

## A NEW HIGH SPEED GLUE MACHINE

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### ABSTRACT

Traditional glue machine designs originated in the 1960's continue to have problems associated with uniformity, slinging, and glue weight control at ever increasing line speeds. A new design with a metering element geometry proven at speeds above 700 meters per minute has been developed. This metering element is so flexible that it can apply starch at the heaviest weight required or it can apply cold bond adhesives at the extremely low weights required for cost competitiveness.

The benefits derived from this improved uniformity and control include:

- A. Reduced warpage.
- B. Lower glue or adhesive consumption.
- C. Smoother board surface with better printability.
- D. More consistent cross machine properties.

### INTRODUCTION

The purpose of this presentation is to review the limitations of the conventional glue machine design, and present details of the advantages of the new glue machine mechanism.

Conventional Glue Machines:

The typical double facer glue applicator is a two (2) roll system. This is shown in Figure 1. An applicator roll is rotating in a pan of glue. This roll is typically a gravure cylinder with pattern of

10-25 grids/inch. A smooth chromed metering roll, adjustable from 0.004"-0.020" gap to the

applicator roll, rotates in the same direction as the applicator roll. Adjusting the gap between the metering roll and the applicator roll changes the glue film thickness and thus, the amount of glue applied to the single face flute tips. A hold down roll is used to force the single face into contact with the applicator roll.

Each of the three main elements contributes to the failure of the whole machine to operate

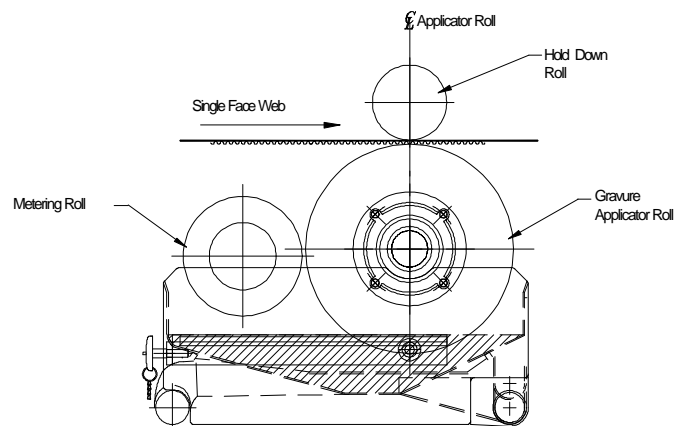


Figure 1

successfully at high speeds.

The gravure roll design limits its effectiveness. Since it has a cell structure, glue cannot be applied evenly as the flute wipes across its surface. After leaving contact with the flute tip, a varying amount of glue is left on the gravure roll.

The film split created when some of the glue leaves the cell and some remains, contributes to cross machine non-uniformity and slinging.

Gravure cylinders are also expensive to maintain and replace.

The metering roll is perhaps the biggest cause of non-uniformity. These rolls are always too small to prevent deflection from high speed hydraulic forces. Since the hydraulic forces vary non-linearly with speed, the roll must be continuously adjusted over the speed range to provide a constant average glue weight.

The deflection between rolls is greatest in the center, so that the middle of the board always receives more starch than the ends. This creates warping problems. The minimum gap that can be set between the two rolls sets a practical limit on the minimum glue weight that can be attained. This has limited the use of cold set adhesives, since the only devices available could not apply them at low enough rates to be economical.

The present hold down roll design has several limitations. As a relatively slender roll, its deflection causes the gap between it and the metering roll to vary from end to end. This affects the pressure distribution and causes cross machine caliper variations.

It has long been known that stronger boards are achieved by keeping the flutes as true to theoretical shape as possible without crushing. It is also known that the adhesive provides better bond strength when it is maintained as high on the flute tip as possible for a given coatweight. The single face comes into contact with the gravure roll with varying cross machine tension. The rider roll must apply some downward pressure to force the flute tips into contact with the gravure roll. This causes compression of the flute tips and reduces the strength of the board non-uniformly across the machine.

### The Rod Metered Glue Machine:

Our coating experience at Kohler comes from coaters used on paper machines for applications of starch and pigmented coatings. These generally are machines that operate at two or three times the speed of a corrugator and at 2 to 4 times the width. Additionally, since paper machines must go for weeks or months without stopping for maintenance or clean up, severe demands are placed on the equipment to provide reliable, easy operation.

The rod metered glue machine shown in figure 2 consists of two basic components, all field proven with many years of use; an applicator roll, and an ISO-BAR metering element.

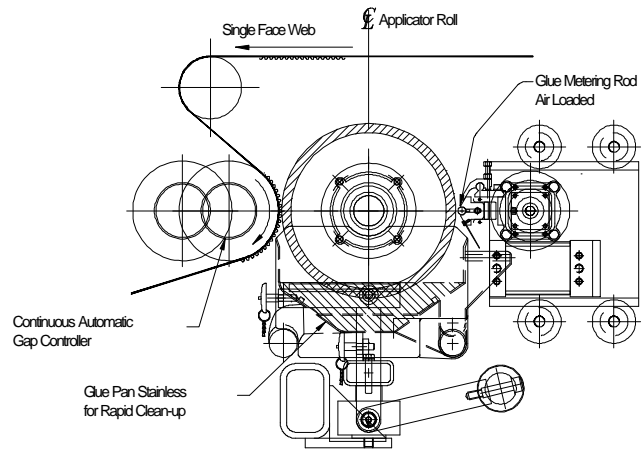


Figure 2

The applicator roll is a rubber covered roll, usually 0-5 P & J hardness. After glue has been volumetrically metered onto it by the rod, the glue assumes a seamless film thickness that is thinner than that required with a gravure cylinder applying the same coatweight. The surface of the roll is completely smooth, with no heavy pockets of coating to cause the slinging typical of gravure cylinders.

The ISO-BAR rod metering element provides the

precise control that has been so difficult to achieve previously. It consists of a grooved rod sitting in a plastic holder, which is loaded against the applicator roll by an inflatable air bag. The holder floats in a channel so that the force from the air bladder is uniformly transferred to the rod. The air bladder and holder make the rod conform to the surface of the roll. An isobar is a line of constant pressure on a weather map. The ISO-BAR metering element provides a line of constant metering pressure on an applicator roll. The grooved rod meters the fluid volumetrically with uniformity virtually independent of line speed. Glue weight can be fine tuned by air bladder pressure, change applicator roll speed, or changed completely by changing rod groove size.

Glue weight profile across the face of the applicator roll will vary by 2-1/2% or less. Its variation with speed is insignificant. This repeatably provides a truly uniform film of glue to the flute tips. The grooved rod is extremely tolerant of viscosity changes. It will pass the same volume of material to the flutes over a much wider viscosity change (over 100%) than any other device.

The Rider Roll is used to provide an even contact surface between the applicator roll and the flute tips.

The rider roll is geared to the single face liner without slippage. The DC digital drive on the rider roll becomes a positive pull point to maintain constant web tension. The applicator roll drive follows a reference from the rider roll so that the applicator roll is electronically geared to the single face web, not some other part of the machine. This eliminates machine direction variations caused by single face tension variation.

The rider roll holds the single face flat to its surface using line tension and 180° wrap angle. The gap between the rider roll and the application roll is set with digital adjustments

that can make a change as small as .01 mm. The flute tips wipe the glue off the applicator roll with virtually no contact pressure. Reduced flute compression results in stronger board that consistently runs at the high end of the caliper specification. If for any reason caliper must be reduced, the gap can be adjusted uniformly to provide the desired result. The board coming out of the glue station is consistent in cross machine and machine direction profiles.

#### Conclusions:

Higher line speeds and tighter performance specifications are exceeding the capabilities of industry standard machines. A new generation of glue machines has been designed and developed that will provide consistent cross machine and machine direction properties independent of line speed. These machines allow glue weight deposition rates that average from 20% to 50% less than required by older machines in order to deliver the same bond and crush strength. This results in smoother, more printable board with greatly reduced warpage. Additionally, since there is no practical lower limit to controlled glue weight, cold set adhesives can be used to further improve board properties and reduce energy costs and warpage losses.