THE SLATE

3D systems, inc.

A quarterly newsletter for the StereoLithography user community

May 1990

Chuck Hull
President, 3D Systems, Inc.
"Entrepreneurship is real hard work".

from concept to product ■

The 3D Systems Story

The term StereoLithography, coined by 3D Systems' president Chuck Hull (a term even he admits no one can pronounce), aptly reflects the industry from which the technology sprang.

Chuck developed the concept of "three-dimensional printing" in 1982 while vice president of engineering at UVP Inc., a company specializing in applications of ultraviolet light technology. One such application was development of UV coatings for the printing industry. Chuck realized that the photopolymers used in the process were, in essence, thin films of plastic, and that overlaying successive layers could potentially yield three dimensional plastic objects. Over the next two years these thoughts evolved into a feasiblity system that could actually build parts, so he applied for a basic patent in 1984. The basic patent for the process was assigned to UVP in March, 1986, and Stereo-Lithography was officially born.

Ray Freed, 3D Systems' CEO, entered the picture that same month when the patented process was presented at the March UVP board meeting. Ray, a member of UVP's board of directors, had sold his previous company and was, in his own words, "looking for something to do". Not yet ready to retire, he instantly realized the potential of the product and technology, and at that very meeting made a business proposal to Chuck and members of the board to fund the product's initial development. As UVP was not financially able to further the technology at that time, a deal was quickly struck to license the technology from UVP, and within a month 3D Systems was formed.

Ray Freed
CEO, 3D Systems, Inc.
"The company is right on plan"

The next step was to obtain financing. In a rare combination of circumstances — being in the right place at the right time with the right idea — Ray

Please see '3D Systems Story', page 5

about this newsletter ◣

We are pleased to introduce to you our first issue of The SLAte, a newsletter written expressly for our StereoLithography users. In this and issues to follow, we hope to provide you with practical, useful and interesting information such as technical tips, product updates, StereoLithography user news, and maybe even a surprise or two. This is your vehicle and we would welcome your questions, ideas, and contributions. Please feel free to call Susan Arellano, editor, at 805/295–5600 ext. 291 with your suggestions.

ATTACHMENT B

new bits

We have to brag

Popular Science magazine has distinguished 3D Systems' Stereo-Lithographic process in their second annual "Best of What's New" products and achievements awards (December 1989 issue). Says Popular Science, "Quicker and cheaper than traditional model-making methods, it's helping manufacturers hurry new products from the computer-design screen to market."

3D also made the news in Forbes Magazine (January 1990), which included the company in their annual listing of the the 25 best investment stocks in America.

Many of you recently received a postcard announcing 3D's premier on the CBS Nightly News. Alas, our stardom was short lived. Originally scheduled to kick off their new weekly technology segment, the 3D film clip has now been "indefinitely postponed" pending CBS' revamping of their graphic designs to introduce the technology section of their newscast. We have been assured, however, that it will be shown at some point. Maybe it's not much to brag about, but it's better than never having been filmed at all!

The Overseas Market

3D now has five distributorships supporting sales in Europe and the Far East. These are Spectra-Physics (Western Europe), Korea Laser Technology, 3D Systems Japan, and most recently Asia International Corp. (Taiwan) and Vipac Engineers and Scientists Limited (Australia).

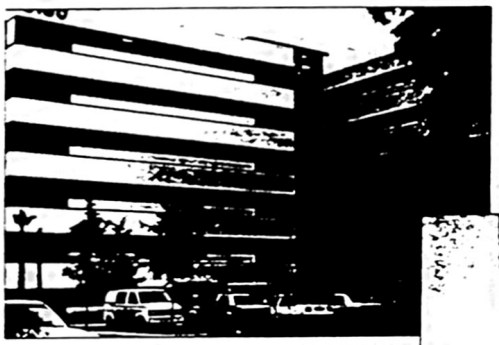
European Users Group

The first European Users' Group meeting was held in Heidelberg, West Germany on January 29-30 of this year. Representing 32 European firms, members of the group include managers from Siemens AG of West Germany, Bosch Robert Bosch GmbH of West Germany, Electrolux R & D Technologies AB of Sweden, and Istema AG and Oederlin Warmpress AG of Switzerland. Otto Laubacher, president of Istema AG, serves as the Group's acting president.

AIDTraining Brings StereoLithography to Huntsville

Alabama Industrial Development Training (AIDTraining) has now incorporated a StereoLithography training system into its recently established Alabama Center for Advanced Technology Transfer(ACATT).

Located in Huntsville, ACATT was originally established to support the Boeing Space Station project whose training systems and inventory now form the nucleus of the center. ACATT promotes several training systems intended to bridge the gap between developers and implementers of advanced technology, and the small to medium size businesss who must integrate it into their own operations if they are to flourish in the '90s.



3D's new Orlando office

Robert Kalinowski (left) and Jay Miller, 3D Application Engineers.

3D Opens Florida Office

To better serve our users in the Southeast, 3D has opened a new Orlando based office in Longwood, Florida. Staffing the office are George Crowell, Senior Sales Representative, Jay Miller, Applications Engineer, and Robert Kalinowski, Applications Engineer. George, Jay and Robert may be reached at 407/774-7070.

people on the move ■

3D is pleased to welcome our new vice president of sales and marketing, Dennis Medler. Dennis comes to 3D from (dare we say it?) DTM in Austin, Texas, where he was vice president of sales and marketing. Prior to DTM, Dennis served as vice president of sales and marketing for 3D Systems (yes, you read that correctly). Those of you who knew Dennis from the "old days" will appreciate the talents and energy he brings to 3D. Dennis will undoubtedly be speaking with many of you in the near future about your product concerns, and will be delighted to receive your calls should you have any questions. Dennis may be reached at 805/295-5600.

Ralph Schubert, who formerly held this position with 3D, has been named vice president of new business opportunities.

product news ■

New PCA Available

A new Post Curing Apparatus will soon be available to Stereo-Lithography users. The new PCA incorporates fluorescent lights positioned on two inside walls to provide better, more even curing with reduced distortion. The new fluorescent bulbs are less expensive and can be replaced directly by the user.

Upgrade kits for the PCA-1 will also be available in the near future. Please contact George Teachout, Manager, Contracts and Sales Administration, at 805/295-5600 ext. 206 for pricing and availability.

386 Upgrade

You will soon be able to update your Wyse 286 Control computers to 386 speed and functionality through an upgrade option. The enhanced computer capabilities will permit faster processing of vectors to provide continuous drawing by the laser during the build process. It is estimated that build time will be improved up to 25%.

The upgrade kit will become available mid-year for approximately $10,000.

Resin Alpha Testing Completed

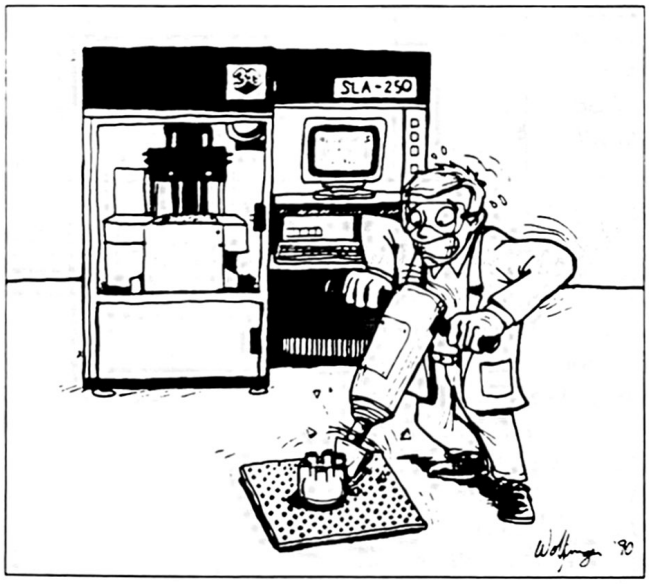
3D Systems has just completed alpha testing on Ciba Geigy's newest resin, LMB 4914, with favorable results. In the fully cured state this new material has an elongation to break of 15%, compared to 4.4% for the CibaTool 5081. In addition, this tougher resin has more than three times the impact resistance of 5081. Beta testing began in mid-April.

The Search Continues

3D applications engineers are hot on the trail of better water-based solvents for part cleaning. Of cleaners recently tested, Fantastik (in 10% solution) was found to be quite effective at removing resin from countertops and platforms — that's the good news. The bad news is that it doesn't work well on the parts themselves. We'll let you know about other solvents that meet our cleaning and safety standards when testing is completed.

Please see 'The Search Continues', page 5

'Incurables'



"Maybe I overcured the supports."

spotlight on... ■

AMP Incorporated

"It's the best thing we've ever purchased." These are the words of Tom Kerschensteiner, Manager of Product Planning and Development for the Automotive/Consumer Business Group of AMP Incorporated. What he's describing is, of course, AMP's StereoLithography Apparatus. AMP is the world's leading supplier and marketer of electrical and electronic connectors and interconnects, with several SLAs in their U.S. and international facilities.

Thomas A. Kerchensteiner
Manager, Product Planning and Development
Automotive /Consumer Business Group
AMP Incorporated

AMP's early integration of solid modeling technology made them an ideal choice as one of 3D Systems' SLA-1 beta test sites. In fact, company engineers were turning out concept models literally within a day of their first SLA installation. Viewing the system as a highly sophisticated machine tool, the SLA was fully integrated into the model shop environment. "From the beginning, we found the SLA to be 3 1/2 to 4 times more efficient than traditional model making methods," says Tom.

That was 2 1/2 years ago. More than 200 separate models, 1400 pieces and 5200 machine hours later, Tom reckons his group has saved more than 9,400 hours in model shop labor, thanks to StereoLithography. Moreover, production of physical models has saved the Auto/Consumer Business Group thousands of dollars by allowing them to detect subtle design errors before moving on to the moldmaking stage. Furthermore, he believes further improvements in the areas of accuracy and resin development will make the SLA an even better product.

With hundreds of solid modeling CAD workstations worldwide, AMP's expansion into the world of real 3D concept models was a natural. "Making products, not pictures, was our purpose, so we went to 3D modeling [software] quite early. Time to market is important and StereoLithography represents a significant change in our product development cycle to better meet our customers' needs. We use the models to strategically design our customers' products for better form and fit. StereoLithography has helped us develop better products, faster."

Taking a team approach, Tom's group uses an SLA physical prototype to validate the concept model with its customers. In fact, the group is so committed to this technology that it will not even propose a product concept without having an SLA model in hand. The end result has been less redesign, improved products and most importantly, greater customer satisfaction.

Now chairman of the StereoLithography Users' Group, Tom advises potential users on the importance of making sound business decisions. "People become enamored with the machine and the technology, but that's not where the rubber meets the road. Companies need to evaluate the level of business, their vision for using the machine, and the data they'll have to feed it to use the technology most effectively."

stereolithography pairs with thermal moldmaking

A technique has been developed to speed the moldmaking process, permitting molds to be formed over virtually any pattern material, including StereoLithography parts. This technique, know as arc sprayed metal moldmaking, was pioneered by TAFA Incorporated of Concord, New Hampshire.

The process produces mold surfaces from a variety of metals including zinc, nickel, tin/zinc and other alloys. Originating as thin wire, the metal is atomized through an electric arc and automatically fed past an air nozzle. The 60-80 psi stream of air sprays the atomized metal onto the pattern surface. Once the pattern is completely coated by the atomized metal, the mold surface can be backed up with an aluminum-filled casting resin or other specially developed metal alloys. What is unique about the process is that the metal spray, although atomized by the high temperature arc, does not raise the pattern surface temperature above 130 degrees F. This allows the sprayed metal mold to be formed over heat sensitive materials without distorting the pattern.

For companies using Stereo-Lithography parts as master patterns, the pairing of these technologies offers the ability to quickly create molds from many complex shapes. Arc sprayed metal molds can be used for applications such as injection molding, blow molding, and investment casting prototyping and limited production runs.

For more information contact Leon Grant, TAFA Product Manager - Tooling, at 603/224-9585.

The 3D Systems Story

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was introduced to a partner of Lionhart Capital, a Canadian venture capital firm. Within a week of the first meeting 3D and Lionhart were at a handshake agreement, and from there development took off. The company went public in September of 1987 on the Vancouver Stock Exchange.

In three short years, the company has introduced three basic products and continues its fast pace of research and development. Chuck and Ray, both coolly blase' about 3D's success, agree that the company is "right on plan".

As for the future of Stereo-Lithography, the two founders see both room for improvements in current technology, and expansion into brand new applications. Achieving even greater accuracy and broadening the range of materials top the list, along with development of StereoLithography into a competitive technology for the production line. And both are quick to point out its potential in the medical industry. "I think it will replace X-rays in certain areas," says Ray. "If you can make a three-dimensional model of a bone implant or a tumor, it's going to be a great deal more valuable to the surgeon than a piece of film."

Ray adds that the future for new applications is wide open. "It's like asking what applications there are for a Xerox machine — it makes copies. You can use it to make one or 10,000 copies. If you look at StereoLithography as something that takes digital data in and hardcopy out, the applications are all the rest of the world. And what does the world need that we can do economically for them?"

When asked whether it's been rewarding, Chuck sums up the events of the past five years, saying, "Entrepreneurship is real hard work. In terms of rewarding, you really don't have time to stick your head up to see whether it's rewarding or not. But that in itself means it must be rewarding."

The Search Continues

continued from page 3

With the known safety problems associated with use of alcohol and trichloroethane, solvent investigation is a high priority for us. If any of you have had success with other solvents, we'd love to hear about it!

Please contact, Marilyn Dowd, Corporate Applications Engineer, at 805/295-5600 ext. 372.

tech tips

The following Technical Tip bulletins are available from the Customer Support Group in Valencia. If you would like a copy please call Carla Jordan, Technical Support Representive at 805/295-5600 ext. 249.

Transferring Large Files/Split Command - No. 89003

Defines procedure for dividing very large files into smaller files which can be transferred via floppy disk between Slice and Control computers.

Curing of down-facing vectors for accuracy - No. 89004

Describes method to cure down-facing vectors separately by setting their cure depths equal to the layer thickness where these vectors occur. This process eliminates over-cure problems associated with reduced part accuracy.

Known software workarounds for release 3.60 - No. 89005

Describes all known bugs associated with this release and recommends procedures to bypass problem areas.

THE SLATE

A new letter for the StereoLithography user community

Published quarterly as a service for the clients and business associates of 3D Systems, Inc. Your comments, questions and ideas are always welcome. Please direct all correspondence to Susan Arellano, Editor.

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26081 Avenue Hall
Valencia, CA 91355
805/295-5600
FAX: 805/295-0249

stereolithography users hotline

If you have technical support-related questions about your hardware or software, call the StereoLithography Hotline!

You will be able to choose the type of support you need: Hardware/Equipment Failure, or Software/Applications.

Please have your system serial number ready when you call.

The Customer Support Hotline numbers are:

800/728-5603 (U.S.)
800/828-8721 (Canada)

Hotline hours are
8:00 am - 5:00 pm (PST).

trade shows

Philadelphia '90 Advanced Productivity Expo
April 10-12
Philadelphia, PA
Call SME, 312/271-1500

Intergraph International Users Group Meeting
May 7-10
Huntsville, AL
Call Intergraph, 205/730-2000

Antec '90
Annual Technical Conference of Society of Plastics Engineers
May 7-11
Dallas, TX
Call SPE, 203/775-0471

East Pack '90
May 9-11
New York City, NY
Call Cahners, 203/352-8250

AeroMat '90
Advanced Aerospace Materials/Processes Conference and Exposition
May 22-24
Long Beach, CA
Call ASM, 216/338-5151

EASTEC
May 22-24
W. Springfield, MA
Call SME, 313/271-2861

COMDEX/Spring
June 3-6
Atlanta, GA
Call Interface Group, 617/449-6600

International Automation Show
June 5-7
Detroit, MI
Call Robotics Industries Assoc., 313/994-6088

Medical Design and Manufacturing Show
June 27-29
New York City, NY
Call Expocon, 203/374-1411

Preliminary

Product Data — Cibatool XB 5134

Description

XB 5134 is a one-component urethane-acrylate photo-curable resin. It is designed for use in the SLA-250 StereoLithography Apparatus in applications where toughness and flexibility greater than that of the XB 5081 resin is required.

Liquid Resin

Appearance	Slightly opaque
Density	1.14 g/cc
Viscosity (35° C)	1050 – 1450 cP

Laser Cured Properties (note 1)

Modulus (Green – 12 mil)	40 – 60 N/mm² 5800 – 8700 psi
Modulus (Green – 20 mil)	60 – 100 N/mm² 8700 – 14,500 psi
Tensile Strength (Green – 20 mil)	4 – 7 N/mm² 580 – 1015 psi
Elongation (Green – 20 mil)	15 – 25%

UV Post Cured Properties (note 2)

Modulus (cured)	600 – 900 N/mm² 87,000 – 130,500 psi
Elongation (cured)	10 – 15%
Yield (cured)	20 – 40 N/mm² 2900 – 5800 psi
I(Impact)	10 kJ/M² (approx.)
H(hardness)	75 – 80 Shore D
Glass Transition Temperature	70 – 80° C

Note 1: Laser-cured samples given exposures to achieve indicated thicknesses.

Note 2: Samples produced as above with additional post-cure in the Post Curing Apparatus.

70047
4/90

3D Systems, Inc.

ATTACHMENT A