

# Roll Leaf Hot Stamping

by Frank J. Olsen

The roll leaf hot stamping process can be used on any thermoplastic without pretreatment of its surface. Fine line designs are reproducible on most thermosetting plastics, and the process has been used commercially on metal parts sprayed with acrylic paints.

One big advantage of roll leaf stamping as a method of marking and decorating is that difficult-to-mark materials such as polyethylene and polypropylene can be stamped without the need for using special surface treatment.

Basically, hot stamping is a technique involving use of a stamping press, an engraved metal die or flat silicone rubber pad, roll leaf material or foil, and a nest, jig or fixture which supports and positions the item to be marked.

The stamping die mounts in the heated head of the press, the item to be marked being positioned directly below on the press's work table. A roll of stamping leaf is mounted so that it will pass between the die and item to be stamped. When the heated die forces the stamping leaf against the plastic and pressure is applied, heat softens the plastic surface and transfers the roll leaf coating into depressions made by the die. When raised areas are to be marked, a flat silicone rubber pad is used instead of a die.

With each impression the strip of roll leaf advances to an unused portion via an automatic roll leaf attachment. Since roll leaf stamping

is a "dry" method, the stamped item can be handled immediately without fear of smearing the mark. The time required to complete this marking cycle will normally vary from one to five seconds depending upon degree of hardness of the object, its resistance to heat, boldness of the mark, stamping die temperature and pressure applied by the die.

A hot stamped plastic item will have its metallic or pigment coating "in-laid" into depressions made by the heated metal die, or laid onto molded-in, raised areas by use of the silicone rubber pad. Although the majority of plastic applications for hot stamping are connected with thermoplastics, thermosetting materials also can be hot stamped using sharply engraved, hardened steel dies under relatively high heat and pressure.

One advantage of hot stamping is that it can be applied to both flat and contoured surfaces. In order to mark a contoured surface, the die is accurately shaped to match the part. The "up" and "down" action of a standard hot stamping press can mark curvatures up to 90 degrees or one quarter the circumference of a cylindrical (round) shape. Rotary hot stamping presses are available which will decorate completely a circular object. These utilize mandrels which rotate objects across metal or silicone rubber dies.

In hot leaf stamping, efficient and economic production requires:

1) Stamping equipment of the prop-

er size and pressure range.

2) Roll leaf formulated for the particular plastic to be decorated.

3) An accurate die set of the loose type, or a silicone rubber pad.

4) A surface that will both properly support the areas to be marked and position the marks in the desired areas.

## Stamping equipment

Stamping equipment must have a stamping area large enough for the size mark to be made, and a frame large enough to accommodate the overall dimensions of the item to be stamped. It must be capable of developing whatever pressure will be required for the work (pressure required depends upon size of the mark, hardness of the material and its resistance to heat).

A stamping press should have an adequate heating system controlled by an adjustable thermostat. The head should be capable of being heated quickly and maintaining temperatures up to 450 degrees F. In stamping operations, temperature settings vary from 175 (for cold operating leaf) to 450 degrees F. (for silicone rubber pad stampings and some plastic marking). Once a thermostat is set it must control the temperature accurately. This is extremely important, as too low a temperature for a given roll leaf causes it to release incompletely, resulting in a partial print. Too much heat causes the leaf to overflow and fill

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in an impression and, sharpness of detail is lost.

An accurate, adjustable dwell control on the press is necessary, too. Softer plastics such as vinyl and polyethylene require shorter dwell or "kiss" impressions; harder plastics (polystyrene and the phenolics) require longer dwell time. On any material, fine line detail requires a shorter dwell period than bold lettering.

Finally, a stamping press should have an adjustable pressure control. In general, rules applying to dwell apply to pressure. It is important to have control of head speed on both the down and up strokes. For best results the stamping die should contact the object only for the time required to transfer coating from the roll leaf carrier strip. When the die is brought away from the object, it is recommended that the carrier strip should remain in place for a fraction of a second "setting time."

Most materials can be stamped using a fast down stroke or "hit." But a brittle object or one not of uniform thickness requires slower head speed so that die heat will soften the material. Peeling the carrier strip off the item is accomplished on the upstroke, and is called "stripping action."

Stripping action is controlled by up stroke speed of the stamping head, position of the "stripper bars" and advance of the roll leaf carrier strip. Naturally a slow up stroke of the stamping head will allow the carrier

strip to remain on the object a fraction of a second before stripping the leaf.

A press has two stripper bars riding up and down with the head to keep leaf away from the hot die. Stripper posts are adjustable up and down and are spring loaded. They must be adjusted so that the horizontal bars always are parallel with the press bed. Many times, one stripper bar will be set lower than the other to help stripping action. This technique also prevents air from being trapped between leaf and object, and trapped air can cause shadows in high luster foils. If a maximum cooling (setting) time is required before leaf is peeled from the object, the stripper bars can be dropped as much as two inches below the die in order to effect this.

Roll leaf usually advances on the up stroke of the stamping head after an impression is made. However, when using high luster colors or metallics that have a tendency to stick, it is advisable to set the machine so that leaf advances on the down stroke. Many machine makers solve this problem by having delayed roll leaf advance action built into the up stroke mechanism.

Basically there are three types of stamping equipment: handfed, hand-operated: hand-fed, power-operated; and automatically-fed. Hand-operated equipment will prove 'satisfactory for limited production runs and intermittent use. However, the operator must be skilled because the uniform dwell time and pressure required for good

results are under his control.

Power equipment is either motor driven or air operated. Motor driven equipment may be had with accurate heat and adjustable pressure controls, but dwell time and head speed are difficult to adjust. And the motor driven press will not compensate satisfactorily for thickness variations commonly found in many items. Therefore air operated machines are most popular because all three variables (heat, dwell time and pressure) can be controlled accurately, and because compensation for thickness variations is automatic.

Hydraulic and air-hydraulic hot stampers have been designed and are being put into use. These machines develop the extremely high pressures required for large metal die stamping on products such as beverage cases and other big items.

### Production rates

The production rate that can be expected from a hand-fed power press is determined by required dwell time, size and shape of the part, and dexterity of the operator. Normally it will vary from a few hundred units per hour on bulky parts (such as radio cabinets) up to 1,200 units per hour on small, flat parts (such as vinyl novelties). On large molded parts the molding machine operator usually has plenty of time to degate the part, hot stamp it and pack it. Production on most small parts can be increased to up to 1,500 units per hour by use of turntable-fed power

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equipment. In some instances the size and shape of an item are such that it can be channel or hopper fed. Thus rates of up to 5,000 units per hour are obtained on combs; tooth-brushes, credit cards and similar high volume items.

### Roll leaf

Obtaining the proper formulation of roll leaf is of utmost importance. Roll leaf consists of a thin carrier strip of acetate, cellophane or polyester film coated on one side. A wide variety of coating formulations are designed to give maximum adhesion with various materials. Naturally, if a formulation is not compatible with the particular plastic being marked the coating won't release properly from the carrier strip.

In general, there are three types of pigment foils and three types of metallic's. Pigments are available for stamping either matte (non-glossy) finish or glossy finish, or stamping with transparent color. Glossy colors are most popular because of their appearance and excellent abrasion resistance.

Transparent foils, actually dye coatings rather than pigment colors, are used for decorating automotive deck medallions, horn buttons, etc. A part usually is hot stamped from the back (second surface), then vacuum metallized for an interesting metallic effect. Transparent foils also are used on household appliance dials and escutcheons to be back lighted. Special "masking" colors, simulated wood grained foils and "day glow" colors are available,

too.

Metallic foils are coated with suspensions of bronze or aluminum powder, with vacuum plated aluminum and with pure gold. Within the past few years the vacuum metallizing process has been adapted to roll leaf manufacturing. Use of roll leaf stamping as a method for decorating molded plastic items has increased tremendously with this development.

A finisher now can "selectively metallize" a part's well defined areas in one simple stamping operation.

Manufacture of metallized imitation gold, silver and colors is a complex operation requiring several steps. Polyester film must be used as the carrier when making a metallized foil. Acetate and cellophane will give off gas and become brittle during the metallizing process. The film first is coated with a release agent with which to transfer the coating from carrier strip to plastic during the stamping operation. If the foil is to be chrome finished the release coating is clear. If the finish is to be gold colored, the release coating is dyed to the desired shade of yellow. (Naturally, other color metallies can be made using the appropriate dyes. It is important that dyes used be as color-fast as possible to prevent fading.) Then the carrier strip is vacuum metallized in a chamber. A final sizing coat is applied to facilitate adhesion to the plastic.

Usually made in 24-inch width, roll leaf normally is supplied in 200-foot lengths wound on one inch diameter cores. It also can be purchased

in continuous length rolls of up to 1000 feet for high speed applications. The supplier usually slits the leaf to whatever width a job calls for. When ordering roll leaf, specify the plastic being marked, whether a metal or silicone rubber die will be used and whether the part will be painted or metallized before or after stamping.

### Roll leaf dies

Dies usually are made on a pantograph machine or chemically by etching the metal. Engraving depth is obtained by routing, and the die is hand finished to eliminate burrs that would tear roll leaf and give ragged looking results. Curved dies are engraved from blanks shaped to match contours.

Hardened tool steel dies are recommended for long production runs on hard materials (phenolics, polystyrene, acrylics). It is important not to have steel dies hardened before they have been tested to see if they match the parts to be stamped.

As mentioned previously, silicone rubber is used for stamping or "selectively metallizing" raised letters, figures, trademarks, panels, etc. Desired markings are engraved into the mold. (We recommend the mold maker engrave to a depth of at least 35 mils.) When the article is molded, the areas are raised from the piece's surface. These raised areas can be either on the viewing side of the item (its first surface) or on a clear item's back side (its second surface).

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The rubber has enough "give" to compensate for slight variations in an article and may be had in sheet form vulcanized to thin sheets of aluminum or steel, simplifying mounting of the die to the heated head of a press. Silicone rubber dies should be mounted as close to the heat source as possible and, since silicone rubber is a comparatively poor conductor of heat, stamping head temperature must be held at approximately 400• F. to maintain the 300• F. die face temperature most roll leaf requires. Other printing elements are available besides steel and silicone rubber.

When stamping soft materials (paper, vinyl plastic, etc.), Brass or deep etched zinc, magnesium or copper dies can be used. Inexpensive etched dies also are used, for making samples on hard plastics. Movable type can be had in many sizes and styles. Hot stamping type is made of composition metal, brass or steel, and lead foundry type, Linotype, Ludlow and other lead printing elements can be used for short runs on soft materials.

The final roll leaf stamping component is the supporting surface, jig, or fixture which positions an item accurately under the stamping die and supports it properly when pressure is applied. If the part is not supported rigidly, work will shift out of level and cause stampings of uneven depth. Poor support also is likely to cause a brittle item to crack or craze.

If the desired mark is to be applied over a hollow section in a product,

a nest, shaped accurately to conform to the hollow section, must be made.

### Preparing a job

A job is made ready as follows: After providing a properly matched supporting surface, bond a piece of hard, smooth paper or cardboard to the surface under the stamping area. Then make an impression on the item put in position on the supporting surface. Examine the impression. Make weak or light spots heavier by building up the surface under the item with various thicknesses of paper wherever necessary. Air operated stamping presses will compensate for thickness variations found in multi-cavity molding of plastics. However, because of improper molding cycles, molding heat variations, and poor mold design, sink marks and other imperfections will appear. In many cases, you can overcome this problem by bonding a thin sheet of firm rubber or cork to the face of the supporting surface as a leveler.

Many shops have minimized make-ready problems by hot stamping directly at the molding machine while items still are hot. This reduces spoilage due to cracking and crazing and produces finer quality stamping with less pressure and better adhesion. Many molders cut costs and spoilage on large, single cavity items by having the machine operator stamp and pack with very little added effort.

Being involved constantly with decoration and marking of all ma-

terials, we see fine and poor quality hot stamping. Yet at very little additional expense, high quality results can be obtained with a few basic principles.

### Design considerations

Proper design of an item to be hot stamped is of utmost importance. The design engineer should:

- 1) Consider decoration of an item when designing it, making certain that its stamping area will remain uniform from one cavity to another. Insure proper support of a hollow item since pressure is to be applied.
- 2) Not place knockout pins, mold marks, gate areas or ribs in or under a stamping area.
- 3) Consider the material flow so he won't have excess weakness in the stamping area.
- 4) Design the item so that stamping will be done over an area of uniform wall thickness. If a thin wall is adjacent to a heavy wall, he will probably encounter varying shrinkage in the heavy wall.
- 5) Highly polish his mold in the stamping area. Tool marks and other imperfections will be magnified when metallic or high luster foils are applied.
- 6) Make sure the area is raised at least 0.030-inch if he intends to "top" stamp a raised area with silicone rubber.

### Operating checklist

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Once the mold has been made it is advisable that personnel:

1) Make certain that parts are clean and not contaminated by dirt, lint, oil or mold release. If they must use mold release make sure it is of the new "printable" type.

2) Check that parts fit nests and dies accurately. Check this by using a cold machine and machinist blue.

3) Make certain' the roll leaf sup-

plier knows the material marked, whether a metal or rubber die is to be used, and any other unusual circumstances involved.

4) Insure proper molding cycles. When decoration is required, speeding up a molding cycle is poor economy. Resulting shrinkage will greatly increase rejects.

5) Use as hard a make-ready over supporting surface as possible: If the make-ready is soft and non-resilient it will break down, causing poor quality and rejects.

6) Keep equipment clean, adjusted and properly lubricated. If equipment is air operated the air must be clean and dry. Drain compressor tanks frequently and add an after-cooler or chemical dryer if excessive water appears in air filters.

7) Not hesitate to notify equipment manufacturers or roll leaf suppliers concerning any technical problems experienced during the production run.











