

Whitepaper

Hot Melt Glue

By John R Henry

Glue, more properly called adhesive is used in many packaging applications. It seals cartons and cases, affixes labels and coupons, combines products and more. Four types of glue are commonly used in packaging:

- Hot melt glue is supplied in pellets or pillow and is melted by heating. It's adhesive properties come from cooling and re-solidifying after application
- Cold glue is supplied as a liquid. It adheres as it dries.
- Pressure sensitive glue is most commonly used on labels and is applied to the label at the converter. It is naturally adhesive and is protected by a paper or plastic backing until application.
- Heat sensitive adhesives are less common these days, largely displaced by pressure sensitive labels. Heat sensitive labels are supplied with a heat activated adhesive. Immediately prior to application, they are heated. On cooling, the glue adheres the label to the product.

For each type of glue, there are over 200 different compounds for specific uses. Some will adhere at low temperatures such as frozen food. Others may be formulated for high temperatures. Some have high shear but low tensile strength (Think of Post-It notes) that allow them to be easily pulled up but stick aggressively when pulled to the side. Others are low shear-high tensile strength. Some work well on glass but not plastic, others vice versa. In short, the glue must be carefully matched to the application. There are some fairly versatile glues available. There is no universal, "one size fits all", glue.

Anytime adhesion problems are encountered, the first culprit to be examined should always be the glue.

One of my clients had been running a plastic bottle with a thin plastic film label for years without problems. One day they started having problems with wrinkling. It took a while to figure out. We finally found that the bottle supplier had changed from flame treatment

of the bottle surface to plasma treatment. The glue which worked well with the flame treated bottle adhered differently to the plasma treated bottle, causing problems. A change in glue fixed it but changing the glue was a major supply chain process.

This paper will focus on hot melt glue and how it is applied.

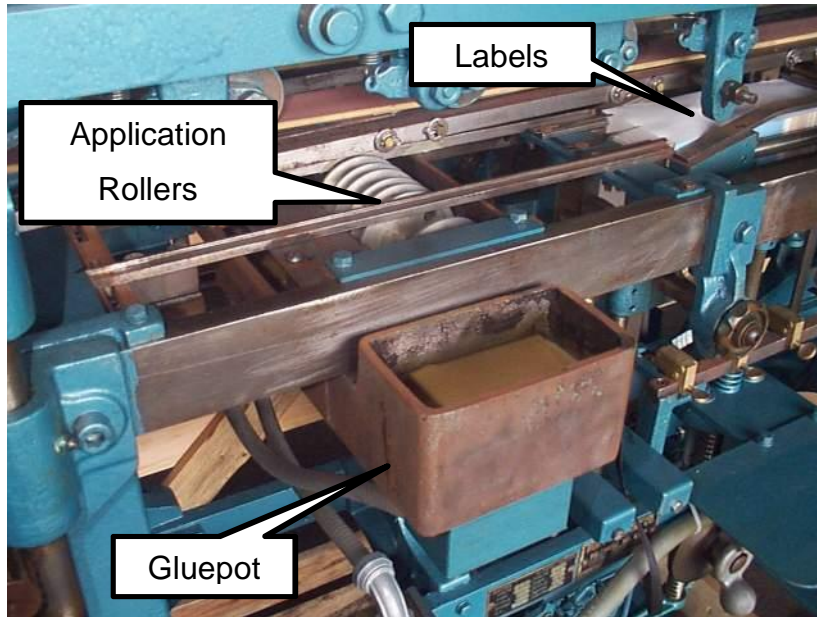
There are many different types of hot melt glue, including some that melts at relatively low temperatures. Most hot melt glue melts and is applied at between 250 and 400 degrees F. When melted, it is sticky and viscous. This, combined with high temperature, means that it can cause severe burns when it comes into contact with human skin. IT IS DANGEROUS AND STRICT SAFETY PRECAUTIONS MUST BE OBSERVED.



One too frequent cause of burns with is failing to deactivate the trigger when working with a hot melt spray applicator. Even though the machine will be E-Stopped, and de-energized via opening guard doors, the hot melt system stays hot. If working, for example, in the flap closing area of a cartoner, it is easy to trigger the photoeye activating the gluer. For safety, machines must be designed so that when the machine is deactivated, the photoeyes are deactivated as well.

Hot melt glue can be applied with a roller or, more versatily, with a spray nozzle. In some applications, a spray nozzle is used to coat roller which transfers the glue to the label.

This is a photo of the hot melt glue pot on a roll through labeler. This type of labelers has been in common use for over a century with cold and hot glue. They are simple, easy to maintain and seem to run forever.



The gluepot is filled with glue pellets. An electric heater underneath heats the pot. The heavy brass construction helps maintain a stable, consistent, temperature.

An applicator roller, in this case a series of disks, rotates through the molten glue. Some adheres to the periphery. As the can, in this application, is rolled over the disks they leave a series of short glue stripes on the can. As the can rolls over the label pallet, these dots pick up the label and hold the end in place as it is wrapped around the can.

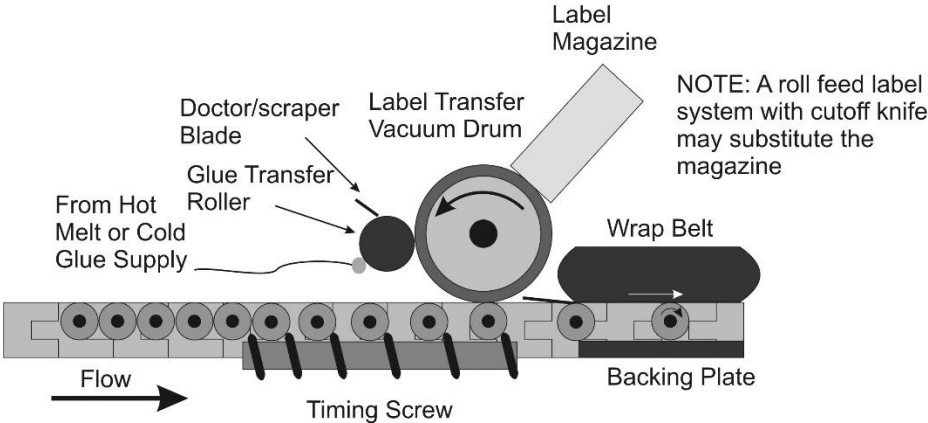
Level control of the glue in the pot is not critical as the roller edges will pick up the same amount whether completely full or almost empty. Temperature control is critical. Glue viscosity is a function of temperature. Too cool and the glue will thicken and too much will be picked up on the rollers. The lower temperature also means that, when applied to the relatively cold can, it may be too cold to adhere properly to the can or the label.

If too hot, the glue will be thin and not enough will be applied. High temperature may prevent it from cooling quickly enough for a good initial tack or grip. Slippage and misaligned labels may occur.

This picture shows a similar labeler. On this machine, instead of smooth application rollers, the rollers are notched. This applies a series of dots instead of a stripe, reducing glue consumption.



Some high speed beverage labelers use hot melt glue applied with vertical, instead of horizontal, rollers. This overhead schematic shows a typical labeler. The glue is heated and dripped onto a vertical glue transfer roller.



Inline hot or cold glue labeler

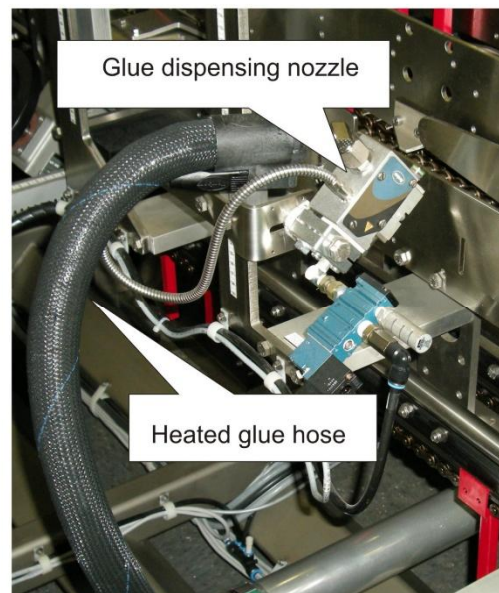
As the glue drips onto the roller, a doctor blade or scraper squeegees the excess back into the glue reservoir.

The label is picked from the magazine by the label transfer vacuum drum and passed over the glue roller, picking up glue. As the vacuum drum continues to rotate, it transfers the label, with glue, onto the bottle.

Rollers may be flat to apply a uniform layer of glue, serrated, grooved or otherwise cut for the optimal pattern of glue while minimizing excess consumption.

Hot melt spray applicators consist of 3 main components.

- The melt tank and pump
- The dispensing nozzle
- The hose connecting tank and nozzle



Glue pellets are placed in the melt tank, heated to and maintained at the proper temperature. A pump maintains the supply of glue to the heated hose under appropriate pressure.

Melt tanks can be designed to support a single or multiple nozzles. The cartoner shown has a nozzle on each side to seal both ends of the carton. A single melt tank with two hoses supplies both.

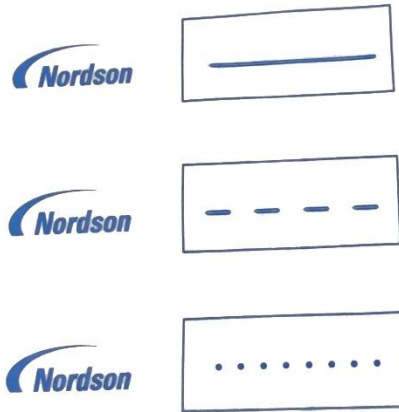
A nozzle at the end of the hose completes the system. A sensor detects the presence of the carton, in this case, and triggers dispensing.



Note the color coded nozzle tip. This tip can be changed to dispense a wide or narrow, thick or thin, solid stream or aerosolized pattern depending on the application requirement. Different glues may have different viscosities requiring different nozzles.

There is always a balance between economy and performance. Too much glue is costly and can be messy. In some applications, too much glue may make the package hard for the customer to use. Not enough glue saves money but may not be sufficient to close a case or apply a label securely.

Fortunately, modern glue applicators can dispense a variety of patterns. In this demonstration sample below, we see a continuous stripe, stitching, or intermittent stripes of glue and dots.



After application and closing, compression is critical. The hot, semi-molten, glue has little adhesiveness until it cools down. The mating surfaces, such as the flaps of a carton, must be compressed tightly during this cooldown. Some cartoners use a pair of side belts at the discharge. Some types of case packer use a mandrel that presses the bottom of the box against a backing plate.

Whatever the method, it is essential that compression is sufficiently forceful to assure good adhesion and of sufficient duration to allow the glue to set up.

This picture below shows an ice cream product as found in a supermarket freezer.



Good hot melt adhesion

No hot melt adhesion

The picture on the left is how a hot melt glue seal should look. It should adhere strongly enough that the paper tears rather than the glue joint separating when opening the carton. This shows that the glue was properly applied. Additionally, the tearing assures the customer that the carton has not been tampered with.

The picture on the right shows improper gluing. There appears to be sufficient glue applied. It appears to be adhering well to the inner major flap which indicates that the temperature was probably correct. Not apparent from the picture is the shape of the bead. It is rounded on top. This is what one would expect if the inner and outer flap had never been compressed together. My guess, based on examination of the carton is that the compression belts on the discharge of the conveyor were improperly adjusted.

This is another example of a similar problem. I found these excellent Italian pastries open on the shelf. Every single carton of this SKU was open. Of course I bought a carton to examine.



In this case, it appears that there was good glue adhesion to the top flap. Good compression was indicated by the flattening of the glue bead. Note the shiny surface of the inner flap. Normally flaps on glued folding cartons will have an uncoated area to promote adhesion. Some will have small diecuts for even better sealing. This carton has a chrome coating where the glue should adhere. It seems that, even when properly applied and compressed, this is a marginal surface for adhesion. I bought and tested



several other SKUs. Even when apparently sealed properly, they were very easy to open. Instead of the paper tearing, the glue releases.

Hot melt glue is a workhorse of packaging. Easy to apply and economical it has a million uses. It is not difficult to use properly if the glue is properly matched to the application and properly applied.