

“EVOL” Large Box Making Machine for Corrugated Cardboard



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1. Introduction

Corrugated cardboard boxes are the most familiar form of packaging and are a key part of the world's logistics and commodity distribution systems. They are also considered to be earth-friendly products dealing with global environmental problems that are major issues of today's society, because they are circulation-type packaging materials that can be recycled after use.

Mitsubishi Heavy Industries, Ltd. (MHI) has been manufacturing corrugating machinery since 1955. Now MHI manufactures corrugators that make corrugated cardboard sheets and box making machines that make corrugated cardboard boxes from corrugated cardboard sheets, and sells them to customers all over the world.

MHI released the EVOL-84 box making machine (84-inch-type machine) in 2003 and the EVOL-100 (100-inch-type machine) in 2006, and has so far received orders for more than 250 units in total mainly from domestic, Asian and North American customers.

This paper presents the EVOL-115 (115-inch-type machine) and EVOL-125 (125-inch-type machine) large corrugated cardboard box making machines, which have been newly developed and released in addition to EVOL-84 and EVOL-100.

2. Corrugated cardboard box making machines

Figure 1 shows the basic configuration and processes of a corrugated cardboard box making machine. The flat corrugated cardboard stacked in the feeding unit enters the machine one sheet at a time. The printing unit prints on the board while it is being transferred by the transfer conveyor. In the creaser slotter unit, the board is creased and slotted to enable folding; it is then glued, folded, and formed in the folding unit. When the sheets finally reach the counter ejector, they are counted and stacked.

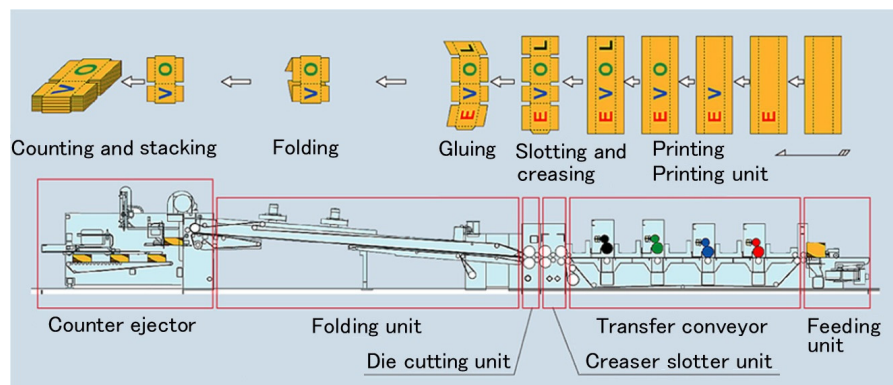


Figure 1 Basic configuration of corrugated cardboard box making machine

3. Basic specifications of EVOL series

The main objectives of the EVOL series are (1) high productivity, (2) the improvement of box quality and a reduction of losses, (3) production flexibility and (4) the improvement of operability and maintainability.

As automation of box packing in shipping processes of various products has become more prevalent, there is a growing demand for folding accuracy of large corrugated cardboard boxes that are difficult to fold. The developed wide EVOL machines follow the main objectives described above and enable the high-speed production of high-quality boxes.

The maximum production speeds of the developed wide EVOL-115 and EVOL-125 are 300 sheets per minute and 250 sheets per minute, respectively. The production speed of the developed EVOL-115 is 20% higher than that of the S-115 previous generation 115-inch-type machine, which was 250 sheets per minute. Therefore the developed wide EVOL machines contribute to the improvement of production efficiency or the shortening of production time at the plants of our customers.

Table 1 compares specifications between the EVOL series including wide machines and the products of other manufacturers.

Table 1 Comparison of specifications between EVOL series and competing products

Item	EVOL 84	EVOL 100	Wide machine		Earlier generation machine S-115	Competitor A	Competitor B
			EVOL 115	EVOL 125			
Maximum machine speed (sheets per minute)	400	350	300	250	250	250	225
Maximum feed paper dimension	870 x 2140	950 x 2555	1150 x 2930	1150 x 3185	1150 x 2900	1220 x 3045	1160 x 2890
Flow dimension x Width dimension (mm)							
Minimum feed paper dimension	220 x 690	250 x 690	290 x 690		300 x 750	280 x 785	300 x 700
Flow dimension x Width dimension (mm)							

4. Features of EVOL wide machines

This chapter describes new functions added to the existing EVOL series in order to attain the high-speed production of large boxes.

4.1 High-quality and high-speed production

There is increasing demand for the high-speed production of large corrugated cardboard boxes with corrugated cardboard sheet folding accuracy and stacking stability. EVOL wide machines have the following features in order to meet such customer needs.

(1) Folding unit: folding device using fans (**Figure 2**)

In the folding process, both edges (face 1 and face 4) of a corrugated cardboard sheet are folded while being guided by the belts. However, the higher the production speed becomes, the greater the tendency of bending or breakage of the corrugated cardboard sheet.

As a countermeasure, fans that support the folding of both sheet ends are added to the operating and driving sides. As a result, reasonable and smooth folding is attained and the folding accuracy is improved even in production with large corrugated cardboard sheets.

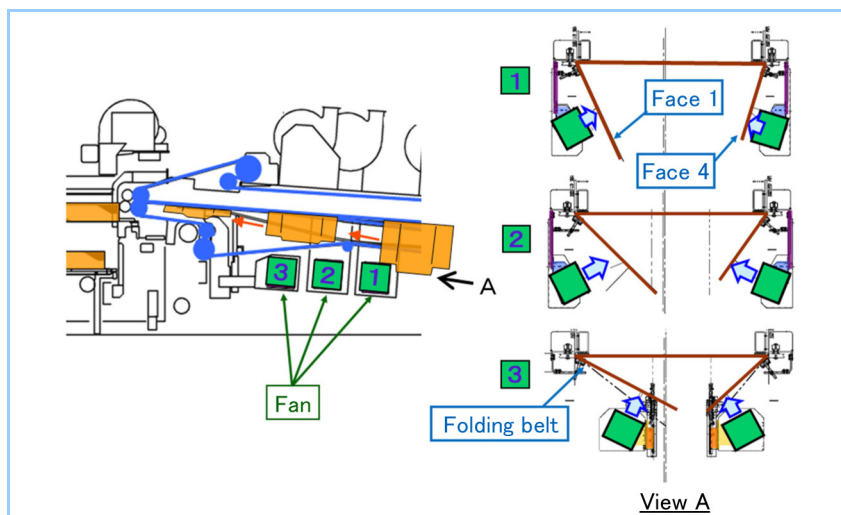


Figure 2 Folding device using fans

(2) Stacker: improvement of folding correction performance

In the stacking process, the front and rear parts of the folded and formed corrugated cardboard boxes are tapped repeatedly for aligning the folding form. However, high-speed operation may cause insufficient tapping numbers. As a countermeasure, independent tapping control with an independent drive system is employed in order to increase the tapping number and improve the tapping performance.

(3) Stacker: Stabilization of stacking of corrugated cardboard boxes (Figure 3)

To achieve the immediate falling of the folded and formed corrugated cardboard boxes in high-speed stacking, the upper blower blows down the box. However, large boxes cannot be blown evenly by a single blower and then may be inclined. As a countermeasure, an additional blower is employed so that the front and rear parts of a box are blown independently in order to stabilize stacking.

Due to these additional features, folding accuracy that enables a target jointing gap of ± 4.0 mm or less is attained even for large corrugated cardboard boxes (Figure 4).

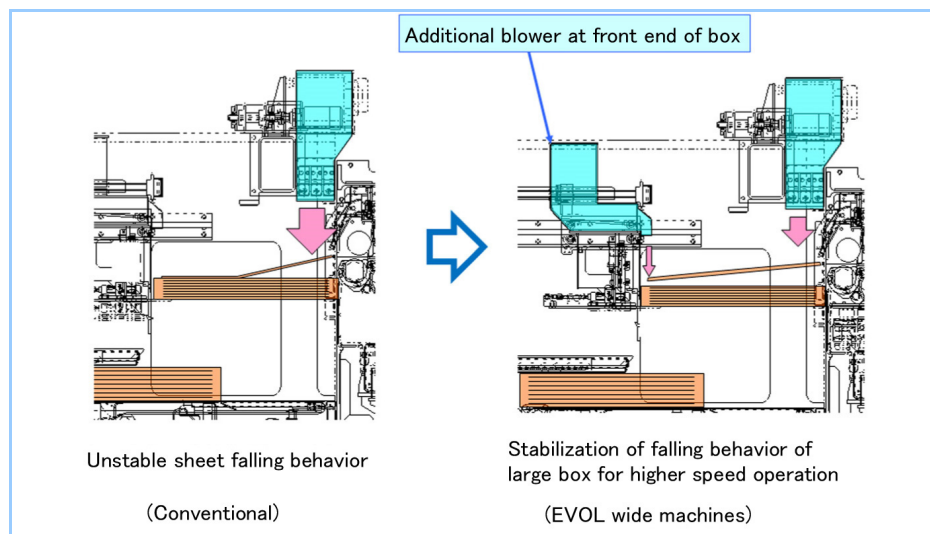


Figure 3 Stabilization of stacking of corrugated cardboard boxes

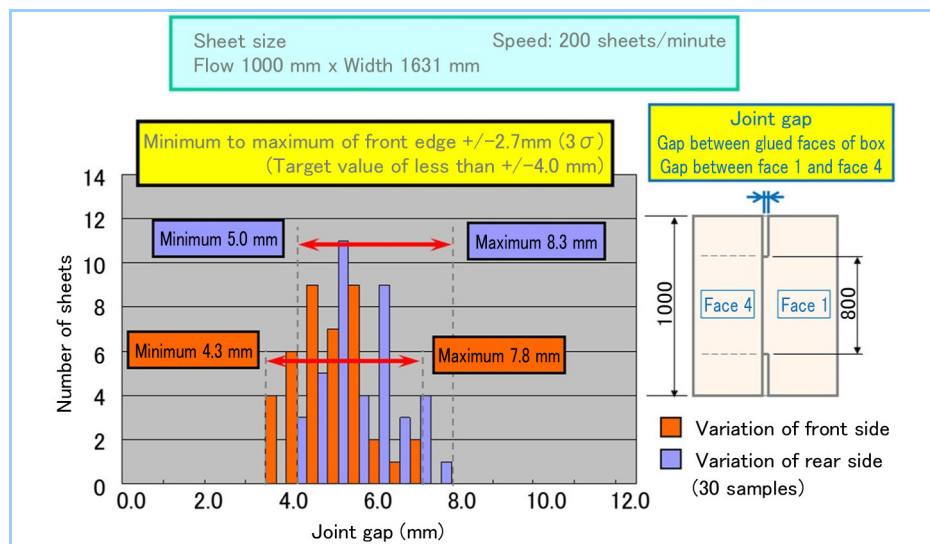


Figure 4 Example of folding accuracy data for large corrugated cardboard box

4.2 Improvement of operability

For the operation of a wide machine, hard-to-handle large corrugated cardboard sheets and large printing plates (relief printing stamps used for printing on corrugated cardboard surfaces) are used, and the burden on the operator increases as a result. The developed EVOL wide machines employ the following equipment in order to improve operability.

(1) Feeding unit: Automatic sheet loading

The S-115 previous generation machine requires the first pile of sheets to be loaded manually, and therefore it compels the operator to perform difficult work, especially when large

sheets are processed. The developed EVOL wide machines have a sheet support at the loading point, which enables automatic sheet loading in conjunction with the automatic operation of the pre-process sheet loading device (auto feeder).

(2) Printing unit: printing plate holding device (**Figure 5**)

For the production of large corrugated cardboard boxes, large printing plates are used in many cases. However, the installation and exchange of a large and heavy printing plate is difficult work, and sometimes needs to be performed as frequently as 150 to 200 times a day. As a countermeasure, a device that supports the holding of the printing plate during installation through the use of a pressing roller is employed for the improvement of operability. This enables the easy installation of large printing plates.

(3) Folding unit: Automatic setting of sheet folding guide bar (folding bar) (**Figure 6**)

During the folding of a sheet, both edges (face 1 and face 4) of the sheet are folded while being guided by the folding bars. To adjust the positions of the folding bars according to the sheet size, the machine has to be stopped and adjustment has to be performed manually. However, EVOL wide machines deal with the production of small to large boxes having various dimensions, and this need to be adjusted frequently.

Accordingly, a width-directional and vertical adjustment mechanism on the folding bars is employed so that adjustment can be performed electrically by easy push-button operation, even while the machine is operating.

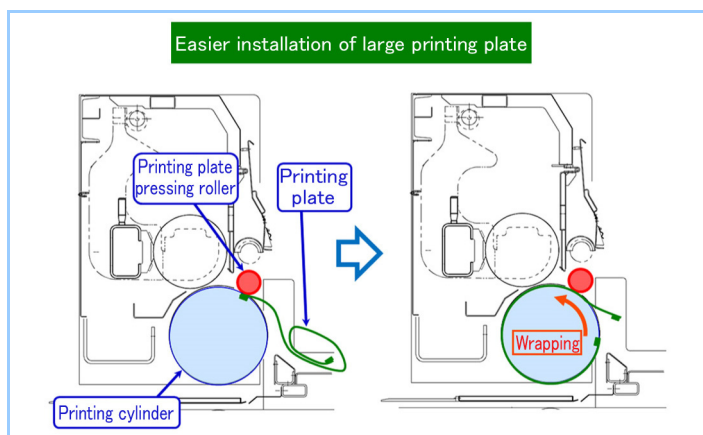


Figure 5 Printing plate holding device

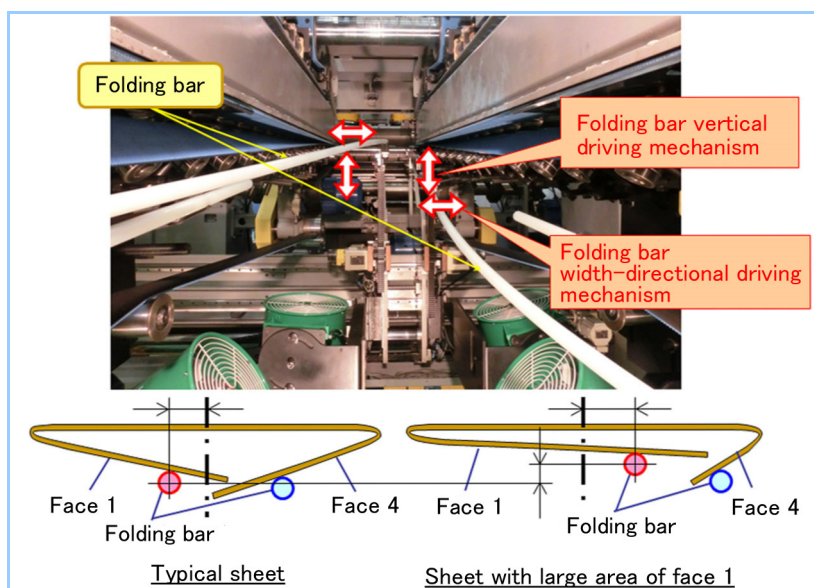


Figure 6 Automatic setting of folding bars

EVOL wide machines have the features described above for the attainment of high-quality and high-speed operation, as well as the improvement of operability even in the production of large corrugated cardboard boxes. MHI is willing to continue improvements in response to customer needs and contribute to the production activities of customers.