Computer to Plate: Digital Workflow and Integration into Quality Offset Printing

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Abstract: An overview on computer to plate equipment and the benefits and contras of the different platesetter design principles will be given. The increasing number of aluminum based printing plates and coating types for CTP will be evaluated stating the trends to processless and/or thermally sensitive plates with also some of them suitable for waterless offset printing. Installation samples in practical use, different workflow configurations and experiences realized at several print shops will be presented and discussed. One target of the new technologies and system solutions arising with computer to plate is the reduction of production times and costs smoothing the workflow from prepress to press. Up-to-date presses are prepared for this workflow shortening the make-ready times by automatic presetting facilities and assuring the print quality by automatic control equipment. To reduce redundant efforts, prepress systems (e.g. the imposition software or the raster image processor) become able to send low resolution data to a press interface using this digital data for example to calculate the ink key presettings for the press directly. This data file is coded in a print production format revised and enhanced by a consortium, the so-called CIP3 (Cooperation for Integration of Prepress, Press and Postpress). To take the specific dot gain into consideration, it is necessary to fingerprint the presses. The kind of proofing is a further workflow aspect of total reappraisal required by the printer when going into CTP.

1. Introduction

As the expression "Computer-to-Plate" suggests this technology consists of 3 essential components (Fig. 1). The time is ripe for the application of

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Computer-to-Plate, because all these components have now reached a stage that is appropriate to implement practical use.

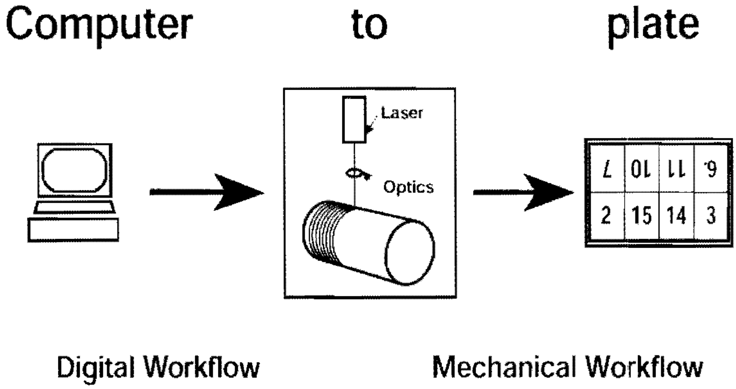

Fig. 1: The essential components of Computer-to-Plate

1) Computer:

Nowadays computer technology has attained such a degree of efficiency that the enormous amount of data in graphic applications may be processed in a short time and at reasonable costs. The processors have become fast enough and the storage facilities are now within the affordable range for printers. This development is leading to digitalization of the entire printing world. There is one essential prerequisite for Computer-to-Plate: the print job must be available in digital i.e. electronic form. This requirement is being met since an increasing number of repro-houses and prepress departments have adjusted to digital production and workflow.

2) "to":

The transfer of digital data from computer to printing plate is performed within the recorder or plate imaging device. Most of these devices are based on laser technics which is nowadays available at relatively acceptable costs and equipped with the necessary performance features. Here the digital data meets the plate, i.e. the crossing of the digital workflow and the mechanical one joined with the progress of the plate.

3) Plate:

In order to permit a safe and low-priced imaging of the plate surface by laser beams, coatings of adequate sensitivity have been developed. The chemistry of the plate surface has been adapted to the new requirements. There are now various types of plates available on the market which will be discussed in detail later on.

This paper concentrates on the high-end printing plates based on aluminum. Of course, there are also printing plates based on polyester or paper which may be imaged by Computer-to-Plate. Especially for high-quality requirements, considerable run lengths and large formats such as 70 x 100 cm, however, aluminum-based printing plates are used. A GATF-study confirmed some restrictions of polyester plates concerning quality (Stanton et. al. 1995).

2. Printing plates for Computer-to-Plate

The increasing number of aluminum-based printing plates and coating types for Computer-to-Plate is confusing. For this reason the plates should be classified according to their coating as set out in Table 1. The upper part of Table 1 shows plates which can be imaged by visible laser-light. At DRUPA 95 some new plate types which may be imaged by thermal laser were announced or launched into the market. Thermal lasers operate within the infrared spectrum at a wavelength exceeding 800 nm. A laser beam on this particular wavelength is likely to diverge over its focal lengths. In order to ensure a precise beam focussing the imaging head has to be located very close to the plate surface. This requirement is easy to meet with an external drum design.

For thermal imaging also several coatings and technologies have been developed. The coating most similar to the conventional type consists of photopolymer with a special spectral sensitivity. This type of coating is offered by Kodak. The Kodak digital printing plate/IR offers unique dual sensitivity characteristics: It may be exposed either digitally by a thermal laser or conventionally in a standard plate frame by UV-light. Due to its functionality it can be used in prepress operations that are making to analogue-to-digital transition. This plate still requires processing in aqueous chemistry (DeBoer, 1995).

The other thermally sensitive plates operate processless and thereby indicate a new trend. This procedure is ecologically beneficial, and it eliminates a step in the workflow.

The ablation technique is applied by Presstek with PEARLdry for waterless offset and PEARLwet for wet offset; both plates are available with an aluminum or polyester base. The PEARLdry plate carries a silicon layer which is removed by the laser beam in the ink conducting areas, so that the underlying surface may accept the ink (Kipphan, 1996). The PEARLwet plate which works according to the laser ablation transfer principle (LAT) is also displayed by Polaroid. A donor sheet is fixed on the plate. This sheet has two coatings: a dynamic ablation coating and a polymer coating. The ablation is effected by the head of the laser beam. By this "explosion" the polymer is transferred to the surface of the plate.

Type	Products (available or announced)
Visible laser (wave length 488 - 670 nm)	
Photopolymer	Agfa Ozasol N90 (formerly Hoechst Celanese), Horsell-Anitec Electra, Western Lithotech Diamond Plate, Fuji High Speed Photopolymer, Kodak Visible Digital, Konica CTP
Silver halid	DuPont-Howson Silverlith, Agfa Lithostar, Mitsubishi Paper Mills Silver DigitalPlate SDP
Silver hybrid (Silver halid with diazo)	Polychrome CTX, Fuji FNH
Thermal laser (wave length > 800 nm)	
Photopolymer	Kodak Digital Plate /IR
Ablation	Presstek PEARLdry, Toray digital dry
Ablation transfer	Presstek PEARLwet, Polaroid LAT
Phase change	3M NPP (No Process)
Ink jet	
Ink jet	Polychrome CTX ink jet version, Lastra Futura

Table 1: Plates for Computer-to-Plate (aluminum based, selection)

The third technology is the phase-change effected by thermal laser energy. 3M announced a digital plate (NPP - No Process Positive).

3. Platesetter design principles

One may distinguish between the following design principles for platesetters, as shown in Fig. 2 (Kipphan, 1995):

- external drum
- internal drum
- flatbed.

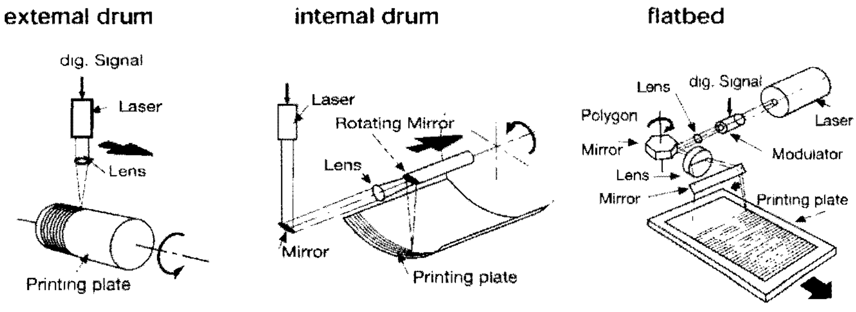

Fig. 2: Platesetter design principles

As far as the workflow aspect is concerned the pros and cons of the external drum design may be listed as follows:
The crucial advantage of this design lies in the fact that it allows to direct several parallel beams to the plate surface which reduces the imaging time. As already mentioned, the external drum design is also most appropriate for thermal imaging. The feature of this design effects the mechanical workflow: it will be more difficult to integrate a punching device. Compared with the other design principles the plate handling, however, can be similar to that within a plate cylinder.

With the internal drum design the punching device can easily be integrated. In the list of platesetters available (see appendices) one third of the devices is based on the internal drum concept.

With the flatbed design, the state of the art was a rotating polygon mirror driving the laser beam across the plate surface. This technique is also illustrated on the right hand side of Fig. 2. A lot of effort is necessary to assure that the laser spot is projected in a sharply defined and round dot at the edges of the plate. For this reason, the flatbed recorders were not suitable for the production of high-quality prints, instead their application was basically restricted to newspaper printing. Much to the surprise of the audience at DRUPA 95 was the presentation of three prototypes for new platesetters designed according to the flatbed principle and appropriate for high-quality prints. Worth mentioning in this context are the various models of Lithosetter by Barco. Depending on the individual model there are either 3 or 5 laser beams located side by side which are responsible for the imaging of the plate. Each beam covers a strip of about 30 cm.

There are several concepts for punching during the plate-making process. Some platesetters are only able to clamp prepunched plates whereas the more sophisticated ones with internal drum design are equipped with integrated punches (for instance, the Gutenberg from Linotype-Hell). The Platesetter 5040 by Misomex - based on the Optronics imaging device -

effects the punching inline after the imaging and processing of the plate. This system has an option for inline bending. With other systems - e.g. Gerber Crescent/42 or Creo Platesetter - the plates have to be punched offline after processing, i.e. in a separate punching device, but basically this could be changed without difficulties.

4. The digital workflow with Computer-to-Plate

The general workflow is sketched in Fig. 3. The layout of the single pages is followed by the impositioning. The data is transferred to the RIP (Raster Image Processor) where the rendering of the data into a bitmap takes place. Unfortunately, in most cases proofer and plate exposure unit are not controlled by the same RIP. Together with the platesetter we often find a monochrome layout proofer. It depends on the job quality and the customer's requirements if this kind of layout proofing is considered to be sufficient.

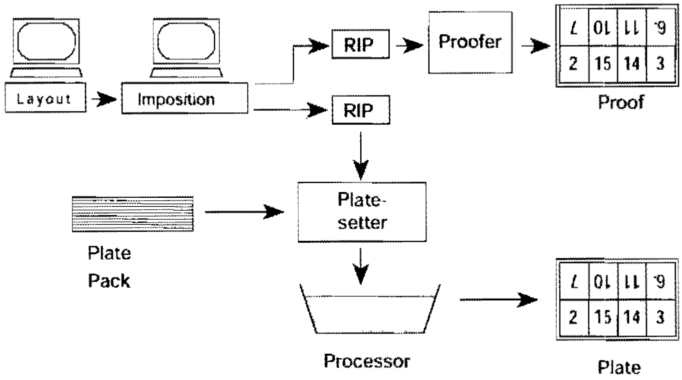

Fig. 3: Typical workflow with Computer-to-Plate

In high-quality offset printing, some customers are used to see a full size color proof such as conventional Matchprint (3M) or Waterproof (DuPont) with true proof features (bitmap proof). Due to this quality requirement some print shops that apply the Computer-to-Plate-technology prefer making use of Computer-to-film output in some cases, since it offers the possibility of conventional proofing. Nowadays there are Ink Jet proofers (Iris) available up to 8-up size, but they issue a continuous tone proof and not a halftone proof. The available halftone proofing devices TrueRite by Dainippon Screen and Intelliproof by Optronics are only able to expose up to 4-up size. Since the prices of these proofers are high, they are not likely to spread strongly in the market.

5. Different workflow solutions

There are different concepts for the data processing workflow. As an alternative to the workflow sketched in Fig. 3, it is possible, for instance, to send single pages to the RIP, to store the bitmaps page by page and to impose them at bitmap level. The advantage of this procedure lies in the possibility to start the 'ripping' even if only 7 of 8 pages are ready and the information of the 8th page is still missing. This workflow concept is pursued for example by Krause-Biagosch. With the slogan "Ripping before stripping" Krause-Biagosch propagates this concept and claims that now flexible, last-minute impositioning has become possible.

As illustrated in Fig. 4, there are also various possibilities for the transfer of bitmap data from the RIP to the Platesetter. Some platesetters are directly connected with the RIP (for example the Creo Platesetters). There is no intermediate storage of the bitmap on disk.

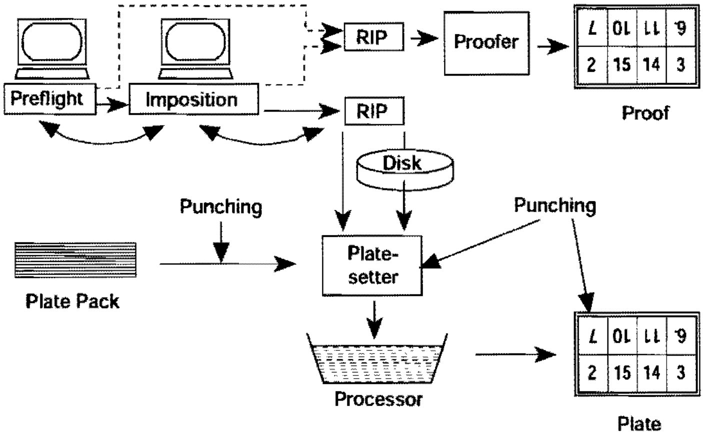

Fig. 4: Different workflow concepts for Computer-to-Plate

Other suppliers, however, follow the concept to buffer the bitmaps on disk. In order to prevent the RIP from being a bottleneck, in some installations two RIPs work together which increases the throughput. In Linotype-Hell's concept two RIPs are bundled together sharing the job. Linotype-Hell employes a third computer (PressGate) which on one hand serves as RIP for the proofing device (B/W-layout proofer) and on the other hand also supplies ink key presetting data for the printing press.

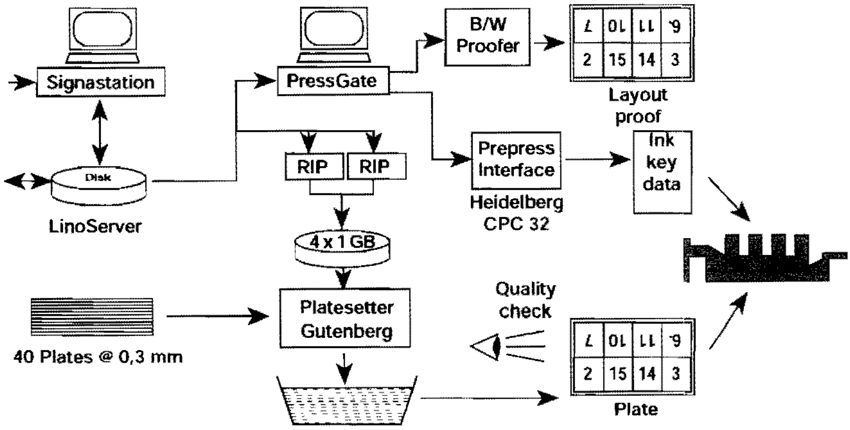

Fig. 5: Workflow with Linotype-Hell's Gutenberg at a print shop

To illustrate a concrete configuration the workflow in a printshop is sketched in Fig. 5. The example given refers to a German commercial printer supplying high-quality offset printing. He is equipped with the Computer-to-Plate-system Gutenberg by Linotype-Hell and employs all the components offered as standard configuration. There is one step in workflow that is not yet solved in a satisfying way, namely the quality check of the produced plate. A special staff member, the plate revisor, has the difficult and responsible task to check visually the plate quality. But he would not be able to exclude all errors. Errors, for instance that are due to minor mispositioning of images (i.e. by a few millimeters). This kind of errors can only be revealed in the printing press. This particular print-shop is also one of the first users of HEIDELBERG's CPC 32 Prepress Interface. Since all digital data is available which makes the effort of plate scanning unnecessary, the Prepress system - in this case Linotype Hell's PressGate - sends a print production file of low resolution data to the Prepress Interface. The Prepress Interface software directly calculates the ink key presetting data for the press.

Until today, however, most of the prepress systems (e.g. the imposition software) do not yet offer an option for writing a print production file. As the print production format (PPF) is not supported fast enough by all preprint systems, HEIDELBERG will offer its Prepress Interface in two different versions (Fig. 6). The first version accepts the full PostScript data and extracts the data required by employing a Harlequin Micro-RIP. The second version accepts a PPF-file directly produced by a prepress system. In close collaboration with the Fraunhofer Institute for Computer Graphics in Darmstadt, HEIDELBERG has initiated the establishment of the print production format. This concept on which Jönér (1995) has given a survey was developed and enhanced by an international study group

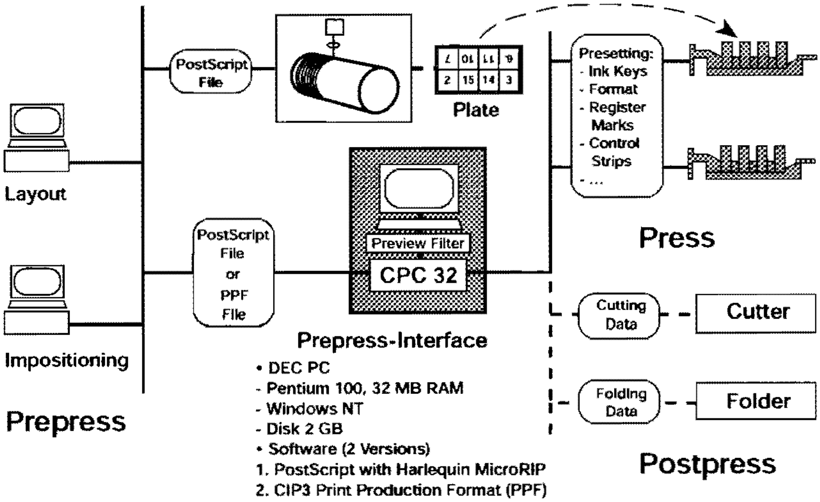

Fig. 6: Prepress Interface (HEIDELBERG)

consisting of many well-known manufacturers for prepress, pressroom and postpress equipment. This study group is called CIP3 (Cooperation for Integration of Prepress, Press and Postpress).

The print production format contains the data of prepress which are directly applicable in industrial printing which makes use of printing presses and postpress machinery. Adobe's PostScript format is used to describe all data relevant to production processes in a uniform manner. This data includes picture information which may be used to calculate ink zone settings, control elements for ink measurement and ink control.

6. Workflow management

The effective workflow management is the most difficult problem to solve in the process of introducing Computer-to-Plate into the market. Why are the printers so reluctant if it comes down to introducing Computer-to-Plate? In order to amortize the investment, the workflow has to be changed or adapted. This is not so easy, since these changes will also affect the staff. The Computer-to-Plate application implies problems with the employees: It leads to an increase in productivity whereas the number of staff is reduced. Moreover, the staff has to be familiar with operating computers which was not an indispensable prerequisite in the plate assembly and plate making department.

The printers' opinions are also divided about the question of where the Computer-to-Plate-system should be located. Some prefer to place it near the press. Then the press operator will request the plates. But is he able to do so? Other successfully working installations are located in the prepress department.

One obstacle to Computer-to-Plate-application or introduction is the lack of suitable workflow management software. It may be distinguished between the job management, the data management and the production relevant management as imposition or color management. Most critical is the data management which should be based on database solutions to administer jobs, pages, images etc. The states of these objects have to be differentiated by indicating whether the data are supplied, buffered, archived, in process, proofed, imaged etc. There are some software packages available offering this feature, but they are hard to implement into an already existing print shop. This "orgware" can only be installed into a sophisticated industrial environment. Most printers already employing Computer-to-Plate will take the view that this is the real challenge about Computer-to-Plate in particular and digital workflow in general. In fact, there is software available on the market, for instance Mainstream by Agfa or OPEN by Adobe, but it is rather production-oriented.

The Franco-German company Dalim has developed a data-management software called Maîstro that covers a lot of requirements. A hierarchical structure splits the product to be printed (for example a magazine) into zones, sections, pages and finally elements. The process time required for each task is recorded. Production parameters are set at the input stage using operator expertise. The next step for this system lies in becoming a learning system.

Creo offers a complete workflow solution named PlateMaster. Its jobflow manager creates a job ticket in the database and a job folder on the server in order to store the data required for the job.

Crosfield's CelServ workflow management software combines OPI image substitution, job tracking, production control, archiving and image browsing in one product based on a relational database and open server standards.

Dainippon Screen offers the modular prepress production system TaigaSPACE. Unlike most other systems, where all pages for a job must be complete prior to imposition, TaigaSPACE allows operators to process and output jobs one signature at a time. With this signature-based workflow, work can therefore proceed by the traditional methods to which most production professionals are accustomed. Even after assignment to a signature, pages and page elements can be edited without returning to the original application or re-executing the imposition process.

7. Trends and outlook for Computer-to-Plate

The digital workflow will become smoother. The CIP3 specification for example will link the prepress with the press area. Up-to-date presses are prepared for this workflow which shortens the make-ready time by automatic presetting facilities and assuring the print quality by automatic control equipment. The proofing issue will also be coped with. As sketched in Fig. 7 the first step for a better and more reliable proofing integration will be a unique RIP for both proofing and imaging. The first approaches are undertaken by Optronics and Dainippon Screen. A further step could be the implementation of Polaroid's Laser Ablation Transfer (LAT)-technology. At Graph Expo 95 Polaroid demonstrated the LAT-technology in a Computer-to-Plate-System with Optronics as well as in a proofer with Isomed. But principally, it should be possible to integrate these functionalities into the same laser exposure unit.

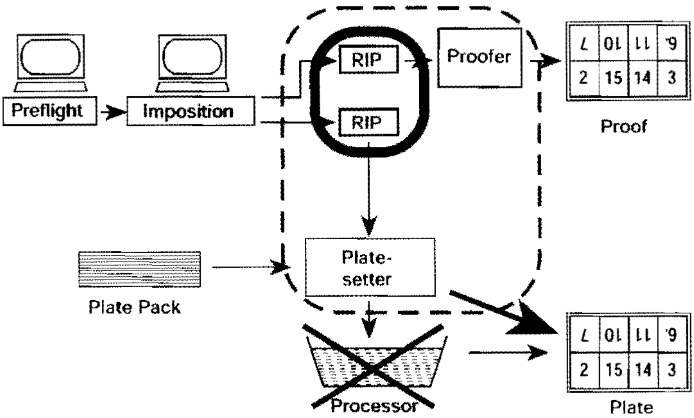

Fig. 7: Workflow trends with Computer-to-Plate

Another trend already marked up with the thermal sensitive plates is the omission of the chemical plate processing. Since more and more data in the prepress area will become digital, Computer-to-Plate will find an increasing application, because of economic considerations. From the economic point of view, Computer-to-Plate is about to become increasingly attractive because of the shorter production times which are due to fewer steps and therefore potential savings in personnel expenditure. This thesis is substantiated by a return on investment calculation published in the book by Limburg (1995), but this calculation example presupposes that all of the jobs are delivered in digital form. This particular assumption, however, is not yet realistic in this early state of Computer-to-Plate. But things are likely to change.

At DRUPA 95 there were only about 100 Computer-to-Plate-installations worldwide. Towards the end of 1995 this number rose to more than 200 installations. Following an evaluation, by the year 2000 there will be more than 5000 installations, following another one there will be approximately 2000 installations. According to another expert forecast, 15 - 20% of the commercial printers in 2000 will be working totally filmless, i.e. with Computer-to-Plate.

At this early stage of Computer-to-Plate, especially book printers and printers using only little color work are predestinated to make use of this new technology. The next group will be the newspaper printers whereas the commercial printers with high quality color products will probably join in last.

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Appendix 1: Computer to plate equipment (selection, for aluminum plates, approx. size A0)
techn. specs. gathered from company product information brochures, unconfirmed

Modell (Technology)	Company (Cooperation)	Plate size, max.Resolution	Imaging time per 70x100-plate at approx. 1200 dpi	Laser (Type, wave length)	Market introduction
Crescent/42L (int. drum)	Gerber (Agfa, Polychrome, Horsell)	1067 x 813 (3600 dpi)	4,4 min/ 1270 dpi	Argon-Ion 488 nm	1992/93
Platesetter 3244 (ext.drum, 480 beams)	Creo Products (Agfa)	1117 x 812 (3200 dpi)	2 min/ 1200 dpi	Nd-YAG 532 nm	1994
Platesetter 3244 Thermal (ext.drum, 240 beams)	Creo Products (Kodak)	1117 x 812 (3200 dpi)	2 min/ 1200 dpi	thermal diode 830 nm	1995
Trendsetter (ext.drum, 240 beams)	Creo Products	1117 x 812 (3200 dpi)	2 min/ 1200 dpi	thermal diode 830 nm	1996
Aurora (semiautom.) Eos (autoload., = PTP 20) Lightning = PTP 80 (Komori) (ext. drum)	Optronics (Bacher, Lastra, Misomex Komori)	1130 x 900 (4000 dpi)	16 beams: 1,5 min / 1000 dpi	Argon-Ion 488 nm	1995
PlateRite PI-R1080 (int. drum)	Dainippon Screen (Scitex, Mitsubishi)	1068 x 820 (4000 dpi)	3,2 min/ 1200 dpi	Argon-Ion 488 nm	1994
Gutenberg (int. drum)	Linotype-Hell	1070 x 825 (3385 dpi)	3,7 min/ 1270 dpi	Nd-YAG 532 nm	1995
LaserStar 110 C (int. drum)	Krause Biagosch	1050 x 850 (2540 dpi)	2,5 min/ 1270 dpi	Argon-Ion 488 nm	1995
Celix 8000 CTP (int. drum)	Crosfield (Fuji)	1045 x 900 (3658 dpi)	4 min/ 1219 dpi	Argon-Ion 488 nm	1995
EG-8000 DTP/M (int. drum, M=manual)	Escher-Grad	1041 x 775 (6000 dpi)	3,5 min/ 1000 dpi	Argon-Ion 488 nm	1995
LithoSetter III (flatbed, 3 beams)	Barco Graphics	1100 x 810 (4000 dpi)	1,75 min/ 1270 dpi	Argon-Ion 488 nm	1996
Titan 582 (flatbed)	ICG	1120 x 840 (3396 dpi)	5 min/ 1270 dpi	Nd-YAG	(1996)

Appendix 2: Computer to plate equipment (selection, for aluminum plates, size less A0)
techn. specs. gathered from company product information brochures, unconfirmed

Modell (Technology)	Company (Cooperation)	Plate size, max.Resolution	Imaging time per 70x100-plate at approx. 1200 dpi	Laser (Type, wave length)	Market introduction
LE 2800 (flatbed)	Gerber (Autologic)	711 x 559 /A2 (4338 dpi)	2 min/ 1446 dpi	Argon-Ion 488 nm	1990
Raystar (flatbed)	Scitex	650 x 550 /A2 (2540 dpi)	3 min/ 1270 dpi	Argon-Ion 488 nm	1992
MagnaSetter 650 CTP (flatbed)	Crosfield	635 x 457 /A2 (1828 dpi)	1,3 min/ 1016 dpi	Argon-Ion 488 nm	1993
Digital Plate Maker (flatbed, 256 beams)	Versitec (Polychrome)	640 x 500 /A2 (2304 dpi)	2 min/ 1152 dpi	red diode 670 nm	1995
EG-2300 (flatbed)	Escher-Grad (Sixt)	736 x585 /A2 (6000 dpi)	1 min/ 1000 dpi	Argon-Ion 488 nm	1995
Crescent/3030R (internal drum "curved platen")	Gerber	762 x 762 /A2 (3810 dpi)	1,35 min / 1270 dpi	red diode 670 nm	1995
Cybersetter duo/quadro (ext. drum, 256 beams)	OptoTech	700 x 500 /A2 (2540 dpi)	2 min /1016 dpi / unit	Nd-YAG 532 nm	(1996)
Optoset plate (ext. drum)	OptoTech (Sack, Theimer)	510 x 400 /A3 (3048 dpi)	9 min /2032x3048 dpi	He-Ne 543 nm	1993
DoPlate 200 (int. drum)	Scitex (Horsell-Anitec)	510 x 400 /A3 (2540 dpi)	5,5 min/ 2032 dpi	Argon-Ion 488 nm	1993
PlateJet (int. drum)	Cymbolic Sciences	940 x 660 /A1 (8000 dpi)	3,9 min/ 2000 dpi	Nd-YAG 532 nm	1995
Ozasol LE 100 (flatbed)	Strobbe (Agfa)	900 x 650 /A1	2 min/ 1200 dpi	Nd-YAG	1995
DMX-620 (int. drum)	Eskofot	820 x 620 /A1	1,5 min/ 1016 dpi	Nd-YAG	(1996)
Platinum 2230 (flatbed)	HighWater Designs	813 x 660 /A1	1,6 min/ 1270 dpi	Nd-YAG	(1996)
AIR 75 (int. drum)	ECRM (Chromos)	749 x 616 /A2	55 sec /1016 dpi	Argon-Ion	(1996)

Appendix 3: Computer to plate equipment with special techniques (selection, for aluminum plates)
techn. specs. gathered from company product information brochures, unconfirmed

Modell (Technology)	**Company** (Cooperation)	**Plate size,** max.Resolution	**Imaging time** per max. plate	**Technique or Laser**	**Market introduction**
Laser Ablation / Transfer (LAT)					
PEARLsetter 52 (ext. drum; 24 beams)	Presstek (Heath Custom Press, Pitman, AM ...)	533 x 400 /A3 (2540 dpi)	5,3 min/ 1270 dpi	diodes 870 nm	1995
PEARLsetter 74 (ext. drum; 32 beams)	Presstek (Heath Custom Press, Pitman, AM ...)	749 x 616 /A2 (2540 dpi)	7,4 min/ 1270 dpi	diodes 870 nm	1995
LAT ThermalSetter (ext. drum)	Optronics			high power laser (5 W)	(1996)
Ink Jet					
IJP-1000 (flatbed /vertical)	Alpha Merics (Polychrome)	1422 x 1422 600 dpi	25 min / 300 dpi	drop on demand, hot melt ink	1995
Extrema Ink Jet (flatbed)	Lastra (Italy)	914 x 610 /A1 720 dpi	4 min	continuous ink jet	1995
Digital Screen					
ProSetter (flatbed)	Basys (Germany)	1340 x 850 2540 dpi	10 min / 1270 dpi / 70x100	UV-Light, Digital Screen	(1996)
Combinations for film and digital data					
Digital PageStripper (flatbed)	Cortron	1676 x 1100 2540 dpi	2 min /1270 dpi/ 70x100-size	Nd-YAG 532 nm	1995
Laserstepper (flatbed)	Misomex	1300 x 1000 2000 dpi	4 min /2000 dpi/ 70x100-size	laser, multi-beam	1995