixel, XY: 84 mm x 63 mm with ERM
- Lens f=75 mm
  21 µm Pixel, XY: 59 mm x 44 mm with ERM
- Lens f=85 mm
  16 µm Pixel, XY: 44 mm x 33 mm with ERM

Dynamic Voxel thickness is from 15 µm to 50 µm with a build speeds up to 15 mm per hour. There are other models available, including custom versions. Please ask if you feel that your application is not served by the Perfactory® Standard or Perfactory® Mini Multi Lens.

Unrivalled Feature Resolution

Using different focal length optics on the output of the projector means we can vary the detail resolution in X and Y direction. Perfactory® is the only 3D printing system with this ability, and it means you can build parts with feature sizes less than to 20 µm. It‘s even possible to have a special adaptation which can increase resolution to around 10 µm.

You Have the Choice – It´s Quite Easy!

Perfactory® Desktop

The Perfactory® Desktop System is designed to support Rapid Prototyping and Direct Manufacturing with a low cost, high resolution solution. Based on the principle of Photopolymerisation the Perfactory® Desktop System creates three dimensional resin models through a patented Digital Light Processing System.

Utilizing a built in Ethernet® interface the Perfactory® Desktop machine can easily connect directly to a PC workstation or be integrated into a network. The Perfactory® Desktop has an embedded PC, which allows the system to work independently from the pre-processing workstation. The Perfactory® Desktop can be remotely monitored from any computer on the network using the communication software from the Perfactory® Software Suite. Any STL data format can be easily imported using the Perfactory® Software Suite.

You Have the Choice – It´s Quite Easy!

PerfactoryXede®/PerfactoryXtreme®

The PerfactoryXede® and PerfactoryXtreme® three dimensional Rapid Prototyping and Manufacturing systems allow for the production of exceptionally large 3D parts at fast build speeds without sacrificing surface quality and part accuracy.

Using state of the art Digital Light Processing technology from Texas Instruments®, a series of Voxel Planes is projected from the projector curing the photopolymer into a solid object where the image is projected and consequently producing a highly crisp and detailed accurate part. The continuous layerless Z build on the PerfactoryXede® and PerfactoryXtreme® eliminates the part layering that is visible in other competing layer based Rapid Prototyping technologies.

The PerfactoryXede® and PerfactoryXtreme® create three dimensional models that range from conceptual to the fully functional using many photopolymer based materials which are like ABS, Polypropylene, and Glass filled Nylon parts. Photopolymer materials filled with Aluminum Oxide, Zirconium Oxide, Silicon Oxide, and Paraffin Wax are also available for use on the new Perfactory® machines.

The PerfactoryXede® / PerfactoryXtreme® System can connect directly to a PC workstation or integrated into a network where pre-processed job files can be transferred. The System has a stand alone PC, which allows the system to work independently from the pre-processing workstation.

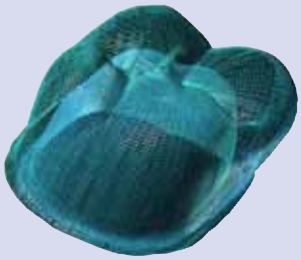
It can be remotely monitored from any computer on the network using the communication software that is integrated into the Perfactory® Software Suite. Any STL data format can be easily converted into Voxel Planes using the Perfactory® Software Suite and then imported into the Perfactory® System to be built.

The build envelope size ranges from 304 x 228 x 381 mm with the PerfactoryXtreme® to 508 x 337 x 457 mm with the PerfactoryXede®. You can reach a continuous producing velocity of up to 25 mm per hour in Z directon at a Voxel depth of 50 µm.

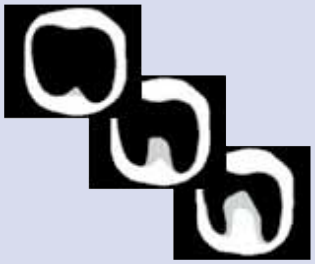
Some Technical Details – If You Like...

How the Perfactory® System Works

Like most 3D printing systems the input data for the Perfactory® is usually in STL format. The STL file is imported into our own proprietary software which prepares the build and then creates a series of voxel planes, which contain individual voxels known as volumetric pixels varying in thickness for each single exposure from 15 µm to 150 µm. The voxel planes are sent to the Perfactory® machine via an ethernet link, either direct from a PC, or on a network. The Perfactory® has its own hard disk, which can store up to 40 jobs in the queue. The voxel planes are sequentially projected into the liquid resin using a DLP® projector, at the heart of which is a DMD® (Digital Micromirror Device). The light cures the liquid based photopolymer, turning it into a solid, and as each Voxel Matrix (projected image with pixels with different gray scale values) is projected one after the other, a complete 3Dimensional part is created.



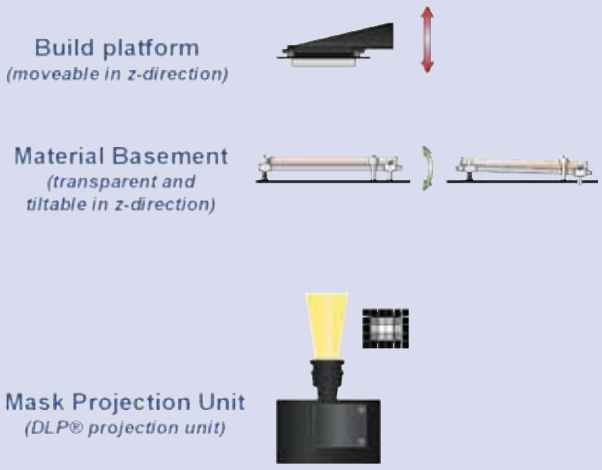
3D CAD Model



Voxel Cube

3D Solid Model

The Perfactory® Layout

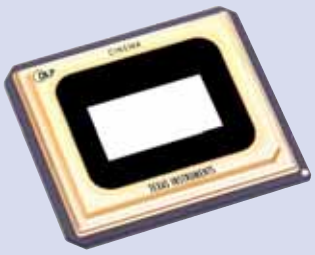


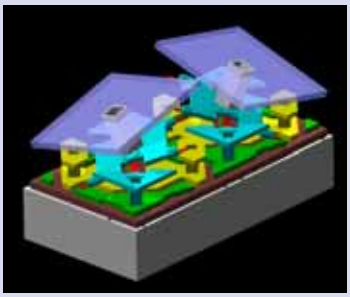
Cutting-Edge Technologies Included

DMD® and DLP® – Heart of all Perfactory® Systems

The Digital Micromirror Device (DMD®) has been developed by Texas Instruments® for high quality digital projection. You will find it in the heart of all Digital Light Processing (DLP®) projectors, such as you may use for business, or for cinema. It consists of around 1.5 million individual mirrors, each mounted on tiny hinges and can be individually controlled. The current resolution of the DMD® is called SXGA+, and it has an array of mirrors 1400 x 1050. Each mirror shown in the following pictures is only of size 13 µm!

You can find out more about the DLP® process and its benefits at www.dlp.com.

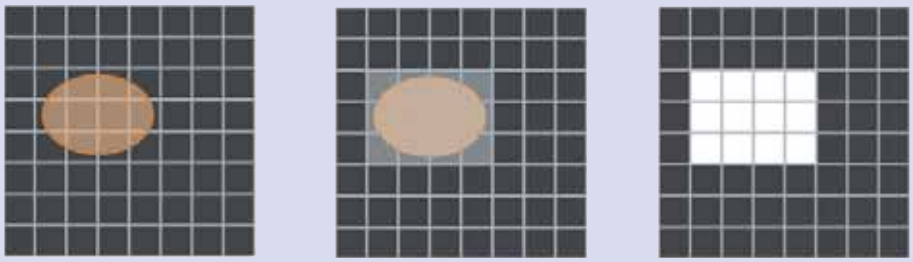




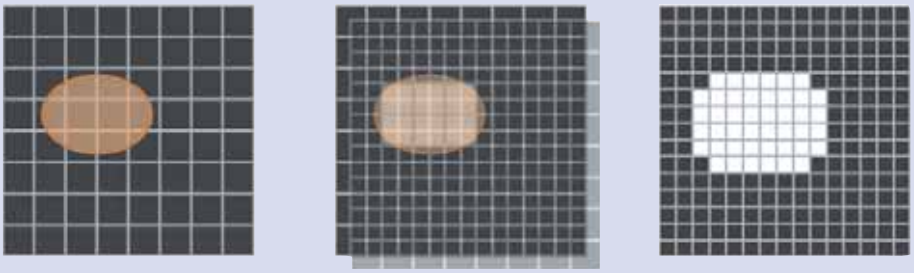
Enhanced Resolution Module – ERM

To further improve surface finish and accuracy, most Perfactory® systems are supplied with ERM. For each voxel built there are two exposures, shifted by half a pixel, which halves the native resolution of the system. For instance a Perfactory® system with a native resolution of 64 µm will build with a resolution of only 32 µm when using ERM. This provides excellent surface finish, reduces pixilation effect, and maintains accuracy to the intent of the 3D CAD design.

Standard Mode



Enhanced Resolution Mode



Finally – It Does Not Cost the World

What the Perfactory® Costs to Run

Buying the envisionTEC Perfactory® Rapid Prototyping and Rapid Manufacturing system is one thing. But what are the running expenses? Less than maybe expected.

Services

The Perfactory® uses only 110 V/240 V single phase electricity, about 5.5 A/2.7 A, so is low cost to operate. For operation it does not require any gases, air-conditioning, compressed air or water. It can be operated in most office and workshop environments.

Consumables

The main consumables used by the Perfactory® are the projector light bulb, the basements (trays for the resin) and the resin. Projector light bulbs last up to 1,000 hours and can be fitted by the operator, so do not need for an engineer visit.

This makes it a low investment to keep multiple materials in stock. Resins typically have a shelf life of up to 12 months when kept in the bottle.

Maintenance Contracts

All new Perfactory® systems come with a 12 months parts and labour warranty. Within the warranty period it is possible to purchase a comprehensive maintenance contract but this is purely optional as the Perfactory® needs little or no maintenance under normal operation. This contract covers all parts and labour. All customers under maintenance are entitled to unlimited telephone and e-mail support. Alternatively you may buy an annual software and firmware upgrade, as well as phone and Internet support service agreement.

Summary

We trust this short document has provided you with an overview of why the Perfactory® system is the acknowledged market leader for creating 3D physical models with high accuracy, high detail and excellent surface finish.

We would be pleased to discuss your application in more detail, and guide you through choosing the right combination of hardware, software and materials. We are always pleased to build benchmark parts, free-of-charge, to demonstrate the Perfactory® capabilities.

Please do not hesitate to get in contact with us if you require any further assistance.

Your envisionTEC Team!

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