OPTO ENGINEERING

OPTICAL IMAGING TECHNOLOGIES

OPTICS · LIGHTING · CAMERAS · SOFTWARE · ACCESSORIES · VISION SYSTEMS

November 2016

Smart vision and optical solutions
for the food and beverage industry

M. Castelletti – *Product Manager*

OPTO ENGINEERING

Table of contents

Table of contents

About Opto Engineering

simple works better

About Opto Engineering

WHO WE ARE

Opto Engineering designs and manufactures optical and illumination systems
for the machine vision industry since 2002.
We specialize in OPTICAL IMAGING TECHNOLOGIES.
Our focus is to build and provide every single component needed to solve imaging applications.

OPTICS

LIGHTING

SMART CAMERAS

SMART VISION SYSTEM

Telecentric	**360° optics**	**Zoom**	**LIghting**	**Smart Cameras**	**Smart Vision system**
2003	2009	2011	2014		2016

Global presence

Opto Engineering HQ
Mantova
ITALY

Opto Engineering GmbH
Munchen
GERMANY

Opto Engineering USA
Houston
USA

Opto Engineering CHINA
Shanghai
CHINA

Opto Engineering South East Asia
Taipei
TAIWAN

Booth 1F44 Hall 1

Our driving principles

Innovation

To set new standards in machine vision.

Simplicity

To ensure the smoothest integration between optical imaging components and mechanics.

Quality

To deliver every product with a certified quality.

Service

To further improve our connection with the local markets thanks to our major locations in Germany, Italy, North America, China and Taiwan.
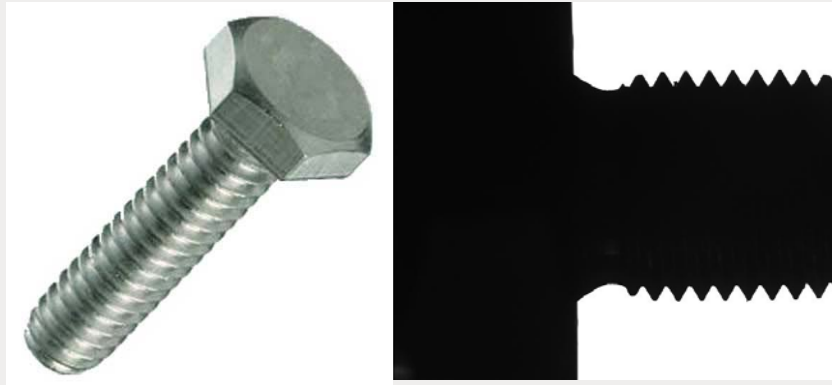
Booth 1F44 Hall 1

Table of contents

TRADITIONAL VISION SYSTEMS

SCREW MEASUREMENT SYSTEM

Operate with **well defined single-variable pass-fail criteria**

The goal of the system is to
- check the dimensions on a screw
- **reject** the component **if one of the dimensions is out of tolerance**

FOOD INSPECTION

CHALLENGES

- The acceptance criterion is often a **complex combination** of many parameters

- The **severity** of the defect is a **subjective** combination of multiple variables

- Products feature a **high degree of variability in shape and/or color**

- One single line is used for **multiple products**

- There is need to simply and rapidly modify the acceptance criteria in order to
    - **inspect new products**
    - follow **changes in production requirements**

FOOD INSPECTION

?

OPTO ENGINEERING

FOOD INSPECTION

Smart vision system based on NEURAL NETS

Smart vision system for food inspection

FOOD INSPECTION

Neural networks

software algorithms that mimic the human brain

- They learn from examples (as humans do) –> easy to use (no complicated settings)
    - They are adaptive → easily tailored to inspect new products

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ALBERT is a vision system for SHAPE and COLOR inspection, based on artificial intelligence techniques.

Learns from examples as humans do.

14

Smart vision system for food inspection

ALBERT

Inspects complex products with high variability as **simply** as a human operator would.

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ALBERT

Self-learning

Learns the features of your products **directly from the production line** without complicated settings.
NO NEED to present the good parts only.

Booth 1F44 Hall 1

ALBERT

Self-learning
Learns the features of your products **directly from the production line** without complicated settings.
NO NEED to present the good parts only.

Simple and Intelligent
Inspects in a more strict or tolerant way by simply moving a slider according to different production requirements.

START | Auto LEARN 100 | LEARN | N° PRODUCTS 100 | STOP
SEVERITY — 4

Booth 1F44 Hall 1

ALBERT

Self-learning
Learns the features of your products **directly from the production line** without complicated settings.
NO NEED to present the good parts only.

Simple and Intelligent
Inspects in a more strict or tolerant way by simply moving a slider according to different production requirements.

Suitable to identify complex defects
Understands the quality of products even with complex features and high variability.

Booth 1F44 Hall 1

Smart vision system for food inspection

ALBERT

Self-learning
Learns the features of your products **directly from the production line** without complicated settings.
NO NEED to present the good parts only.

Simple and Intelligent
Inspects in a more strict or tolerant way by simply moving a slider according to different production requirements.

Suitable to identify complex defects
Understands the quality of products even with complex features and high variability.

IP65 Rated
Ideal for the food industry.

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Smart vision system for food inspection

ALBERT

SPECS

Increase / decrease
SEVERITY LEVEL

POWER

STOP CHECK

START CHECK

Press together
LEARN PHASE

LED diffuse strobe illuminator, white

8 mm f1.4 f16 lens
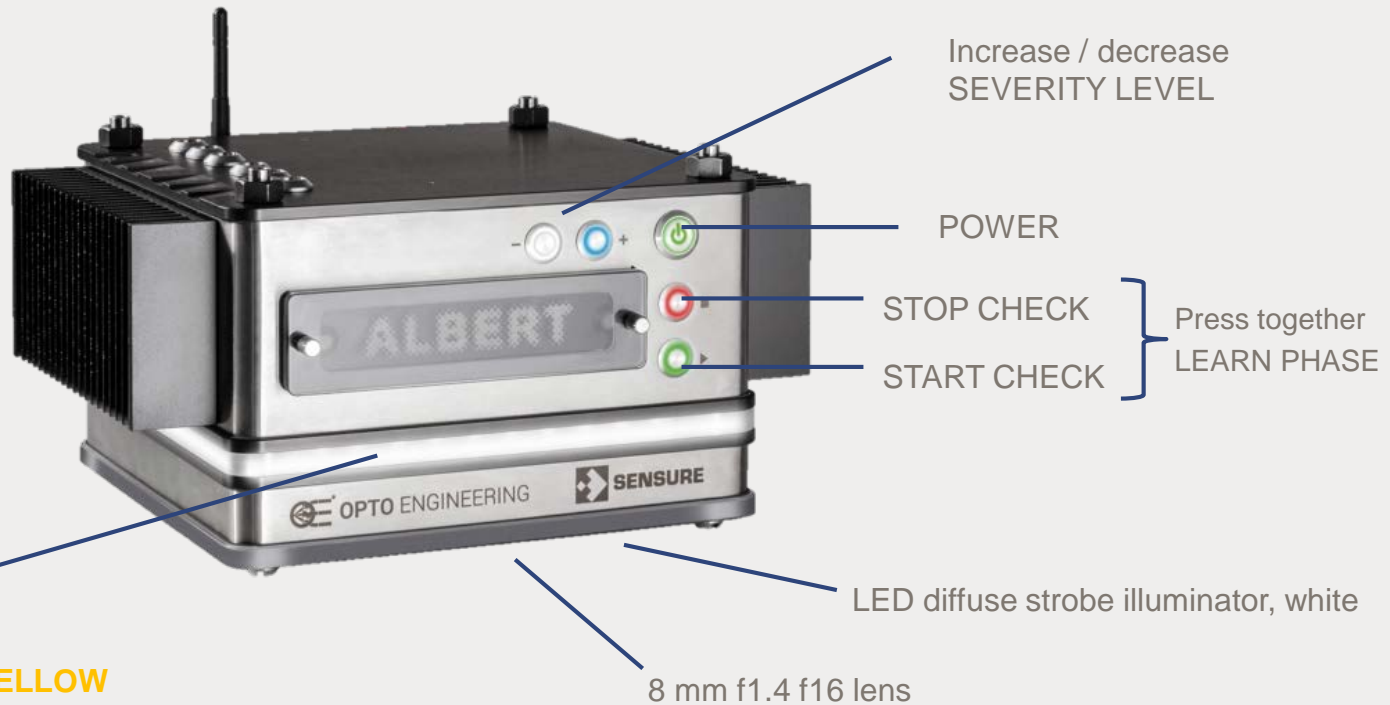
LED status BAR
LEARN PHASE = **YELLOW**
CHECK PHASE = **GREEN** (OK PART) **RED** (NOK PART)
SET SEVERITY LEVEL = **BLUE**

Booth 1F44 Hall 1

Smart vision system for food inspection

APPLICATIONS

→ **PRODUCTS FEATURING NATURAL VARIATIONS IN THEIR INGREDIENTS**
→ **PRODUCTS FEATURING A HIGH DEGREE OF VARIABILITY IN SHAPE AND/OR COLOR WHERE TRADITIONAL VISION SYSTEMS SUFFER (e.g. → FOOD)**
→ **PRODUCTS THAT ARE NOW INSPECTED BY HUMAN OPERATORS (OBSERVATION)**
→ **ONE SINGLE LINE FOR MULTIPLE PRODUCTS**
→ **NOT OVERLAPPED PRODUCTS**

Booth 1F44 Hall 1

Smart vision system for food inspection

APPLICATIONS EXAMPLES
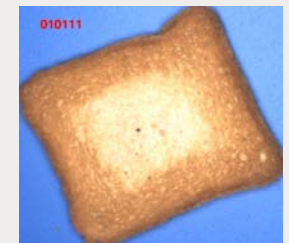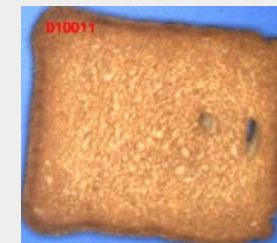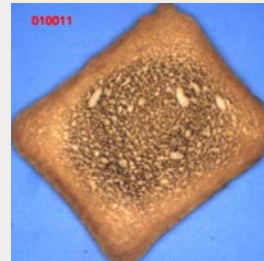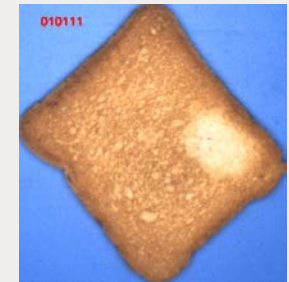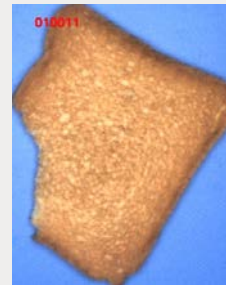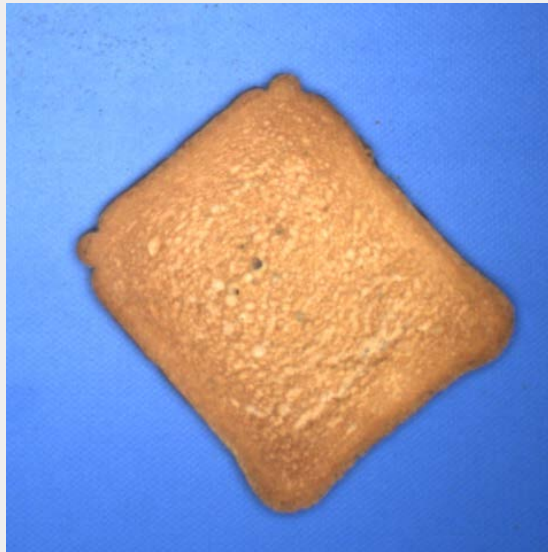
TOASTED BREAD

OK	TYPE OF DEFECTS

Booth 1F44 Hall 1

APPLICATIONS EXAMPLES

TOASTED BREAD

OK	TYPE OF DEFECTS

Booth 1F44 Hall 1
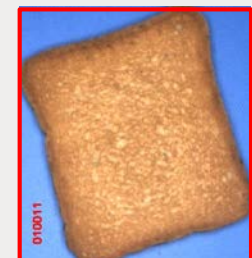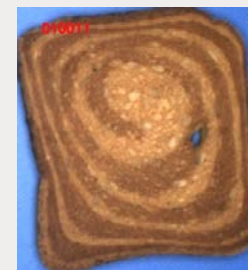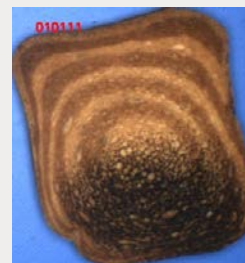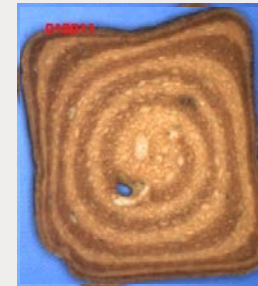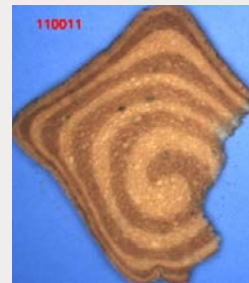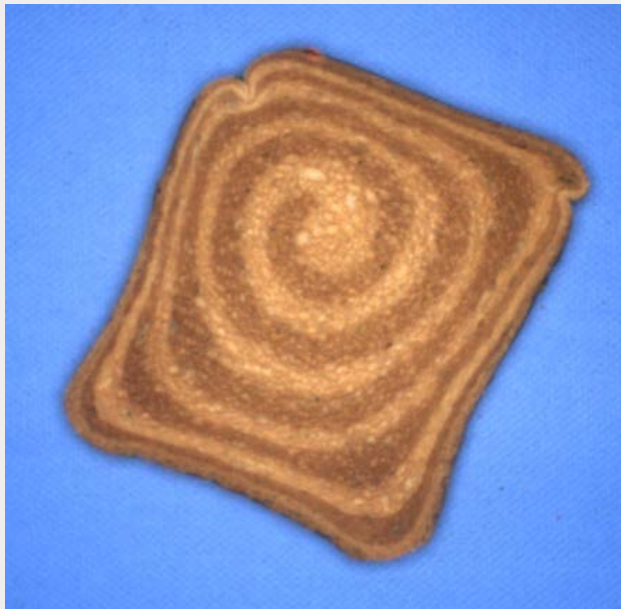
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APPLICATIONS EXAMPLES

COOKIES

OK   **TYPE OF DEFECTS**

OPTO ENGINEERING SENSURE   Booth 1F44 Hall 1
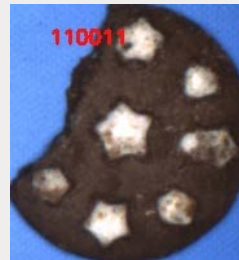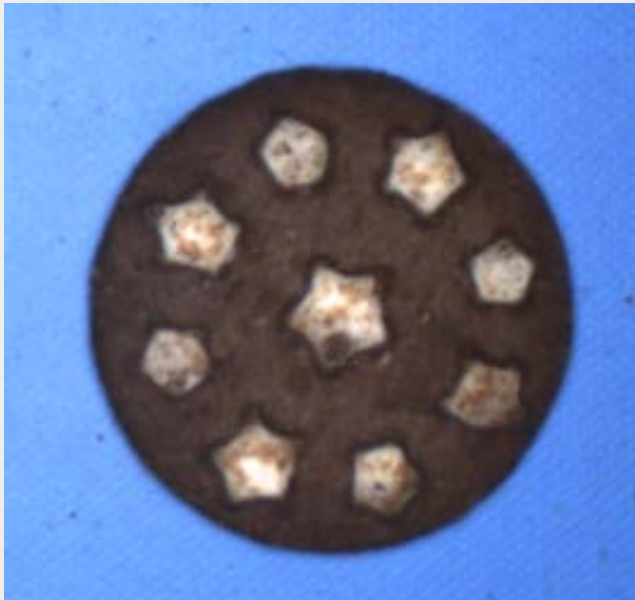
Table of contents

1	**Who we are**
2	**Smart vision system for food inspection & application cases**
3	**360° Optics & application cases**

ENTOCENTRIC

TELECENTRIC

PERICENTRIC

Booth 1F44 Hall 1

ENTOCENTRIC (FIXED FOCAL)

Diverging rays

Entrance
pupil

Entocentric: entrance pupil inside lens

10 mm

TELECENTRIC

Parallel rays
infinity

Entrance pupil

infinity

Telecentric: entrance pupil at infinity

10 mm
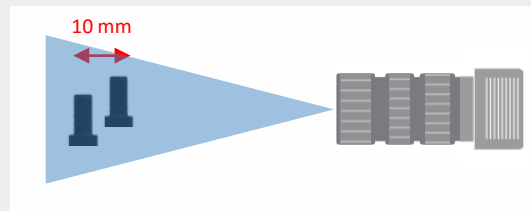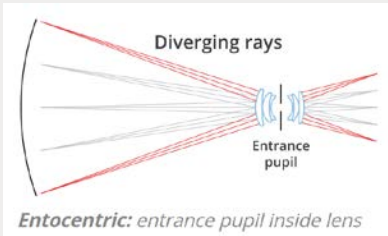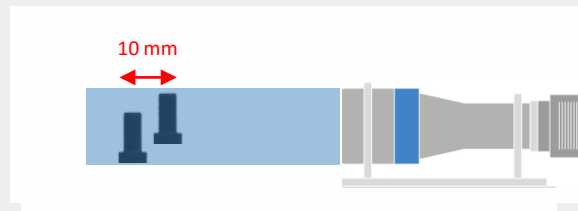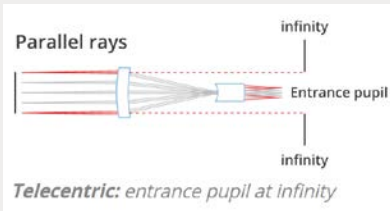
Required for dimensional measurement imaging applications

PERICENTRIC or 360° VIEW OPTICS

Convergent rays

Entrance pupil
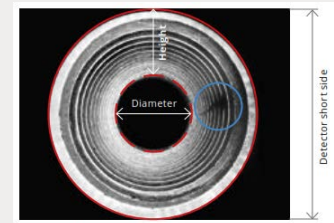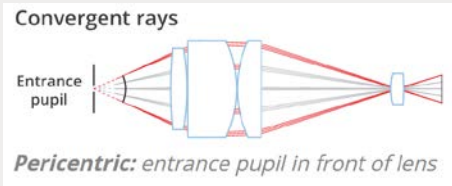
Pericentric: entrance pupil in front of lens

Traditional approach:
use of 4-5 cameras with FFL lenses

360° view optics:
complete inspection with 1 camera

- Flexibility to be adapted to different sample formats and sizes
- Complex software work, sincronization and alignment of cameras is pricy and time-consuming

- Unique solution
- Inspection from the TOP (compact solution)
- Use of 1 camera instead of 4-5 cameras
- No need for specific sample orientation, the defect is always visibile
- Less components = less possibility that something gets broken and has to be repaired

- Accurate centering is needed
- Less resolution vs 4-5 cameras
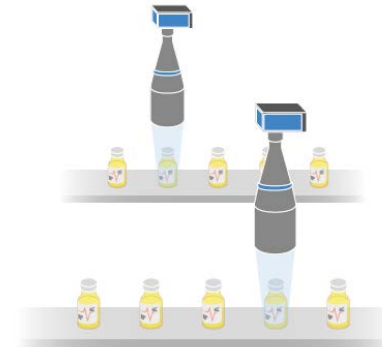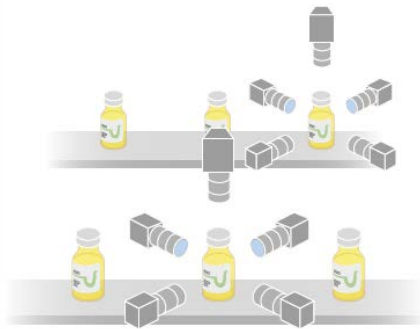
360° view optics & application cases

Product: PCCD012 CATADIOPTRIC LENS

360° imaging of small objects

Parts down to 7.5 mm in diameter can be imaged
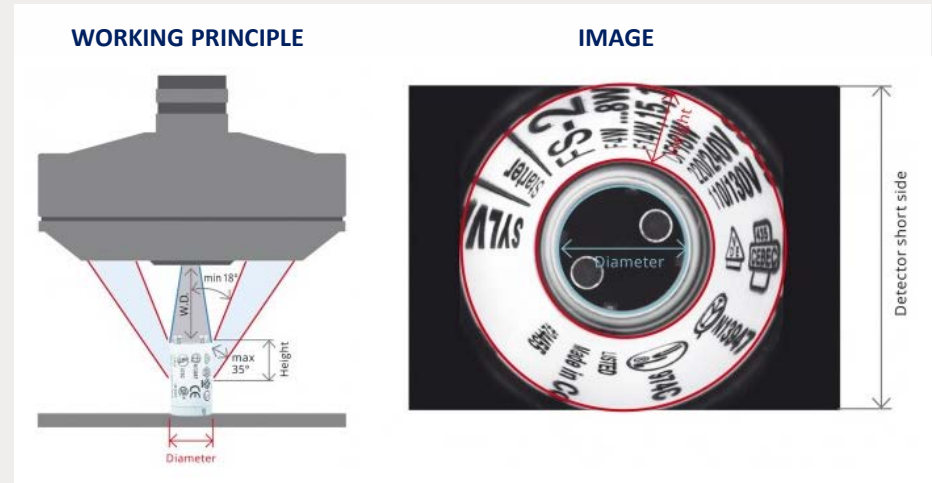
Extra wide lateral viewing angle

Object sides viewing angle approaches 45°

Compactness

The lens can be easily held and integrated in any system

Perfect chromatic correction

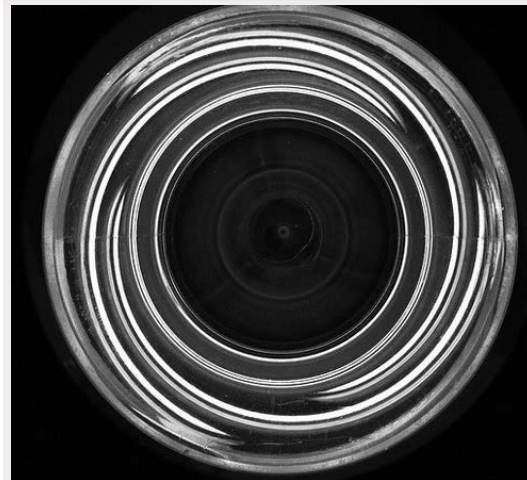For RGB camera applications and color inspection

WORKING PRINCIPLE   IMAGE

Product: PCCD012 CATADIOPTRIC LENS

Application: Examining the threads of a PET bottle neck preform

OBJECT

IMAGE

Detection of:

- Incomplete thread

- Defective thread

- Oval Shape

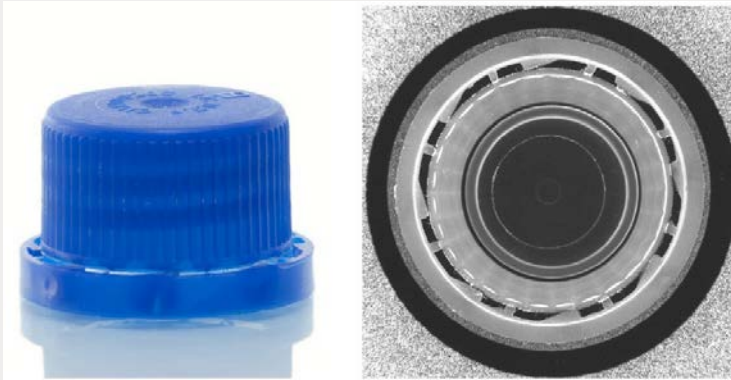- Mouth defects

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Product: PCCD012 CATADIOPTRIC LENS

Application: Examining the integrity of caps retaining rings

OBJECT   **IMAGE**

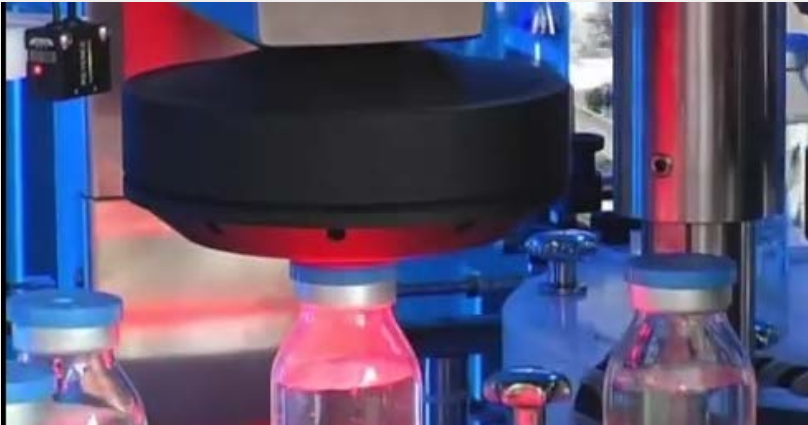**Detection of:**

- Integrity of retaining ring

- Oval Shape

- Color

Product: PCCD012 CATADIOPTRIC LENS

Application: CHECK FOR CORRECT SEALING OF VIALS (FLIP OFF CAP)

SA10 automatic inspection machine for vials

- Production of 6.000 p/H - Totally electronic

- Products are loaded in the machine through baskets.

- Separated in "good" and "reject"

Detection of:

- Stopper absence

- Defective Crimp

- Dents

- Flip Off Deformation

- Wrong Color

- Cap Scratches and Deformation
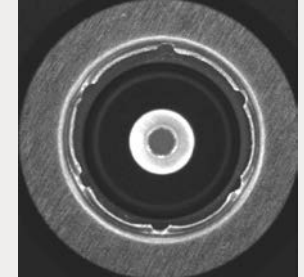
Image courtesy CMP Pharma

Product: PCHI023 hole Inspection optics

Perfect focusing of holed objects
Both the walls and the bottom of a cavity are imaged in high resolution

Cavity inspection from the outside
No need to put an optical probe into the hole

Very high field depth
Objects featuring different shapes and dimensions can be imaged by the same lens

Wide viewing angle
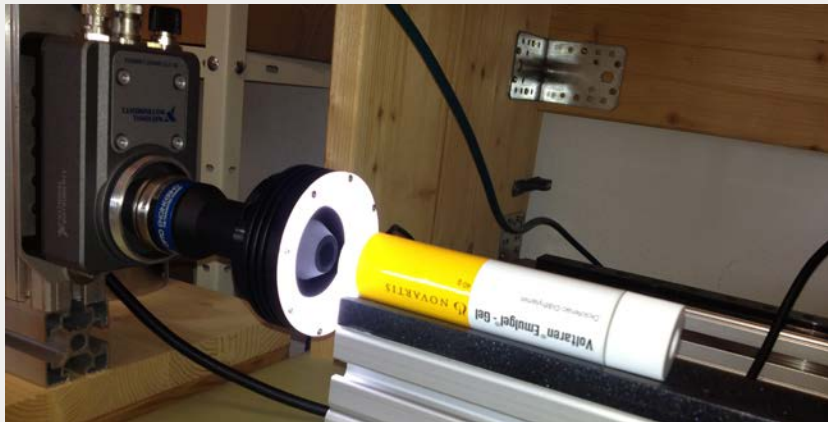Sample surfaces are acquired by the lens under a convenient perspective to clearly display their features

Cavity vertical wall

Cavity bottom

NO DEFECTS   MISSING PART

Booth 1F44 Hall 1
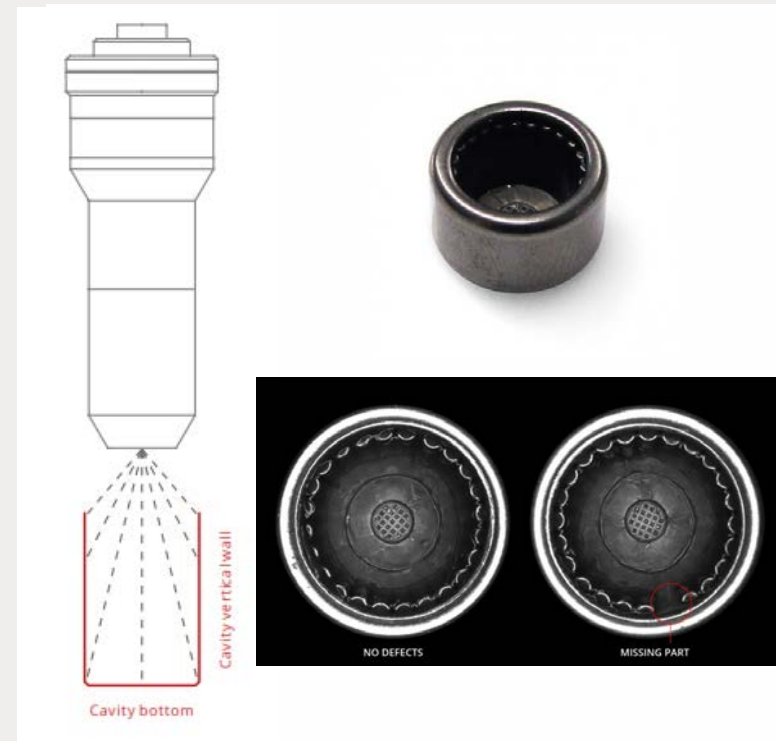
360° view optics & application cases

Product: PCHI023 Hole Inspection optics

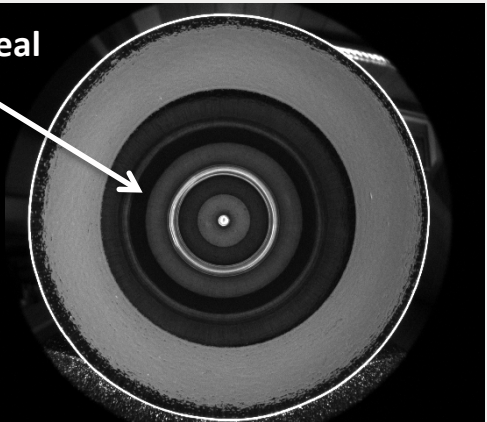**Application: Check of aluminium tubes for latex seal integrity**

SET UP

IMAGES

NOT OK

OK

latex seal

Zind Engineering
Your Partner for VISIONs

Image courtesy ZIND ENGINEERING

Product: PCHI023 Hole Inspection optics + ringlight

Application: Icream cups code reading
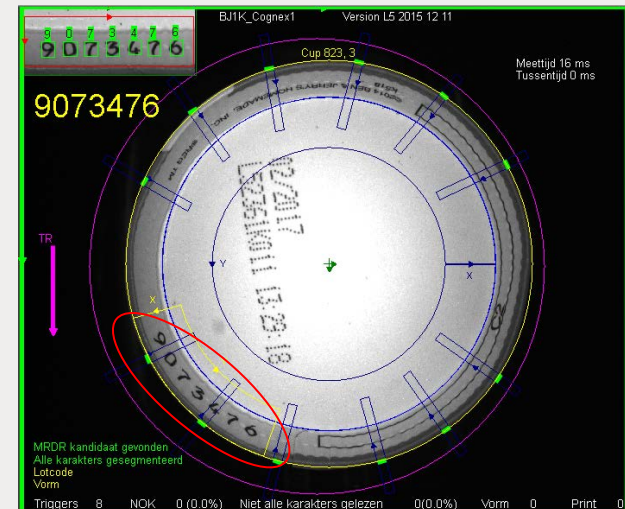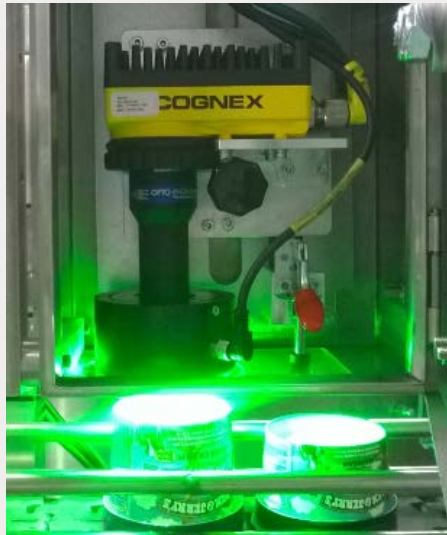**image and read code inside the wall of the jar for its identification**

SET UP

IMAGES

Image courtesy AMVS Netherlands

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Product:

PCHI023 Hole Inspection optics + LTLAB2-W high power strobe ringlight

Application: caps inspection

Camera:
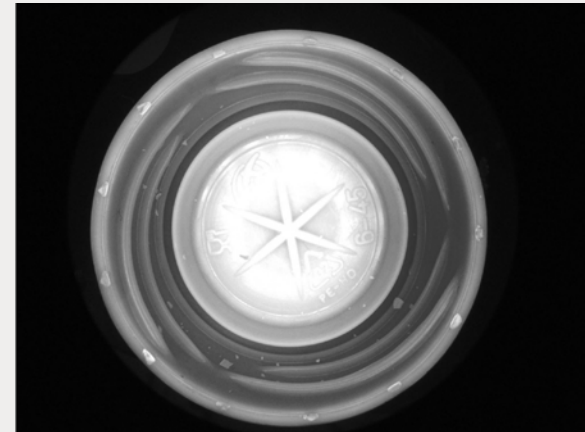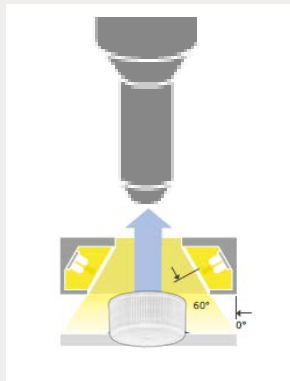
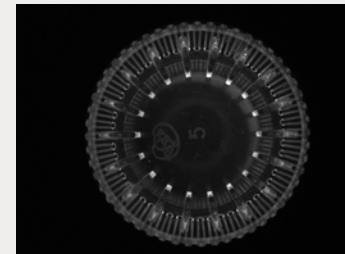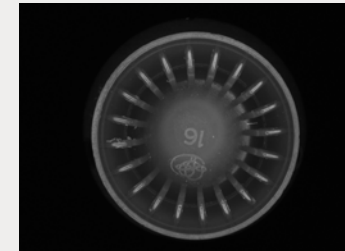**Exposure time = 50 µs**

Sensor= 1600x1200 4.4 µm

Optics:

PCHI012

Lights:

LTLAB2-W

Strobe controller:

LTDV1CH-17V

SET UP

IMAGES

Booth 1F44 Hall 1

Product:

PCHI023 Hole Inspection optics + LTLAB2-W high power strobe ringlight

Application: caps inspection

Optics:

PCHI012

Lights:

LTLAB2-W

Camera:

Exposure time = 50 μs

Sensor= 1600x1200 4.4 μm

Strobe controller:

LTDV1CH-17V

SET UP

IMAGES

Booth 1F44 Hall 1

OPTO ENGINEERING

Product:

PCHI023 Hole Inspection optics + LTLAB2-W high power strobe ringlight

Application: caps inspection

Camera:
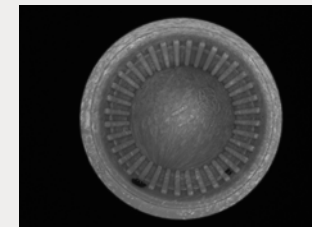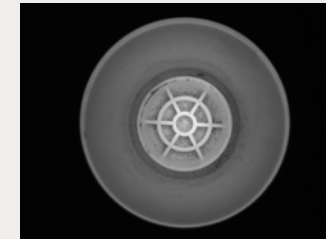
Exposure time = 50 μs

Sensor= 1600x1200 4.4 μm

Optics:

PCHI012

Lights:

LTLAB2-W

Strobe controller:

LTDV1CH-17V

SET UP

IMAGES

Booth 1F44 Hall 1

OPTO ENGINEERING

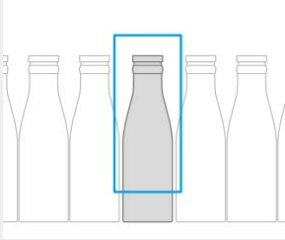**High power strobe lights**

Beverage industry typical conditions

- Inspection of fast moving parts

- Cameras set at short exposure times

- Optics set at high F/N

Whenever the image is too dark, ways to obtain a processabile image are:
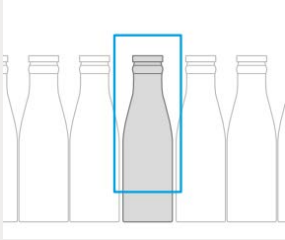
Increase camera gain → which leads to higher noise level

Lower the lens F/N → which leads to higher aberrations (e.g. coma / spherical aberration) and decrease in depth of field

Both of these ways will however lead to an image
where *fewer details* can be distinguished.

Booth 1F44 Hall 1
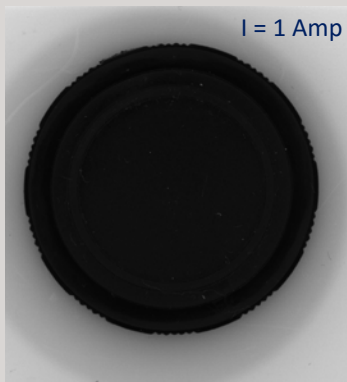
High power strobe lights

Beverage industry typical conditions

- Inspection of fast moving parts

- Cameras set at short exposure times

- Optics set at high F/N

Whenever possible we suggest to:

1. **Set the lenses at higher F/N → increase in Depth of Field al lower aberrations**

2. **Increase the amount of light using strobe lights**

I = 1 Amp

I = 17 Amp

(P/N LTDMC2-W)

STANDARD DOME LIGHT　　　**OE DOME LIGHT**

- **SETTINGS**

Optics:

Model = Computar M3514-MP2

Aperture = F/8

Camera:

Exposure time = 400 µs

Sensor= ICX445

LED Lighting:

T on = 1 ms

Product: PC pericentric optics

Product:

Just one camera
No need for multiple cameras placed around and over the object.
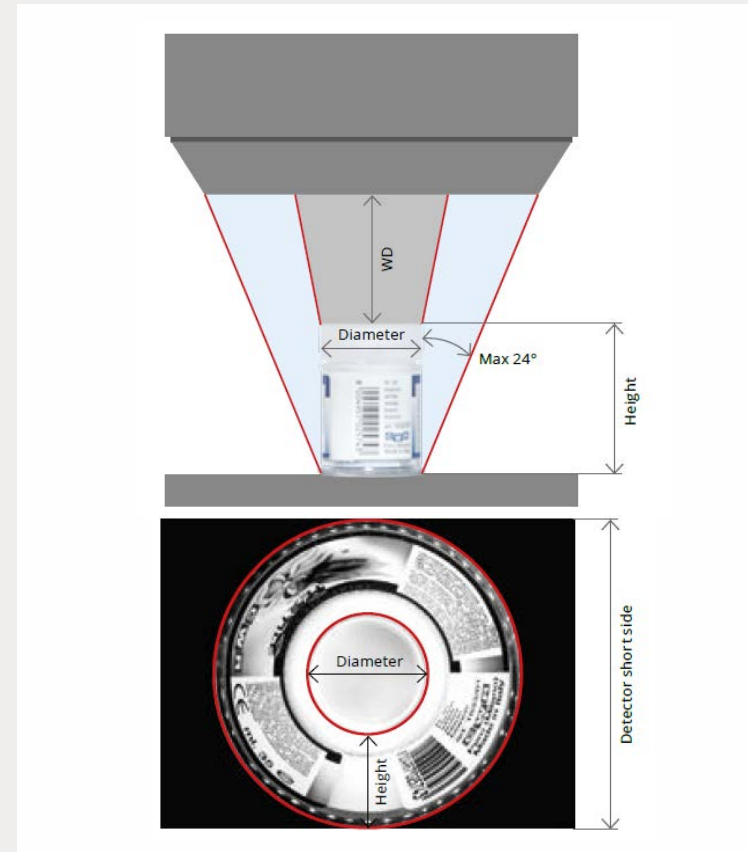
Fast image analysis
No image matching software is needed as the picture is not segmented.

Single point of view
No perspective effects typical of multi-image systems.

Smooth on-line integration
Inspected parts pass unobstructed in the free space below the lens.

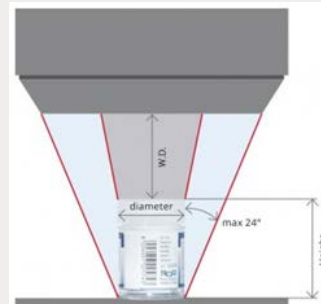# 360° view optics & application cases

Product: PC12030HP

Application: label OCR regardless the position of the label

SET UP

IMAGES

Barcode reading and OCR easily done on the unwrapped image

Image courtesy AMVS Netherlands

Booth 1F44 Hall 1

Product: PC12030HP

Application: closures inspection

SET UP	IMAGES
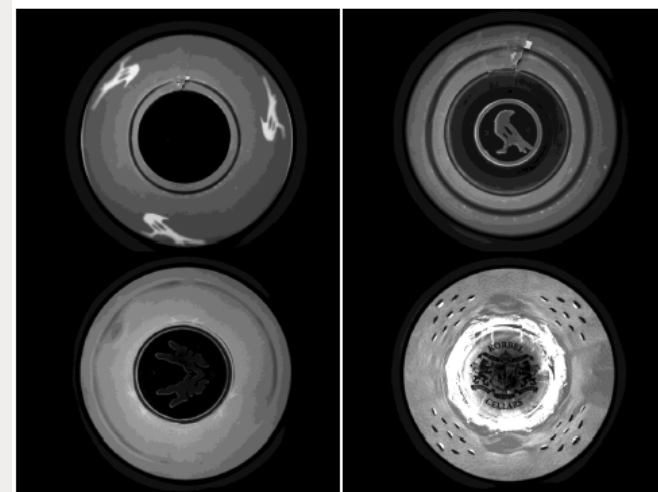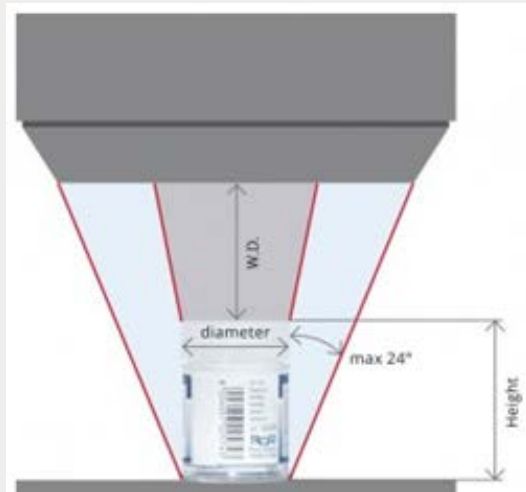
360° view optics & application cases

Product: PCPW012

Just one camera
No need for multiple cameras placed around and over the object
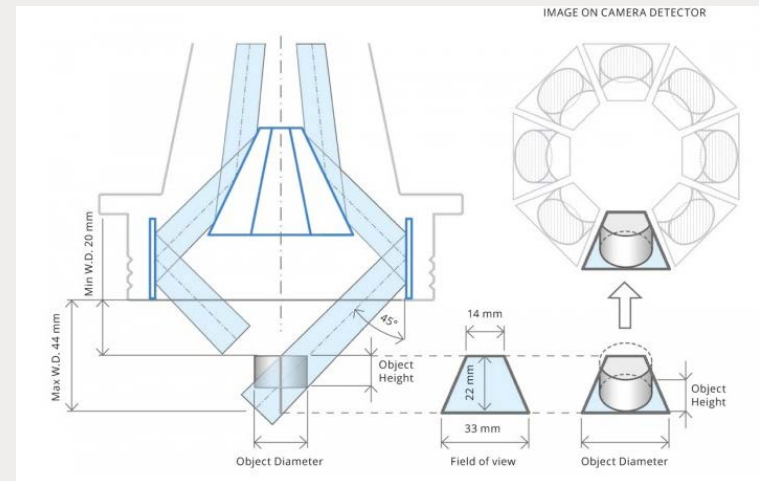
Wide viewing angle
45° object sides view makes otherwise hidden features visible

Complete surface inspection
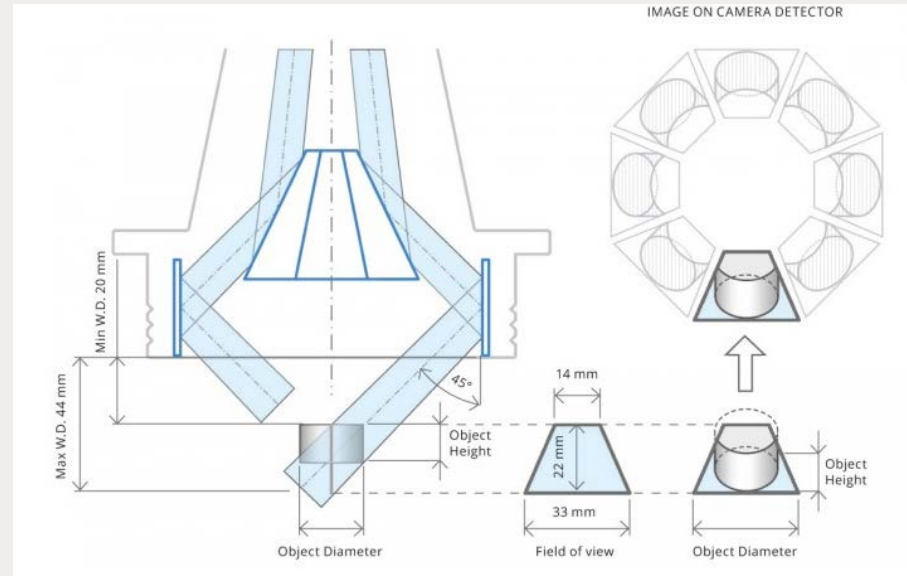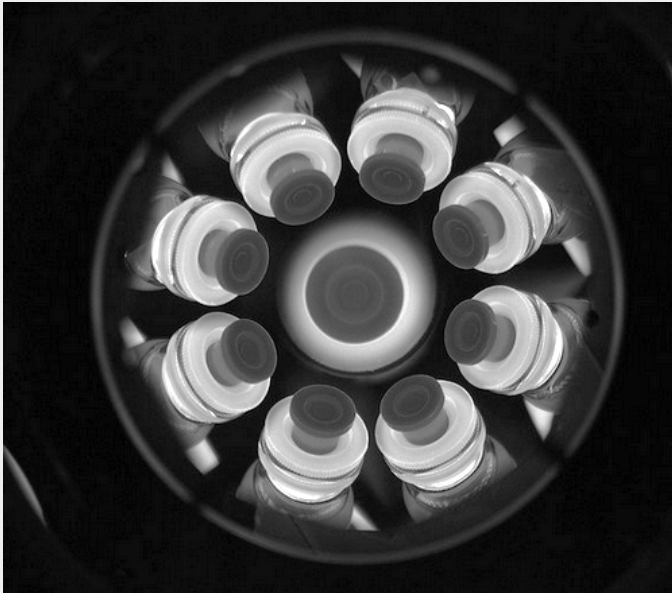Both inner and outer object surfaces can be imaged in one shot

Very high resolution
Even the tiniest defects can be detected.

Product: PCPW012

Application: cap inspection with one single camera

Booth 1F44 Hall 1

Product: PCPW012

Application: FLIP OFF cap inspection with one single camera

Booth 1F44 Hall 1

**Product: Telecentric lens TC23036 + telecentric illuminator LTCLHP036-G**

- BI telecentricity

- Nearly zero distortion

- Excellent resolution

- Simple and robust design (fixed aperture)

- Detailed test report with measured optical parameters

- Matching telecentric illuminator
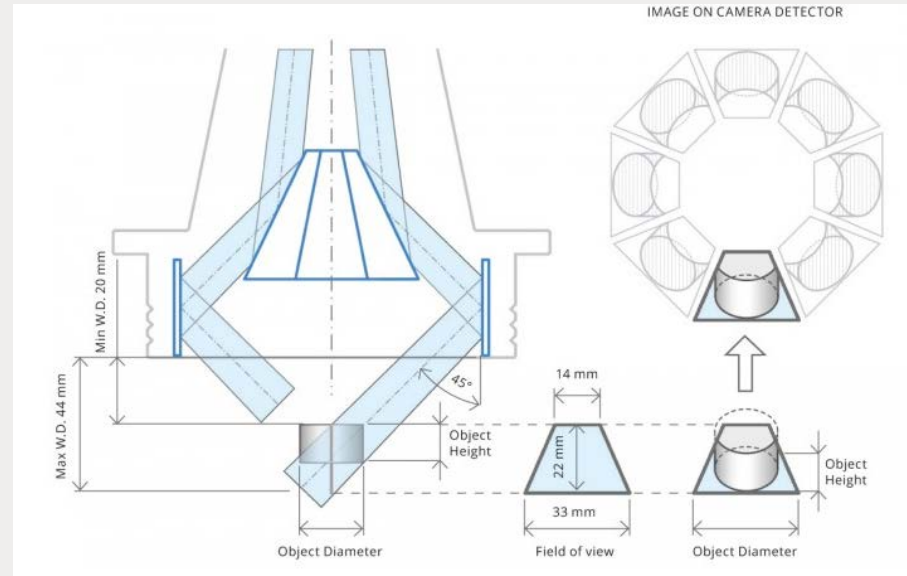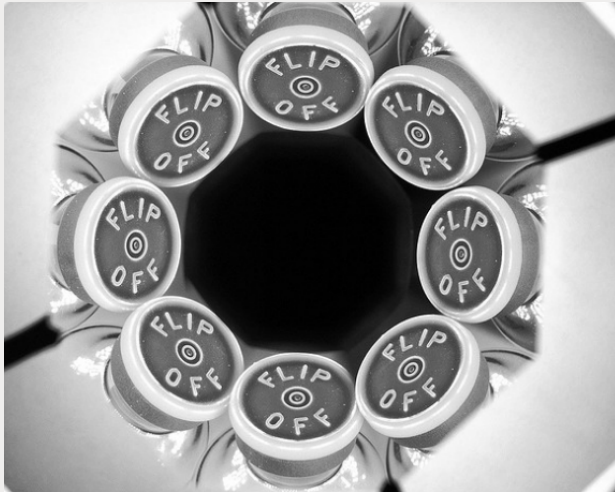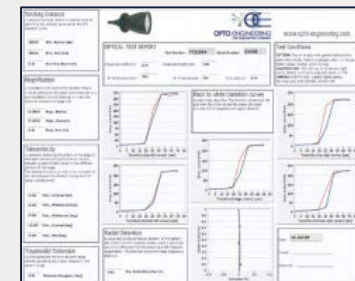
Telecentric optics & application cases
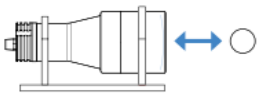
Product: Telecentric lens TC23036 + telecentric illuminator LTCLHP036-G
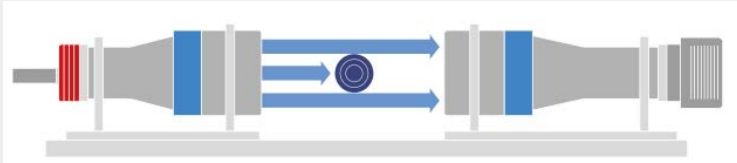
- **High speed** production lines
  The high throughput allows for shorter exposure times

- **Silouetting** and for detecting edges and defects
  Elimination of blurred edges caused by diffuse reflections

- **Increased distance** between object and illumination source

- **Precision measurements**
  where accuracy, repeatability, and throughput are key factors

- **Complete light coupling**
  very high signal-to-noise ratio

- **Border effects removal**
  collimated rays are typically much less reflected

- **Field depth and telecentricity improvement**
  Collimated illumination geometry increases
  a telecentric lens natural field depth

Product: Telecentric lens TC23036 + telecentric illuminator LTCLHP036-G

Application: Glass vials measurement
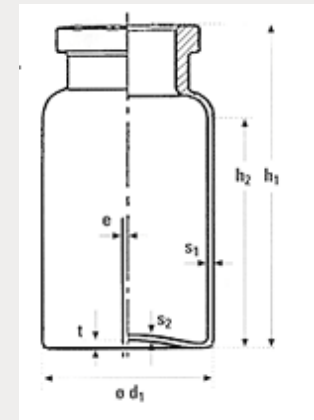

Diffused lighting	Telecentric lighting

Clear object contours can be seen under telecentric lighting,

making accurate measurements of the object possible.

Type of measurements:

- Finish / collar/ cone profile

- Diameter of the neck / cone

- Planarity of the mouth

- Axiality of the neck

- Shoulder angles

- Total length

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