U.S. License Plate Technology Overview

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Introduction

License plates have come a long way since Massachusetts started making license plates in 1903. The earliest tags were made from leather, wood and porcelain (Delaware still permits porcelain plates). The earliest reflectorized plates were actually introduced in Mexico in 1936, but reflectorization didn't come into use in the United States until 1948 in Connecticut. This early reflectorization was accomplished by a beads-on-paint process, a process Connecticut just discontinued in 2000. Most states have already converted to reflective sheeted plates, a process first introduced by 3M in the 1960's.

The earliest plates were simply numbered sequentially, but both California and New York reached tag number 1,000,000 in 1924 - coincidentally the same year the John R. Wald Company was founded.

License plate manufacturing has typically been a correctional industry with an emphasis on inmate employment and a relatively low level of technological integration. However, as early as 1928, Idaho introduced tags with a potato motif and in 1931, Pennsylvania became the first to produce 'vanity' tags. These early forays into the use of license plates for advertising / personalization statements have grown to become a major driving force in the modern day license plate business. In light of all the changes license plate manufacturing has seen, it remains important to remember the **core purpose of license plates**: *To provide a unique and clear personal identity of a vehicle and its owner, day or night*.

What's New? As plate designs and numbering requirements have become more complex, technology has become an important factor in the manufacturing process. With ever increasing computer literacy, the need for reduced waste, improved reporting on manufacturing status and more efficient methods for getting the finished plate to the end user, there has been a flurry of evolution in license plate manufacturing. The purpose of this document is to assemble a comprehensive reference source for all entities involved in the license plate process. Specifically, this resource will serve to describe typical license plate manufacturing processes and the potential for enhancement of operations by computer integration into one streamlined, cohesive system. We welcome any comments to suggest alternatives or corrections to this document.

Order Entry / Processing

Orders to the license plate manufacturing facility typically come from the state Department of Motor Vehicles (DMV) in the form of a paper document that specifies the plate characteristics (type, design, size, etc.) and the number that is to be placed on the plate. In some cases, the physical appearance of the finished plate evolved at the manufacturing facility as a function of what was possible with the equipment on hand. Sometimes this was formalized in an official policy/procedure document for license plate manufacturing.

As computer technology increases in the license plate manufacturing business arena, such a document becomes very important. For Instance, having a supervisor or inmate operator simply 'know' that a handicap plate has a certain sequence and placement of characters with a handicap symbol becomes a problem when computer controls are integrated into the manufacturing process. Clearly defined rules are an absolute necessity for computer integration and also serve an important law enforcement function as well.

Production Scheduling is usually handled by shop supervisors who are aware of equipment and operator capabilities and shipment deadlines. This can be a very complicated process. In addition to regular orders, there are usually remakes, special orders, lost plates, production machines down for repairs, etc. that need to be considered when creating a production schedule.

What's new? **Digital Order Fulfillment** is a new term used in the license plate industry to define the integration of computer based control with license plate manufacturing technology to increase accuracy and efficiency at every step from the ordering of raw materials to the delivery of a finished license plate to the end user. The ultimate goal is to interconnect existing computer operations and equipment with additional systems that enhance the operations and complete the information feedback loop to provide a clear digital trail for a specific plate at each step of the manufacturing and distribution process.

With this new computerized system, **Orders** would typically be generated on DMV computer systems where a database of vehicle owners is maintained. Orders with or without owner addresses (depending on security issues) are then transmitted to the manufacturing facility in digital format. The actual method of order placement might be via removable storage media such as floppy disk, flash drive, CD, etc., or it might be a direct digital link via modem, network share, or via an FTP web site. (*FTP is File Transfer Protocol, a procedure for file transfer between computers using the internet.)*

Order Entry / Processing (cont'd)

What's New? (cont'd) **Production Scheduling** software package should address a number of issues. First is to sort the DMV order data into logical production batches that might be broken down by day, machine, delivery requirement, etc. as required. Once production batches have been created, the next step could be a paper document or a digital transfer of data via removable media or network to the production area. This information would inform operators (for manual production) or computer controlled embossing / printing equipment for automatic production as to which plates are to be produced and organize the list in the most efficient sequence.

Materials

SUBSTRATE is the primary structural component of a license plate. At one time, steel was the main substrate material. Rusting concerns then brought galvanized steel and prepainted steel into much wider acceptance. Those materials continue to be used at a few sites, but aluminum is now the predominant substrate of choice. Material cost for aluminum is a little higher than galvanized steel. However, if finished plate distribution costs are factored in, the overall cost of using aluminum is 25-30% less than using galvanized steel.

Cost Comparison - Assumptions	**.032 Aluminum**	**.0217 Steel**
Substrate weight per plate	3.64 oz	6.25 oz.
Substrate cost per plate (1 lb.)	$ .2409 ($1.06)	$ .181 ($.40)
Sheeting cost per plate (.90 sq. ft.)	$ .45	$ .45
Mailing cost per plate (first class)	$ .99	$1.65
Total Material & Mailing Cost	$1.68	$2.28

Aluminum:

For embossed license plate production, it is very important to use aluminum with the proper working properties. This can be accomplished using several different alloys if they have the proper temper.

The most widely used aluminum alloys are 3003, 3105, 8112 and 7069. Like steel, aluminum has evolved some over the years. Almost all license plate plants used to run the 3003 alloy with H-121 temper. This alloy is a pure aluminum with excellent working properties. It is also the most expensive. Very few states still use this alloy.

With the increase in awareness of recycling across the country, alloys using recycled aluminum were developed. The most common are 3105, 8112 and 7069. These alloys are not only cheaper to produce but have good working properties, if made properly. The mill has to control the chemical composition of the aluminum being recycled. Improper quality control at the mill may result in inconsistent characteristics of the aluminum. This can lead to license plate manufacturing problems (excess warping, machine jams ups, and cutting through during embossing) and thus rejected plates.

Materials (cont'd)

Aluminum (cont'd):

Any reputable aluminum supplier will replace or give credit for defective material upon proper documentation that manufacturing problems and rejects are the result of inconsistent quality or aluminum that does not meet specifications. However, the cost of the aluminum due to rejects is often substantially less than the cost of wasted reflective sheeting and labor. Purchasing aluminum just on the basis of price is not always the best policy.

The Environmental Protection Agency has stated that in the near future, chrome is to be removed from all coating processes such as chromate conversion coating. For this reason, most mills have changed or will be changing to an environmentally friendly chrome-free conversion coating. Chrome-free conversion removes the heavy metal chrome from the mills processing and eliminates it from the wash / rinse tank water in the license plate plant.

With the emergence of flat license plates, aluminum usage is changing again. Because of the lack of embossing on the plate, a harder and thinner aluminum can be used. This does not substantially affect the price of aluminum per pound, but normally allows more plates to be produced per pound.

REFLECTIVE SHEETING with a pre-clear protective coating is the most common face treatment material used in license plate manufacture, although there are still a few painted plates in use. (The precursor to pre-clear sheeting was the clear dip coat process. This "post-clear" sheeting is virtually extinct now.) The 3M Company and Avery Dennison are the leading suppliers of reflective sheeting in the United States' license plate industry, although Nippon, Oracal, and Kiwa Chemical Company are also suppliers in this field.

Prices for reflective sheeting may range from $0.50 to $1.00 per sq.ft. for plain white sheeting to $0.70 to $1.50 (or more) per sq.ft. for pre-printed graphics (depending on quantities and colors). See Graphics Section for further details relevant to short-run graphics.

Graphics and Printing

GRAPHICS, in addition to the tag number, make a given license plate unique. The days of plain, single-color, unadorned plates are pretty much a thing of the past. Just about anything is fair game for consideration as a license plate background.

Graphics Preparation may start as the idea of a special interest group or political entity. From preliminary ideas, artwork must be developed, usually with the aid of computer graphics software. Original images may be created on screen, scanned from photographs, etc. Configuration of the graphics image should consider many factors - physical size of license plate, mounting holes, quantity and size of identification characters that will be added to finished plates, color contrast, etc. Once the completed graphic image is arrived at, the next step is to decide how the image will be transferred to the reflective sheeting. Printing plates may be etched or engraved, printing screens may be developed, or in the case of digital printing, the image may be simply printed directly by a special computer controlled printer. In most cases, the computer graphics software must create color separation templates that sort a multicolored image into its constituent primary colors. Each of these color separated images must also include a method of accurately registering (or locating) so that when colors are placed on the sheeting the end result doesn't show any color shadowing.

Long Run Graphics are what you find on standard issue plates. These are the plate background styles that are found on large quantities of license plates. They are usually mass produced at the sheeting manufacturer's facilities by a couple of different methods, but typically the printed image is 'buried' inside the reflective sheeting component layers to protect it.

Roto-Gravure method is one in which millions of minute cells are etched or engraved below the surface of a printing cylinder in a web press. Very fluid inks are transferred from these cells to the sheeting at high press speeds. Because of the expense and complexity of rotogravure cylinder engraving, this process is suitable only for long run printing jobs. Each of four colors that make up a finished image requires a separate cylinder and each color must be dried before the next color is applied.

Rotary Flexographic printing is also typically web fed and is similar to Roto-Gravure in that each color must be dried after printing. The difference is that these cylinders use a raised image (like a typewriter key or rubber stamp) on the cylinder surface to transfer the image to the sheeting.

Rotary Screen printing is more often seen in the textile business but could also be considered for long run graphic sheeting. In this system, cylindrical screens are created of meshed material in which the desired image areas are porous and the colors are forced from the inside of the cylinder onto the surface of the reflective sheeting.

Graphics and Printing (cont'd)

Short Run Graphics are the specialty background images and logos for special interest groups. These include the low quantity custom graphics such as Purple Heart, wildlife plates, institutional (university, fire department, etc.), and more. If the quantity is large enough, these can be done with some of the long run graphics methods, but the per-unit cost is higher. (May be $2.00 to $5.00 per plate or more for sheeting alone, depending on quantity and complexity.) One caution here is that as graphics become easier to change, the diversity and content of the image can lead to the production of plates that have lost their primary purpose of quick identification. Some states, including PA, VA and AZ have already had designs recalled.

Screen Printing (Manual and Automatic) has been the usual method of creating short run graphics in the past, and continues to be a viable method today. This is similar to rotary screen except the screens are flat and may print as few as 1 to 4 license plates at a time directly on plain sheeted individual license plates. This is an economical, relatively easy to use, but low volume production system.

What's New?

Digital Printing

Digital methods can be used to quickly produce just about any conceivable graphic background. Digitally printed flat plates may be simply monochromatic printing of the identification number on a preprinted or plain background, or it may be the entire background image and identification number printed with a multicolor graphics printing system. The main difference is the computer software that controls the printers. Instead of repetitively printing the same background (or maybe a number of backgrounds) on the reflective sheeting, now the identification number and possibly some other variable data may also be printed.

This high tech addition to license plate manufacturing systems can be difficult to understand without a few basic definitions for clarification.

Definitions:

Media for purposes of this discussion is the reflective sheeting or clear laminate that will receive the printed image.

Thermal Transfer Printing places a ribbon between the print head and the media. Heat from the print head melts components of the ribbon and transfers them to the media. Lubricants are frequently incorporated into the thermal transfer ribbons to significantly extend life of print head. This explains why many manufacturers are adamant about use of proprietary ribbons and void the warranty when generic ribbons are used. This process is currently the most common type of digital license plate printing in use today.

Graphics and Printing (cont'd)

Thermal Transfer Ribbons are typically available in three varieties: wax, resin and combination wax/resin. Wax is less expensive, less durable and easily smeared. Resin ribbons require higher print head temperatures but produce very durable images. Combination ribbons are an attempt to achieve lower cost, but the tradeoff is durability. Resin ribbons are used almost exclusively for the production of license plates.

Process Color is where 3 primary colors (cyan, magenta and yellow) are combined with black (or a 4th color) to produce a full spectrum of colors.

Spot Color is used where a very specific shade of color or perhaps a metallic or fluorescent tint is required. In those cases a custom ribbon color is developed for these specific applications.

Fixed data is the background image, state name, etc. that is unchanged from plate to plate.

Variable data is the number, and possibly some other items such as expiration date, special symbols, special legends, etc. that may change from plate to plate. Typically, the printer manufacturer supplies variable data software that eases the manipulation of this variable data and links it to a database. This type of software usually separates the fixed and variable elements of the finished license plate image to speed up the **Raster Image Processing (RIP)** operation, then merges the data streams on the fly to ensure consistent quality and registration (within 40 microns, or so) in the finished printed image.

Printers:

While there are potentially a number of digital printing methods available on the market capable of printing on reflective sheeting, thermal transfer technology has become the most commonly accepted method for license plate production. Due to the unique requirements of license plates, nearly all digitally printed sheeting is being processed on one of the following print engines.

Datametrics Condor Thermal transfer printer can print four process or spot colors at 900 ft. per hour on an 11.73" wide image area at up to 300 dpi. This is equivalent to a maximum of 1,800 passenger car tags per hour. Depending on the complexity of the design, the printer may need to run slower and/or the resolution decreased in order to achieve acceptable print quality. Overlaminate is usually required. This is the most widely used printer in the market today. However, while still being supported by a third party, this manufacturer is no longer in business.

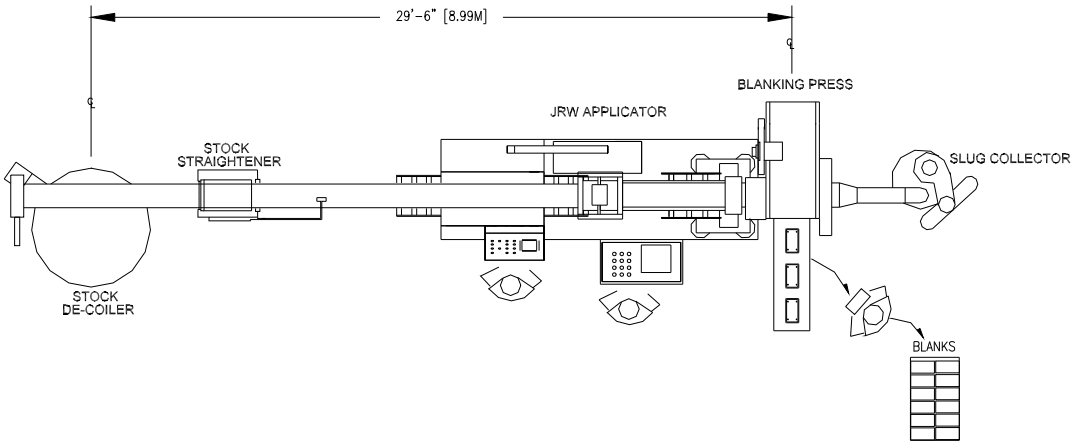
Graphics and Printing (cont'd)

Matan SprinG3 Thermal transfer printer can print six process or spot colors at 885 ft. per hour on a 12.1" wide image area. This is equivalent to a maximum of 1770 passenger car tags per hour. The printer supports multiple resolutions, up to 400x1600 dpi. Special rollers and ribbon are available for processing 7" wide material. Typically, plates with full graphic coverage are printed at 400x400 DPI at a slower production rate of 525 ft. per hour or, 1050 plate images per hour. Overlaminate is usually required. This printer offers better resolution and more color flexibility with its six print heads, and has therefore been gaining its share of the market. The manufacturer continues to improve the design and offers both hardware and software upgrades to keep the technology current.

Both of these commonly used printer models are typically integrated into a printer "system" that includes roll handling, in-line overlaminate application, and appropriate computer and software controls.

Production - Blanking

BLANKING is the process by which license plate stock is converted from roll form to individual license plate sized blanks. Unless the plates are prepainted or non-reflective sheeted, this process includes lamination of reflective sheeting to the substrate metal.



Major components of a blanking line are as follows:

Horizontal Coil Handler - Provides a safer, easier-to-load system for holding and supplying license plate metal substrate as it is unwound and fed through the blanking line. An added benefit is that the easier handling of substrate coils, results in less likelihood of damage to coils.

Stock Reel – An alternative to the newer horizontal coil handler, the stock reel has been utilized as standard equipment in most license plate manufacturing facilities for a number of years. Loading of aluminum coils is more difficult and often requires an overhead hoist.

Optional Wash /Rinse Tank -(not shown above) Is used to clean any residual contaminants from the surface of the substrate. Typically this is an insulated tank containing hot water or cleaning solution and incorporating squeegee rolls at the discharge end to remove excess liquid from the substrate. An added benefit of the heat is that adhesion of reflective sheeting to the substrate is improved. It may also have a power rotary brush submerged in the solution for improved cleaning. There also could be an optional second tank so that one tank might be used for cleaning and one for rinsing. In production, steel substrate usually requires cleaning and rinsing while aluminum substrate requires only a hot rinse.

Production - Blanking (cont'd)

Coil Stock Straightener - Pulls the substrate from the uncoiler through the wash tank. In addition, it flattens the inherent curl from coiled substrate and introduces a controlled amount of upcurl. This final upcurl property of the substrate carries through the applicator where it improves performance at the blanking die.

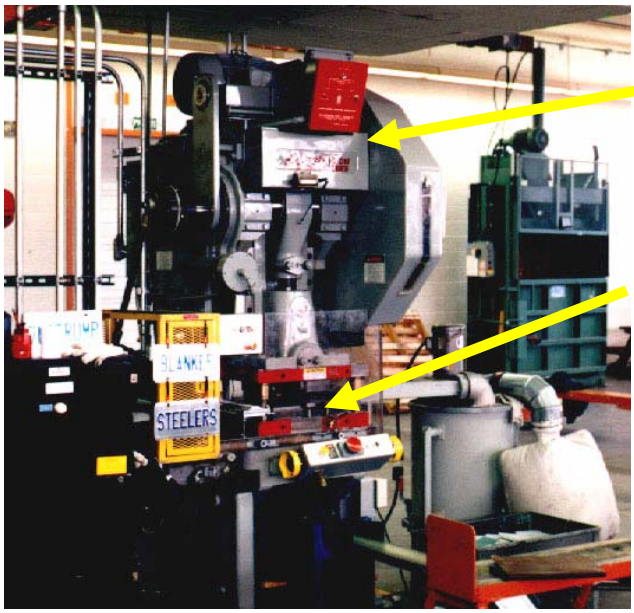
Applicator - Applies reflective sheeting to the substrate and rewinds the protective liner for disposal. In the normal case of preprinted reflective sheeting, changes in humidity and temperature can cause minor variations in the actual size of the preprinted images. While these variations are quite small, the finished blank size is identical every time. Without a control system, blanks would often be cut with the image off center from top to bottom, rendering the blank useless. The applicator shown below has a control system that measures every image and stretches the sheeting to just the right size. In those cases where a digitally printed graphic requires a clear overlaminate, the applicator can include a second application system for that overlaminate material.

John R. Wald Applicator

Production - Blanking (cont'd)

Feeder/Graphic Registry System – The laminated stock is fed into the Blanking Press and Blanking Die by a precision Servo Roll Feed. The Servo Roll Feed receives timing signals from the Blanking Press as well as the Graphic Registry System. A photoelectric sensor detects a registration mark on the graphic sheeting and controls the length of material fed in to the Blanking Die. This ensures a consistent location of the graphic printing on the blank as well as blank size. Older feeder systems use mechanically driven roll feeds or air feeds which are less accurate.

Blanking Press -is typically a 30-60 ton mechanical press operating at a set speed of 90-120 strokes per minute. This provides the muscle to blank 4,000-7,000 license plates per hour from the laminated substrate/sheeting roll stock.



Blanking Press

Drop Thru Blanking Die

Slug Collector

Drop Thru Blanking Die - is designed such that no waste or scrap is generated as an inherent function of the manufacturing process. The only scrap is the slugs punched from the mounting holes, and the corners trimmed to provide the corner radius. Everything is mounted in a 4 post leader pin die set to maximize accuracy.

Compound Blanking Die - In flat plate operations, a compound die may sometimes be used. This type of die incorporates the blanking operation with the border embossing in the same unit.

Vacuum Slug Collector - uses a combination of aimed and timed compressed air with a heavy duty industrial vacuum system to capture the trims from radiused corners. (Punched hole slugs drop through to a collection pan.)

Production - Embossing

EMBOSSING is the process by which raised or depressed letters, numbers, symbols, and/or border is created for a license plate. A significant benefit of an embossed plate is the difficulty of counterfeiting. The most common type of license plate is manufactured as a fully embossed or debossed product.

Embossing Presses are typically hydraulic presses with tonnage capacities as low as 30 tons and up to 200 tons. Historically, most license plate embossing presses were 200 ton HPM machines. These were sturdy, trouble free machines that were very good at making license plates, especially when one considers that most license plates were steel in the past and required higher embossing pressures.

New embossing presses are usually Hydraulic Press Brakes in the 58 to 135 ton range, depending on service needs. The 58 ton Beckwood press (shown here) is well suited to the installation of a safety feeder and offers a faster cycle time.

Larger press brakes such as the Cincinnati CB-135 have the capability of being fitted with either two safety feeders or a safety feeder and a sliding die if necessary.

Production - Embossing (cont'd)

Traditional embossed plates are usually created with the custom feeding and embossing systems installed in embossing presses. The **Safety Feeder** shown in the picture below is a two-station system that permits loading of blanks by one operator and changing of embossing dies by a second operator. Inherently safe design features keep operators hands safely out of pinch points. This unit uses male/female rim dies to create the border of the plate, and hinge dies (which are easily interchangeable) to create the license plate alphanumerics. Different parts of the country refer to hinge dies as flipper dies, paddle dies, etc. These dies are available in numerous sizes and designs for specific applications and incorporate male and female inserts for each embossed character. Safety feeder embossing provides the best character definition, and is available in standard 6x12 license plate format or 4x7 motorcycle format. This type of embossing can produce embossed license plates, complete with embossed or debossed border at 900-1,200 plates or pairs per hour. (When license plate pairs are required, two blanks are fed into the system at the same time, and both are embossed in the same operation.)

John R. Wald
M-48
Safety Feeder
in
Cincinnati
Press Brake

J.R.Wald Medium Weight Hinge Die

Production - Embossing (cont'd)


J.R. Wald M50
Sliding Die

A **Sliding Die** is a single station system that uses a male and female rim die for the border of the plate and interchangeable male block dies for each character to be embossed. Female block dies are used only for legend inserts (typically for top or bottom line legends). The female portion of the rim die encases a special elastomeric pad to control embossing. A single operator loads blanks and changes the embossing dies. As with the safety feeder, inherently safe design features keep operators hands out of the pinch points. Production capability of the Sliding Die is up to 400-500 plates per hour.

Single aluminum plates require approximately 60 tons embossing pressure. Pairs of aluminum plates are sometimes embossed in a sliding die, but require at least a 135 ton press and excellent quality aluminum. This method of embossing is often referred to as **rubber counter embossing** and is not suitable for every application, especially in cases of pairs of steel plates.

What's new? In some cases, **License Plate Identification** might be a better term than embossing for this phase of production, especially when computer technology is introduced to this area. This part of the manufacturing process is where the specific license plate number is assigned to a particular blank. Traditionally (and still most commonly by far) this has been done by embossing (or debossing) the alpha-numeric and symbol identification number into the blank. Digital "flat plate" systems print the identification number directly on the reflective sheeting which is then applied to aluminum at the blanking line to produce a flat plate. (See Graphics and Printing for more information.)

Production - Embossing (cont'd)

What's new? (cont'd) **Manual Embossing** continues to be the primary mode of plate identification for most license plate production facilities. To introduce computerization to manual embossing, an **Embossing Production Enhancement System (PES)** has been designed to assist and verify manual embossing requirements. This is particularly valuable in the case on non-sequential plates. This unit can take a variety of physical configurations, but the primary function is to provide a graphic display of each required license plate number to an embossing press operator.

The sequence of this data might be optimized for the most efficient production sequencing or, if required, would display each number in a predetermined production sequence. In addition to displaying the tag number, the display also presents the required sequence of manually placed tooling, including spacers and special characters. Once the operator places tooling as specified and presses the dual palm buttons, the system verifies that tooling placement is correct before engaging a press permissive interlock. In addition to reducing waste due to mis-made plates, an added benefit of this step is to link the production status of each specific plate back to the database for digital order fulfillment (see Order Entry). The other advantage of verifying the embossing is that production date and time is trackable since the process is computer based. This data can be communicated back to the Production Scheduling computer system to provide real time tracking of production status.

In addition to manual systems, License Plate Identification may also be done by a computer driven equipment such as an **Automatic Embossing System**, although the equipment cost is much higher and production capacity normally lower. With this type of system, the required identification number is digitally delivered to the automatic stamping system by the computer scheduling software and the required plate is created without the need for an operator to change tooling manually. Production capacity of a machine such as this is up to 500 plates per hour.

Production - Finishing

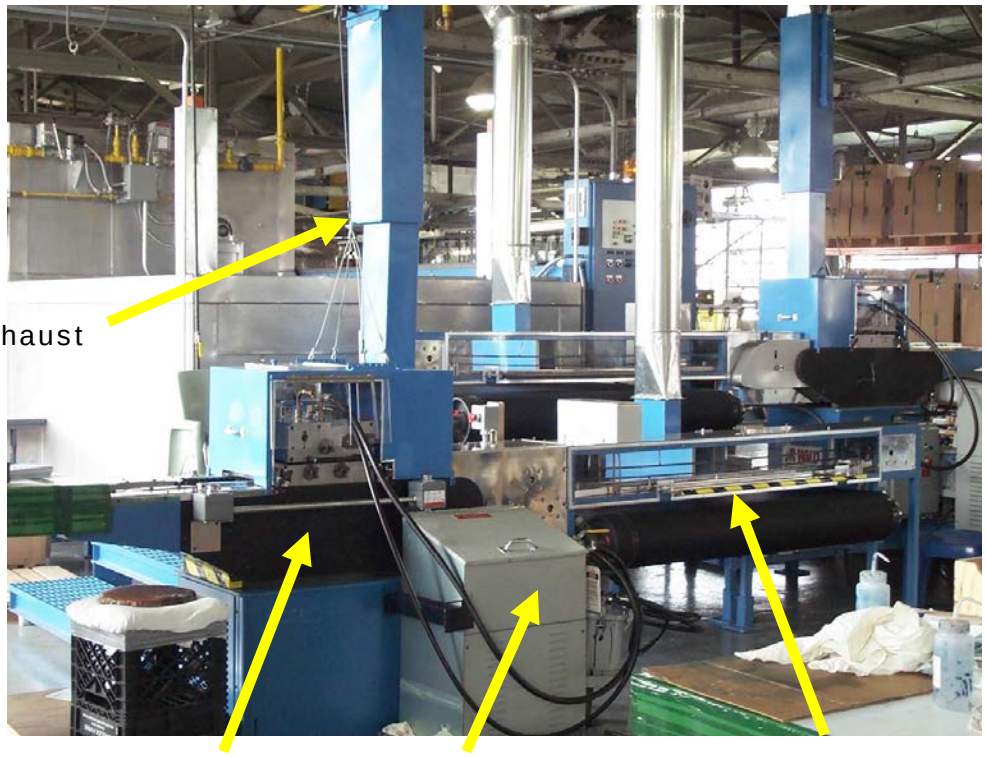
FINISHING operations typically complete the manufacturing process. This step is not used with digitally printed “flat” plates that are protected by a clear overlaminate.

Liquid Numeral Coating is the traditional method used for embossed plates. Not only is it the most economical method of finishing plates, but it is excellent for high production rates. In this process, a custom designed roll coating machine is typically used to apply a liquid ink coating to the raised (embossed) portions of a license plate at a rate of 2,000 or more plates per hour. This system usually incorporates a timed feeding mechanism with the special designed roll application action to efficiently coat all raised areas. In some cases, the identification numbers are debossed into the plate and the roll coating material is applied to the surrounding flat areas of the license plate.

M31 Coating Machine

Typically, the M31 Coating Machine applies solvent based coating inks to raised portions of an embossed license plate, it has also been tested for applying water based and UV curable formulations of coating inks

Production - Finishing (cont'd)



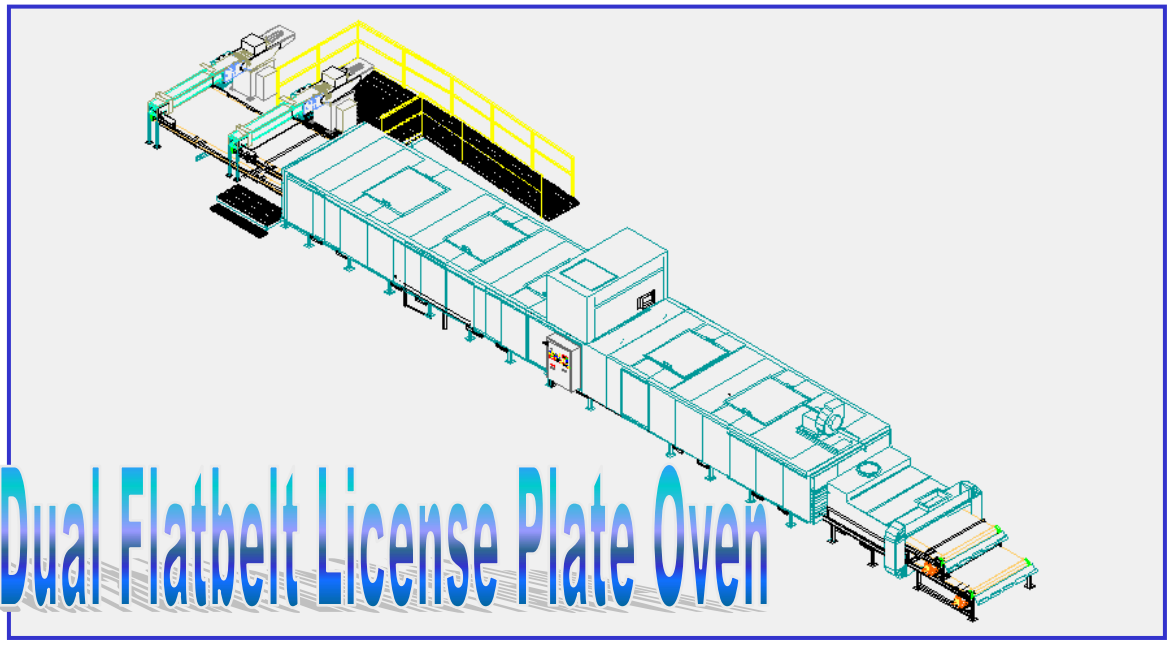
Environmental concerns have forced most solvent-based liquid coating manufacturers to use a high solids formulation. To maintain the best viscosity for application, an optional circulation system designed to operate in conjunction with the coating machine may be used. In addition to viscosity control, this unit also assures a constant ink flow to the coating rolls to maintain quality of coating. This same feature also eliminates the problem of coating rolls drying out. Rolls that dry out may stick together and cause major damage to the coating machine. In cases where liquid coatings with high VOC content are in use, an optional **Fume Exhaust System** may be added for fume control at the coating machines.

Production - Finishing (cont'd)

Curing Systems for license plates in past years had to deal not only with numeral curing but also with an additional curing requirement - clearcoat. The earliest systems were typically crossbar ovens. In these, license plates were hung from hooks on crossbars that were conveyed through the dip coating and oven areas. In later systems, numerals were coated and cured typically on a combination carrier suspended from a monorail conveyor. The carrier had shelves for numeral coated plates for curing and a hook arrangement on the bottom. Plates that were numeral coated and cured were then hung from the bottom of the carrier and dipped in a clearcoat dip tank prior to going through the oven a second time to cure the clearcoat.

Combination Carrier

The advent of **Pre-cleared Reflective Sheeting** eliminated the need for clear coating systems in the license plate manufacturing facilities. The new curing system is typically now a single or dual flat belt oven. Nominally, the flat belt conveyor operates at about 5 fpm and curing takes place in 10 minutes or less at 240-300° F. The oven system normally uses a direct gas fired heating system with an internal ductwork distribution system to spread the heat evenly across the oven belts. A refrigerated cooling tunnel at the discharge end of the oven ensures plates are easy to handle and coating has cured to proper hardness. An added benefit is that the oven also relaxes sheeting wrinkles that may occur during embossing.



Production - Finishing (cont'd)

Flatbelt Curing Ovens are typically available in single or dual belt configurations rated at 2,000, 4,000 or 6000 plates per hour depending on space and production requirements. Normal method of feeding the flat belts that run through the oven is via plate distributors that convert a serial plate stream to a parallel arrangement.

A **Plate Distributor** at the discharge of the coating machine automatically transfers a single file production line of wet, coated plates to a 4 (or more) wide flat belt running perpendicular to the coating line. This eliminates operator handling (common in the past) and subsequent risk of touching (and therefore ruining) wet numeral ink on the license plate.

J.R. Wald M94 Plate Distributor at entrance of Flatbelt Oven

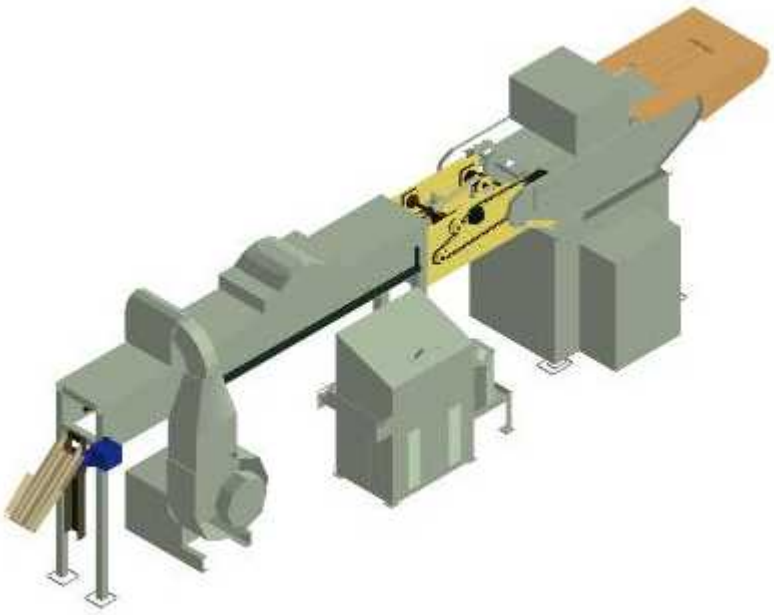
Discharge of Dual Flatbelt License Plate Oven

Hot Foil Stamping (also known as Dry Roller Coating) is another numeral coating process more often seen in European markets, but has been gaining acceptance in the United States. This method of finishing is most suitable for low production facilities, where industrial space is limited. In this process, a hot platen presses a section of roll fed hot stamping media against the raised numerals to apply the foil to the license plate. While the equipment investment isn't as much as for a liquid curing system, the consumable supplies are considerably greater. To achieve similar production capacity as a liquid numeral curing system, this system has similar space and power requirements due to the lower production output of each machine. Chief advantages are the elimination of solvents and easy changeover between colors.

Production - Finishing (cont'd)

What's New? At the load end of the oven, **Optical Scanning Systems** are one possibility. The primary purpose is to link a coated license plate back to a computer system for production or quality control purposes adding another control point of data for digital order fulfillment. In many facilities, plates may be embossed, palletized and inventoried for future coating. An optical scan could alert the manufacturing management software as to the current status of a plate and verify that it has been coated and fed into the oven. At the same time, an optional feature would be to provide quality control for detection of ink smudges while the coating is still wet and removable with a solvent cloth.

UV Curable Inks for numeral coating have recently made improvements, allowing them to meet the rigid durability requirements of license plates. Advantages are that traditional solvent fumes are reduced or eliminated and the system is quite compact. However, the odor from the UV ink is also a problem, so a ventilation system is typically required. An ultraviolet light curing system is required, and that carries some operator hazards of its own, in particular, heat from the lamps and ozone generation. In the past these coatings have proven to be insufficiently durable to meet warranty requirements. Recent testing shows that inks are now available in a variety of colors that are appropriate for widespread use. Shown below is a UV curing system that is designed to integrate with an M-31 coating machine:



M31-UV Numeral Coating Machine With Integral Ultraviolet Curing System

Packaging and Distribution

Packaging of finished license plates can be handled in a variety of ways. Plates may be plastic wrapped, bagged, boxed or packaged in envelopes. Singles or pairs may be placed in shipping or mailing envelopes or possibly boxed/ bagged for bulk mailing. Boxes are typically palletized for ease of loading. Plates may be sent directly to the motorist, to DMV distribution facilities, local distribution authorities, or to private sector bulk mailing facilities. In short, a wide variety of methods have been employed to get finished plates to the end consumer and to update DMV database as to the status of delivery - most of these methods have been somewhat inefficient and labor intensive until recently.

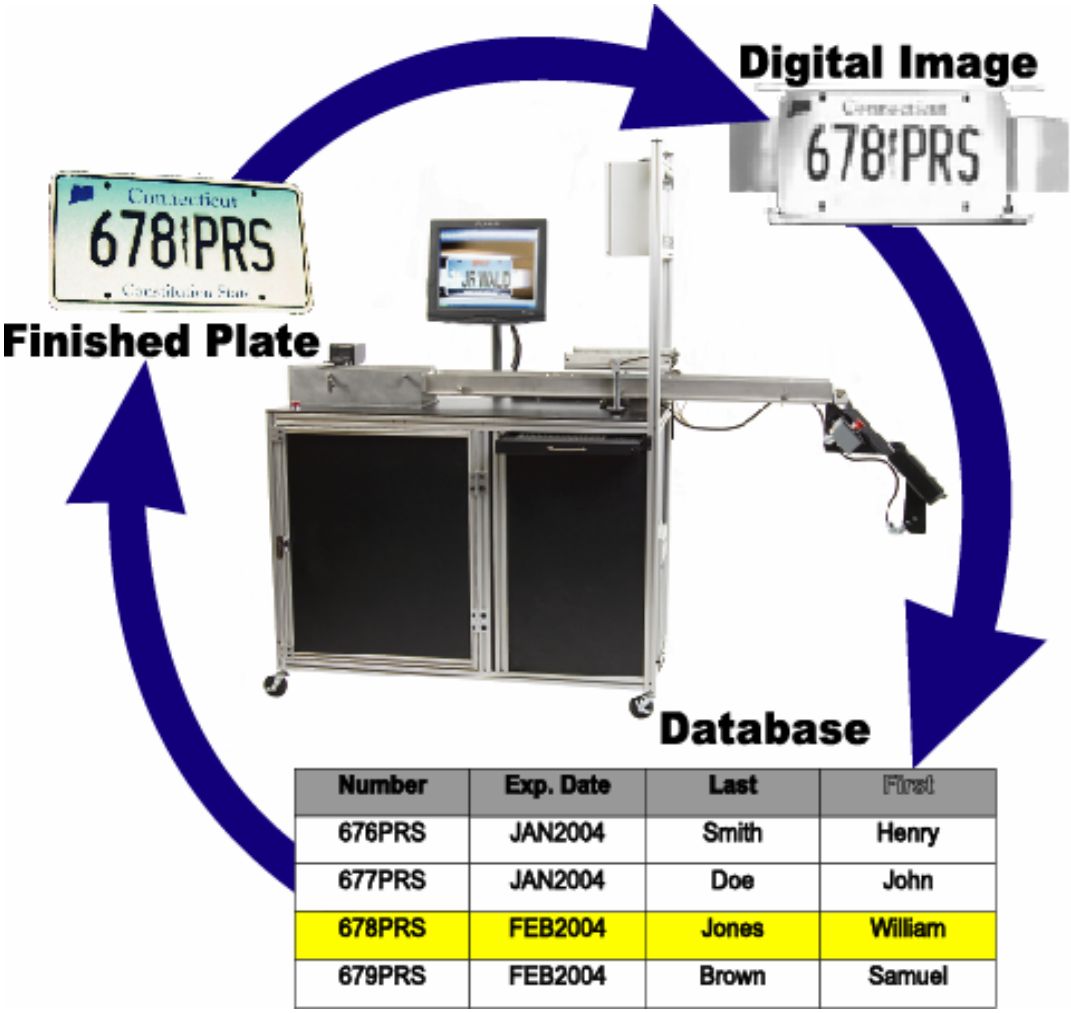
What's New? **License Plate Digitizer (LPD) Systems** allow production or distribution facilities to digitize/computerize flat or embossed finished plates so that computer software can be utilized to offer a myriad of improvements in tracking, distribution, and reporting.

Computerized Optical Verification of a plate's completion is far superior to visual verification by operators. Experience has shown that an error rate of 5-8% from visual inspection can be improved to significantly less than 1% with the LPD System.

How does the LPD work? A database of license plates in current production is transferred from the production scheduling system. A camera and custom OCR (optical character recognition) software operate in conjunction with a custom Graphical User Interface (GUI) and mechanical hardware to optically scan and interpret finished plates. An optical sensor detects when a plate is in the camera's field of view and tells the computer to capture an image for computer recognition and database processing. The computer recognized plate numbers are evaluated in conjunction with the production database to determine and update the plate's status in the database (plate found and marked as read, plate not in database, etc.). This serves as another data control point for digital order fulfillment..

Packaging and Distribution (cont'd)

In addition, when a plate is marked as "Read", the database also gets a time and date entry to serve as further production scheduling feedback.



Number	Exp. Date	Last	First
676PRS	JAN2004	Smith	Henry
677PRS	JAN2004	Doe	John
678PRS	FEB2004	Jones	William
679PRS	FEB2004	Brown	Samuel

The **LPD System** creates a digital link between physical plates and their corresponding electronic order data. This effectively closes the digital loop to enable a multitude of digital order fulfillment benefits, including: verification, reporting, support document processing, distribution, and more..

Production - Finishing (cont'd)

Shipping/Mailing: The final step in complete Digital Order Fulfillment is the capability to sort bulk shipments by postal zones/zip codes to reduce mailing costs. This step could be taken during initial production scheduling if a specific shipping sequence is not pre-defined. Alternatively, products processed through the LPD System and identified with barcodes that include address information can be sorted for bulk mailing advantages.

Direct, real time printing of mailing envelopes is one major benefit of the LPD System. A high speed printer in conjunction with the OCR system prints vehicle owner addresses on **Mailing Envelopes** or labels at a rate of approximately 1,000 per hour. As an added feature, additional software can be incorporated to enhance zip coding and verify address accuracy.
Both 1 and 2 dimensional **Barcodes** can be applied to paper order documents, individual plates or pairs, boxes of plates, pallets of boxes, etc. to provide any level of data tracking and control desired. As an added advantage, in the situation where name and address data is not to be viewed by production staff, name and address data can be coded in the barcode to provide data security and when scanned can trigger a mailing label to be applied at a later stage..

Customized **Reports** that can list plates missing from order and duplicate plates (to develop a remake list) and indicate completion status at the plate, box or order level, shipment status, etc. are a common feature of the LPD System. In addition, this data can be exported to the production management or DMV mainframe database as required.

Production - Finishing (cont'd)

Other Benefits: Companion documents for license plates, such as **Owner's Registration Cards**, **Validation Stickers**, etc. can also be printed for insertion into mailing envelopes. This eliminates the need for manual sorting and matching of items from different sources prior to mailing. In addition, the capability to sort bulk shipments by postal zones/zip codes can significantly reduce mailing cost by taking advantage of bulk mail distribution rates.

Barcoding: Direct printing of barcodes on license plates or on labels for automatic in-line application to the front or back of each plate are optional features of the LPD System

Credits and References

Historical notes:
Summer 1998 Issue of Move Magazine (AAMVA) Article by Michael Wiener
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http://195.0.66.23/ComWebsite/servlet/be.xeikon.visual.homepage.HomepageServlet

General JRW License Plate Manufacturing Information:
John R.Wald Company Employees, particularly Mike Rodli, Sam Lynn and Paul Post
Update edits Oct. 24, 2007 courtesy of Wald employees David Donnelly and Lynn Conaway