

# Investing in inspection

PETER DETZNER AND ALFRED VOGEL ASK WHETHER IT IS TIME FOR AUTOMATIC PRINT INSPECTION

Should a glass decorator invest in an automatic print inspection system now? Ignoring the hype, the answer to this question is not a simple "Yes" or "No".

Today, digital cameras, computers and software algorithms for image analysis have advanced to a point where, for almost every specific application, a specific solution can be found. Two examples illustrate this point.



THE LONDON PRIDE LOGO WAS INSPECTED WITH AN AREA SCAN CAMERA AND BACKLIGHTING; A PINHOLE WAS DETECTED

## DIFFERENT SOLUTIONS FOR DIFFERENT IMAGES

A camera can have a resolution of 14 µm per pixel and can check extremely fine tracks printed onto a 100 mm x 200 mm ceramic substrate. A different camera can check multiple hot-foil-stamped images on a 1100 x 700 mm sheet of carton blanks at a speed of three sheets per second.

Glass decorators' requirements for automatic print inspection can be met: detection accuracy, speed and print sizes are well within the range of today's print inspection systems. However, different images require different solutions.

## DIFFERENTIATING BETWEEN IMAGES

Automatic print inspection of images on translucent glass hollowware differentiates between three types of images:

- single side images such as product logos or product descriptions printed on one side of round, oval or square glass items
- narrow bands that wrap around glasses or bottles
- wide wrap-arounds.

A single side image on a glass item is inspected with an area-scan camera. The glass item is held stationary, while the backlighting shines through the glass item. In this way, pin holes in the printed image can be detected.

## INSPECTING A NARROW BAND

A narrow band is inspected using a line-scan camera. A glass item is rotated underneath the camera. The camera is mounted at an angle to the glass surface, and a back light shines through the glass item. When the glass item rotates, only the image on the front of the glass item is in focus, while the back of the image on the other side of the item is visible but not in focus.

After one rotation, a sharp image of the complete band has

been captured. The associated fuzzy image of the back of the band has also been captured, but the fuzzy band is above the sharp band in the photo due to the angular mounting of the camera. The fuzzy band is ignored by the algorithm.

A wide wrap-around on a glass item is inspected by shining light onto the printed image while the item is rotating under a line-scan camera. Printed images on coated or opaque glass hollowware are also inspected in this way.

## DEFECT DETECTION

An automatic print inspection system delivers 100% inspection; this means the printed image on every item is inspected, but this does not equate to 100% defect detection.

The photo image captured by a camera is compared with a reference image stored in the system. The software algorithm can identify and then ignore stretch, compression or rotation of a printed image. Multiple internal re-positioning of each scanned image reduces the requirement for accuracy in positioning an item under a camera.

Error detection depends in part on the resolution of a camera and on the speed of a printed image rotating under the camera. On-line print inspection systems in screenprinting machines use black and white cameras with a resolution of 0.1 mm to 0.2 mm per pixel; the smallest detectable error would have an area of approximately 2 x 2 pixels. Black and white cameras are very cost efficient; colour cameras are available but the cost is higher.

An operator can define several windows within the reference image and set individual quality levels for each window. The software algorithm checks for variations in location and grey scale, and when a variation outside the set tolerances is detected, the item is diverted to a reject gate. ➤





PRINT INSPECTION USING A LINE SCAN CAMERA WITH A WIDE WRAP-AROUND



the same screenprinting machine, only one of the jobs – either the square or the cylindrical bottles – can be inspected with the camera of a print inspection system. Changing an area-scan camera for a line-scan camera is very time-consuming and not economical.

#### INVESTING IN INSPECTION

Returning to the question “Should a glass decorator invest in an automatic print inspection system now?”, the answer would be “Yes, provided the glass decorator is serious about continuous process improvements or wants to increase the level of automation and at the same time, substantially reduce the possibility that products with obvious print defects will be shipped to customers.”

Further increases in production speeds will render manual print inspection uneconomical; more automation of the decoration and packaging process will make automatic print inspection in high-performance screenprinting machines a necessity. ■

#### > EXPERIENCE AND TRAINING

Setting the windows and defining the quality levels requires experience in screenprinting and training in the use of an automatic print inspection system. An operator does not need to know the mathematics of the software algorithm, but a correct definition of the quality levels will ensure that items that have passed the inspection are free from print defects in the inspected areas and waste is not increased to an unacceptable level.

In most cases the introduction of an automatic print inspection system will initially increase production waste. The print inspection system is an unbiased measuring instrument: it classifies errors and provides a protocol of each print run. This makes it an ideal tool for glass decorators who want

to improve their screenprinting process. Any change made to their process can be checked for a resulting improvement in print quality. Print inspection can support continuous process improvements that in turn will significantly reduce production costs.

An automatic print inspection system will become a necessity when product handling between different process stages is automated. When printed products are automatically palletised or packed into cartons for shipping, print inspection will ensure that product shipments are not returned due to clearly visible print defects. Print inspection will also be necessary when print buyers insist on 100% inspection.

#### PRINT INSPECTION IN GLASS DECORATION

As stated above, print inspection is possible for virtually any specific application in glass decoration, but it requires advice from machine manufacturers and print inspection system suppliers to identify an economical solution.

The shape of the items and the images determines the type of camera used. For example, an area-scan camera is used for inspecting printed images on square bottles, a line camera for inspecting wide wrap-arounds on round bottles. When both jobs are to be printed on

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