



About **Boehringer Ingelheim**



Boehringer Ingelheim is a research-driven group of companies dedicated to researching, developing, manufacturing and marketing pharmaceuticals that improve health and quality of life. The **Boehringer Ingelheim Corporation** currently has 41,534 employees and 142 affiliated companies spread around the globe. www.boehringer-ingelheim.com

The Challenge: **Inspect 80,000 Medicine Capsules per Hour**

At their main location in Ingelheim, Germany, **Boehringer** produces, amongst other items, highly effective inhaled medications for respiratory disease. The active ingredient is loaded in micronized powder form into pharmaceutical hard gelatine capsules. Patients then load these capsules into specialized inhalation devices.

Each capsule contains only 5.5 mg of powder which is dispensed by filling machines into the capsules in the form of a weakly compacted cylinder. The precise and yet rapid dosing of such a small amount of powder is a masterstroke of **Boehringer** engineering. Nevertheless, there remains in this procedure, as in any industrial process, a residual risk that the amount deposited into individual capsules might deviate from the intended value. For **Boehringer**, such risk was unacceptable. To eliminate it, a 100% test system was required, but no capsule filling machinery manufacturer offered such a system.



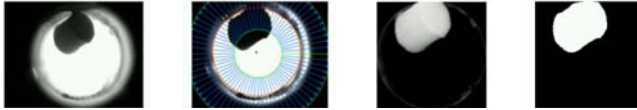
The Solution: Self-Developed Machine Vision Solution

Boehringer decided to develop and implement an optical testing facility in-house under the direction of Dr. Peter Stöckel, a senior scientist at **Boehringer**.

This system was positioned in the assembly process after the filling and before the sealing of the capsules. After filling, the content of each still-open capsule is imaged from above. The filling machine's clock pulse triggers a digital camera and its dedicated LED flash unit, not via the PC but rather directly via the camera's external trigger input. The half-capsule is then

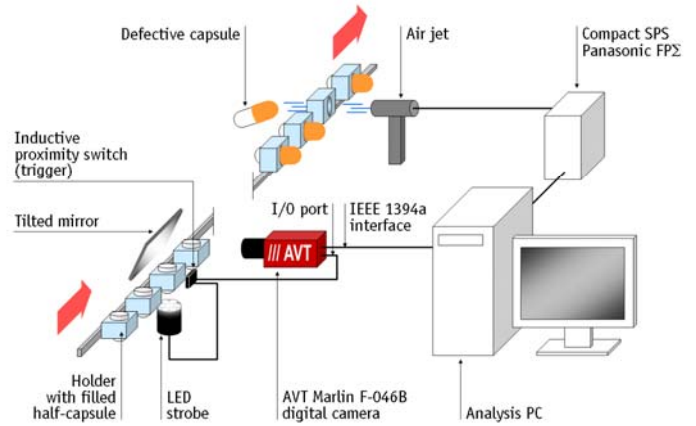
illuminated from below using a high-intensity LED. Since the camera cannot be housed over the capsules that are traveling past, it captures their contents via a tilted mirror on the side.

Via its FireWire connection (IEEE1394a), the camera transmits the image data to an industrial PC. There, applications software analyzes the images. The software was internally programmed by Boehringer Ingelheim based on NI LabVIEW 7.1 by National Instruments. After the capsule has been localized within the image, the imaging software first tests whether it contains powder at all. If so, then it analyzes the silhouette of the powder cylinder to derive the volumes and amounts of the active ingredient. If a capsule is identified as defective, it is sorted out by a SPS-controlled air jet.



Medical Capsule Inspection

Boehringer Ingelheim (Germany)



AVT Marlin Captures 22 Capsules per Second

The most important challenge for the testing mechanism is speed. "At an output of 80,000 capsules per hour, one capsule leaves the filling machine every 45 ms – put another way, the capsules move at a speed of 1.5 m/s", calculated Dr. Stöckel. For the camera, this means that 22 capsules per second must be captured. To avoid motion blurring, the exposure time cannot exceed 80 μ s.

The camera in use is a Marlin F-046B from Allied Vision Technologies. According to Dr. Stöckel, the AVT Marlin camera meets these tough requirements fully and completely. "We're very satisfied with the Allied Vision Technologies camera. In continuous operation, it gives us sharp images that are indispensable for reliable evaluation", the Boehringer expert explained.



Use in Practice: Serial Production on Several Machines

Meanwhile, the imaging system has successfully been installed on several machines in series production. "We are especially proud to have developed this innovative testing procedure in-house, in cooperation with Allied Vision Technologies and National Instruments", commented Dr. Peter Stöckel.

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**Dr. Peter Stöckel,
Boehringer Ingelheim Pharma GmbH & Co. KG**

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