State-of-the-art screen printers from AISA

No templates, accuracy, quick set-up, high reliability and low maintenance are the principal features of all AISA screen printers. With a newly-designed registration system, in one machine screen printing can be done on windscreens, backlights, sidelights and quarterlights, which means cost-savings for the customer.

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Fig. 1
Universal glass registration system for any glass shape

Winning features

Since its inception in 1977, AISA has designed and engineered many glass handling machines with registration systems, using the knowledge it has acquired in robot manufacturing. Today, screen printing equipment is the focal point of the Italian company's production range. Printer models developed by AISA over the years have several different glass registration systems, considered state-of-the-art technology in this field, and have become landmarks for the competition. The same systems have been used for other purposes in glass processing lines, whenever precise positioning is necessary for a particular process.

The principal features of these systems are:

- no use of glass templates;
- great accuracy (within ±0.15mm, but with a very low standard deviation);
- quick set-up time;
- high reliability and low maintenance.

No templates

First, AISA systems do not require the use of templates (or nests) for windscreens and backlights. The glass is registered by rollers made of hard plastic, which are free to rotate. In order to protect the screen from the squeegee on the edge of the glass, AISA suggests attaching rubber nests to the lower face of the screen. If the registration is done on the entrance station, and a walking beam shuttle effects transfer of the glass to the printing table, squeegee support plates that do not touch the glass for registration can be positioned on the top of the printing table. Two reference holes are provided on the printing table in fixed positions.

Registration without templates allows the customer to save a considerable amount of money. There are two basic points to be taken into consideration about the potential savings:

1. The templates are often made of aluminium, polycarbonate or stainless steel with nylon inserts. This means, therefore, that the following points must be considered:

- raw material costs;
- labour cost in preparing the templates;
- the number of templates varies from 50 to 120;
- storage space;
- maintenance requirements due to wear.

The rubber nests used by AISA only for squeegee support are very cheap and can be cut roughly from rubber sheets; they do not need maintenance.

2. The rubber nests used by AISA do not need particular care in the application. Obviously, the same cannot be said about setting up registration templates on the printer.

Fig. 2 Screen printing machine for sidelights and vents

Accuracy

All screen printing machines are subjected to SPC - statistical process control - tests before leaving the factory. Special care is given to the glass registration system, for which we considered the theoretical limit of ±0.15 mm in the case of backlights and windscreen registration and ±0.2 mm for very asymmetrical glass shapes. Many reports of these tests have already been published in previous issues of *Glass-Technology International*.

All AISA screen printing machines are auto centring to permit minimal effects of the glass cutting tolerances that affect screen printing precision, and to eliminate any eventual slack generated by wear.

Since 1992, AISA has been producing screen printer *GHS17* for windscreens and backlights, which is capable of a cycle time of 9 seconds, with nine or ten numerically controlled axes for process parameters. This model has four or five NC axes (depending on glass shapes) only to register the glass, and reaches a standard deviation error on final glass positioning (including glass transport) of less than one hundredth of a millimetre with a Cp (process capability) greater than 6.

In late 1994, AISA then introduced a completely new glass registration system (patent pending), which has been installed, for instance, in the GHS37 screen printer. It works with six rollers made of hard plastic and is able to print asymmetrical sidelights and quarterlights on the same machine with the use of templates. Slight errors of the glass position can be corrected with three mechanical X-X-Y knobs with digital read-out, positioned on the operator side. The knobs are set in a zero position to register the glass in a pre-set position, which corresponds exactly to the position of the screen as registered in the master frame on the off-line pre-alignment table.

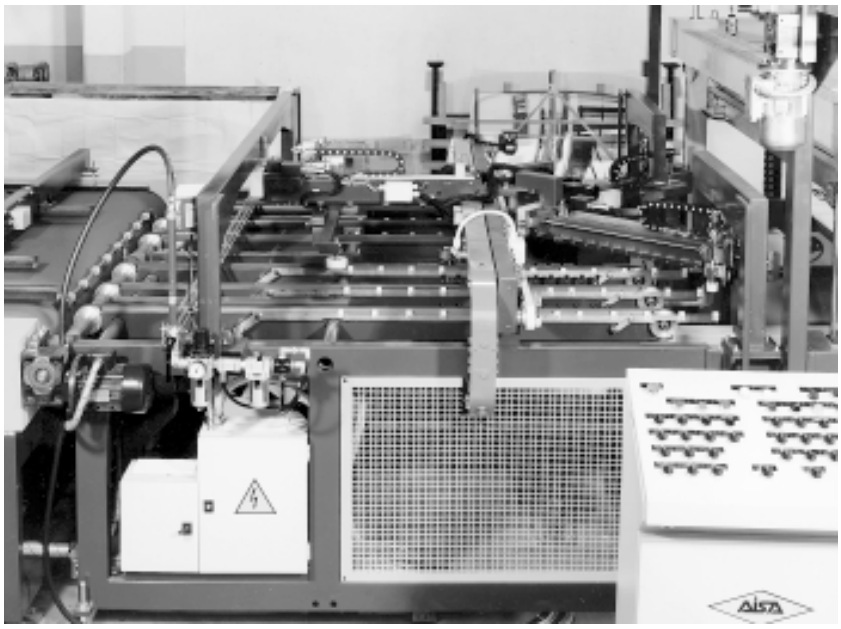


Fig. 3
NC glass registration system of GHS17-T

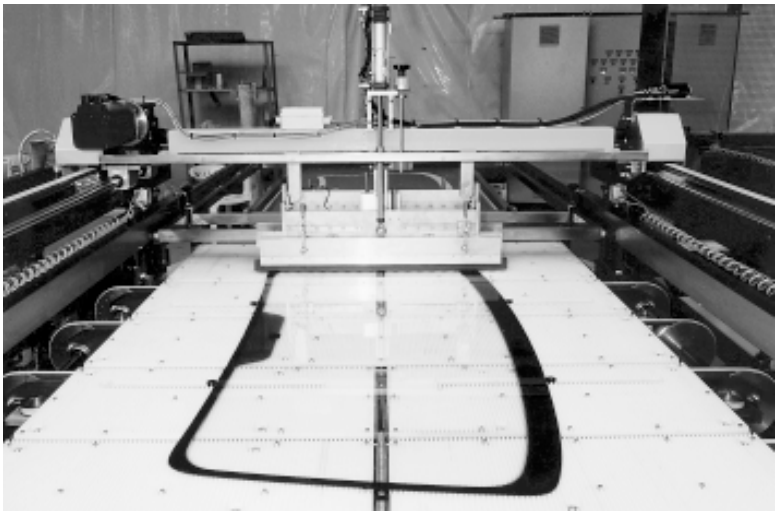


Fig. 4
Glass registration system of GHS37-T

This is more practical and allows the screen set-up time to be saved.

The new registration system guarantees high precision without using numerical axes. The result of standard deviation is less than three hundredth of a millimetre with a Cp greater than two, which is much better than what the automotive companies require.

AISA has, therefore, achieved the goal of drastically reducing the cost of the equipment, and at the same time has maintained the same features and almost the same performance.

Quick set-up

In the NC systems, all glass registration and printing parameters are stored in the PLC (or PC) memory. When the operator needs to change over the machine and set up new parameters, the only thing that needs to be done for glass registration is to select the new part number on the PLC or PC display. This means that GHS17 screen printers can be completely changed over in about 5 minutes from the last painted glass of a former part number to the first painted glass (which meets the customer's quality requirements) of a new part number, provided that the "off-line screen alignment table" is used.

In the new system without NC - GHS37 model - the glass position can be adjusted with three mechanical X-X-Y knobs with digital read-out positioned on the operator side. The knobs are set in a zero position to register the glass in a pre-set position that corresponds exactly to the position of the screen as registered in the master frame on the off-line pre-registration table. This is more practical than the usual procedure of screen locating on the machine, and allows the screen set-up time to be saved.

In addition, the new registration system has a short set-up time. The values of the X-X-Y axis can be memorised on a table for each part number and set by using the manual knobs with digital readout. In this way, the operator's action is limited to moving three knobs, and the "guesswork" of the operator during set-up is eliminated. This has been the aim of all AISA studies. The set-up time does not increase in comparison with the NC system in the GHS17 model.

Therefore, the total changeover time of the machine is still around 5 minutes from good glass to good glass.

Low maintenance

The speed and precision of AISA's printers have been achieved through technology acquired by the company during its many years of constructing robotic equipment. However, it is also due to a new design and manufacturing concept that considers the screen printer a machine tool.

For each movement, high quality components like prismatic guides with recirculating ball sliding units and brushless motors are used. And, in general, the machine is sturdily constructed, so that very high speeds can be obtained without causing vibrations.

The machines are designed to prevent any mechanical play and to give the same performance after years of operation. The reliability rate is very high, and complete production lines built by AISA have an engineering downtime of less than 1 per cent after five years.

New glass registration system

In the last six months, AISA has studied and developed a new glass registration system capable of registering in the same machine backlights or windscreens, sidelights, and quarterlights. This is done without templates or NC axes.

The system is installed in the printers with glass transport via shuttle, and it uses only two auto centring units, with five rollers (or four for quarterlights) mounted on arms. The position of each roller on the arms can be adjusted with a knob and a graduated scale. Fine misplacement of the glass can be corrected with three X-Y-Theta knobs with digital read-out, positioned on the operator side.

The set-up of the new system is only 2 minutes more than AISA's previous systems, but the versatility of this system, which is capable of registering any glass shape, is very attractive for the customer who cannot invest in different lines for backlights and for sidelights and vents.

The simplicity of the system's design can make it popular for sidelight screen printers, as well as for pick-up grippers for tempering furnace loading. This system has been tested at AISA's plant on a screen printer recently sold to Chrysler of the United States. The results of the test follow.

Statistical process control

The test was performed by measuring the final glass position on the printing table as one glass part was registered, transferred to the printing table and then deposited on it; these movements were repeated 100 times for the same part.

The variation of the glass position was measured along two axes, longitudinal and transversal in the direction in which the glass is moved (see Fig. 5 for method of measurement).

Statistical analysis of the test gave the results in Figures 6 and 7 where the extent of the specification was fixed to ±0.2 mm.

Fig. 5 Method used to measure glass positioning repeatability

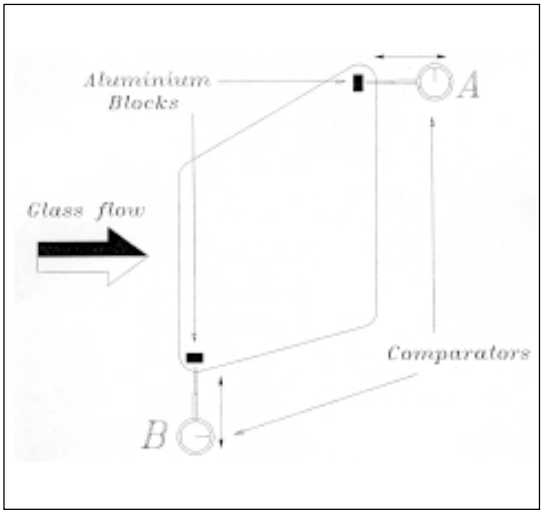


Fig. 6 - Glass positioning repeatability (comparator "B")

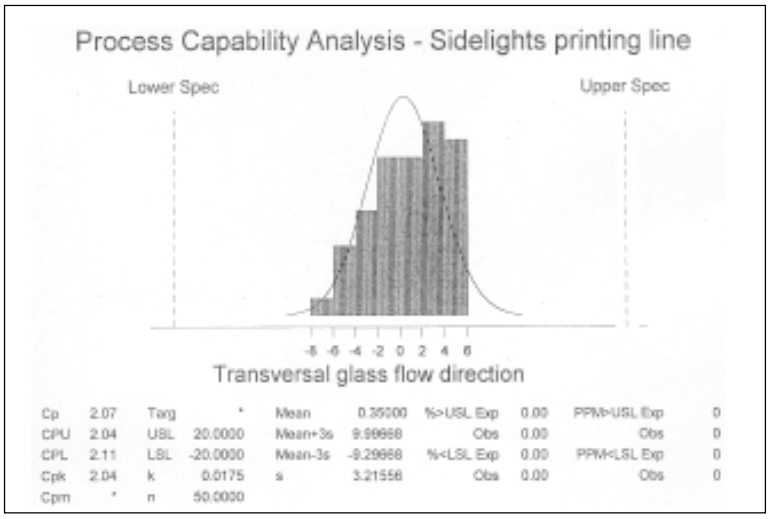
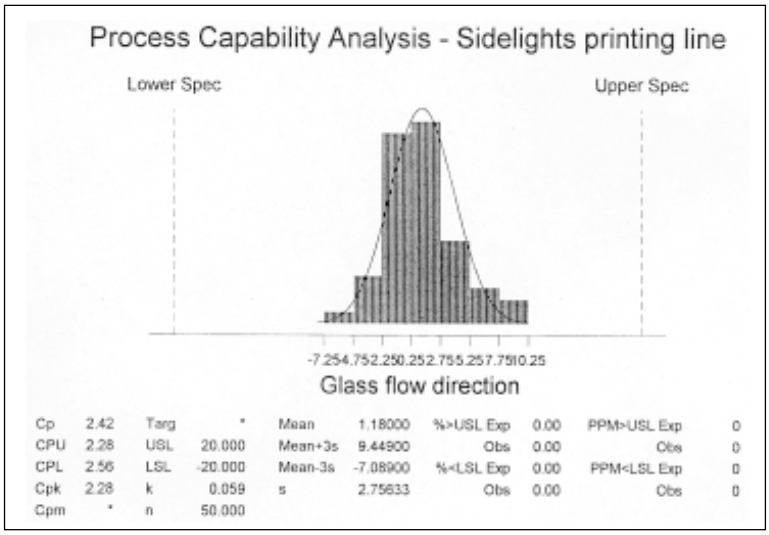


Fig. 7 - Glass positioning repeatability (comparator "A")



Conclusion

The results of the test show the success of AISA's investment in research and development, which keeps the company in the lead for high performance, efficiency and state-of-art technology.

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