10 Appendix

Critical success factors and competition strategies

Siegwart and Sieger [Siegwart, 91] presented a model that allowed a structured evaluation of new technologies. For this they established so-called critical success factors. These are points that can be condensed into individual factors and therefore are used as a measure for evaluating the success of a process in the context of a corporate strategy.

Although the quantification of success factors is currently controversial, they still are an effective instrument to discuss and evaluate products and product strategies.

Requirements for new products are characterized by the following critical success factors:

- Shortening time of development
- Reduction of costs
- Increasing the flexibility (product and manufacturing flexibility)
- Improving the quality

In general, this list is not obligatory, but currently it suggests a wide consensus.

Single critical success factors are in the mathematical sense not independent of each other, but rather they represent factors that, by weighting and connecting in the sense of a strategy, lead to useful statements. In a strategy, the self-concept of a company in an interplay with its competitors is expressed. Today (it might be different tomorrow) successful companies (market leaders and “hidden champions”) pursue the following strategies:

1. Technology leadership (pioneer leadership)
2. Cost leadership
3. Differentiation
4. Concentration
5. Overhauling strategy

The critical success factors of time and flexibility are in the foreground of the pioneer strategy, while quality and costs are in the background. In pursuing cost leadership, the rest of the critical success factors step behind the costs. The strategy of differentiation follows for a unique product, for example with an unmistakable design. Compared to quality and flexibility, costs and time play a subordinated role. Concentration is not an independent strategy, but rather is an application of cost leadership and differentiation to a chosen market segment. Outpacing is the change between the strategies of cost leadership and differentiation, based on the situation of the competition. The "provocative outpacing" strategy first involves procuring a share of the market with inexpensive products, followed by differentiation with high-quality products. "Preventive outpacing" goes directly after cost leadership, to fend off low prices from competitors from the beginning.

A strategy known as market skimming is similar to outpacing. A product, preferably upscale, unrivaled, and introduced to the market before the competition, which is temporary and intense, is put on the market with the necessary advertising expense. When the competition begins on the market, the business is over or reduced to a low and low-priced afterbusiness. This applies especially to fancy goods, for example the mp3 player iPod (Apple). In this case, all competitive factors play a similar role, but have different weighting related to the stage.

These examinations show that most of the actually used strategies are a mixture of single projections, which are followed over the period with different weightings.

The individualization of mass products can be seen as a combination of the pioneer and differentiation strategies.

The implementation of the theory explained in the following makes it clear that time especially plays an important role.

Economic model by Siegwart and Singer

The approach of Siegwart and Singer allows for a quantitative assessment of the economic impact in the use of new technologies, taking into account the risk associated with new technologies. Steger and Conrad [Steger, 95] applied this approach to rapid prototyping. Conventional five-axis milling and stereolithography were compared, for example.

Even from an operational perspective, the authors determine the benefits of stereolithography in terms of production time and costs. The quality of the component, in particular on the surfaces, from milling is better.

The strategic assessment of the technology covers all critical success factors in the calculation. The assessment is no longer based on the costs, as in the operational view.

Procedure

An economic efficiency ratio is defined, indicating how well a strategy is supported by the application of rapid prototyping.

The economic efficiency ratio is the quotient of the growth of capacity (capacity value) and the total costs (cost value). The costs include all of the classic cost types and the cost savings that are due to the use of additive manufacturing processes. The capacity includes the critical success factors (which may be defined differently in other basic approaches) cost, quality, and flexibility. The improvement or deterioration (in percent) is calculated in each case compared with the conventional reference case (which equals 100 %).

As part of the strategic review, Steger and Conrad compare the economic importance of the use of rapid prototyping for four different competitive strategies:

1. Technology leadership (pioneer strategy)
2. Cost leadership
3. a) Differentiation or b) Concentration
4. Overtaking strategy (outpacing)

Rapid prototyping technology has an influence on the critical success factors of

1. shorter development time,
2. reduction of costs,
3. improved quality, and
4. increased flexibility

entered into the calculation. For this purpose, the effect of an additive manufacturing process is estimated on the critical success factors: for each strategy, the critical success factors of time, quality, and flexibility are connected to a capacity value and transferred to the factor cost in a cost value.

The capacity and cost factors consist of a value for the performance ratio, which indicates how much the property in question could be improved by the use of an additive manufacturing process (for example, speed increased by 80% leads to the fulfillment level 180) and a weighting factor (depending on the importance of the criterion for the strategy, between 1 and 3).

The average of the capacity values of time, quality, and flexibility is multiplied by the reciprocal value of the cost value, the efficiency index WI, which is a measure of the potential or prediction of a new technology.

An evaluation of the individual capacity values, with a probability of arriving at the predictions, leads to an economy measure WII and additionally encompasses the risk that is associated with the introduction of the new technology.

The analogous application of the process to the basic technology gives reference values for the assessment of the new technology.

Determine the numerical values

The values for the variation of the critical success factors

1. shorter development time,
2. reduced costs,
3. improved quality, and
4. increased flexibility

were estimated as follows:

No. 1: Shortening the development time

Quickly available prototypes have the potential to reduce the development time by up to 80 %.

The shortening of the production time of prototypes often plays only a minor role. This advantage can be used, depending on the strategy, for

- earlier market entry,
- quality improvement, or
- cost reduction.

The total reduction of development time that is finally realized is therefore dependent on the type of strategy.

No. 2: Reducing cost

The reduction of costs is achieved in two ways, first, the effect of earlier cost-cutting, and second, through cheaper production of models. The literature states that about 50 % is production costs and that the savings from an earlier assessment of the cost of product development indicate about 25 % of the savings in the production model. Through following necessary processes when using the additive manufacturing process, with the conventional process the total numbers may still change.

While the cost advantage in the production always occurs, the degree of realization of the further potential, in turn, depends on the strategy.

Reducing costs, therefore, makes up at least 50 % but not more than 75 %.

No. 3: Improving quality

Through the use of an additive manufacturing process, a higher product maturity is attained earlier.

Methods of QFD (quality function deployment) and FMEA (failure mode and effects analysis) are thereby effectively supported, and an expensive troubleshooting later on is avoided.

The magnitude of the effect depends, as already mentioned, on a cost/benefit strategy that determines how much is spent by the time that is saved.

No. 4: Increasing flexibility

The rapid availability of prototypes influences the flexibility outward and inward. Changing market requirements can be quickly and effectively responded to by serial identical prototypes.

Shorter reaction times within the company improve communication and put the organization in a position to respond faster and better to changes of all kinds (provisions computing process, process production, environmental conditions). They are the basis for continuous learning in an operation and an important factor in increasing the rate of innovation of the company.

A quantification of these effects is very difficult.

In order to obtain meaningful answers, a competitive strategy must be defined, such as cost leadership, and depending on each critical success factor, a performance level shall be determined. In view of the fact that the maximum savings are 75% of the cost for the application of rapid prototyping, a performance level of 175% results (100% corresponds to conventional milling). Because the cost leadership strategy assumes that the time gained is fully reinvested in cost reduction, the success factors of development and quality remain unchanged (100%), which, however, are difficult to measure. Increased flexibility is assumed to be 20% (= 120%).

The performance levels thus determined are weighted by factors of 1 to 3 (1 = low importance, 2 = average meaning, 3 = very important) and hence are the importance of the individual factors of success for each competition strategy.

In the case of cost leadership, this results in a 3 for the cost, a 2 for the time, and a 1 each for quality and for flexibility.

The average of the values of capacity is determined from the product of the weight and degree of completion, and the cost value is the reciprocal of the product of the weight and the degree of satisfaction regarding the success factor costs.

The value of the cost-effectiveness ratio WI results from the ratio of capacity value and cost value. Although it contains estimates for the potential of the technology, it does not consider the risk. Therefore, for each success factor is defined a probability (<1), multiplied by the value for each success factor and the mean re-formed for the performance. By dividing by the cost value, the profitability index WII follows in terms of risk.

The performance level and the probability are specified for conventional technology with 100% or 1. By weighting and averaging, the following efficiency characteristics WI and WII result:

	WI Conventionally	WII Conventionally
Cost leadership	3.99	3.99
Differentiation strategy	2.67	2.67
Pioneer strategy	2.33	2.33
Outpacing strategy	9.00	9.00

The calculation of the cost-effectiveness ratios for the rapid prototyping technology is based on the following values:

The weighting depends on the competitive strategy.

	Costs	Time	Quality	Flexibility
Cost leadership	3	2	1	1
Differentiation strategy	1	2	3	3
Pioneer strategy	1	3	1	3
Outpacing strategy	3	3	3	3
The probability is assumed to be:	1	1	0.7	0.6

This results in the following values related to the conventional results for the profitability figures I and II:

	WI / WI Conventionally	WII / WII Conventionally
Cost leadership	1.84	1.75
Differentiation strategy	0.86	0.70
Pioneer strategy	2.14	2.02
Outpacing strategy	1.91	1.76

The pioneer, the cost leadership, and the outpacing strategies rely mainly on the factors of time and costs: such strategies that are supported by the RP process are almost twice as effective as conventional methods.

In the differentiation strategy, the advantages of the additive process, time and costs, play only a subsequent role. However, the factors of quality and flexibility, which are not positively influenced by additive processes, are very important. Consequently, the strategy of differentiation of the additive manufacturing process is worse than that supported by conventional.

Technical data and information

The following are technical data and addresses collected on the topics of

- CAD systems and software for additive manufacturing,
- additive manufacturing machines (prototypers and fabricators), and
- materials for additive manufacturing processes and casting resins.

The information was derived from the manufacturers, but occasionally also from independent research institutes and from the literature. The description is limited to selected machines and representative materials for which sufficient data are available. Therefore, they do not make any mention of the machine in the text and nor mention all of the material. Many technical details were deliberately included in the description of the machines in the text because they can be commented upon there. Also, some machines are missing on further representation in table

form. If technical information is missing in the table in the appendix, reference should be made to the corresponding chapters. All prices are included in Figs. 8.1 and 8.2, "System Costs."

The information has been compiled to the best of the author's knowledge and belief. Because of the high speed of development, before using this information, it should be checked on the manufacturers' website or question the manufacturer. Therefore, wherever Internet addresses were available, they are also indicated. The data from older machines and material can be looked up in previous editions of this book.

Table A2.1, "Manufacturers of Additive Manufacturing Machines," also shows manufacturers that are not mentioned in Chapter 3. More information should be obtained directly from the manufacturer. Above all, the current partners are to be reviewed because the distribution networks are continuously expanded. Casting resins are collected in Table A3.12, "Casting Resins." Because the range here is confusingly large, one elastic, one hard, one impact resistant, one high-temperature resistant, and one clear quality resin were selected as examples. This choice does not mean that similar qualities would not be delivered by other manufacturers. In particular, no rating is associated with the selection.

CAD Systems and Software for Additive Manufacturing

Table A1.1: 3D CAD Systems

It may be assumed that each of these systems has a STL-capable interface.

Table A1.2: Additive Manufacturing Software (Rapid Prototyping Software)

Additive Manufacturing Machine (Prototypers and Fabricators)

Table A2.1: Manufacturers of Additive Manufacturing Machines

Table A2.2: Stereolithography Machines I

Table A2.3: Stereolithography Machines II

Table A2.4: Stereolithography Machines III

Table A2.5: Stereolithography Machines IV

Table A2.6: Stereolithography Machines V

Table A2.7: Stereolithography Machines VI

Table A2.8: Stereolithography Machines VII

Table A2.9: Stereolithography Machines VIII

Table A2.10: Stereolithography Machines IX

Table A2.11: Stereolithography Machines X

Table A2.12: Stereolithography Machines XI

Materials for Additive Manufacturing Processes and Casting Resins

Table A1.1 3D CAD Systems

Manufacturer	Product	Website
Autodesk Ltd.	Autodesk Inventor 2013 AutoCAD Mechanical	www.autodesk.com
Bentley Systems	MicroStation	www.bentley.com
CAD Schroer	Meduas4	www.cad-schroer.com
Cimatron	CimatronE	www.cimatron.com
DATA BECKER GmbH Co. KG	BeckerCAD 8 PRO	Closed March 2014
DataSolid GmbH	CADdy++	www.datasolid.com
Delcam UK	PowerShape ArtCAM	www.delcam-na.com
Encee CAD / CAM Systeme GmbH	VX Designer VX Mold&Die	www.encee.de
Evolution Computing Inc.	FastCAD7.5	www.fastcad.com
FEGS Ltd.	CADFIX	www.fegs.co.uk
GK-Planungssoftware GmbHI	TurboCAD	www.turbocad.com
IronCAD LLC.	IronCAD	www.ironcad.com
LGPL	FreeCAD	www.freecadweb.org
MASTERCAM	MASTERCAM	www.mastercam.com
MSCsoftware	MSC/PATRAN	www.mscsoftware.com
MCS Ltd.	ANVIL EXPRESS	www.mcsaz.com
Mecadat GmbH	VISI20 CAD/CAM	www.mecadat.com
NT CADCAM Ltd.	SolidWorks	www.ntcadcam.co.uk
Bihler of America, Inc.	bihlerbNX	www.bihler.com
Pathtrace Engineering Systems Ltd.	EdgeCAM	www.edgecam.com
PTC Inc.	PTC Cero Elements/Direct CADDS 5 Pro/ENGINEER	www.ptc.com
Siemens	NX I-DEAS Solid Edge	www.siemens.com
Tebis	Tebis CAD	www.tebis.com
Tinkercad Inc.	Tinkercad	www.tinkercad.com
Tnodiana	FEMGV	www.tnodiana.com
Trimple Navigation Ltd.	SketchUp	www.sketchup.com
Toyota Caelum Inc.	Caelum	www.caelum.co.jp
VariCAD	VariCAD	www.varicad.com
3DS	CATIA ICEM Surf	www.3ds.com

Table A1.2 Additive Manufacturing Software

Manufacturer	DeskArtes Oy	Marcam Engineering	Material-ise N.V.	Netfabb GmbH	Solid Concepts Inc.
Website	deskartes.fi	marcam.com	materialise.com	Netfabb.com	solidview.com
Program	3DataExpert	AutoFab	Magics	Netfabb Professional	Solid View/ Pro RP
RP Software	yes	yes	yes	yes	yes
CAD Software, Module	yes	no	no	no	no
Visualization software	yes	yes	yes	yes	yes
Interface formats					
▪ **Import**	STL, VRML, ZPR, OBJ, DXF, PLY, 3DS, Collada, FBX, 3DE	STL, IGES, VDA-FS, DXF (3D FACE), VRML (1&2), PLY	Google SketchUp 8.0, AMF, DXF, OBJ, VRML, ZPR, PLY, 3DS, 3DM (Optional: FBX, STEP, ACIS, VDA, IGES)	STL, X3D, WRL, GTS, CLI, SLI, SLC, SSL, OBJ, CLS, G-Code	DXF, DWG, SFX, SVD, STL, WRL, (Optional: IPT, IAM, SAT, SAB, SESSION, MODEL, EXP, CATPART, CATPRODUCT, CGR, IGES, IGS, VDA, PRT, ASM, STP, STEP, X_B, X_T, IDI, MCA, PAR, ASM, PSM, DFT, SLDPRT, SLDDRW, PRT
▪ **Export**	STL, VRML, ZPR, DXF, PLY, 3DE	STL, CLI, SLI, CLF, F&S, ILT, AFF, CLS, (Optional: MTT, SLM)	n. a.	SLI, CLI, CLS, SLC, SSL, USF, ABF, SLM, SVG, DXF, STL, PNG, BMP, PS, ASC	STL, PLY, SVD
Possibility to repair STL files	yes	yes	yes	yes	yes
Possibility to modify STL files	yes	yes	yes	yes	yes
Measuring objects	yes	yes	yes	yes	yes
Possibility to create slice files	yes	yes	yes	yes	yes
Support generation	yes	yes	yes	yes	yes
Tooling module	yes	no	yes	yes	yes
Hardware request	PC, Workstation	PC, Workstation	PC, Workstation	PC, Workstation	PC, Workstation
Operating system	Win NT	Windows	Windows	Windows, MAC, Linux	Windows

Table A2.1 Manufacturers of Additive Manufacturing Machines

Manufacturer	City	Country	Website
3D Systems, GmbH	64291 Darmstadt	Germany	www.3dsystems.com
3D Systems, Inc.	Rock Hill, SC 29730	USA	www.3dsystems.com
Arcam AB (publ.)	431 37 Mölndal	Sweden	www.arcam.com
Boxford Limited	Halifax, HX3 5AF	Great Britian	www.boxford.co.uk
Charlyrobot SA BP 22	74350 Cruseilles	France	www.charlyrobot.com
CMET Inc.	Kanagawa, 222-0033	Japan	www.cmet.co.jp
CONCEPT Laser GmbH	96215 Lichtenfels	Germany	www.concept-laser.de
CRP-Technology	41100 Modena	Italy	www.crptechnology.com
Cubic Technologies, Inc.	Carson, CA 907463608	USA	www.cubictechnologies.com
Cubital	The company is no longer active		
D-MEC Ltd.	Tokyo 1040045	Japan	www.d-mec.co.jp
Envisiontec GmbH	45968 Gladbeck	Germany	www.envisiontec.de
EOS GmbH	82152 Krailling	Germany	www.eos.info
F & S Stereolithography-technik GmbH	33100 Paderborn	Germany	www.fockeleandblacke.de
Kinergy Precision Engineering Co., Ltd.	Nantong	VR China	www.kinergy-nt.com
KIRA Corp. Co., Ltd.		Japan	www.kiracorp.co.jp
Kira Europe GmbH	40699 Erkrath	Germany	www.kira-europe.com
MCP HEK Tooling GmbH	23560 Lübeck	Germany	www.mcp-group.de
MEIKO Co., Ltd.		Japan	www.meiko-inc.co.jp
Microfabrica Inc.	Van Nuys, CA 91406	USA	www.Microfabrica.com
microTEC, Ges. f. Mikro-technologie mbH	47057 Duisburg	Germany	www.microtec-d.com
Mk Technology GmbH	53501 Grafschaft	Germany	www.mk-technology.com
NEXT FACTORY S.R.L.	36015 Schio (Vi)	Italy	www.nextfactory.com
Optomec Inc.	Albuquerque, NM 87109	USA	www.optomec.com
Phenix Systems	63100 Clermont Ferrand	France	www.phenix-systems.com
POM Advanced Product Development Center	Auburn Hills, Michigan 48326	USA	www.pomgroup.com
ProMetal	Irwin, PA 15642	USA	www.prometal-rt.com
ProMetal RCT GmbH	86167 Augsburg	Germany	www.prometal-rct.com
Röders GmbH (Röders TEC)	29614 Soltau	Germany	www.roeders.de
Shanghai Union Technology Co., Ltd.	Shanghai	VR China	www.union-tek.com
Solidica	Ann Arbor, MI 481088942	USA	www.solidica.com

Table A2.1 *(continued)* Manufacturers of Additive Manufacturing Machines

Manufacturer	City	Country	Website
Solidimension Ltd.		USA, Italy, China	www.solido3d.com
Solidscape	Merrimack, NH 030544115	USA	www.solid-scape.com
Soligen	Northridge, CA 91324	USA	www.soligen.com
Speedpart	431 37 Mölndal	Sweden	www.speedpart.se
Stratasys Inc.	Eden Prairie, MN 553442020	USA	www.stratasys.com
Stratasys GmbH	60314 Frankfurt/Main	Germany	www.stratasys.com
Stratoconception/CIRTES	Saint-Dié-des-Vosges 88100	France	www.stratoconception.com
Trump Precision Machinery Co., Ltd.	Shanghai, Zhongshan	VR China	www.trumpsystem.com
TRUMPF Laser- and Systemtechnik GmbH	71254 Ditzingen	Germany	www.trumpf.com
Tschopp Technical Enginnering	Ramlinsburg	Switzerland	www.tschopptech.ch
Voxeljet	86167 Augsburg	Germany	www.voxeljet.de
Weihbrecht	74549 Wolpertsausen	Germany	www.weihbrecht.de
Zimmermann, F. GmbH	73770 Denkendorf	Germany	www.f-zimmermann.com
Z Corporation	Burlington, MA 01803	USA	www.zcorp.com

Table A2.2 Stereolithography Machines I

RP Process	Unit	SL	SL	SL	SL	SL*
Machine Designation/ Type		SLA 250	SLA 5000	SLA 7000	Viper-SLA	Viper Pro
Manufacturer		3D Systems				
Distribution in Germany		www.3dsystems.com				
Dimensions, Connection values						
Width/depth/height	m/m/m	1.24/1.64/0.69	1.88/1.19/2.02	1.88/1.22/2.03	1.34/0.86/1.78	ca. 2/1.5/2
Weight	Kg	362	1318	1196	463	
Electrical connection	V/A	230/8	200–240/15	200–140/20	220–240/16	200–140/20
Power consumption	kW	1.2	2.2	3	1.51	3
Working gas	l/min	–	–	–	–	–
Cooling water	l/min	–	–	–	–	–
Extraction	m^3/h	–	–	–	–	–
Work room temperature	°C	20–26	20–26	20–26	20–26	20–26
Relative moisture	%	< 50	< 50	< 50	< 50	< 50
Process						
Fumes, Exhaust		Closed system with active carbon filter				
Disposal, Waste		Cured polymer				
Hazardous Waste		Uncured polymer, solvent				
Contouring Element						
Kind		Laser	Laser	Laser	Laser	Laser
Type		HeCd	$Nd:YV0_4$	$Nd:YV0_4$	$Nd:YV0_4$	$Nd:YV0_4$
x-y Contour generation		Scanner	Scanner	Scanner	Scanner	Scanner
x-y Contour accuracy	mm	Depending on the material	Depending on the material	Depending on the material	Depending on the material	Depending on the material
Position repeatability	mm	–	0.013	0.001	0.0076	0.0076
z Contour accuracy	mm	0.0025	0.00177	0.00125	0.0025	0.0025
z Contour repeatable accuracy	mm	Depending on the material	Depending on the material	Depending on the material	Depending on the material	Depending on the material
Coating cycle	s	Depending on geometry	Depending on geometry	Depending on geometry	Depending on geometry	Depending on geometry
Coating arm speed	mm/s	Typ. 25–50	Typ. 25–50	Typ. 25–50	Typ. 25–50	Typ. 25–50
Power fluctuation	%	± 5	± 5	± 5	± 5	± 5
Model characteristics						
Installation space max. (Width/depth/height)	mm	254/254/254	508/508/584	508/508/600	254/254/254	min: 650/350/300 max: 1500/750/500
Model dimensions max.	mm	254/254/254	508/508/584	508/508/600	254/254/254	
Layer thickness	mm	0.075–0.15	0.05–0.15	0.025–0.15	0.025–0.15	0.05–0.15
Spot (laser diameter)	mm	ca. 0.25	ca. 0.25	ca. 0.25 plus 0.8	ca. 0.075 plus .25	0.13
Accuracy absolute	mm	0.1	0.1	0.1	0.1	0.1
Repeatability	mm	–	–	–	–	–
Additional support		yes	yes	yes	yes	yes
EDP interfaces						
Interfaces format		STL, SLC	STL, SLC	STL, SLC	STL, SLC	STL, SLC
EDP system		PC	PC	PC	PC	PC
Operating system		MS-DOS	Windows XP	Windows XP	Windows XP	Windows XP
Software		Buildstation 4.0	Buildstation 5.5	Buildstation 5.5	Buildstation 5.5	Buildstation 5.5

* The technical data, especially the building chambers, change with the equipment of the machine.

Table A2.3 Stereolithography Machines II

RP Process	Unit	Stereolithography	Stereolithography	SL
Machine designation/Type		InVision 3-D Printer	InVision HR 3-D Printer	FS-Realizer STL
Manufacturer		3D Systems		F&S Stereolitho-graphytechnik GmbH
Distribution in Germany		www.3dsystems.com		
Dimensions, Connection values				
Width/depth/height	m/m/m	0.96/1.42/1.67	0.96/1.42/1.67	1.6/0.8/2.3
Weight	kg	254	254	500
Electrical connection	V/A	100–127/15; 200–240/10	100–127/15; 200–240/10	230/16; 400/32
Power consumption	kW			1.5
Working gas	l/min			–
Cooling water	l/min			–
Extraction	m^3/h			yes
Work room temperature	°C		18–28	< 33
Relative moisture	%			45
Process				
Fumes, Exhaust				low
Disposal, Waste				
Hazardous waste				
Contouring Element				
Kind		Multijet Modeling	Multijet Modeling	Laser
Type		with UV curing	with UV curing	Nd-YAG
x-y Contour generation				Scanner
x-y Contour accuracy	dpi	328/328	656/656	± 0.02
Spot repeatability	dpi			0.002
z Contour accuracy	dpi	606	800	± 0.1
z Contour repeatable accuracy	mm			± 0.1
Coating cycle	s			< 10
Coating arm speed	mm/s			0–1000
Power fluctuation	%			± 2
Model characteristics				
Installation space max. (width/depth/height)	mm		127/178/50	400/400/300
Model dimensions max.	mm	298/185/203	64.5 cm^2 (*x*, *y*); 5.0 cm (*z*)	400/400/300
Layer thickness	mm			> 0.1
Gauge	mm			0.1
Accuracy absolute	mm			± 0.1
Repeatability	mm			± 0.1
Additional support				yes
EDP Interface				
Interface formats		Ethernet, .stl		F&S
EDP System				PC
Operating system		Windows XP, Professional, 2000, NT	Windows XP, Professional, 2000, NT	Win NT
Software		InVision print client software	InVision print client software	F&S

Table A2.4 Stereolithography Machines III

RP Process	Unit	SL	SL	SL	SL	SL*
Machine designation/ Type		DigitalWax 008J	DigitalWax 009J	DigitalWax 028J	DigitalWax 028J+	DigitalWax 029J
Manufacturer		DWS Additive Manufacturing				
Distribution		www.dwssystems.com				
Dimensions, Connection values						
Width/depth/height	m/m/m	0.38/0.52/0.56	0.38/0.52/0.56	0.38/0.52/0.73	0.38/0.52/0.73	0.61/0.66/1.4
Weight	kg	43	43	56	56	150
Electrical connection	V/A	230/115	230/115	230/115	230/115	230/115
Power consumption	kW	0.2	0.2	0.4	0.4	0.5
Working gas	l/min	–	–	–	–	–
Cooling water	l/min	–	–	–	–	–
Extraction	m^3/h	–	–	–	–	–
Work room temperature	°C	22–25	22–25	22–25	22–25	22–25
Relative moisture	%	60	60	60	60	60
Process						
Fumes. Exhaust		–				
Disposal, Waste		–				
Hazardous waste		–				
Contouring Element						
Kind		Laser	Laser	Laser	Laser	Laser
Type		Solid State BluEdge® BE-100	Solid State BluEdge® BE-	Solid State BluEdge® BE-1500A/ BE-1500AHR	Solid State BluEdge® BE-1500A/ BE-1500AHR	Solid State BluEdge® BE-1700/ BE-1700HR
x-y Contour generation		Plotter	DLP® Texas Instruments Inc.	Galvanometer	Galvanometer	Galvanometer
x-y Contour accuracy	mm	Depending on the material	Depending on the material	Depending on the material	Depending on the material	Depending on the material
Position repeatability	mm	–	–	–	–	–
z Contour accuracy	mm	–	–	–	–	–
z Contour repeatable accuracy	mm	Depending on the material	Depending on the material	Depending on the material	Depending on the material	Depending on the material
Coating cycle	s	Depending on geometry	Depending on geometry	Depending on geometry	Depending on geometry	Depending on geometry
Coating arm speed	mm/s	Typ. 0-40	–	Typ. 0-2200	Typ. 0-2200	Typ. 2600
Power fluctuation	%	–	–	–	–	–
Model characteristics						
Installation space max. (width/depth/height)	mm	65/65/90	50/37/90	65/65/90	90/90/90	110/110/100
Model dimensions max.	mm	65/65/90	50/37/90	65/65/90	90/90/90	110/110/110
Layer thickness	mm	0.01–0.10	0.01–0.10	0.01–0.10	0.01–0.10	0.01–0.10
Spot (laser diameter)	mm	–	–	–	–	–
Accuracy absolute	mm	–	–	–	–	–
Repeatability	mm	–	–	–	–	–
Additional support		yes	yes	yes	yes	yes
EDP Interface						
Interface formats		STL, SLC	STL, SLC	STL, SLC	STL, SLC	STL, SLC
EDP system		PC	PC	PC	PC	PC
Operating system		32-bit Windows XP Pro, Vista, 7	Windows XP	Windows 7	Windows 7	Windows 7
Software		DigitalWax 008J Controller	DigitalWax 009J Controller	DigitalWax 028J Controller	DigitalWax 028J Controller	DigitalWax 029J Controller

Table A2.5 Stereolithography Machines IV

RP Process	Unit	SL	SL	SL	SL	SL*
Machine designation/ Type		DigitalWax 029J+	DigitalWax 030J	DigitalWax dfab	DigitalWax 008D	DigitalWax 020D
Manufacturer		DWS Additive Manufacturing				
Distribution		www.dwssystems.com				
Dimensions, Connection values						
Width/depth/height	m/m/m	0.61/0.66/1.4	1.15/1.45/2.1	–	0.38/0.52/0.56	0.38/0.52/0.81
Weight	kg	150	–	–	45	58
Electrical connection	V/A	230/115	230/115	–	230/115	230/115
Power consumption	kW	0.5	–	–	0.2	0.4
Working gas	l/min	–	–	–	–	–
Cooling water	l/min	–	–	–	–	–
Extraction	m^3/h	–	–	–	–	–
Work room temperature	°C	22–25	22–25	22–25	22–25	22–25
Relative moisture	%	60	60	60	60	60
Process						
Fumes, Exhaust		–				
Disposal, Waste		–				
Hazardous waste		–				
Contouring Element						
Kind		Laser	Laser	Laser	Laser	Laser
Type		Solid State BluEdge® BE-1800A/ BE-1800AHR	Solid State Blu Edge®	–	Solid State Blu Edge® BE-1000	Solid State Blu Edge® BE-1500C
x-y Contour generation		Galvanometer	–	–	Plotter	Galvanometer
x-y Contour accuracy	mm	Depending on the material	Depending on the material	Depending on the material	Depending on the material	Depending on the material
Position repeatability	mm	–	–	–	–	–
z Contour accuracy	mm	–	–	–	–	–
z Contour repeatable accuracy	mm	Depending on the material	Depending on the material	Depending on the material	Depending on the material	Depending on the material
Coating cycle	s	Depending on geometry	Depending on geometry	Depending on geometry	Depending on geometry	Depending on geometry
Coating arm speed	mm/s	Typ. 5000	–	–	Typ. 0–40	Typ. 0–2000
Power fluctuation	%	–	–	–	–	–
Model characteristics						
Installation space max. (width/depth/height)	mm	150/150/100	300/300/300	–	65/65/90	130/130/90
Model dimensions max.	mm	150/150/100	300/300/300	–	65/65/90	130/130/90
Layer thickness	mm	0.01–0.10	–	–	0.01–0.10	0.01–0.10
Spot (laser diameter)	mm	–	–	–	–	–
Accuracy absolute	mm	–	–	–	–	–
Repeatability	mm	–	–	–	–	–
Additional support		yes	yes	yes	yes	yes
EDP Interface						
Interface formats		STL, SLC	STL, SLC	STL, SLC	STL, SLC	STL, SLC
EDP system		PC	PC	PC	PC	PC
Operating system		Windows 7	–	–	32-bit Windows XP Pro, Vista, 7	Windows XP Professional
Software		DigitalWax 029J Controller	DigitalWax 030J Controller	–	DigitalWax 008D Controller	DigitalWax 008D Controller

Table A2.6 Stereolithography Machines V

RP Process	Unit	SL	SL	SL	SL	SL*
Machine designation/ Type		DigitalWax 028D	DigitalWax 029D	DigitalWax 030D	DigitalWax 029X	DigitalWax 030X
Manufacturer		DWS Additive Manufacturing				
Distribution		www.dwssystems.com				
Dimensions, Connection values						
Width/depth/height	m/m/m	0.38/0.52/0.73	0.61/0.66/1.4	1.1/0.7/2.0	0.61/0.66/1.4	1.15/1.45/2.1
Weight	kg	56	150	–	150	–
Electrical connection	V/A	230/115	230/115	230/115	230/115	230/115
Power consumption	kW	0.4	0.5	–	0.5	–
Working gas	l/min	–	–	–	–	–
Cooling water	l/min	–	–	–	–	–
Extraction	m^3/h	–	–	–	–	–
Work room temperature	°C	22–25	22–25	22–25	22–25	22–25
Relative moisture	%	60	60	60	60	60
Process						
Fumes, Exhaust		–				
Disposal, Waste		–				
Hazardous waste		–				
Contouring Element						
Kind		Laser	Laser	Laser	Laser	Laser
Type		Solid State BluEdge® BE-1500	Solid State Blu Edge® BE-1800B	Solid State Blu Edge®	Solid State Blu Edge® BE- 1800C	Solid State Blu Edge®
x-y Contour generation		Galvanometer	Galvanometer	–	Galvanometer	–
x-y Contour accuracy	mm	Depending on the material	Depending on the material	Depending on the material	Depending on the material	Depending on the material
Position repeatability	mm	–	–	–	–	–
z Contour accuracy	mm	–	–	–	–	–
z Contour repeatable accuracy	mm	Depending on the material	Depending on the material	Depending on the material	Depending on the material	Depending on the material
Coating cycle	s	Depending on geometry	Depending on geometry	Depending on geometry	Depending on geometry	Depending on geometry
Coating arm speed	mm/s	Typ. 0–2000	Typ. 5000	–	Typ. 5000	–
Power fluctuation	%	–	–	–	–	–
Model characteristics						
Installation space max. (width/depth/height)	mm	90/90/90	150/150/150	250/250/250	150/150/150	300/300/300
Model dimensions max.	mm	90/90/90	150/150/150	250/250/250	150/150/150	300/300/300
Layer thickness	mm	0.01–0.10	0.01–0.10	0.01–0.10	0.01–0.10	0.01–0.10
Spot (laser diameter)	mm	–	–	–	–	–
Accuracy absolute	mm	–	–	–	–	–
Repeatability	mm	–	–	–	–	–
Additional support		yes	yes	yes	yes	yes
EDP Interface						
Interface formats		STL, SLC	STL, SLC	STL, SLC	STL, SLC	STL, SLC
EDP system		PC	PC	PC	PC	PC
Operating system		Windows XP Professional	Windows XP Professional	Windows	Windows 7	Windows 7
Software		DigitalWax 028D Controller	DigitalWax 029D Controller	DigitalWax 030D Controller	DigitalWax 029X Controller	DigitalWax 030X Controller

Table A2.7 Stereolithography Machines VI

RP Process	Unit	SLA	SLA	SLA	SLA	SLA
Machine designation/ Type		Perfactory Micro	Perfactory Micro DDP	Perfactory Micro EDU	Perfactory Aureus	PixCera
Manufacturer		EnvisionTEC GmbH				
Distribution		Envisiontec.com				
Dimensions, Connection values						
Width/depth/height	m/m/m	0.23/0.18/0.58	0.23/0.23/0.52	0.28/0.25/0.61	0.45/0.78/0.45	0.45/0.78/0.45
Weight	kg	13	13	11	35	35
Electrical connection	V/A	100-240/2-3	100-240/2-3	100-240/2-3	100-240/1-2	100-240/1-2
Capacity	KW	n. a.	n. a.	n. a.	n. a.	n. a.
Work room temperature	°C	n. a.	n. a.	n. a.	n. a.	n. a.
Air moisture	%	n. a.	n. a.	n. a.	n. a.	n. a.
Model characteristics						
Installation space max. (width/depth/height)	mm	40/30/100	40/30/100	86/64.5/100	60/45/100	60/45/100
Model dimensions max.	mm	40/30/100	40/30/100	86/64.5/100	60/45/100	60/45/100
Layer thickness	mm	0.025–0.035	0.05/0.1	0.025–0.1	0.025–0.035	0.025–0.035
Accuracy absolute	mm	n. a.	n. a.	n. a.	n. a.	n. a.
EDP Interface						
Interface formats		STL	STL	STL	STL	STL
EDP system		n. a.	n. a.	n. a.	PC	PC
Operating system		n. a.	n. a.	n. a.	n. a.	n. a.
Miscellaneous						
Building materials		PIC 100, EC500, HTM140	Press-E-Cast	LS 600, HTM140V2	R5/R11, PIC 100/100G, WIC 100G, EC500, RCP30/130, HTM140	E-Dent, E-PKin-dial, Press-E-Cast
ERM pixel resolution	mm	0.031	-	-	-	-
Resolution in *x* and *y*	mm	-	0.075	-	-	-
Native pixel size	mm	-	-	0.084	0.043	0.043
Linear *z*-axis resolution	mm	0.001	-	0.001	-	-

Table A2.8 Stereolithography Machines VII

RP Process	Unit	SLA	SLA
Machine designation/ Type		Perfactory Mini DDSP	Perfactory DDSP
Manufacturer		EnvisionTEC GmbH	
Distribution		Envisiontec.com	
Dimensions, Connection values			
Width/depth/height	m/m/m	0.73/0.48/1.35	0.73/0.48/1.35
Weight	kg	79	79
Electrical connection	V/A	100–240/2.4–5.4	100–240/2.4–5.4
Capacity	KW	n. a.	n. a.
Work room temperature	°C	n. a.	n. a.
Model characteristics			
Installation space max. (width/depth/height)	mm	60/45/100	100/75/100
Model dimensions max.	mm	60/45/100	100/75/100
Layer thickness	mm	0.25–0.1	0.25–0.15
Accuracy absolute	mm	n. a.	n. a.
EDP Interface			
Interface formats		STL	STL
EDP system		n. a.	n. a.
Operating system		n. a.	n. a.
Miscellaneous			
Materials		E-Shell: 200 Series, 300 Series, 500 Series, 600, 3000 Series	E-Shell: 200 Series, 300 Series, 500 Series, 600, 3000 Series
Native pixel size, *xy*	mm	0.043	0.071

Table A2.9 Stereolithography Machines VIII

RP Process	Unit	SLA	SLA	SLA	SLA	SLA
Machine designation/ Type		DDP4	DDP4 M	DDP4 XL	Perfactory 4 Mini	Perfactory 4 Mini XL
Manufacturer		EnvisionTEC GmbH				
Distribution		Envisiontec.com				
Dimensions, Connection values						
Width/depth/height	m/m/m	0.73/0.48/1.35	0.73/0.48/1.35	0.73/0.48/1.35	0.73/0.48/1.35	0.73/0.48/1.35
Weight	kg	85	85	85	85	85
Electrical connection	V/A	100-240/ 2.4-5.4	100-240/ 2.4-5.4	100-240/ 2.4-5.4	100-240/ 2.4-5.4	100-240/ 2.4-5.4
Capacity	KW	n. a.	n. a.	n. a.	n. a.	n. a.
Work room temperature	°C	n. a.	n. a.	n. a.	n. a.	n. a.
Model characteristics						
Installation space max. (width/depth/height)	mm	115/72/160	160/100/160	192/120/160	84/52.5/230	115/72/160
Model Dimensions max.	mm	115/72/160	160/100/160	192/120/160	84/52.5/230	115/72/160
Layer thickness	mm	0.025–0.15	0.025–0.15	0.025–0.15	0.015–0.150	0.015–0.150
Accuracy absolute	mm	n. a.	n. a.	n. a.	n. a.	n. a.
EDP Interface						
Interface formats		STL	STL	STL	n. a.	n. a.
EDP system		PC	PC	PC	n. a.	n. a.
Operating system		n. a.	n. a.	n. a.	n. a.	n. a.
Miscellaneous						
Building materials		Clear Guide. E-Denstone, E-Dent, E-PKin-dial, Press-E-Cast	Clear Guide, E-Denstone, E-Dent, E-PKin-dial, Press-E-Cast	Clear Guide, E-Denstone, E-Dent, E-PKin-dial, Press-E-Cast	ABStuff,ABflex, EC500, E-Shell 200, E-Shell 300, HTM Series, LS600, Photosilver, PIC 100, R5/R5 Gray/R11, RCP30/RC31	
Native pixel size, *xy*	mm	0.060	0.083	0.1	0.019–0.044	0.060
ERM voxel size, *xy*	mm	0.030	0.042	0.050	0.010–0.022	0.030

Table A2.10 Stereolithography Machines IX

RP Process	Unit	SLA	SLA
Machine designation/ Type		Perfactory DDP3	Perfactory 3 SXGA W/ERM Mini Multi Lens
Manufacturer		EnvisionTEC GmbH	
Distribution		Envisiontec.com	
Dimensions, Connection values			
Width/depth/height	m/m/m	0.73/0.48/1.35	0.73/0.48/1.35
Weight	kg	70	70
Electrical connection	V/A	100–240/2.4–5.4	100–240/2.4–5.4
Capacity	KW	n. a.	n. a.
Work room temperature	°C	n. a.	n. a.
Model characteristics			
Installation space max. (width/depth/height)	mm	90/68/230	90/67.5/230
Model dimensions max.	mm	90/68/230	90/67.5/230
Layer thickness	mm	0.050–0.15	0.015–0.15
Accuracy absolute	mm	n. a.	n. a.
EDP Interface			
Interface formats		STL	STL
EDP system		n. a.	PC
Operating system		n. a.	n. a.
Miscellaneous			
Materials		EC-1000, WIC300,WIC402,QID200,E-Dent, RC31, LS600, HTM140 iv	ABStuff,ABflex, EC500, E-Shell 200, HTM Series, LS600, Photosilver, PIC 100, R5/R5 Gray/R11, RCP30/RC31
Native pixel size, *xy*	mm	0.050	0.032–0.060
ERM voxel size, *xy*	mm	0.025	0.016–0.042

Table A2.11 Stereolithography Machines X

RP Process	Unit	SLA	SLA	SLA	SLA	SLA
Machine designation/ Type		Perfactory 4 DSP	Perfactory 4 DSP XL	Perfactory 4 Standard	Perfactory 4 Standard XL	Perfactory 3 Digital Shell Printer
Manufacturer		EnvisionTEC GmbH				
Distribution		Envisiontec.com				
Dimensions, Connection values						
Width/depth/height	m/m/m	0.73/0.48/1.35	0.73/0.48/1.35	0.73/0.48/1.35	0.73/0.48/1.35	0.73/0.48/1.35
Weight	kg	85	85	85	85	70
Electrical connection	V/A	100-240/2.4-5.4	100-240/2.4-5.4	100-240/2.4-5.4	100-240/2.4-5.4	100-240/2.4-5.4
Capacity	KW	n. a.	n. a.	n. a.	n. a.	n. a.
Work room temperature	°C	n.a	n.a	n.a	n.a	n.a
Model characteristics						
Installation space max. (width/depth/height)	mm	160/100/160	192/120/160	160/100/160	192/120/160	140/105/230
Model dimensions max.	mm	160/100/160	192/120/160	160/100/160	192/120/160	140/105/230
Layer thickness	mm	0.025–0.150	0.015–0.15	0.025–0.150	0.025–0.150	0.050–0.150
Accuracy absolute	mm	n. a.	n. a.	n. a.	n. a.	n. a.
EDP Interface						
Interface formats		n. a.	n. a.	n. a.	n. a.	n. a.
EDP system		PC	PC	n. a.	n. a.	PC
Operating system		n. a.	n. a.	n. a.	n. a.	n. a.
Miscellaneous						
Materials		E-Shell: 200 Series. 300 Series, 500 Series, 600, 3000 Series	E-Shell: 200 Series, 300 Series, 500 Series, 600, 3000 Series	ABStuff,ABflex, EC500, E-Shell 200, E-Shell 300, HTM Series, LS600, Photosilver, PIC 100, R5/R5 Gray/R11, RCP30/RC31	ABStuff,ABflex, EC500, E-Shell 200, E-Shell 300, HTM Series, LS600, Photosilver, PIC 100, R5/R5 Gray/R11, RCP30/RC31	E-Shell: 200 Series, 300 Series, 500 Series, 600, 3000 Series
Native pixel size, *xy*	mm	0.083	0.100	0.083	0.100	0.050
ERM voxel size, *xy*	mm	0.042	0.050	0.042	0.050	0.025

Table A2.12 Stereolithography Machines XI

RP Process	Unit	SLA	SLA
Machine designation/ Type		Perfactory Xtreme	Perfactory Xede
Manufacturer		EnvisionTEC GmbH	
Distribution		Envisiontec.com	
Dimensions, Connection values			
Width/depth/height	m/m/m	1.8/1.8/2.28	1.8/1.8/2.28
Weight	kg	710	710
Electrical connection	V/A	100–240/2.4–5.4	100–240/2.4–5.4
Power consumption	kW	n. a.	n. a.
Work room temperature	°C	n. a.	n. a.
Relative moisture	%	n. a.	n. a.
Model characteristics			
Installation space max. (width/depth/height)	mm	368/229/356	444.5/355.6/500
Model dimensions max.	mm	368/229/356	444.5/355.6/500
Layer thickness	mm	0.025–0.15	0.025–0.15
Accuracy absolute	mm	n. a.	n. a.
EDP Interface			
Interface formats		STL	STL
EDP System		PC	PC
Operating system		n. a.	n. a.
Miscellaneous			
Materials		ABS, polypropylene, glass-filled nylon parts, aluminum oxide, zirconium oxide, silicon oxide, paraffin wax	ABS, polypropylene, glass-filled nylon parts, aluminum oxide, zirconium oxide, silicon oxide, paraffin wax
Native pixel size, *xy*	mm	0.143	0.103–0.130
ERM voxel size, *xy*	mm	0.072	0.052–0.065

Table A2.13 Stereolithography Machines XII

RP Process	Unit	SLA	SLA	SLA	SLA	SLA
Machine designation/ Type		3Dent with 3SP Technology	ULTRA 3SP 3D Dental Printer	ULTRA 3SP	ULTRA 3SP High Definition	ULTRA2
Manufacturer		EnvisionTEC GmbH				
Distribution in Germany		Envisiontec.com				
Dimensions, Connection values						
Width/depth/height	m/m/m	0.74/0.76/1.17	0.74/0.76/1.17	0.74/0.76/1.17	0.74/0.76/1.17	0.74/0.76/1.17
Weight	kg	90	89.8	89.8	89.8	90
Electrical connection	V/A	100–240/2–3	100–127; 200–240/8; 4	100–127; 200–240/8; 4	100–127; 200–240/8; 4	100–127; 200–240/8; 4
Power consumption	kW	n. a.	n. a.	n. a.	n. a.	n. a.
Work room temperature	°C	n. a.	n. a.	n. a.	n. a.	n. a.
Model characteristics						
Installation space max. (width/depth/height)	mm	280/180/76	279/184/76	279/184/203	279/184/203	267/165/203
Model dimensions max.	mm	280/180/76	279/184/76	279/184/203	279/184/203	267/165/203
Layer thickness	mm	0.025–0.100	0.025–0.100	0.025–0.100	0.025–0.100	0.015–0.100
Accuracy absolute	mm	n. a.	n. a.	n. a.	n. a.	n. a.
EDP Interface						
Interface formats		STL	STL	STL	STL	STL
EDP system		n. a.	n. a.	n. a.	n. a.	n. a.
Operating system		n. a.	n. a.	n. a.	n. a.	n. a.
Miscellaneous						
Materials		E-Denstone	E-Denstone	E-Denstone	E-Denstone	HTM140IV
Resolution in *xy*	mm	0.050	0.100	0.100	0.050	-
Native voxel resolution in *xy*	mm	-	-	-	-	0.045–0.090

Table A2.14 Stereolithography Machines XIII

RP Process	Unit	SLA	SLA
Machine designation/ Type		ULTRA2	ULTRA
Manufacturer		EnvisionTEC GmbH	
Distribution		Envisiontec.com	
Dimensions, Connection values			
Width/depth/height	m/m/m	0.74/0.76/1.17	0.74/0.76/1.17
Weight	kg	90	90
Electrical connection	V/A	100–127; 200–240/8; 4	100–127; 200–240/8; 4
Power consumption	kW	n. a.	n. a.
Work room temperature	°C	n. a.	n. a.
Model characteristics			
Installation space max. (width/depth/height)	mm	267/165/203	267/165/203
Model dimensions max.	mm	267/165/203	267/165/203
Layer thickness	mm	0.015–0.100	0.025–0.150
Accuracy absolute	mm	n. a.	n. a.
EDP Interface			
Interface formats		STL	STL
EDP system		n. a.	n. a.
Operating system		n. a.	n. a.
Miscellaneous			
Materials		HTM140IV	ABS-Stuff, AB-flex, SI-500, LS600, EC-500
Voxel resolution in *xy*	mm	0.021	0.139

Table A2.15 Stereolithography Machines XIV

RP Process	Unit	File Transfer Imaging (FTI)	File Transfer Imaging (FTI)	Stereo-lithography	Stereo-lithography	Stereo-lithography
Machine designation/ Type		ProJet 1000	ProJet 1500	ProJet SD 7000	ProJet HD 7000	ProJet MP 7000
Manufacturer		3D Systems				
Distribution		www.3dsystems.com				
Dimensions, Connection values						
Width/depth/height	m/m/m	0.56/0.91/0.72	0.56/0.91/0.72	0.98/0.85/1.83	0.98/0.85/1.83	0.98/0.85/1.83
Weight	kg	55.3	55.3	272	272	272
Electrical connection	V/A	100–120/3A; 220–240/1.5 A	100–120/3 A; 220–240/1.5 A	100–240/ n. a.	100–240/ n. a.	100–240/ n. a.
Capacity	KW	n. a.	n. a.	0.75	0.75	0.75
Work room temperature	°C	n. a.	n. a.	18–28	18–28	18–28
Model characteristics						
Installation space max. (width/depth/height)	mm	171/203/178	171/228/203	380/380/250	380/380/250	380/380/250
Model dimensions max.	mm	171/203/178	171/228/203	380/380/250	380/380/250	380/380/250
Layer thickness	mm	0.102	0.102–0.152	0.1–0.125	0.05–0.125	0.05–0.125
Accuracy absolute	mm	n. a.	n. a.	0.025–0.05	0.025–0.05	0.025–0.05
EDP Interface						
Interface formats		STL, CTL	STL, CTL	STL, SLC	STL, SLC	STL, SLC
EDP System		PC	PC	PC	PC	PC
Operating system		Windows XP to Windows 7	Windows XP to Windows 7	Windows XP to Windows 7	Windows XP to Windows 7	Windows XP tp Windows 7
Miscellaneous						
Pressure speed in *z*	mm/h	12.7	12.7–20.32	n. a.	n. a.	n. a.
Materials		Cream	Cream, Red, Gray, Blue, Black, Zoom	VisiJet SL: Flex, Tough, Clear, Black, HiTemp	VisiJet SL: Flex, Tough, Clear, Black, HiTemp, Jewel	VisiJet SL: Flex, Tough, Clear, Black, HiTemp, Jewel, e-Stone

Table A2.16 Polymer Printing Machines I

RP Process	Unit	Polymer Printing/Jetting		
Machine designation/ Type		EDEN260	EDEN350	EDEN500
Manufacturer		Stratasys Ltd. 2 Holtzman St. Science Park Rehovot, 76124, Israel		
Distribution		http://www.stratasys.com/		
Dimensions, Connection values				
Width/depth/height	m/m/m	0.87/0.735/1.2	1.32/0.99/1.20	1.3/0.99/1.2
Weight	kg	280	410	410
Electrical connection	V/A	230/50; 115/60	230/50; 115/60	230/50; 115/60
Power consumption	kW	1.5	1.5	3
Working gas	l/min	–	-	–
Cooling water	l/min	–	-	–
Extraction	m^3/h	–	-	–
Work room temperature	°C	18–25	18–25	18–25
Relative moisture	%	30–70	30–70	30–70
Process		–	-	–
Fumes, Exhaust		–	-	–
Disposal, Waste		Cured models	Cured models	Cured models
Hazardous waste		Residues from cleaning system	Residues from cleaning system	Residues from cleaning system
Contouring Element				
Kind		InkJet	InkJet	InkJet
Type		–	–	–
x-y Contour generation		–	–	–
x-y Contour accuracy	mm	0.042/0.084	600 dpi	0.042/0.042
Spot repeatability	mm	–	–	–
z Contour accuracy	mm	0.016	0.016/0.030	0.016/0.030
z Contour repeatable accuracy	mm	–	–	–
Coating cycle	s	–	–	–
Coating arm speed	mm/s	–	–	–
Power fluctuation	%	–	–	–
Model characteristics				
Installation space max. (width/depth/height)	mm	258/252/205	350/350/200	500/400/200
Model dimensions max.	mm	256/250/203	340/340/200	490/390/200
Layer thickness	mm	0.016	0.016/0.30	0.016/0.030
Gauge	mm	–	-	–
Accuracy absolute	mm	< 0.1	<0.1	< 0.1
Repeatability	mm	–	-	–
Additional support		Water-soluble support material	Water-soluble support material	Water-soluble support material
EDP Interface				
Interface formats		STL, LAN-TCP/IP	STL, LAN-TCP/IP	STL, LAN-TCP/IP
EDP system		Pentium IV	PC, Workstation	Pentium IV
Operating system		Windows 2000, Win XP	Windows 2000, Win XP	Windows 2000, Win XP
Software		Objet Studio	Objet Studio	Objet Studio

Table A2.17 Polymer Printing Machines II

RP Process	Unit	Polymer Printing/Jetting			
Machine designation/ Type		Connex260	Connex350	Connex500	Objet1000
Manufacturer		Stratasys Ltd. 2 Holtzman St. Science Park Rehovot, 76124, Israel			
Distribution		http://www.stratasys.com/			
Dimensions, Connection values					
Width/depth/height	m/m/m	0.87/0.735/1.2	1.4/1.12/1.13	1.42/1.12/1.13	2.8/1.8/1.8
Weight	kg	264	500	500	1950
Electrical connection	V/A	230/50; 115/60	230/50; 115/60	230/50; 115/60	-
Power consumption	kW	1.5	1.5	1.5	-
Working gas	l/min	-	-	-	-
Cooling water	l/min	-	-	-	-
Extraction	m^3/h	-	-	-	-
Work room temperature	°C	18–25	18–22	18–22	18–22
Relative moisture	%	30–70	30–70	30–70	30–70
Process		-	-	-	-
Fumes, Exhaust		-	-	-	-
Disposal, Waste		Cured models	Cured models	Cured models	Cured models
Hazardous waste		Residues from cleaning system	Residues from cleaning system	Residues from cleaning system	Residues from cleaning system
Contouring Element					
Kind		InkJet	InkJet	InkJet	InkJet
Type		-	-	-	-
x-y Contour generation		-	-	-	-
x-y Contour accuracy	mm	600	600	600	600
Spot repeatability	mm	-	-	-	-
z Contour accuracy	mm	0.016/0.030	0.016/0.030	0.016	0.016/0.030
z Contour repeatable accuracy	mm	-	-	-	-
Coating cycle	s	-	-	-	-
Coating arm speed	mm/s	-	-	-	-
Power fluctuation	%	-	-	-	-
Model characteristics					
Installation space max. (width/depth/height)	mm	260/260/200	350/350/200	500/400/200	1000/800/500
Model dimensions max.	mm	255/252/200	342/342/200	490/390/200	1000/800/500
Layer thickness	mm	0.016/0.030	0.016/0.030	0.016	0.016/0.030
Gauge	mm	-	-	-	-
Accuracy absolute	mm	<0.1	<0.1	<0.1	<0.1
Repeatability	mm	-	-	-	-
Additional support		Water-soluble support material	Water-soluble support material	Water-soluble support material	Water-soluble support material
EDP Interface					
Interface formats		STL, LAN-TCP/IP	STL, LAN-TCP/IP	STL, LAN-TCP/IP	STL, LAN-TCP/IP
EDP system		PC, Workstation	PC, Workstation	PC, Workstation	PC, Workstation
Operating system		Windows XP, Windows Vista, Windows 7	Windows XP, Windows Vista	Windows XP, Windows Vista	Windows 7 x64
Software		Objet Studio	Objet Studio	Objet Studio	Objet Studio

Table A2.18 Polymer Printing Machines III

RP Process	Unit	Polymer Printing/Jetting	
Machine designation/ Type		Objet24	Objet30 Pro
Manufacturer		Stratasys Ltd. 2 Holtzman St. Science Park Rehovot, 76124, Israel	
Distribution		http://www.stratasys.com/	
Dimensions, Connection values			
Width/depth/height	m/m/m	0.825/0.62/0.59	0.825/0.62/0.59
Weight	kg	93	93
Electrical connection	V/A	230/50; 115/60	230/50; 115/60
Power consumption	kW		1.5
Working gas	l/min	-	-
Cooling water	l/min	-	-
Extraction	m^3/h	-	-
Work room temperature	°C	18–25	18–25
Relative moisture	%	30–70	30–70
Process		-	-
Fumes, Exhaust		-	-
Disposal, Waste		Cured models	Cured models
Hazardous waste		Residues from cleaning system	Residues from cleaning system
Contouring Element			
Kind		InkJet	InkJet
Type		-	-
x-y Contour generation		-	-
x-y Contour accuracy	mm	600	600
Spot repeatability	mm	-	-
z Contour accuracy	mm	0.028	0.016/0.028
z Contour repeatable accuracy	mm	-	-
Coating cycle	s	-	-
Coating arm speed	mm/s	-	-
Power fluctuation	%	-	-
Model characteristics			
Installation space max. (width/depth/height)	mm	240/200/150	300/200/150
Model dimensions max.	mm	234/192/148.6	294/192/148.6
Layer thickness	mm	0.028	0.016/0.028
Gauge	mm	-	-
Accuracy absolute	mm	< 0.1	< 0.1
Repeatability	mm	-	-
Additional support		Water-soluble support material	Water-soluble support material
EDP Interface			
Interface formats		STL, LAN-TCP/IP	STL, LAN-TCP/IP
EDP system		PC, Workstation	PC, Workstation
Operating system		Windows XP, Windows 7	Windows XP, Windows 7
Software		Objet Studio	Objet Studio

Table A2.19 Polymer Printing Machines IV

RP Process	Unit	MJM	MJM	MJM	MJM	MJM
Machine designation/ Type		ProJet 3510 SD	ProJet 3510 HD	ProJet 3510 HDPlus	ProJet 3500 HDMax	ProJet 5000
Manufacturer		3D Systems				
Distribution		www.3dsystems.com				
Dimensions, Connection values						
Width/depth/height	m/m/m	0.75/1.2/1.51	0.75/1.2/1.51	0.75/1.2/1.51	0.75/1.2/1.51	1.53/0.91/1.45
Weight	kg	323	323	323	323	538
Electrical connection	V/A	100–127/15A; 200–240/10A	100–127/15A; 200–240/10A	100–127/15A; 200–240/10A	100–127/15A; 200–240/10A	115–240/k.a
Capacity	KW	n. a.	n. a.	n. a.	n. a.	1.2
Work room temperature	°C	18–28	18–28	18–28	18–28	18–28
Model characteristics						
Installation space max. (width/depth/height)	mm	298/185/203	298/185/203	298/185/203	298/185/203	550/393/300
Model dimensions max.	mm	298/185/203	298/185/203	298/185/203	298/185/203	550/393/300
Layer thickness	mm	0.032	0.029–0.032	0.016–0.032	0.016–0.032	0.029–0.064
Accuracy absolute	mm	0.025–0.05	0.025–0.05	0.025–0.05	0.025–0.05	0.025–0.05
Max. resolution	dpi *x/y/z*	375/375/790	750/750/890	750/750/1600	750/750/1600	750/750/890
EDP Interface						
Interface formats		STL, SLC	STL, SLC	STL, SLC	STL, SLC	STL, SLC
EDP system		PC	PC	PC	PC	PC
Operating system		Windows XP, Vista, 7	Windows XP, Vista, 7	Windows XP, Vista, 7	Windows XP, Vista, 7	Windows XP, Vista, 7
Miscellaneous						
Building materials/Supports		VisiJet: X, Crystal, Proplast, Navy, Techplast/ VisiJet S300	VisiJet: X, Crystal, Proplast, Navy, Techplast, Procast/VisiJet S300	VisiJet: X, Crystal, Proplast, Navy, Techplast, Procast/VisiJet S300	VisiJet: X, Crystal, Proplast, Navy, Techplast, Procast/VisiJet S300	

Table A2.20 Polymer Printing Machines V

RP Process	Unit	MJM	MJM	MJM	MJM
Machine designation/ Type		ProJet 3510 CP	ProJet 3510 CPX	ProJet 3510 CPCPlus	ProJet 3500 CPXMax
Area of application		RealWax process for precision casting models			
Manufacturer		3D Systems			
Distribution		www.3dsystems.com			
Dimensions, Connection values					
Width/depth/height	m/m/m	0.83/1.43/1.74	0.83/1.43/1.74	0.83/1.43/1.74	0.83/1.43/1.74
Weight	kg	323	323	323	323
Electrical connection	V/A	100-127/15A; 200-240/10A	100-127/15A; 200-240/10A	100-127/15A; 200-240/10A	100-127/15A; 200-240/10A
Capacity	KW	n. a.	n. a.	n. a.	n. a.
Work room temperature	°C	18–28	18–28	18–28	18–28
Model characteristics					
Installation space max. (width/depth/height)	mm	298/185/203	298/185/203	298/185/203	298/185/203
Model dimensions max.	mm	298/185/203	298/185/203	298/185/203	298/185/203
Layer thickness	mm	0.033	0.016–0.033	0.016–0.033	0.016–0.033
Accuracy absolute	mm	0.025–0.05	0.025–0.05	0.025–0.05	0.025–0.05
Max. resolution	dpi	375 × 375 × 775	694 × 750 × 1600	694 × 750 × 1600	694 × 750 × 1600
EDP Interface					
Interface formats		STL, SLC	STL, SLC	STL, SLC	STL, SLC
EDP system		PC	PC	PC	PC
Operating system		Windows XP, Vista, 7	Windows XP, Vista, 7	Windows XP, Vista, 7	Windows XP, Vista, 7
Miscellaneous					
Building materials/ Supports		VisiJet Prowax/ VisiJet S400	VisiJet Hi-Cast/ VisiJet S400	VisiJet Hi-Cast/ VisiJet S400	VisiJet Hi-Cast/ VisiJet S400

Table A2.21 Polymer Printing Machines VI

RP Process	Unit	MJM	MJM
Machine designation/ Type		ProJet 3510 DP	ProJet 3510 MP
Area of application		Medical and dental Applications	
Manufacturer		3D Systems	
Distribution		www.3dsystems.com	
Dimensions, Connection values			
Width/depth/height	m/m/m	0.75/1.2/1.51	0.75/1.2/1.51
Weight	kg	323	323
Electrical connection	V/A	100-127/15A; 200-240/10A	100-127/15A; 200-240/10A
Capacity	KW	n. a.	n. a.
Work room temperature	°C	18–28	18–28
Model characteristics			
Installation space max. (width/depth/height)	mm	298/185/203	298/185/203
Model dimensions max.	mm	298/185/203	298/185/203
Layer thickness	mm	0.029–0.032	0.032
Accuracy absolute	mm	0.025–0.05	0.025–0.05
Max. resolution (*x*/*y*/*z*)	dpi	750/750/890	375/375/790
EDP Interface			
Interface formats		STL, SLC	STL, SLC
EDP system		PC	PC
Operating system		Windows XP, Vista, 7	Windows XP, Vista, 7
Miscellaneous			
Building materials/ Supports		VisiJet Dentcast/ VisiJet S300	VisiJet PearlStone, Stoneplast/ VisiJet S300

Table A2.22 Sintering Machines I

RP Process	Unit	SLM	SLM
Machine designation/ Type		SPro125	SPro250
Manufacturer		3D Systems	
Distribution		www.3dsystems.com	
Dimensions, Connection values			
Width/depth/height	m/m/m	1.35/0.8/1.9	1.7/0.8/2.03
Weight	kg	900	1100
Electrical connection	V/A	208/30 3-phase	208/30 3-phase
Power consumption	kW	n. a.	n. a.
Work room temperature	°C	n. a.	n. a.
Relative moisture	%	n. a.	n. a.
Contouring Element			
Kind		Laser	Laser
Laser capacity	W	100; 200	200; 400
Type		n. a.	n. a.
Max. scan speed	mm/s	1000	1000
Build speed	cm^3/h	5–20	5–20
Model characteristics			
Installation space max. (width/depth/height)	mm	125/125/125	250/250/320
Model dimensions max.	mm	125/125/125	250/250/320
Layer thickness	mm	0.02–0.1	0.02–0.1
Spot (laser diameter)	mm	0.035	0.070

Table A2.23 Sintering Machines II

RP Process	Unit	SLS	SLS	SLS	SLS	SLS
Machine designation/ Type		sPro 60 SD	sPro 60 HD Base	sPro 60 HD-HS	sPro 140 Base	sPro 140 HS
Manufacturer		3D Systems				
Distribution		www.3dsystems.com				
Dimensions, Connection values						
Width/depth/height	m/m/m	n. a.	n. a.	n. a.	n. a.	n. a.
Weight	kg	n. a.	n. a.	n. a.	n. a.	n. a.
Electrical connection	V/A	240/n. a. 3-phase	240/n. a. 3-phase	240/n. a. 3-phase	208/n. a. 3-phase	208/n. a. 3-phase
Power consumption	kW	12.5	12.5	12.5	17	17
Working gas	l/min	54	60	108	180	300
Contouring Element						
Kind		Laser	Laser	Laser	Laser	Laser
Type		CO_2	CO_2	CO_2	CO_2	CO_2
Imaging system		High Torque Scanning Motors (analog)	ProScan™ CX (digital)	ProScan™ DX Dual Mode	ProScan™ DX Digital	ProScan™GX Dual Mode
Scanning speed	m/s	5	6	6; 12	10	15
Laser capacity	W	30	30	70	70	200
Model characteristics						
Installation space max. (width/depth/height)	mm	381/330/457	381/330/457	381/330/457	550/550/460	550/550/460
Model dimensions max.	mm	381/330/457	381/330/457	381/330/457	550/550/460	550/550/460
Layer thickness	mm	0.08–0.15	0.08–0.15	0.08–0.15	0.08–0.15	0.08–0.15

Table A2.24 Sintering Machines III

RP Process	Unit	SLS	SLS
Machine designation/ Type		sPro 230 Base	sPro 230 HS
Manufacturer		3D Systems	
Distribution		www.3dsystems.com	
Dimensions, Connection values			
Width/depth/height	m/m/m	n. a.	n. a.
Weight	kg	n. a.	n. a.
Electrical connection	V/A	208/n. a. 3-phase	208/n. a. 3-phase
Power consumption	kW	17	17
Working gas	l/min	180	300
Cooling water	l/min	–	–
Extraction	m^3/h	–	–
Work room temperature	°C	n. a.	n. a.
Moisture	%	n. a.	n. a.
Contouring Element			
Kind		Laser	Laser
Type		CO_2	CO_2
Imaging system		ProScan™ DX Digital	ProScan™GX Dual Mode High Speed Digital
Scanning speed	m/s	10	15
Laser capacity	W	70	200
Model characteristics			
Installation space max. (width/depth/height)	mm	550/550/750	550/550/750
Model dimensions max.	mm	550/550/750	550/550/750
Layer thickness	mm	0.08–0.15	0.08–0.15

Table A2.25 Sintering Machines IV

RP Process	Unit	Metal Laser Sintering (DMLS)	Plastic Sintering	Plastic Sintering	Sand Sintering (Direct Cast)
Machine designation/ Type		EOSINT M 280	EOSINT P 395	EOSINT P 760	EOSINT S 750
Manufacturer		EOS GmbH Electro Optical Systems Robert-Stirling-Ring 1 82152 Krailling / München Germany			
Distribution		www.eos-gmbh.de			
Dimensions, Connection values					
Width/depth/height	m/m/m	2.2/1.07/2.29	1.84/1.175/2.1	2.25/1.55/2.10	1.42/1.40/2.15
Weight	kg	1250	ca. 1060	ca. 2300	ca. 1050
Electrical connection	V/A	400/32	400/32	400/32	400/32
Power consumption	kW	Max 8.5 Typical 3.2	Max 10 Typical 2.4	Max. 12 Typical 3.1	Max. 12 Typical 6
Working gas	l/min	Compressed air 20 m^3/h, argon 100 l/min	Compressed air min. 6 m^3/h	Compressed air min. 20 m^3/h	Compressed air min. 15 m^3/h
Cooling water	l/min	Depending on the option, not necessary	0	0	0
Extraction	m^3/h				

RP Process	Unit	Metal Laser Sintering (DMLS)	Plastic Sintering	Plastic Sintering	Sand Sintering (Direct Cast)
Work room temperature	°C	15–30	19–30	15–30	19–29
Relative moisture	%	80 (at 15–20 °C)	max. 50	max. 60	20–50
Process					
Fumes, Exhaust		low	low	low	low
Disposal, Waste		Remote support structures	Powder remains		Dried sand
Hazardous waste		Metal powder remains	–	–	Phenolic resin
Contouring Element					
Kind		Laser	Laser	Laser	Laser
Type		Yb fiber laser; 200 W or 400 W	CO_2; 50 W	CO_2; 2 × 50 W	CO_2; 2 × 100 W
x-y Contour generation		Galvanometer scanner	F-Theta Lens	F-Theta Lens	Galvoscanner
x-y Contour accuracy	mm	–	0.01	0.01	0.01
Spot repeatability	mm	0.005	± 0.51	± 0.51	± 0.51
z Contour accuracy	mm	–	0.1	0.1	0.1
z Contour repeatable accuracy	mm	0.005	–	–	–
Coating cycle	s	Typ. 12 s	variable	variable	variable
Coating arm speed	mm/s	Variable, max. 7000	Variable, max. 6000	Variable, max. 2 × 6000	120
Power fluctuation	%	10–100			
Model characteristics					
Installation space max. (width/depth/height)	mm	250/250/325	340/340/625	700/380/580	718/381/381
Model dimensions max.	mm	250/250/325	350/350/625	700/380/580	718/381/381
Layer thickness	mm	0.02–0.1	0.06–0.18	0.06–0.18	0.2
Gauge	mm	min. ca. 0.3			
Accuracy absolute	mm	Typ. 0.05	0.1–0.2% (Typ.)	0.1–0.2% (Typ.)	± 0.3
Repeatability	mm	–			
Additional support		for overhang > ca. 60° (depending on material)	none	none	none
EDP Interface					
Interface formats		STL, converter to all current format	STL, CLI	STL, converter to all current format	STL, CLI
EDP system		STL, CLI			
Operating system		Workstation or PC	Current Windows system	Current Windows system	
Software		EOS RP Tools		EOS RP Tools	

Table A2.26 Sintering and Melting Machines V

RP Process	Unit	SLM	SLM	SLM	Laser-cusing	Laser-cusing	Laser-cusing	Laser-cusing
Machine designation/ Type		Realizer SLM250	Realizer SLM100	Realizer SLM50	Mlab cusing	M1 cusing	M2 cusing	Xline 1000R
Manufacturer		Realizer GmbH			Concept Laser GmbH			
Distribution		www.realizer.com			Directly by Concept Laser			
Dimensions, Connection values								
Width/depth/height	m/m/m	1.8/ 1/ 2.2	0.9/ 0.8/ 2.4	0.8/ 0.7/ 0.5	0.705/ 1.833/ 0.955	1.990/ 1.790/ 1.775	2.44/ 1.63/ 1.992	4.415/ 3.9–4.5/ 3.070
Weight	kg	800	500	80	500 kg	1700 kg	1500	8000
Electrical connection	V/A	400/16	400/16	230/16	230/16	400/16	400/32	400/63
Power consumption	kW	2.5	1.5	1.0	1.5 kW	7.4 kW		13
Working gas	l/min	0.7	0.6	0.5	< 4; Ar or N_2	1.5–2.0 m^3/h; N_2	0.6–0.8 m^3/h	17–34; N_2
Cooling water	l/min	internal		none		Internal closed circulation		
Extraction	m^3/h	yes		no	intern	intern	intern	
Work room temperature	°C	RT			15–35 °C	15–35 °C	RT	
Relative moisture	%	45			n. a.	n. a.		
Process								
Fumes, Exhaust		none		none		Inside activated carbon filter		
Disposal, Waste		–				Waste		
Hazardous waste		–				no		
Contouring Element								
Kind		Laser	Laser	Laser	Laser	Laser	Laser	Laser
Type		Nd-YAG; 200 or 400 W	Fiber laser; 200 W	Fiber laser, 100 W	NdYAG, diode-pump, 100 W	NdYAG, diode-pump 200 W	Fiber laser, 200 W or 400 W	Fiber laser
x-y Contour generation		Scanner			Scanner head and linear axes	Scanner head	Galvo-scanner	
x-y Contour accuracy	mm	± 0.03				±50 micrometer		-
Spot repeatability	mm	0.002				n. a.		-
z Contour accuracy	mm	Layer thickness ± 0.05				±50 micrometer		-
z Contour repeatable accuracy	mm	Layer thickness ± 0.05				n. a.		-
Coating cycle	s	–				3–5		
Coating arm speed	mm/s	0–1000				n. a.		
Power fluctuation	%	± 2				Self-controlled system		

RP Process	Unit	SLM	SLM	SLM	Laser-cusing	Laser-cusing	Laser-cusing	Laser-cusing
Model characteristics								
Installation space max. (width/depth/height)	mm	250/ 250/ 300		Diameter: 70, Height: 40	$x = y =$ 50 × 50 70 × 70, 90 × 90; $z = 80$	150/ 220/ 200	250/ 250/ 280	630/ 400/ 500
Model dimensions max.	mm	250/ 250/ 300		Diameter: 70, Height: 40	as above	120/ 120/ 200	250/ 250/ 280	630/ 400/ 500
Layer thickness	mm	0.02–0.1	0.02–0.1	0.02–0.1	0.02–0.05	20–100 micro-meter	0.02–0.05	0.03–0.2
Gauge	mm	0.15–0.3				ca. 250 micro-meter		
Accuracy absolute	mm	± 0.1				see above		
Repeatability	mm	± 0.1			.	n. a.		
Additional support		none				dependent on the geometry		
EDP Interface								
Interface formats		F&S	F&S	F&S	STL, AMF	STL, AMF	STL, AMF	STL, AMF
EDP system		PC	PC	PC	PC	PC	PC	PC
Operating system		Windows	Windows	Windows	Windows	Windows	Windows	Windows
Software		Realizer	Realizer	Realizer	Materialise Magics	Materialise Magics	Materialise Magics	

Table A2.27 Sintering and Melting Machines VI

RP Process	Unit	Laser melting	Laser melting	Beam melting	Beam melting	Beam melting	Beam melting
Machine designation/ Type		AM125	AM250	SLM® 125 HL	SLM® 250 HL	SLM® 500 HL	SLM® 280 HL
Manufacturer		Renishaw GmbH Karl-Benz Straße 12 72124 Pliezhausen Deutschland (Germany) www.renishaw.com		SLM Solutions GmbH Roggenhorster Straße 9c 23556 Lübeck (Germany) www.slm-solutions.com			
Distribution		Directly by Renishaw		Directly by SLM Solutions			
Dimensions, Connection values							
Width/depth/height	m/m/m	1.35/0.8/ 1.9	1.7/0.8/ 2.025	1.35/0.8/ 1.9(2.4)	1.650/1.0/ 1.9(2.4)	3.0/1.5/ 2.0(2.5)	1.8/1.0/ 1.9(2.4)
Weight	kg	900	1100	700	850	2000	1000
Electrical connection	V/A	230/16	230/16	400/32	400/32	400/32	400/32
Power consumption	kW			4	5	8	6
Working gas	l/min			0.5 (Flushing: 1000 l); Ar or N_2	1.5 (Flushing: 1500 l); Ar or N_2	3.0 (Flushing: 2000 l); Ar or N_2	2.5 (Flushing: 1700 l); Ar or N_2
Cooling water	l/min						
Extraction	m^3/h						
Work room temperature	°C						
Relative moisture	%						
Process							
Fumes, Exhaust							
Disposal, Waste							
Hazardous waste							
Contouring Element							
Kind		Laser	Laser	Laser	Laser	Laser	Laser
Type		100 W or 200 W	200 W or 400 W	YLR fiber laser; 100 W or 200 W	YLR fiber laser; 200 W or 400 W	2 × YLR fiber laser; 1 × 400 W, 1 × 1000 W	YLR fiber laser; 1 × 400 W, 1 × 1000 W
x-y Contour generation							
x-y Contour accuracy	mm						
Spot repeatability	mm						
z Contour accuracy	mm						
z Contour repeatable accuracy	mm						
Coating cycle	s						
Coating arm speed	mm/s						
Power fluctuation	%						
Model characteristics							
Installation space max. (width/depth/height)	mm	120/120/ 125	245/245/ 300 (*z* = 360 mm on demand)	125/125/ 75 (125)	248/248/ 250 (350)	500/280/ 325	280/280/ 350
Model dimensions max.	mm	120/120/ 125	245/245/ 300 (*z* = 360 mm on demand)	125/125/ 75 (125)	248/248/ 250 (350)	500/280/ 325	280/280/ 350
Layer thickness	mm	0.02–0.1	0.02–0.1	0.02–0.075	0.02–0.075	0.02–0.2	0.02–0.15
Gauge	mm			min. 0.140	min. 0.150	min. 0.180	min. 0.2
Accuracy absolute	mm						

RP Process	Unit	Laser melting	Laser melting	Beam melting	Beam melting	Beam melting	Beam melting
Repeatability	mm						
Additional support							
EDP Interface							
Interface formats		STL, AMF	STL, AMF				
		PC	PC	PC	PC	PC	PC
		Windows	Windows	Windows	Windows	Windows	Windows
		Materialise, Marcam Autofab	Materialise, Marcam Autofab	AutoFabMC	AutoFabMC	AutoFabMC	AutoFabMC

Table A2.28 Sintering Machines VII

RP Process	Unit	Electron beam melting (EBM)	Electron beam melting (EBM)	SLM	SLM	SLM
Machine designation/ Type		**Q10**	**A2**	**PXS**	**PXM**	**PXL**
Manufacturer		Arcam AB Krokslätts Fabriker 27A SE 431 37 Mölndal Sweden		Phenix Systems Parc Européen d'Entreprises Rue Richard Wagner 63200 Riom Frankreich, France		
Distribution		Directly by ARCAM				
Dimensions, Connection values						
Width/depth/height	m/m/m	1.85/0.9/2.2	1.85/0.9/2.2	1.2/0.77/1.95	1.2/1.5/1.95	2.4/2.2/2.4
Weight	kg	1420	1420	1000	1500	5000
Electrical connection	V/A	3 × 400/32	3 × 400/32	230	400	400
Power consumption	kW	7	7	3 kVA	10 kVA	15 kVA
Working gas	l/min	1 l/h; He 50–75 l cooldown		6–8 bar compressed air	6–8 bar compressed air	6–8 bar compressed air
Cooling water	l/min					
Extraction	m^3/h					
Work room temperature	°C					
Relative moisture	%					
Process						
Fumes, Exhaust						
Disposal, Waste						
Hazardous waste						
Contouring Element						
Kind		Electron beam	Electron beam	Laser	Laser	Laser
Type		Single crystalline CeB_6		Fiber laser; 50 W; 1070 nm	Fiber laser; 300 W; 1070 nm	Fiber laser; 500 W; 1070 nm
x-y Contour generation						
x-y Contour accuracy	mm		0.13–0.2			
Spot repeatability	mm					
z Contour accuracy	mm					
z Contour repeatable accuracy	mm					
Coating cycle	s					
Coating arm speed	mm/s					
Power fluctuation	%					

Table A2.28 *(continued)* Sintering Machines VII

RP Process	Unit	Electron beam melting (EBM)	Electron beam melting (EBM)	SLM	SLM	SLM
Model characteristics						
Installation space max. (width/depth/height)	mm	200/200/180	250/250/400 or 350 × 350 × 250	100/100/80	140/140/100	100/100/80
Model dimensions max.	mm	200/200/180	200/200/350 or Ø300/200	100/100/80		
Layer thickness	mm					
Min. spot diameter	mm	0.1				
Accuracy absolute	mm					
Repeatability	mm			x = 0.02 y = 0.02 z = 0.02	x = 0.02 y = 0.02 z = 0.02	
Additional support						
EDP Interface						
Interface formats		STL	STL	STL, IGES, STEP	STL, IGES, STEP	STL, IGES, STEP
EDP system		PC	PC	PC	PC	PC
Operating system				Windows	Windows	Windows
Software				Phenix Processing, Phenix Manufacturing, Phenix Dental	Phenix Processing, Phenix Manufacturing, Phenix Dental	Phenix Processing, Phenix Manufacturing, Phenix Dental

Table A2.29 Extrusion Machines I

RP Process	Unit	Extrusion	Extrusion	Extrusion	Extrusion
Machine designation/ Type		Mojo 3D Printer	uPrint SE / Plus	Dimension 1200es	Dimension Elite
Manufacturer		Stratasys Inc., USA			
Distribution		www.stratasys.com			
Dimensions, Connection values					
Width/depth/height	m/m/m	0.63/0.45/0.53	0.635/0.66/0.787	0.838/0.737/1.143	0.686/0.914/1.041
Weight	kg	27	76	148	136
Electrical connection	V/A	120/6; 230/2.5	120/15; 230/7	120/15; 230/7	120/15; 230/7
Power consumption	kW	n. a.	n. a.	n. a.	n. a.
Working gas	l/min	–	–	–	–
Cooling water	l/min	–	–	–	–
Extraction	m^3/h	–	–	–	–
Work room temperature	°C	n. a.	n. a.	n. a.	n. a.
Relative moisture	%	n. a.	n. a.	n. a.	n. a.
Process					
Fumes, Exhaust		–	–	–	–
Disposal, Waste		yes	yes	yes	yes
Hazardous waste		–	–	–	–
Contouring Element					
Kind		Extruder	Extruder	Extruder	Extruder
Type					
x-y Contour generation		Belt drive *xy*	Belt drive *xy*	Belt drive *xy*	Belt drive *xy*
x-y Contour accuracy	mm	n. a.	n. a.	n. a.	n. a.
Spot repeatability	mm	–	–	–	–
z Contour accuracy	mm	n. a.	n. a.	n. a.	n. a.
z Contour repeatable accuracy	mm	n. a.	n. a.	n. a.	n. a.
Coating cycle	s	0	0	0	0
Coating arm speed	mm/s	–	–	–	–
Power fluctuation	%	0	0	0	0
Model characteristics					
Installation space max. (width/depth/height)	mm	127/127/127	203/152/152	254/254/305	203/203/305
Model dimensions max.	mm	127/127/127	203/152/152	254/254/305	203/203/305
Layer thickness	mm	0.178	0.254	0.33; 0.254	0.254; 0.178
Gauge	mm	n. a.	n. a.	n. a.	n. a.
Accuracy absolute	mm	± n. a.	± n. a.	± n. a.	± n. a.
Repeatability	mm	n. a.	n. a.	n. a.	n. a.
Additional support		yes	yes	yes	yes
EDP Interface					
Interface formats		STL	STL	STL	STL
EDP system		PC, Workstation	PC, Workstation	PC, Workstation	PC, Workstation
Operating system		Windows XP, 7	Windows XP, 7	Windows XP, 7	Windows XP, 7
Software		Print Wizard, Control Panel	CatalystEX	CatalystEX	CatalystEX

Table A2.30 Extrusion Machines II

RP Process	Unit	Extrusion	Printing Extrusion	Extrusion	Extrusion
Machine designation/ Type		Fortus 250mc	Fortus 360mc	Fortus 400mc	Fortus 900mc
Manufacturer		Stratasys Inc., USA			
Distribution		www.stratasys.com			
Dimensions, Connection values					
Width/depth/height	m/m/m	0.838/0.737/1.143	1.281/0.896/1.962	1.281/0.896/1.962	2.772/1.683/2.027
Weight	kg	186	786	786	3287
Electrical connection	V/A	120/15; 230/7	230/16/3-phase	230/16/3-phase	230/40
Power consumption	kW	n. a.	n. a.	n. a.	n. a.
Working gas	l/min	–	–	–	–
Cooling water	l/min	–	–	–	–
Extraction	m^3/h	–	–	–	–
Work room temperature	°C	30	n. a.	n. a.	n. a.
Relative moisture	%	30–70	n. a.	n. a.	n. a.
Process					
Fumes, Exhaust		–	–	–	–
Disposal, Waste		yes	yes	yes	yes
Hazardous waste		–	–	–	–
Contouring Element					
Kind		Extruder	Extruder	Extruder	Extruder
Type					
x-y Contour generation		Belt drive *xy*	Belt drive *xy*	Belt drive *xy*	Belt drive *xy*
x-y Contour accuracy	mm	n. a.	n. a.	n. a.	n. a.
Spot repeatability	mm	–	–	–	–
z Contour accuracy	mm	n. a.	n. a.	n. a.	n. a.
z Contour repeatable accuracy	mm	n. a.	n. a.	n. a.	n. a.
Coating cycle	s	0	0	0	0
Coating arm speed	mm/s	–	–	–	–
Power fluctuation	%	0	0	0	0
Model characteristics					
Installation space max. (width/depth/height)	mm	254/254/305	406/355/406	406/355/406	914/610/914
Model dimensions max.	mm	254/254/305	406/355/406	406/355/406	914/610/914
Layer thickness	mm	0.33; 0.254; 0.178	0.33; 0.254; 0.178; 0.127	0.33; 0.254; 0.178; 0.127	0.33; 0.254; 0.178
Gauge	mm	n. a.	n. a.	n. a.	n. a.
Accuracy absolute	mm	± 0.241	± 0.127	± 0.127	± 0.09
Repeatability	mm	n. a.	n. a.	n. a.	n. a.
Additional support		yes	yes	yes	yes
EDP Interface					
Interface formats		STL	STL	STL	STL
EDP System		PC, Workstation	PC, Workstation	PC, Workstation	PC, Workstation
Operating system		n. a.	n. a.	n. a.	n. a.
Software		Vorhanden Insight	Vorhanden Insight	Vorhanden Insight	Vorhanden Insight

Table A2.31 Commercial 3D Printer: "Fabber" I

RP Process	Unit			
Machine designation/ Type		The Replicator™	The Replicator™ 2	The Replicator™ 2X
Manufacturer		Makerbot Objet® Industries LLC		
Distribution		http://www.makerbot.com/		
Dimensions, Connection values				
Width/depth/height	m/m/m	320/467/381	490/420/380	490/420/531
Weight	kg	14.5	11.5	12.6
Kit		–	–	–
Electrical connection	V	100–240	100–240	100–240
Power consumption	kW	n. a.	n. a.	n. a.
Working gas	l/min	–	–	–
Cooling water	l/min	–	–	–
Extraction	m^3/h	–	–	–
Work room temperature	°C	–	n. a.	n. a.
Build platform temperature max.	°C	120	–	180
Relative moisture	%	–	–	n. a.
Process				
Fumes, Exhaust		–	–	–
Disposal, Waste		yes	yes	yes
Hazardous waste		–	–	–
Contouring Element				
Kind		Extruder	Extruder	Extruder
Type				
x-y Contour generation		Belt drive *xy*	Belt drive *xy*	Belt drive *xy*
x-y Contour accuracy	mm	0.011	0.011	0.011
Spot repeatability	mm	–	–	–
z Contour accuracy	mm	0.0025	0.0025	0.0025
z Contour repeatable accuracy	mm	n. a.	n. a.	n. a.
Coating cycle	s	–	–	–
Pressure speed	mm/s	40	n. a.	n. a.
Power fluctuation	%	n. a.	n. a.	0
Nozzle diameter	mm	0.4	0.4	0.4
Model characteristics				
Installation space max. (width/depth/height)	mm	225/145/150	285/153/155	250/160/150
Model Dimensions max.	mm	–	–	–
Layer thickness	mm	0.2–0.3	0.1–0.34	0.1–0.34
Minimum wall thickness	mm	n. a.	n. a.	n. a.
Accuracy absolute	mm	± n. a.	± n. a.	± n. a.
Repeatability	mm	n. a.	n. a.	n. a.
Additional support/ Extruder		no	no	no
Material form		Filament	Filament	Filament
Filament diameter	mm	1.75	1.75	1.75

Table A2.31 *(continued)* Commercial 3D Printer: "Fabber" I

RP Process	Unit			
EDP Interface				
Interface formats		STL, GCode	STL, Obj., thing	STL, Obj., thing
EDP system		PC, Workstation	PC, Workstation	PC, Workstation
Connectivity		USB, SD Card	USB, SD card (max. 2 GB)	USB, SD card (included)
Operating system		Linux, OSX, Windows	Windows (XP/7), Mac OS X (10.6/10.7/10.8), Linux (Ubuntu 12.04+)	Windows (XP/7), Mac OS X (10.6+), Linux (Ubuntu 11, 10+) 7
Software		ReplicatorG™	MakerBot Makerware™ Bandle 1.0	MakerBot Makerware™ 2.0

Table A2.32 Commercial 3D Printer: "Fabber" II

RP Process	Unit			
Machine designation/ Type		Fabbster	Cube	Delta Tower
Manufacturer		Sinteringmask GmbH	3D Systems	3DreamFactory
Distribution		http://www.fabbster.de	www.3dsystems.com	www.3dreamfactory.com
Dimensions, Connection values				
Width/depth/height	m/m/m	590/470/540	260/260/340	d55/d55/124
Weight	kg	n. a.	4.3	22
Electrical connection	V	110–240	n. a.	85–264
Power consumption	kW	0.35	n. a.	0.3
Working gas	l/min	–		–
Cooling water	l/min	–	–	–
Extraction	m^3/h	–	–	–
Work room temperature	°C	–	n. a.	–
Build platform temperature max.	°C	n. a.	n. a.	n. a.
Relative moisture	%	–	–	–
Fumes, Exhaust		–	–	–
Disposal, Waste		yes	yes	yes
Hazardous waste		–	–	–
Contouring Element				
Kind		Extruder	Extruder	Extruder
Type				
x-y Contour generation		Belt drive *xy*	Belt drive *xy*	Delta Kinematik
x-y Contour accuracy	mm	n. a.	n. a.	n. a.
Spot repeatability	mm	–	–	–
z Contour accuracy	mm	n. a.	n. a.	n. a.
z Contour repeatable accuracy	mm	n. a.	n. a.	n. a.
Coating cycle	s	–	–	–
Pressure speed	mm/s	600	n. a.	n. a.
Power fluctuation	%	n. a.	n. a.	n. a.
Nozzle diameter	mm	0.4	n. a.	0.4/0.5
Model characteristics				
Installation space max. (width/depth/height)	mm	225/225/210	n. a.	200/200/580, 350/350/450
Model Dimensions max.	mm	–	140/140/140	–

RP Process	Unit			
Layer thickness	mm	0.044–0.176	0.2	0.1
Minimum wall thickness	mm	0.6	n. a.	n. a.
Accuracy absolute	mm	± n. a.	± n. a.	± n. a.
Repeatability	mm	n. a.	n. a.	n. a.
Additional support / Extruder		no	yes	no
Material form		Sticks	ABS-, PLA-CKindridges	Filament
Filament diameter	mm	–	–	1.75, 3
EDP Interface				
Interface formats		STL, GCode	n. a.	GCode
EDP system		PC, Workstation	PC, Workstation	PC, Workstation
Connectivity		USB	USB, Wireless (WiFi)	USB
Operating system		Windows (XP/7/8), Mac OS X	Windows (XP with SP 3/7), Mac OS X 10.8	Windows, Mac, Linux
Software		Netfabb Engine	Cube Software	Open Source (Marlin, Cura/Slic3r, Repetier Host)

Table A2.33 Commercial 3D Printer: "Fabber" III

RP Process	Unit	FDM	FDM	FDM
Machine designation/ Type		Rapman 3.1	Cube	CubeX
Manufacturer		3D Systems		
Distribution		www.3dsystems.com		
Dimensions, Connection values				
Width/depth/height	m/m/m	0.65/0.57/0.82	0.26/0.26/0.34	0.52/0.52/0.6
Weight	kg	17	4.3	36–38
Electrical connection	V/A	12/5	n. a./n. a.	110-240/n. a.
Capacity	KW	0.06	n. a.	n. a.
Work room temperature	°C	n. a.	n. a.	n. a.
Model characteristics				
Installation space max. (width/depth/height)	mm	270/205/210	140/140/140	275/265/240
Model dimensions max.	mm	270/205/210	140/140/140	275/265/240
Layer thickness	mm	0.125	0.2	0.1
Accuracy absolute	mm	+/– 0.2	n. a.	+/– 0.2
EDP Interface				
Interface formats		STL	CUBE	STL
EDP system		PC	PC	PC
Operating system		n. a.	Windows XP, Vista, 7 and Mac OS 10.8	Windows XP, Vista, 7
Miscellaneous				
Materials		n. a.	PLA/ABS or Tough recyclable or compostable plastic	PLA/ABS/Dissolvable natural PLA

Table A2.34 Layer Laminate Machines I

RP Process	Unit	LOM	LOM	PLT	PLT
Machine designation/ Type		LOM-1015P	LOM-2030H (TÜV/GS)	PLT-20 KATANA	PLT-A4
Manufacturer		Helisys Inc., USA		KIRA Europe GmbH	
Distribution		http://cubictechnologies.com/		http://www.kiracorp.co.jp	
Dimensions, Connection values					
Width/depth/height	m/m/m	1.1/1.0/1.47	2.08/1.47/1.42	320	800/920/1563
Weight	kg	750	1250	100/15	450
Electrical connection	V/A	230/16	230/32		100 V
Power consumption	kW	1.5–2.5	3–5		
Working gas	l/min	–	–		–
Cooling water	l/min	no	yes (internal)		–
Extraction	m^3/h	yes	yes	10–30	–
Work room temperature	°C	RT	RT	ca. 60	10–30
Relative moisture	%	40–50 (preferably)			35–75
Process					
Fumes, Exhaust		yes	yes		–
Disposal, Waste		yes	yes		yes
Hazardous waste		–	–		–
Contouring Element					
Kind		Laser	Laser	Cutting blade	Cutting blade
Type		CO_2	CO_2		
x-y Contour generation		Plotter	Plotter		Plotter
x-y Contour accuracy	mm	0.025	0.025		± 0.025
Spot repeatability	mm	–	–		
z Contour accuracy	mm	Layer thickness 0.05–0.2		0.1	
z Contour repeatable accuracy	mm	Layer thickness	Layer thickness		0.1
Coating cycle	s	–	–		
Coating arm speed	mm/s	130–200	130–200		
Power fluctuation	%	± 2	± 2		
Model characteristics					
Installation space max. (width/depth/height)	mm	254/380/355	559/812/508	280/180/150	297/210/200
Model dimensions max.	mm	250/376/355	555/808/508		280/190/200
Layer thickness	mm	0.05–0.2	0.05–0.2		0.08
Gauge	mm	arbitrary	arbitrary		
Accuracy absolute	mm	± 0.15	± 0.15		± 0.2
Repeatability	mm	± 0.05	± 0.05		± 0.025
Additional support		no	no		
EDP Interface					
Interface formats		STL	STL	STL	STL
EDP system		PC	PC		PC
Operating system		Win NT	Win NT		Win NT/95
Software		LOMSlice	LOMSlice		RP-CAD

Table A2.35 Layer Laminate Machines II

RP Process	Unit	RPS	RPS	RPS
Machine designation/ Type		ZIPPY I	ZIPPY II	ZIPPY III
Manufacturer		KINERGY-NT, Nantong		
Distribution		-		
Dimensions, Connection values				
Width/depth/height	m/m/m	1730/1000/1600	2570/1860/2000	2100/1500/1800
Weight	kg	800	1.5 K	2.5 K
Electrical connection	V/A	220/20	380/30	380/25
Power consumption	kW	4.4	11.4	9.5
Working gas	l/min			
Cooling water	l/min	7.50	7.50	7.5
Extraction	m^3/h	9	12	12
Work room temperature	°C	20–28	20–28	20–28
Relative moisture	%	60	60	60
Process				
Fumes, Exhaust				
Disposal, Waste				
Hazardous waste				
Contouring Element				
Kind		Laser	Laser	Laser
Type		CO_2	CO_2	CO_2
x-y Contour generation		CKindesian Robot	CKindesian Robot	CKindesian Robot
x-y Contour accuracy	mm	0.01	0.01	0.01
Spot repeatability	mm	0.01	0.01	0.01
z Contour accuracy	mm	0.01	0.01	0.01
z Contour repeatable accuracy	mm	0.01	0.01	0.01
Coating cycle	s			
Coating arm speed	mm/s			
Power fluctuation	%			
Model characteristics				
Installation space max. (width/depth/height)	mm			
Model dimensions max.	mm	400/300/350	1180/730/550	
Layer thickness	mm	0.12	0.125	0.122
Gauge	mm	350	880	600
Accuracy absolute	mm	0.15	0.3	0.25
Repeatability	mm	0.15	0.3	0.25
Additional support				
EDP Interface				
Interface formats		STL	STL	STL
EDP System		PC	PC	PC
Operating system		Win 98	Win 98	Win 98
Software		RPP-S016	RPP-S026	RPP-S036

Table A2.36 Layer Laminate Machines III

RP Process	Unit	Sheet Lamination	
Machine designation/ Type		LD 3D Printer	Graphtec XD 700
Manufacturer		3D Systems	
Distribution		www.3dsystems.com	
Dimensions, Connection values			
Width/depth/height	m/m/m	0.465/0.77/0.42	0.465/0.77/0.42
Weight	kg	36	45
Electrical connection	V/A		200-240
Power consumption	kW	0.66	0.62
Working gas	l/min		
Cooling water	l/min		
Extraction	m^3/h		
Work room temperature	°C	35	18–30
Relative moisture	%		
Process			
Fumes, Exhaust			
Disposal, Waste			
Hazardous waste			
Contouring Element			
Kind			
Type			
x-y Contour generation		± 0.25	
x-y Contour accuracy	mm		
Spot repeatability	mm		
z Contour accuracy	mm		± 0.15
z Contour repeatable accuracy	mm		
Coating cycle	s		
Coating arm speed	mm/s		
Power fluctuation	%		
Model characteristics			
Installation space max. (width/depth/height)	mm		
Model dimensions max.	mm	160/210/135	160/210/135
Layer thickness	mm	0.15	0.168
Gauge	mm		
Accuracy absolute	mm		
Repeatability	mm		
Additional support			
EDP Interface			
Interface formats		STL, 3DS	STL, 3DS
EDP system		PC	PC
Operating system		Windows 2000, XP	Windows 2000, XP
Software			SDview

Table A2.37 3D Printer I

RP Process	Unit	3DP	3DP	3DP	3DP	3DP
Machine designation/ Type		ProJet 160	ProJet 260C	ProJet 360	ProJet 460Plus	ProJet 660Pro
Manufacturer		3D Systems				
Distribution in Germany		www.3dsystems.com				
Dimensions, Connection values						
Width/depth/height	m/m/m	0.74/0.79/1.4	0.74/0.79/1.4	1.22/0.79/1.4	1.22/0.79/1.4	1.88/0.74/1.45
Weight	kg	165	165	179	193	340
Electrical connection	V/A	90–100/7.5; 110–120/5.5; 208–240/4	90–100/7.5; 110–120/5.5; 208–240/4	90–100/7.5; 110–120/5.5; 208–240/4	90–100/7.5; 110–120/5.5; 208–240/4	100–240/ 7.5–15
Capacity	KW	n. a.	n. a.	n. a.	n. a.	n. a.
Work room temperature	°C	13–24	13–24	13–24	13–24	13–24
Air moisture	%	20–55	20–55	20–55	20–55	20–55
Model characteristics						
Installation space max. (width/depth/height)	mm	236/185/127	236/185/127	203/254/203	203/254/203	254/381/203
Model dimensions max.	mm	236/185/127	236/185/127	203/254/203	203/254/203	254/381/203
Layer thickness	mm	0.1	0.1	0.1	0.1	0.1
Accuracy absolute	mm	n. a.	n. a.	n. a.	n. a.	n. a.
EDP Interface						
Interface formats		STL, VRML, PLY, 3DS, FBX, ZPR	STL, VRML, PLY, 3DS, FBX, ZPR	STL, VRML, PLY, 3DS, FBX, ZPR	STL, VRML, PLY, 3DS, FBX, ZPR	STL, VRML, PLY, 3DS, FBX, ZPR
EDP system		PC	PC	PC	PC	PC
Operating system		Windows Vista, 7	Windows Vista, 7	Windows Vista, 7	Windows Vista, 7	Windows Vista, 7
Miscellaneous						
Building material		VisiJet PXL	VisiJet PXL	VisiJet PXL	VisiJet PXL	VisiJet PXL
Colors		Monochrome	64 Colors	Monochrome	> 2.8 Million colors	> 6 Million colors
Quantity of nozzles		304	604	304	604	1520
Printer heads		1	2	1	2	5
Vertical build speed	mm/h	20	20	20	23	28
Minimum feature size	mm	0.4	0.4	0.15	0.15	0.1

Table A2.38 3D Printer II

RP Process	Unit	3DP
Machine designation/ Type		ProJet 860Pro
Manufacturer		3D Systems
Distribution in Germany		www.3dsystems.com
Dimensions, Connection values		
Width/depth/height	m/m/m	1.19/1.16/1.62
Weight	kg	363
Electrical connection	V/A	100–240/7.5–15
Capacity	KW	n. a.
Work room temperature	°C	13–24
Air moisture	%	20–55
Model characteristics		
Installation space max. (width/depth/height)	mm	508/381/229
Model dimensions max.	mm	508/381/229
Layer thickness	mm	0.1
Accuracy absolute	mm	n. a.
EDP Interface		
Interface formats		STL, VRML, PLY, 3DS, FBX, ZPR
EDP system		PC
Operating system		Windows Vista, 7
Miscellaneous		
Building materials		VisiJet PXL
Colors		> 6 Million
Quantity of nozzles		1520
Printer heads		5
Vertical build speed	mm/h	5–15
Minimum feature size	mm	0.1

Table A2.39 3D Printer III

RP Process	Unit	3D Printing						
Machine designation/ Type		Z™150/ 250 3D Printer	Z™310 3D Printer	Z™350 3D Printer	Z™450 3D Printer	Z™650 3D Printer	Z™650 3D Printer	Z 850 System
Manufacturer		Z Corporation www.zcorp.com						
Distribution in Germany								
Dimensions, Connection values								
Width/depth/height	m/m/m	0.74/ 0.79/1.4	0.74/ 0.81/1.09	1.22/ 0.79/1.4	1.2/0.79/ 1.4	1.07/ 0.79/1.27	1.88/ 0.74/1.45	1.19/ 1.16/1.62
Weight	kg	165	179	193	179	204	340	363
Electrical connection	V/A	230/16	230/16	230/16	230/16	230/16	100/15; 240/7.5	100/15; 240/7.5
Power consumption	kW		< 1					
Working gas	l/min	–	–	–	–	–	–	–
Cooling water	l/min	–	–	–	–	–	–	–
Extraction	m^3/h	–	–	–	–	–	–	–
Work room temperature	°C	18–25	18–25	18–25	18–25	18–25	18–25	18–25
Relative moisture	%	30–80	30–80	30–80	30–80	30–80	30–80	30–80

RP Process	Unit	3D Printing						
Process								
Fumes, Exhaust		–	–	–	–	–	–	–
Disposal, Waste		yes	yes	yes	yes	yes	yes	yes
Hazardous waste		–	–	–	–	–	–	–
Contouring Element								
Kind		1 or 2 Ink-jet print heads	1 Inkjet print head	2 Inkjet print heads	1 Inkjet print head	4 Inkjet print heads	5 Inkjet print heads	5 Inkjet print heads
Type		HP DeskJet	HP DeskJet	HP DeskJet	HP DeskJet	HP DeskJet	HP DeskJet	HP DeskJet
x-y Contour generation		Printer/ Plotter	Printer/ Plotter	Printer/ Plotter	Printer/ Plotter	Printer/ Plotter	Printer/ Plotter	Printer/ Plotter
x-y Contour accuracy	dpi	450 × 300 dpi	450 × 300 dpi	450 × 300 dpi	450 × 300 dpi	300 × 450 dpi	600 × 540 dpi	600 × 540 dpi
Spot repeatability	dpi							
z Contour accuracy	mm							
z Contour repeatable accuracy	mm							
Coating cycle	s	3	3	3	3	3		
Coating arm speed	mm/s							
Power fluctuation	%	–	–	–	–	–	–	–
Model characteristics								
Installation space max. (width/depth/height)	mm	236/185/ 127	203/254/ 203	203/254/ 203	203/254/ 203	203/254/ 203	254/381/ 203	508/381/ 229
Model dimensions max.	mm	236/185/ 127 (mono-chrome+ color)	203/254/ 203 (mono-chrome)	203/254/ 03 (mono-chrome + color)	203/254/ 203 (mono-chrome)	203/254/ 203 (mono-chrome + color)	254/381/ 203 (mono-chrome + color)	508/381/ 229 (mono-chrome + color)
Layer thickness	mm	0.1	0.09–0.1	0.1	0.09–0.1	0.09–0.1	0.09–0.1	0.09–0.1
Gauge	mm		10	10	10	10		
Accuracy absolute	mm		0.20%	0.20%		0.20%		
Repeatability	mm							
Additional support		–	–	–	–	–	–	–
EDP Interface								
Interface formats		STL/ VRML/ PLY/3DS/ FBX/ZPR	STL/ VRML/ PLY/3DS/ FBX/ZPR	STL/ VRML/ PLY/3DS/ FBX/ZPR	STL/ VRML/ PLY/3DS/ FBX/ZPR	STL/ VRML/ PLY/3DS/ FBX/ZPR	STL/ VRML/ PLY/3DS/ FBX/ZPR	STL/ VRML/ PLY/3DS/ FBX/ZPR
EDP system		PC	PC	PC	PC	PC	PC	PC
Operating system		Windows 7/Vista/ XP	Windows 7/Vista/ XP	Windows 7/Vista/ XP	Windows 7/Vista/ XP	Windows 7/Vista/ XP	Windows 7/Vista/ XP	Windows 7/Vista/ XP
Software		Zprint	Zprint	Zprint	Zprint	Zprint	Zprint	Zprint

Table A2.40 3D Printer IV

RP Process	Unit	3D Printing				
Machine designation/ Type		S-Max	S-Print	M-Lab	M-Print	ThermoJet
Manufacturer		ExOne				3D Systems
Distribution in Germany		www.exone.com				www.3dsys-tems.com
Dimensions, Connection values						
Width/depth/height	m/m/m	7/3.6/2.9	2.5/2.6/2.15	0.97/0.71/1.07	2.3/2.6/2.12	1.37/1.12/0.76
Weight	kg	6500	2500	–	2500	375
Electrical connection	V/A	400/-	400/32	120/1	400/-	100/12.5; 115/10; 230/6.3
Power consumption	kW	Max. 5	5	–	12	–
Working gas	l/min	–	–	–	–	–
Cooling water	l/min	–	–	–	–	–
Extraction	m^3/h	–	–	–	–	–
Work room temperature	°C	–	–	–	–	–
Relative moisture	%	–	–	–	–	–
Process						
Fumes, Exhaust		–	–	–	–	no
Disposal, Waste		–	–	–	–	yes
Hazardous waste		–	–	–	–	no
Contouring Element						
Kind		Inkjet print head	Inkjet print head	Inkjet print head	Inkjet print head	Multijet modeling
Type		–	–	–	–	
x-y Contour generation		Printer/Plotter	Printer/Plotter –	Printer/Plotter –	Printer/Plotter –	Printer
x-y Contour accuracy	dpi	–	–	–	–	300/400
Spot repeatability	dpi	–	–	–	–	–
z Contour accuracy	mm	–	–	–	–	600
z Contour repeatable accuracy	mm	–	–	–	–	–
Coating cycle	s	–	–	–	–	–
Coating arm speed	mm/s	–	28	–	–	ca. 1
Power fluctuation	%		–		–	–
Model characteristics						
Installation space max. (width/depth/height)	mm	1000/1800/ 700	380/750/400	40/60/35	390/760/400	250/190/200
Model dimensions max.	mm	1000/1800/ 700	380/750/400	40/60/35	390/760/400	250/190/200
Layer thickness	mm	0.280.5	–	0.05	–	0.04
Gauge	mm	–	–	–	–	–
Accuracy absolute	mm	0.07–0.98	–	–	–	–
Repeatability	mm	–	–	–	–	–
Additional support		–	–	–	–	Automatic configuration
EDP Interface						
Interface formats		STL	STL, CLI	STL	STL, CLI	TCP/IP, Ethernet
EDP system		Workstation	Workstation	Workstation	Workstation	PC/.stl
Operating system		Windows 7	Windows 7	Windows 7	Windows 7	Windows 98/2000/XP
Software						ThermoJet print client software

Table A2.41 3D Printer V

RP Process	Unit	3D Printer				
Machine designation/ Type		VX200	VX500	VX1000	VXC800	VX4000
Manufacturer		Voxeljet Systems				
Distribution in Germany		www.voxeljet.de				
Dimensions, Connection values						
Width/depth/height	m/m/m	0.9/1.7/1.5	1.8/1.8/1.7	2.8/2.4/2	2.8/4/2.2	3.8/19.5/7
Weight	kg	450	1200	3500	2500	–
Electrical connection	V/A	–	–	–	–	–
Power consumption	kW	–	–	–	–	–
Working gas	l/min	–	–	–	–	–
Cooling water	l/min	–	–	–	–	–
Extraction	m^3/h	–	–	–	–	–
Work room temperature	°C	22 +/-2	22 +/-2	22 +/-2	22 +/-2	22 +/-2
Relative moisture	%	55–75	55–75	55–75	55–75	55–75
Process						
Fumes, Exhaust		–	–	–	–	–
Disposal, Waste		–	–	–	–	–
Hazardous waste		–	–	–	–	–
Contouring Element						
Kind		Piezo Printhead System	Printhead	Printhead	Printhead	Printhead
Type		–	–	–	–	–
x-y Contour generation		Printer/Plotter	Printer/Plotter	Printer/Plotter	Printer/Plotter	Printer/Plotter
x-y Contour accuracy	dpi	300	600	600	600	600
Spot repeatability	dpi	–	–	–	–	–
z Contour accuracy	mm	–	–	–	–	–
z Contour repeatable accuracy	mm	–	–	–	–	–
Coating cycle	s	–	–	–	–	–
Coating arm speed	mm/s	–	–	–	–	–
Power fluctuation	%	–	–	–	–	–
Model characteristics						
Installation space max. (width/depth/height)	mm	200/300/150	400/500/300	600/1060/500	500/850/ 1500/2000	2000/4000/ 1000
Model dimensions max.	mm	200/300/150	400/500/300	600/1060/500	500/850/ 1500/2000	2000/4000/ 1000
Layer thickness	mm	0.15	0.08–0.15	0.1–0.3	0.3	0.12–0.3
Gauge	mm	21	112	112/450	112	1210
Accuracy absolute	mm	–	–	–	–	–
Repeatability	mm	–	–	–	–	–
Additional support		–	–	–	–	–
EDP Interface						
Interface formats		STL	STL	STL	STL	STL
EDP system		Workstation	Workstation	Workstation	Workstation	Workstation
Operating system		Current Windows	Current Windows	Current Windows	Current Windows	Current Windows
Software						

Materials for Additive Manufacturing Processes and Casting Resins

The materials described in the following represent only a selection of the available materials. Because in this field there are frequent new and further developments, at this point, one must refer to the manufacturer.

Table A3.1 Stereolithography Materials I

Properties	Unit	3D Systems Accura Bluestone	3D Systems AccuGen	3D Systems Acura 50	Vantico RhenShape SL7580	Vantico RhenShape SL7565	DSM Somos ProtoTool 20L	DSM Somos NanoForm 15120	DSM Somos WaterShed 11120	DSM Somos Somos 9120
Type		Photopolymer	Photopolymer	Photopolymer	Photopolymer	Photopolymer	Photopolymer UV aftercure	Photopolymer UV + thermal aftercure	Photopolymer	Photopolymer
Color		Opaque blue	Translucent amber	Amber-white/ gray	White	Transparent amber	Gray	Gray	Transparent green	Translucent amber
E-Modulus/Tensile modulus/ Young's modulus	MPa	7600–11700	2280	2480–2690	2300	2000–2500	10100–11200	5900	2650–2880	1227–1462
Breaking elongation	%	1.4–2.4	15	5.3–15	11	>20	1.2–1.3	1.2	11–20	15–25
Flexural modulus	MPa	8300–9800	1720	2210–2340	2400	1900–2100	9240–9600	4450	2040–2370	1310–1455
Flexural strength	MPa	124–154	63	72–77	83	60–66	118–123	129	63–74	41–48
Charpy impact strength	kJ/m^2									
Charpy notch impact strength	kJ/m^2	13–17	25	16.5–28.1	34	27–38				48–53
Tensile strength	MPa	66–68	50	48–50	53	46–54	72–79	53	47–54	30–32
Hardness at 23 °C	Shore A	92	82	86	84	84				80–82
Residual ash	%									
Melting point	°C									
Heat resistance										
▪ at 0.45 MPa	°C						269	257–259	45.9–54.5	52–61
▪ at 1.84 Mpa	°C	66	n.a.	43–46	52		115	83–94	49–49.70	n.a.
Glass transition temperature	°C	65–66	n.a.	49–53	63	48–52	49	80	39–56	n.a.

Table A3.2 Stereolithography Materials II

Properties	Unit	Envisiontec RHarz	Objet FullCure M-720	Objet FullCure M-830	Objet FullCure M-840	Objet TangoBlack	Objet TangoGray
Type		Photopolymer	Photopolymer	Photopolymer	Photopolymer	Photopolymer	Photopolymer
Color			Transparent	White	Blue-gray	Black	Gray
E-Modulus/Tensile modulus/ Young's modulus	MPa	1980	2870	2495	2740	–	–
Breaking elongation	%		15–25%	15–25%	15–25%	47.7 %	47%
Flexual moduleus	MPa	2450	1718	2137	1983	–	–
Flexural strength	MPa	75	75.8	74.6	83.6	–	–
Charpy impact strength	kJ/m^2		–	–	–	–	–
Charpy notch impact strength	kJ/m^2		39.6	37.5	42.5	–	–
Tensile strength	MPa		60.3	49.8	55.1	2.0	4.36
Hardness at 23 °C	Shore A	85	83	83	83	61	75
Residual ash	%		< 0.01	< 0.4	< 0.3	–	–
Melting point	°C		–	–	–	–	–
Heat resistance							
▪ at 0.45 MPa	°C		48.4	47.6	48.8	n. a.	n. a.
▪ at 1.84 MPa	°C	64	44.4	43.6	44.8	n. a.	n. a.
Glass transition temperature	°C	135	48.7	58	48.7	n. a.	n. a.

Table A3.3 Stereolithography Materials III

Property	Condition	Unit	Accura ClearVue	Accura PEAK Plastic	Accura Saphire
Appearance			Transparent	Amber colors	Sapphire blue
Density, liquid	at 25 °C	g/cm^3	1.1	1.32	1.1
Density, solid	at 25 °C	g/cm^3	1.17	1.36	1.18
Viscosity	at 30 °C	cps	235-260	605	160-200
Penetration depth		mils	6.1	5.6	2.9
Critical energy		mJ/cm^2	9.5	11.5	8.23
Tested build styles					Viper Hi-Resolution Exact™, Viper High-Resolution Thin Layer™
Tensile strength	ASTM D 638	MPa	46-53	57-78	20-24
Modulus of elasticity	ASTM D 638	MPa	2270-2640	4220-4790	910-1110
Breaking elongation	ASTM D 638	%	3-15	1.3-2.5	9-16
Flexural strength	ASTM D 790	MPa	72-84	77-126	28-38
Flexural modulus	ASTM D 790	MPa	1980-2310	4180-4790	1080-1420
Impact strength	ASTM D 256	J/m	40-58	21.3-27.3	29-40
Heat resistance	ASTM D 648				
	at 66 PSI	°C	51	78	38
	with heat treatment			153	
	at 264 PSI	°C	50	59	33
	with heat treatment			124	
Hardness, Shore D			80	86	72
Coefficient of thermal expansion	ASTM E 831-93				
		µm/m °C	TMA (T<Tg, 25-50 °C): 122	TMA (T<Tg, 0-50 °C): 48	TMA (T<Tg, 25-50 °C): 135
		µm/m °C	TMA (T<Tg, 50-100 °C): 155	TMA (T<Tg, 50-120 °C): 92	TMA (T<Tg, 75-140 °C): 165
Glass transition temperature	DMA, E″	°C	62	104, with heat treatment at 120 °C: 110	58
Water absorption	ASTM D 570-98	%	0.3		

Table A3.4 Stereolithography Materials IV

Property	Condition	Unit	Accura Xtreme White 200	Accura Xtreme	Accura 60
Appearance			White	Gray	Transparent
Density, liquid	at 25 °C	g/cm^3	1.12	1.13	1.13
Density, solid	at 25 °C	g/cm^3	1.18	1.19	1.21
Viscosity	at 30 °C	cps	650–750	250–300	150–180
Penetration depth		mils	4.6	4.1	6.3
Critical energy		mJ/cm^2	8.3	11.7	7.6
Tested build Styles				EXACT™	EXACT™, FAST™, QuickCast™
Tensile strength	ASTM D 638	MPa	45–50	38–44	58–68
Modulus of elasticity	ASTM D 638	MPa	2300–2630	1790–1980	2690–3100
Breaking elongation	ASTM D 638	%	7–20	14–22	5–13
Flexural strength	ASTM D 790	MPa	75–79	52–71	87–101
Flexural modulus	ASTM D 790	MPa	2350–2550	1520–2070	2700–3000
Impact strength	ASTM D 256	J/m	55–66	35–52	15–25
Heat resistance	ASTM D 648				
	at 66 PSI	°C	47	62	53–55
	at 264 PSI	°C	42	54	48–50
Hardness, Shore D			78–80		86
Coefficient of thermal expansion	ASTM E 831-93				
		µm/m °C	TMA (T<Tg, 30–50 °C): 95		TMA (T<Tg, 0–20 °C): 71
		µm/m °C	TMA (T<Tg, 70–140 °C): 180		TMA (T<Tg, 75–140 °C): 153
Glass transition temperature	DMA, E"	°C	52		58
Water absorption	ASTM D 570-98	%	0.38		

Table A3.5 Stereolithography Materials V

Property	Condition	Unit	Accura CeraMAX	Accura 48HTR	Accura e-Stone
Appearance			White	Transparent amber	Green
Density, liquid	at 25 °C	g/cm^3	1.59	1.17	1.13
Density, solid	at 25 °C	g/cm^3	1.62	1.23	1.19
Viscosity	at 30 °C	cps	1500–2000	200–250	200–300
Penetration depth		mils	5.7	5.5	4.2
Critical energy		mJ/cm^2	7.2	7.4	10.5
Tested build styles				Viper™-EXACT™, EXACT™-HR, Viper™ Pro-EXACT™	EXACT™
Tensile strength	ASTM D 638	MPa	78–87	64–67	37–39
Modulus of elasticity	ASTM D 638	MPa	9460–9680	2800–3980	1500–1750
Breaking elongation	ASTM D 638	%	1–1.5	4–7	10–23
Flexural strength	ASTM D 790	MPa	137–145	105–118	54–59
Flexural modulus	ASTM D 790	MPa	8270–8370	2760–3400	1350–1750
Notched impact strength	ASTM D 256	J/m	14.5–17.9	22–29	18–25
Heat resistance	ASTM D 648				
	at 66 PSI	°C	148	65	58–63
	with heat treatment		220	130	
	at 264 PSI	°C	95	57	51–55
	with heat treatment		97	110	
Hardness, Shore D			89	86	80
Coefficient of thermal expansion	ASTM E 831-93				
		µm/m °C	TMA ($T<T_g$, 25–57 °C): 31.1	TMA ($T<T_g$, <50 °C): 115	
		µm/m °C	TMA ($T<T_g$, 70–200 °C): 87.4	TMA ($T>T_g$, >120 °C): 165	
Glass transition temperature	DMA, E"	°C	108–110, with heat treatment at 120 °C: 112–114	62, with heat treatment at 160 °C: 132	60

Table A3.6 Stereolithography Materials VI

Property	Condition	Unit	Accura CastPro	Accura 55	Accura 25
Appearance			Transparent	White	White
Density, liquid	at 25 °C	g/cm^3	1.08	1.13	1.14
Density, solid	at 25 °C	g/cm^3	1.17	1.20	1.19
Viscosity	at 30 °C	cps	240–260	155–185	250
Penetration depth		mils	6.2	5.2	4.2
Critical energy		mJ/cm^2	8.7	7.4	10.5
Tested build styles				EXACT™, FAST™; EXACT-HR	FAST™, EXACT™, EXACT-HR
Tensile strength	ASTM D 638	MPa	52–53	63–68	38
Modulus of elasticity	ASTM D 638	MPa	2490–2620	3200–3380	1590–1660
Breaking elongation	ASTM D 638	%	4.1–8.3	5–8	13–20
Flexural strength	ASTM D 790	MPa	82–84	88–110	55–58
Flexural modulus	ASTM D 790	MPa	2310–2340	2690–3240	1380–1660
Notched impact strength	ASTM D 256	J/m	43–49.5	12–22	19–24
Heat resistance	ASTM D 648				
	at 66 PSI	°C	51	55–58	58–63
	at 264 PSI	°C	50	51–53	51–55
Hardness, Shore D			85	85	80
Coefficient of thermal expansion	ASTM E 831-93				
		µm/m °C	102.9	TMA (T>T_g, >120 °C): 61	TMA (T>T_g, >120 °C): 107
		µm/m °C	160.2	TMA (T>T_g, >120 °C): 163	TMA (T>T_g, >120 °C): 151
Glass transition temperature	DMA, E"	°C	70	56	60
Water absorption	ASTM D 570-98	%	0.33		

Table A3.7 Stereolithography Materials VII

Property	Condition	Unit	Accura Bluestone	Accura Amethyst
Appearance			Blue	Purple
Density, liquid	at 25 °C	g/cm^3	1.70	1.1
Density, solid	at 25 °C	g/cm^3	1.78	1.23
Viscosity	at 30 °C	cps	1200–1800	350
Penetration depth		mils	4.1	3.7
Critical energy		mJ/cm^2	6.9	14.4
Tested build styles			EXACT™	FAST™, EXACT™, EXACT-HR
Tensile strength	ASTM D 638	MPa	66–68	22–38
Modulus of elasticity	ASTM D 638	MPa	7600–11700	3514–3996
Breaking elongation	ASTM D 638	%	1.4–2.4	0.56–1.04
Flexural strength	ASTM D 790	MPa	124–154	87–125
Flexural modulus	ASTM D 790	MPa	8300–9800	3652–3721
Notched impact strength	ASTM D 256	J/m	13–17	9–12
Heat resistance	ASTM D 648			
	at 66 PSI	°C	65–66	77
	with heat treatment		267–284	
	at 264 PSI	°C	65	62
	with heat treatment			
Hardness, Shore D			92	87
Coefficient of thermal expansion	ASTM E 831-93			
		µm/m °C	TMA ($T>T_g$, >120 °C): 33–44	TMA ($T>T_g$, >120 °C): 57
		µm/m °C	TMA ($T>T_g$, >120 °C): 81–98	TMA ($T>T_g$, >120 °C): 133
Glass transition temperature	DMA, E″	°C	71–83	103

Table A3.8 Stereolithography Materials VIII

Property	Condition	Unit	RenShape SL7800		RenShape SL7810	
Appearance					White	
Density, liquid	at 25 °C	g/cm^3	1.12		1.13	
Density, solid	at 25 °C	g/cm^3	1.15		1.16	
Viscosity	at 30 °C	cps	205		210	
Penetration depth		mils			5.6	
	on SLA 7000/5000		5.74			
	auf SLA 500/3500/Vipser Si_2 System		5.67			
Critical energy		mJ/cm^2			9.9	
	auf SLA 7000/5000		9.98			
	auf SLA 500/3500/Vipser Si_2 System		9.51			
			90 minute + UV postcure	90 minute UV + 2 h at 80 °C thermal treatment	90 minute UV postcure	90 minute UV + 2 h at 80 °C thermal treatment
Tensile strength	ASTM D 638	MPa	41–47	44	35–51	39–51
Modulus of elasticity	ASTM D 638	MPa	2075–2400	2180–2250	1793–2400	2000–2400
Breaking elongation	ASTM D 638	%	10–18	10–15	10–20	10–14
Flexural strength	ASTM D 790	MPa	69–74	72–74	58–69	62–69
Flexural modulus	ASTM D 790	MPa	2280–2650	2380–2640	1896–2400	2096–2400
Notched impact strength	ASTM D 256	J/m	37–58	37–48	44–49	44–50
Heat resistance	ASTM D 648					
	at 66 PSI	°C	62	62	51	50
Hardness, Shore D			87	87	86	87
Coefficient of thermal expansion	ASTM E 831-93					
		µm/m °C	100	109	96	99
		µm/m °C				
Glass transition temperature	DMA, E″	°C	57	59	62	62
Water absorption	ASTM D 570-98	%				

Table A3.9 Stereolithography Materials IX

Property	Condition	Unit	RenShape SL7820		RenShape SL7840	
Appearance			White		Clear	
Density, liquid	at 25 °C	g/cm^3	1.13		1.13	
Density, solid	at 25 °C	g/cm^3	1.16		1.16	
Viscosity	at 30 °C	cps	210		320	
Penetration depth		mils	4.5		5	
Critical energy		mJ/cm^2	10		15	
			90 minute + UV post-cure	90 minute UV + 2 h at 80 °C thermal treatment	90 minute + UV postcure	90 minute UV + 2 h at 80 °C thermal treatment
Tensile strength	ASTM D 638	MPa	36–51	39–51	36–45	37–45
Modulus of elasticity	ASTM D 638	MPa	1900–2400	2000–2500	1700–2200	1600–2200
Breaking elongation	ASTM D 638	%	8–18	9–14	11–17	11–18
Flexural strength	ASTM D 790	MPa	59–80	62–80	65–80	62–80
Flexural modulus	ASTM D 790	MPa	2000–2400	2100–2500	1600–2200	1600–2200
Impact strength	ASTM D 256	J/m	42–48	30–49	37–60	35–60
Heat resistance	ASTM D 648					
	at 66 PSI	°C	51	50	48	46
Hardness, Shore D			86	87	86	87
Coefficient of thermal expansion	ASTM E 831-93	µm/m °C	93	93	100	110
Glass transition temperature	DMA, E″	°C	62	62	58	59

Table A3.10 Stereolithography Materials X

Property	Condition	Unit	RenShape SL7870	
Appearance			Clear	
Density, liquid	at 25 °C	g/cm^3	1.13	
Density, solid	at 25 °C	g/cm^3		
Viscosity	at 30 °C	cps	180	
Penetration depth		mils	7.2	
Critical energy		mJ/cm^2	10.6	
			90 minute + UV postcure	90 minute UV + 2 h at 80 °C thermal treatment
Tensile strength	ASTM D 638	MPa	38–42	39–42
Modulus of elasticity	ASTM D 638	MPa	1930–2020	1860–2030
Breaking elongation	ASTM D 638	%	10–22	10–23
Flexural strength	ASTM D 790	MPa	65–71	65–74
Flexural modulus	ASTM D 790	MPa	1980–2310	2010–2350
Impact strength	ASTM D 256	J/m	45–61	43–60
Heat resistance	ASTM D 648			
	at 66 PSI	°C	48	49
	at 264 PSI	°C		
Hardness, Shore D			86	87
Glass transition temperature	DMA, E″	°C	56	57
Water absorption	ASTM D 570-98	%		

Table A3.11 Sintering Materials I

Properties	Unit	3D Systems DuraForm PA	3D Systems DuraForm GF	3D Systems DuraForm Flex*	3D Systems CastForm PS	3D Systems LaserForm A6
Type		Polyamide	Polyamide, glass-filled	Elastomer	Wax infiltrated	Bronze infiltrated
Manufacturer/Distributor/Info		3D Systems				
Color		White	Gray	Natural white	White	Gray
Average particle size	µ	58	48	85	62	34
Particle size	95% < µ	92	92	138	106	58
Particle size area	µ	25–92	10–92	21–138	25–106	20–58
Moisture absorption	%	0.41	0.3			
Specific weight	g/cm^3	1.01–1.02	1.49	0.44		7.8
Density (powder)	g/cm^3	0.59	0.84	0.58		8.15
Density (sintered material)	g/cm^3	0.97	1.4	0.91		7.5
E-Modulus	MPa	1600	4068	7.4		138×10^3
Breaking elongation	%	14	1.4	110		10.0–20.0
Flexural modulus	MPa	1387	3106	5.9		
Flexural strength	MPa		37			
Charpy impact strength	kJ/m^2	336	123			
Charpy notch impact strength	kJ/m^2	32	41			
Tensile strength	MPa	44	27	1.8		610
Hardness	Shore A	73	77	60		HRC 22
Residual ash	%				0.03	
Melting point	°C	184	185	192		
Glass transition temperature	°C	–			89	
Dimensional stability temperature	°C	180	175			

* All values for DuraForm Flex in infiltrated state.

Table A3.12 Sintering Materials II

Properties	Unit	EOS PrimePKind	EOS PA 2200	EOS PA 3200GF	EOS Alumide	EOS PrimeCast 100
Type		PA 12	PA 12	Glass-filled PA 12	Aluminum-filled PA 12	Polystyrene
Color		White	White	White	Gray-silver	White
Average particle size	µm	56	60	60	60	80
Particle size	95% < µ					
Particle size area	µm					
Moisture absorption at 23 °C	%					
Specific weight	g/cm^3					
Bulk density (powder)	g/cm^3	0.44	0.44	0.61	0.64	0.61
Density (laser-sintered material)	g/cm^3	0.92	0.93	1.26	1.36	0.78
E-Modulus/Tensile modulus/ Young's modulus	MPa	1700	1700	3200	3800	1600
Breaking elongation	%	15	20	6	3.5	0.4
Flexual moduleus	MPa	1240	1240	2100	3000	
Flexural strength	MPa				74 ± 2	
Charpy impact strength	kJ/m^2	53	53	35	29	
Charpy notch impact strength	kJ/m^2	4.8	4.8	5.4	4.6	
Tensile strength	MPa	47	45	48	46	1.2–5.5
Hardness	Shore D	75	75	80	76	
Residual ash	%					0.002
Melting point	°C	172–180	172–180	172–180	172–180	
Dimensional stability						
according to Vicat Last A/ 50 K/Std.	°C	181	181	179		
according to Vicat Last B/ 50 K/Std.	°C	163	163	166	169	
Glass transition temperature	°C					105 ± 1

All data should be regarded as guide values.

Table A3.13 Sintering Materials III

Properties	Unit	EOS DirectMetal 20	EOS DirectSteel 20	EOS DirectSteel H20	EOS CoCr*	EOS Stainless steel*
Type		Bronze-based metal powder	Steel-based metal powder	Steel-based metal powder	CoCr alloy metal powder	Stainless steel powder
Color		Brown	Gray	Gray	Gray	Gray
Average particle size	µm	< 20	< 20	< 20	< 20	< 20
Particle size	95% < µ					
Particle size area	µm					
Moisture absorption at 23 °C	%					
Specific weight	g/cm^3					
Density (powder)	g/cm^3					
Density (sintered material)	g/cm^3	up to 7.6	up to 7.6	up to 7.8		
E-Modulus/Tensile modulus/ Young's modulus	MPa	80	130	180		
Breaking elongation	%				5–12	30
Flexural modulus	MPa					
Flexural strength	N/mm^2	700	1000	2000		
Charpy impact strength	kJ/m^2					
Charpy notch impact strength	kJ/m^2					
Tensile strength	MPa	up to 400	up to 600	up to 1100	1300	1000
Hardness		110 HB, 115 HV	220 HB, 225 HV	350–420 HV, 35–42 HRC	30–52 HRC	240 HB
Residual ash	%					
Melting point	°C					
Heat resistance						
▪ at 0.45 MPa	°C					
▪ at 1.84 MPa	°C					
Glass transition temperature	°C					

All data should be regarded as guide values.
* Preliminary values
** Hardness testing by Vickers (HV), Rockwell B (HRB), and Rockwell C (HRC).

Table A3.14 Sintering Materials IV

Properties	Unit	EOS Ceramics 5.2	EOS QuKindz 4.2	EOS QuKindz 5.7
Type		Aluminum silicate sand	Quartz sand	Quartz sand
Color		Brown	Brown	Brown
Average particle size	µm	130 ± 20	140 ± 20	160 ± 10
Particle size	95% < µ			
Particle size area	µm			
Moisture absorption at 23 °C	%			
Specific weight	g/cm^3			
Bulk density (powder) (by VDGP27)	g/cm^3	1.64 ± 0.05	1.4 ± 0.04	1.35 ± 0.03
Density (sintered material)	g/cm^3			
E-Modulus/Tensile modulus/ Young's modulus	MPa			
Breaking elongation	%			
Flexual moduleus	MPa			
Hot flexural strength (according to VDGP74)	N/cm^2	800 ± 80	600 ± 60	550 ± 55
Cold flexural strength (nach VDGP74)	N/cm^2	2000 ± 200	1600 ± 160	1500 ± 150
Charpy impact strength	kJ/m^2			
Charpy notch impact strength	kJ/m^2			
Tensile strength	MPa			
Hardness at 23 °C	Shore A			
Residual ash	%			
Melting point (sand base material)	°C	1825	1700	1700
Heat resistance				
▪ at 0.45 MPa	°C			
▪ at 1.84 MPa	°C			
Glass transition temperature	°C			
Loss on ignition (according to VDG-P74)	%	5.2 ± 0.2	4.2 ± 0.2	5.7 ± 0.2

Table A3.15 Sintering Materials V

Properties	Unit	Windform XT	Windform Pro B Polyamide	ARCAM H13	ARCAM Ti6A114V
Type		Carbon composite		CrMoVa Leg.	Titan Leg.
Manufacturer/Vertreiber/Infos		CRP-Technology www.windform.it		ARCAM Sweden www.arcam.com	
Color		Black	Gray	Gray	Gray
Average particle size	µ				
Particle size	95% < µ				
Particle size area	µ			15–40	20–50
Moisture absorption	%				
Specific weight	g/cm^3			7.8	4
Density (powder)	g/cm^3				
Density (sintered material)	g/cm^3				
E-Modulus	MPa	7320	3612	210,000	128,000
Breaking elongation	%	2.6	3.81		10
Flexural modulus	MPa	1387	3106		
Flexural strength	MPa	131.5	96.1		
Charpy impact strength	kJ/m^2				
Charpy notch impact strength	kJ/m^2	4.73	2.69		
Tensile strength	MPa	77.85	47.05	1300	930
Hardness	Shore A	92		HRC 48–50	HRC 30–35
Residual ash	%				
Melting point	°C	179.33	180		
Glass transition temperature	°C	–			
Dimensional stability temperature	°C				

* All values for DuraForm Flex in infiltrated state.

Table A3.16 FDM Materials

Properties	Unit	Polycarbonat	ABS	ABSplus	ABSi	PPSU
Manufacturer/Contact/Web		www.stratasys.com				
E-Modulus	MPa	2000	1627	2265	1915	2068
Breaking elongation	%	3	6	4	3.1	3
Flexural modulus	MPa	2137	1834	2198	1820	2206
Flexural strength	MPa	97	41	52	61	110
Notch impact strength	kJ/m^2	53.4	106	96	101.0	58.73
Tensile strength	MPa	52	22	36	37	55
Heat resistance						
▪ at 0.45 MPa	°C	127	96.00		95	189
▪ at 1.84 MPa	°C					
Glass transition temperature	°C	161	104	n. a.	116	230
Density	g/cm^3	1.2	1.05	1.04	1.08	1.28

Special Features:
The materials are available in colors: white, black, red, blue, green, yellow, and custom-made in any RAL color.
ABSi: meets all FDA USP CLASS VI requirements, gamma-sterilizable.

Table A3.17 Model Maker Materials

Properties	Unit	Protobuild	Protosupport
Type		Green building materials	Red supports
Manufacturer		Solidscape	
Density	g/cm^3	1.25	0.93
Melting temperature	°C	92–106	50–72
Flame temperature	°C	> 175	> 175
Shore hardness	Shore A	45	33
Coefficient of thermal expansion			
▪ at 50 °C	ppm/°C	82.7	351.3
▪ at 55 °C	ppm/°C		403.2
▪ at 60 °C	ppm/°C	87.6	
▪ at 70 °C	ppm/°C	91.4	

Table A3.18 LOM Materials

Properties	Unit	LPH 042		LXP 050		LGF 045	
Type		Paper		Polyester		Glass fiber	
Manufacturer		Helisys		Helisys		Helisys	
Model characteristics		Fiber	Transverse	Fiber	Transverse	Fiber	Transverse
Density	g/cm^3	1.449		1.0–1.3		1.3	
E-Modulus	MPa	2524		3435		–	
Tensile strength	MPa	26	1.4	85		> 124.1	4.8
Compressive strength	MPa	15.1	115.3	17	52	–	–
Compression modulus	MPa	2192.9	406.9	2460	1601	–	–
Max. deformation under pressure	%	1.01	40.4	3.58	2.52	–	–
Flexural strength	MPa	2.8–4.8		4.3–9.7		–	
Glass transition temperature	°C	30		–		53–127	
Coefficient of expansion	ppm/K	3.7	185.4	17.2	229	*x*: 3.9 *y*: 15.5	*z*: 111.1
Thermal conductivity	W/mK	0.117		–		–	
Ash content	%	2.7–3.1		–		–	

Table A3.19 3D Printer Materials

Properties	Unit	zp130*
Manufacturer		Z Corporation
Color		White
Average particle size	µm	50.00
Particle size	95% < µ	
Particle size area	µm	
Moisture absorption at 23 °C	%	
Specific weight	g/cm^3	
Density (Powder)	g/cm^3	1.60
Density (sintered material)	g/cm^3	
E-Modulus/Tensile modulus/ Young's modulus	MPa	
Breaking elongation	%	
Flexural modulus	MPa	
Flexural strength	MPa	
Charpy impact strength	kJ/m^2	
Charpy notch impact strength	kJ/m^2	
Tensile strength	MPa	
Hardness at 23 °C	Shore A	
Residual ash	%	
Melting point	°C	

* All data without infiltration.
The component receives its individual properties only through infiltration.

Table A3.20 Casting Resins

Property	Unit	PX 774	2170	Biresin G 55	MG 8051	Megithan 2MD787
Manufacturer		Axson	HEK	SIKA	ebalta	BIOTOOL
Pronounced property		Elastic	Hard	Impact / flexural strength	High-temperature resistant	Clear (UV resistant)
Aspect/Color		Black	Yellowish	Opaque	Black	Transparent
Mixing ratio A:B	g:g	44:100	100:150	80:100	100:70	100:300
Pot life (g; °C)	min	2–3 (100; 25)	4 (100; 25)	4 (300; 20)	5–7 (200; 20)	15–20 (200; 20)
Viscosity (25 °C)						
Component A	Pa · s	0.025–0.045	0.63	1.45 (23 °C)	0.7 ± 0.10	1.5
Component B	Pa · s	0.8–1.2	0.23	0.3 (23 °C)	0.7 ± 0.10	0.8–2.2
Spec. Weight (25°)						
Component A	kg/dm^3	1.18–1.22	1.11	1.06 (23 °C)	1.14 ± 0.2	–
Component B	kg/dm^3	1.03–1.07	1.22	1.22 (23 °C)	1.16 ± 0.2	–
Hardness	Shore A	75 (23 °C)				
	Shore D		82 (23 °C)	81–84 (23 °C)	80 ± 3 (23 Grad)	85–87 (RT)
Flexural strength	MPA		120	110–120	100 ± 5	
Flexural modulus	MPA		2690	2800	1930 ± 100	
Tensile strength	MPA	7	78.5	70–80	67 ± 5	90
Tension/E-Modulus	MPA		3530			
Impact strength	kJ/m^2			> 100	63 ± 10	
Breaking elongation	%	300	6.5	6–8	10.5 ± 2	
Stretching	%		5.5			
Shrink	%		0.1	0.25–0.35	ca. 0.3	0.1
Thermal conductivity	W/m K		224			
Heat resistance	°C	80	85	80	120 ± 3	90–100

Due to the wide product range, every manufacturer and therefore all products cannot be listed and characterized.
The casting materials listed here are only examples representing what different pronounced properties can be crucial for the right choice. There are certainly other materials that are similar or have properties even better than expected. For specific information, the manufacturer should be contacted directly.

Glossary

In this list are frequently used terms and their abbreviations that are often used in the literature but not always clearly explained there.

Abbreviation	Definition	Explanation
3DP	Three-Dimensional Printing	Rapid prototyping process. Layer formation by injecting liquid into powder. Trademark of Massachusetts Institute of Technology
ACES	Accurate Clear Epoxy Solids	Stereolithography building style (3D Systems)
AF	Additive Fabrication	Production by adding volume elements
AF	Anatomic Facsimile	Medical anatomical (operations) models
AFM	Anatomic Facsimile Models	Medical anatomical (operations) models
AIM	ACES Injection Molding	(Injection molding) tool of stereolithography material (see ACES) (3D Systems)
AM	Additive Manufacturing	Production by adding volume elements
AM	Agile Manufacturing	Proprietary designation from 3D Systems for process for direct production. The point is to emphasize the effectiveness of the process
BASS	Break Away Support System	Support structure for the FDM process, which can be removed by manually (Stratasys)
BIS	Beam Interference Solidification	Rapid prototyping process. Polymerization point by two intersecting laser beams in the polymerization
BPM	Ballistic Particle Manufacturing	Rapid prototyping process. Layer formation by stacking shooting of volume elements
	Buy-to-fly ratio	Ratio of the volume of material to be paid for to the volume used; a measure of the waste in a manufacturing process
CAD	Computer-Aided Design	Computer-aided design, preferably in the sense of geometric construction
CAE	Computer-Aided Engineering	Computer-aided design in terms of an interpretation defined using geometric and mathematical basic elements
CAL	Computer-Aided Logistics	Computer-aided material supply
CAM	Computer-Aided Manufacturing	Computer-aided manufacturing
CAMOD	Computer-Aided Modeling Devices	Software and hardware elements for the production of models
CAP	Computer-Aided Production	Computer-aided production
CAQ	Computer-Aided Quality Assurance	Computer-aided quality assurance

Abbreviation	Definition	Explanation
CAS	Chemical Abstracts Service	US-American nomenclature and institution for the identification of chemical substances
CAS	Computer-Aided Styling	Computer-aided shaping (styling within the meaning of the German conception of design)
CAT	Computer-Aided Testing	Computer-aided measurement and testing
CAx	Computer-Aided … Computer-Assisted …	Abbreviation for any kind of computer-aided process
	AutoFabs	Automated fabricator(s). Equivalent to fabricator
CD	Concurrent Design	Parallelized design and construction classifications
CEM	Contract Electronics Manufacturing	Contract manufacturing for electronic components and products
CIM	Computer-Integrated Manufacturing	Production based on a closed chain CAD-CAM. Equivalent to ICAM
CMB	Controlled Metal Buildup	Rapid prototyping process. Laser generation and subsequent contour milling of metal (FhGIPT)
CMC	Computer-Mediated Communication	Computer-mediated communication
CP	Centrum für Prototypenbau GmbH	Rapid prototyping service providers located in Erkelenz/Dusseldorf (Germany)
CPDM	CIMATRON Product Data Management	PDM System Co. CIMATRON
CS …	Computer-Supported …	Computer-aided process
CSCW	Computer-Supported Cooperative Work	Computer-aided communication system
CSG	Constructive Solid Geometry	Description of a complex body by combining simple body about Boolean operations
CT	Computed Tomography	X-ray film process, preferably in medicine
DCM	Direct Composite Manufacturing	Direct fabrication of components made of composite material. Preferably used by OptoForm for the M3D Process
DMLS	Direct Metal Laser Sintering	Sintering process company EOS for direct sintering of metal
DMU	Digital Mock-Up	Digitale prototype, mostly in the sense of animatable in virtual reality
D_P	Cure Depth	For stereolithography, the optical penetration depth for resin
DSPC	Direct Shell Production Casting	Hardware and software solution from the company Soligen for direct sintering of ceramic molds
DTM	Desktop Manufacturing	Process for fast production of three-dimensional physical models “on the desk”
DTM	DTM Corp., Austin, TX, USA	Manufacturer of laser sintering machines; now 3D Systems
DXF	Drawing Exchange Format	Data format for storing CAD drawings
E_C	Critical Energy	For stereolithography; the threshold energy at which a chemical reaction occurs

Abbreviation	Definition	Explanation
EDM	Electronic Data Management; Engineering Data Management	Program systems for managing large, multiple beneficiaries of simultaneously processed files
EDM	Electrical Discharge Machining	Electrical discharge machining
EDM	Electronic Document Management	Electronic archiving of documents
EOS	Electrical Optical Systems GmbH, Planegg/ Munich, Germany	Manufacturer of sintering machinery
ERM	Enterprise Resource Management	System and software programs for the management and planning of logistics supply chains
ERP	Enterprise Resource Planning	System and software programs for the management and planning of logistics supply chains
	Fabber	Short form of fabricator
	Fabrikator (Fabricator)	Additive manufacturing machine for the direct production of components with product character
FDM	Fused Deposition Modeling	FLM process for the company Stratasys
FFF	Fast Freeform Fabrication	Process for the rapid production of three-dimensional physical models
FLM	Fused Layer Modeling	Rapid prototyping process. Film formation by extrusion of molten thermoplastics and solidification due to heat conduction
FM	Facsimile Models	Scale mapping of existing geometry
FRP	Foam Reaction Prototyping	Process for layered application of self-reacting foams. Preferably proprietary designation of Herback (Hennings 2004)
	Grower	*For growing;* designation for additive manufacturing machinery, mainly used by Solidscape for the T66
HIS	Holographic Interference Solidification	Rapid prototyping process. Polymerization by projecting holographic images onto photosensitive materials
HPGL	Hewlett Packard Graphic Language	Plotter interface
HSC	High-Speed Cutting	High-speed milling
HSPC	High-Speed Precision Cutting	HSC of the company Kern Microtechnik
ICAM	Integrated Computer-Aided Manufacturing	Production based on a closed-chain CAD-CAM; equivalent to CIM
IGES	Initial Graphics Exchange Specification	File format for the exchange of neutral geometry data between CAD systems
KMG	Coordinate Measuring Machine	3D Coordinate measuring machine
LCVD	Laser Chemical Vapor Deposition	Rapid prototyping process. Laser-assisted deposition of material in the gas phase

Abbreviation	Definition	Explanation
LENS	Laser-Engineered Net Shaping	Rapid prototyping process. Laser-generated metal (Company OPTOMEC)
LLM	Layer Laminate Manufacturing	Rapid prototyping process. Contouring by laser, knife, or cutter. Layer formation by bonding
LM	Laminate Manufacturing	Collective term for rapid prototyping processes after layer laminate processes
LMC	Layer Milling Center	Layer milling machine of the company Zimmermann
LMP	Layer Milling Process	Layer milling process of the company Zimmermann/ Pauser
LMPM	Low Melting Point Metal	Low-melting metal alloy
LMS	Laser Model System	Stereolithography process of the company Fockele & Blacke
LMT	Layer Manufacturing Technologies & Techniques	General term for layer-oriented operating manufacturing processes
LOM	Laminated Object Manufacturing	LLM process of the company Helisys
LS	Laser Sintering	Rapid prototyping process. Layer formation by local melting and subsequent solidification of powder-like materials
LSM	Laser Surface Melting	Laser-sintering process of the company Fockele & Blacke for the production of metal prototypes
MEMS	Micro Electromechanical Systems	Microelectromechanical systems
MIM	Metal Injection Molding	Injection-molding process based on plastifiable metal-plastic mixtures
MIM/ MAM/ MDM/	Material Increase Manufacturing/ Material Addition Manufacturing/ Material Deposition Manufacturing	Production by the juxtaposition and successive joining of volume elements
MJM	MultiJet Modeling	FLM process of the company 3D Systems
MJS	Multiphase Jet Solidification	FLM process of the company ITP
	Modden (Modding)	Fitting of accessories, ornamentation, and so on, especially in their function of unchanged products. Most often externally, for example on the housing of computers (case modding). Equivalent to tune, style, pimp
MRT	Magnetic Resonance Tomography	Medical imaging process, preferably for the examination of soft tissue
NMR	Nuclear Magnetic Resonance	Process used in medical imaging
OEM	Original Equipment Manufacturer	Supplier for products that the original manufacturer sells under its own name
	Pimp	Especially externally spectacular treatment of a product that is otherwise unchanged, especially in its function. See “Pimp My Ride” TV show (off air)

Abbreviation	Definition	Explanation
PDM	Product Data Management	EDP systems for product data management
PET	Positron Emission Tomography	Imaging process, preferably for medicine
PPS	Production Planning System	Production planning and control system
	Prototyper	Additive manufacturing machine for the direct production of prototypes, patterns, and dummies
RMM	Rapid Mock-up Machine	Additive manufacturing machine for the production of prototypes, dummies (mock-ups), and models. Preferably from the Kira Corp. for the *Katana* term coined
RIM	Reaction Injection Molding	Injection-molding process on the basis of plasticizable chemically reactive metal-plastic mixtures
RM	Rapid Modeling	Process for the rapid production of models
RP	Rapid Prototyping	Technology that deals with processes and methods for production of layered models directly from 3D CAD data
RP	Reinforced Plastics	Preferably fiber-reinforced plastics (as opposed to nonreinforced plastics)
RP&M	Rapid Prototyping & Manufacturing	Process for the rapid production of prototypes and their immediate production
RPD	Rapid Product Development	Rapid product development
RPro	Rapid Production	Rapid manufacturing or production
RPT	Rapid Prototyping Techniques/Technologies	Processes and methods for the implementation of rapid prototyping
RT	Rapid Tooling	Process for the manufacturing of tools by rapid prototyping methods
SAHP	Selective Adhesive and Hot Press Process	LLM process of the company KIRA
SDU	Shell Design Unit	Hardware and software combination for the calculation of negatives for ceramic molds (Soligen)
SE	Simultaneous Engineering	Methodic approach for parallel work of several people or teams on a (development-) task
SET	Standard d'Echange et de Transfer	File format for neutral data exchange of geometry data between CAD systems
SFF	Solid Freeform Fabrication	Designation of (additive manufacturing) process for production of physical volume models (solids)
SFM	Solid Freeform Manufacturing	Designation of (additive manufacturing) process for production of physical volume models
SFP	Solid Foil Polymerization	Additive manufacturing process. Layer formation contoured by gluing films by polymerization
SGC	Solid Ground Curing	Stereolithography process of the company Cubital
SL	Stereolithography	Additive manufacturing process. Layer formation by local solidification of photosensitive resins (photopolymerization)

Abbreviation	Definition	Explanation
SLA	Stereolithography Apparatus	Stereolithography system of the company 3D Systems
SLPR	Selective Laser Powder Remelting	Additive manufacturing process. Film formation by melting and then solidifying of one-component metal powder (FhGILT)
SLS	Selective Laser Sintering	Additive manufacturing process. Layer formation by local melting and subsequent solidification of powder-like material
SOM	Stratified Object Manufacturing	Software system for undercut-free and optimal treatment by milling a complex body (ERATZ)
SOUP	Solid Object Ultraviolet Laser Plotter	Additive manufacturing process and the same stereolithography system of the company CMET
SPECT	Single Photon Emission Computed Tomography	Imaging process, preferably in medicine
SPF	Super Plastic Forming	"Inflation" of sandwich structures
STAR-Weave	Staggered Alternated Retracted Hatch	Stereolithography building style (3D Systems)
STEP	Standard of Exchange of Product Model Data	File format for the neutral exchange of complete product data between CAx systems
STL	Stereolithography Language	Interface format for the exchange of geometry data between CAD systems and additive manufacturing machines. Originally was "standard transformation language." Initially developed for simple shading of 3D CAD structures. Additive manufacturing process, especially stereolithography, to engross, to pocket
TCT	Time-Compressing Technologies	Collective designation for all processes capable of shortening the product development time
THESA	Thermoelastic Stress Analysis	Process for the experimental verification of component stress by measuring thermal effects
TI	Taylored Implants	Individual "tailored" implants
TP	Thermal Polymerization	Polymerization by heat
UV	Ultraviolet	Range of wavelengths from 38 nm (sensitivity limit of the eye in the ultraviolet) to 19 nm. In the range 60–10 nm, overlaid with X-rays
VDAFS	Association of Automobile Manufacturer, surface interface	CAD interface dedicated to the transmission of freeform surfaces
VDAIS	Association of Automobile Manufacturer, IGES Interface	CAD interface, which represents a subset of the elements defined in the IGES
VR	Virtual Reality	Realistic simulation of components, assemblies or whole products on the computer, usually combined with real-time animation. Input and output through data gloves, 3D projection, or the like