# Perfection lies in simplicity

**FULL CRATE INSPECTION** | A new generation of full crate inspection systems offer a high level of flexibility in terms of application and user-friendliness, with reduced mechanical and sensor requirements. An innovative process uses a camera and a line laser that counters the disadvantages of current systems.

**FULL CRATE INSPECTION UNITS INSPECT CRATES** after the packer to see if they are complete. They are an integral part of quality control for filling lines. Today's technology includes on the one hand inspection systems that use sensors and on the other hand machines that use cameras and crate lighting. Both techniques, however, have their disadvantages. Sensor-based full crate inspection units are very awkward to operate; in particular changing the crate type is very complex, which in practice, given the increasing variety of bottles and crate types represents a significant disadvantage. With conventional camera-based systems, a satisfying test result can only be achieved for the different crate and bottle designs with a high level of technical effort. These problems can be solved by one inspection process that involves the use of a line laser in addition to a camera. Thus, a full crate inspection is possible that combines a high level of user friendliness with a comprehensive level of competence with respect to individually designed bottles and crates. This is achieved using „lean" technology that is cost-effective, low maintenance and is less susceptible to any disruptions.

## Sensor and camera-based full crate inspection units

Sensor based full crate inspection units use light sensors or ultrasonic reflection sensors, where the bottle cap is used as a reflective surface. Using a logic circuit, PLC or a microcomputer, the bottles in the crate are counted when it passes through the machine and the result is compared to the threshold value. Sensor-based full crate inspection units are, however, very complex to operate in practice. This is especially true if bottles of various types and with different types of closure are filled and different crate types are packed because, when the bottle or crate type is changed, the position of the sensors must be readjusted each time. Although so-called quick-change devices can be used, these involve a high level of mechanical and electrical work. Another disadvantage is that for special crate and bottle types the level of inspection reliability is reduced due to the large difference in cap colour, compartment order and the handles of the crates. Camera-based full crate inspection units also use a light source in addition to the camera that lights up the crate from above. Here, either standard lamps are used that have the disadvantage of a limited lifespan and a comparatively high energy consumption, or expensive and technically complex modern lighting systems are used, such as, for example, LED lighting.

These camera-based full crate inspection units also possess a high technical complexity in other respects in order to be able to achieve reliable inspection results. For example, additional light barriers to trigger the presence of a crate are generally needed.

## Camera-based full crate inspection units with line laser

Through the great advances in electronic and laser technology, disadvantages of existing design principles can be avoided. The result is the development of a full crate inspection unit that uses a line laser as light source in addition to the camera. This new type of full crate inspection unit can be set in the simplest way for almost all crate types, bottle-heights and cap colours, by just entering the specific crate and cap parameters. In addition, unusual types of crates and bottles are checked with the same level of reliability. What is amazing here is that overall a

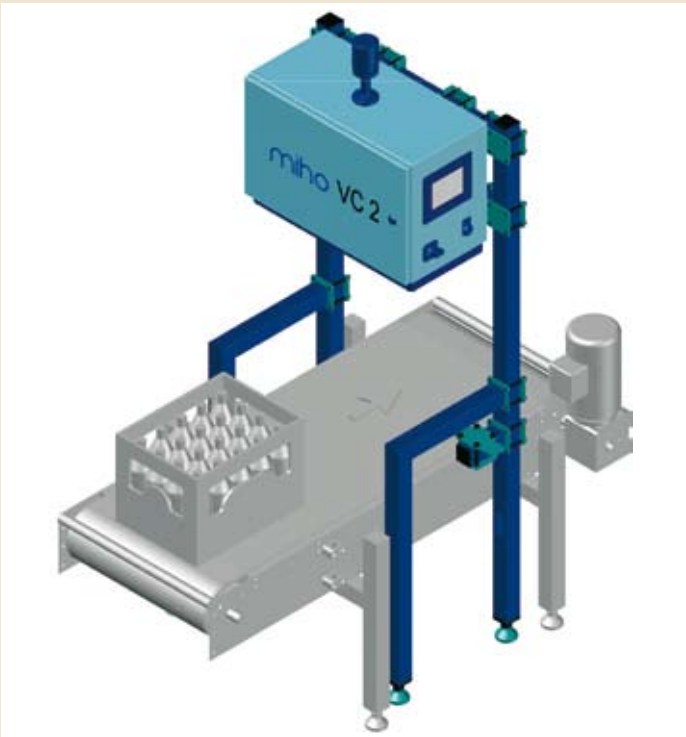


**Fig. 1**
**Example of an installation of the basic components**

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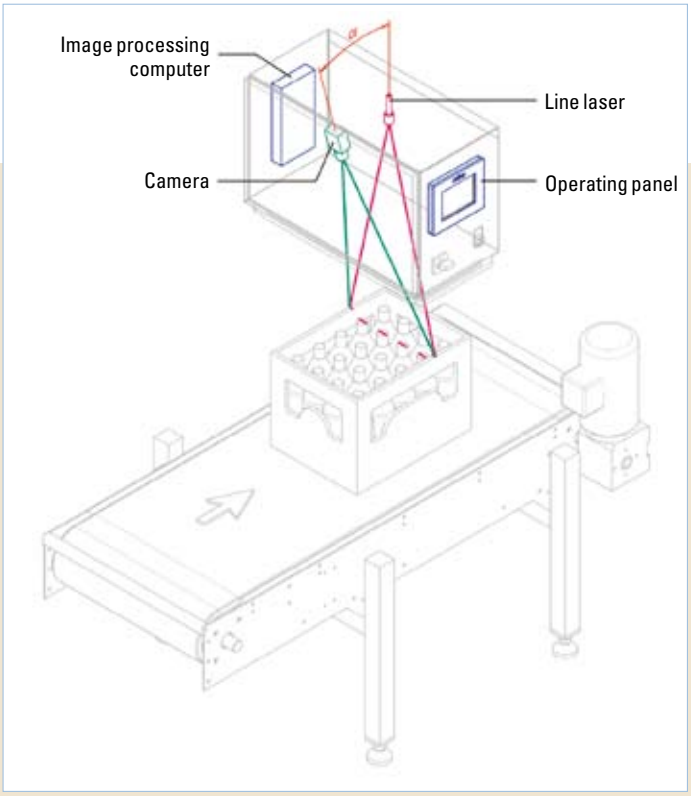


Fig. 2 Functions of the camera line laser construction

Fig. 3 Selected bottle and crate types at Voelkel GmbH

much lesser technical effort is needed, with tangible advantages, such as, for example, the operating safety of the machine and the maintenance requirements.

## Construction and inspection process

The basic components of this patent-pending full crate inspection unit are a line laser generator, a CCD camera and an image-processing computer with operating panel. The structure is shown in fig. 1, where you will see that all the components are in one housing. The installation requires little effort since apart from the supply cable for the operating voltage and possibly a cable to a reject system, no other cables for light barriers or sensors are required.

Fig. 2 schematically shows the arrangement of the line laser and its corresponding light ray in the cabinet, the image-recording camera, the image-processing computer and the operating panel.

In addition, you can see the reflecting red light of the line laser from the bottle cap. It is important for the functioning of the camera-line-laser construction that the camera and the laser beam should be arranged at a defined angle Alpha as is shown in fig. 2, that allows an additional height information to be generated from the image evaluation.

In contrast to camera inspection systems that use top illumination and which usually only evaluate one image, the new crate inspection unit evaluates many images. As long as the line laser is reflected by parts of the crate (for example, the crate edge) and by the caps whilst the crate passes under the inspection unit, the image-processing computer saves many images. Since the camera and the line laser are arranged at an angle Alpha, any lines recorded of higher reflection surfaces (for example, the crate edge or handle) will be displayed at the top of the image and lower reflection surfaces(for example, the compartments)will be displayed lower in the image.

The image-processing computer can therefore concentrate on assessing whether the crate is complete, in other words, on the reflection surfaces of the bottle caps that have been pre-selected when setting the machine. Reflection lines of the caps are represented, for example, as a broken line in the centre. Two small strokes, one on the left and the other one on the right further towards the top of the image represent the crate edge. Other image data that is not relevant for the evaluation is displayed outside the pre-selected image height and is therefore excluded from the analysis.

## An example in practice

Which advantages the new inspection process brings with it can be shown by taking a look at the machine in practice, with a brief before and after comparison. The new full crate inspection unit was recently installed in the filling line at the Voelkel GmbH in Pevestorf, Germany. The Voelkel GmbH produces fruit juices and many different kinds of drinks from high-quality organic raw materials. The bottles are packed in many different types of crates (fig. 3).

Previously, these cases were checked with a full crate inspection unit with light sensors to see if they were complete. Due to the many different crate sizes, the different arrangements of the compartments and the different handles in the crates going in different directions, the light sensors had to be repositioned for each change of crate type in production. The repositioning was awkward and in practical daily production hardly affordable. Some crates could not be checked at all with the existing light sensor device.

The new camera-based full crate inspection unit now performs a more reliable inspection for all crate and bottle-types. Production changes are now possible without any mechanical adjustments by just switching over on the display. Here, the evaluation of the expected image data is not only adjusted to the crate formats but also to a variety of cap colours. The time required for the conversion to other types of crates is reduced to a few seconds and can easily be carried out by the operating personnel.

## Conclusion

Line laser full crate inspection units have in the meantime, particularly in difficult applications, passed their practical test. They are characterized not only by a high level of flexibility in terms of crate formats, but also by their ease of use. All this has been achieved whilst also reducing the amount of construction involved. ■