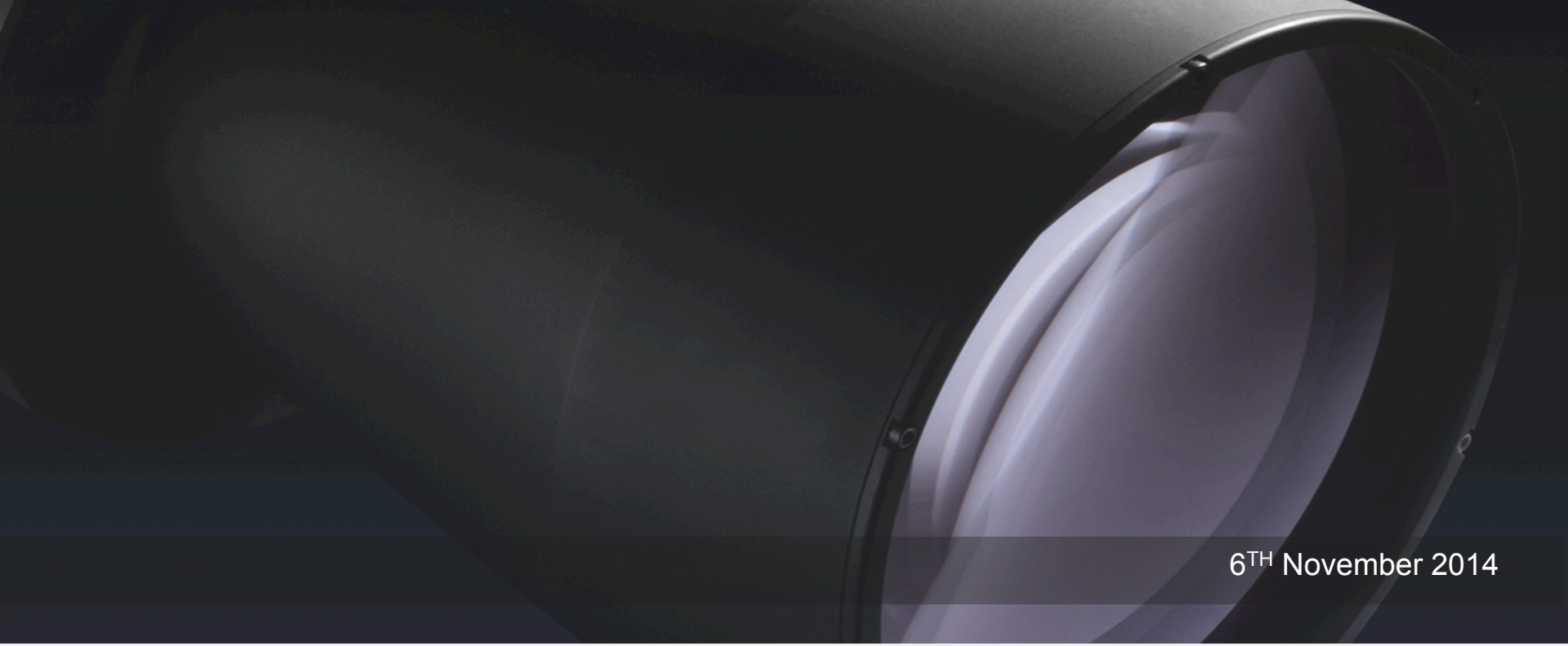

6TH November 2014

Inspection, optical measurement and illumination solutions for the automotive parts manufacturing industry

M. Castelletti – *Product Manager*

OPTO ENGINEERING
THE TELECENTRIC COMPANY

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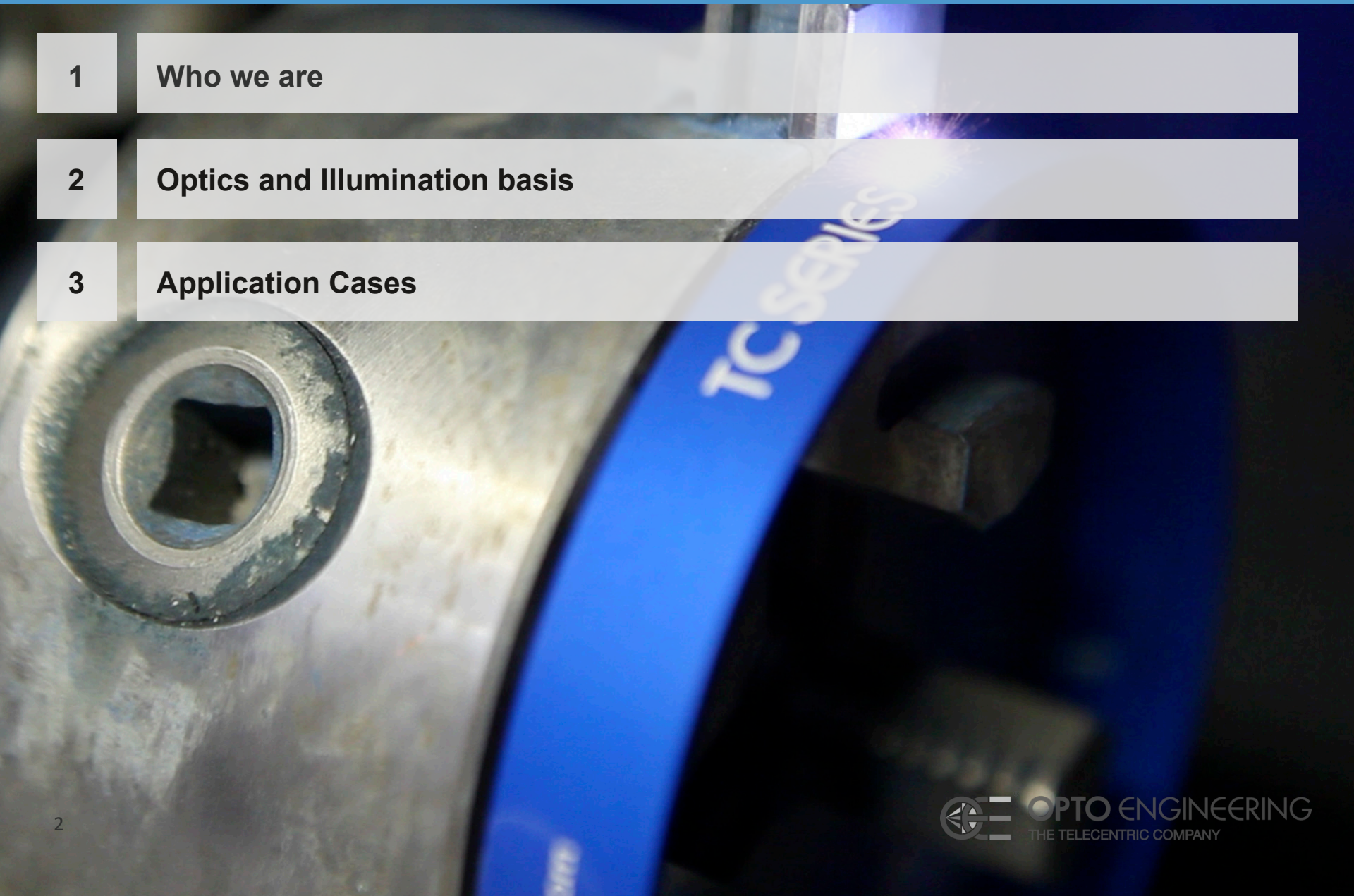

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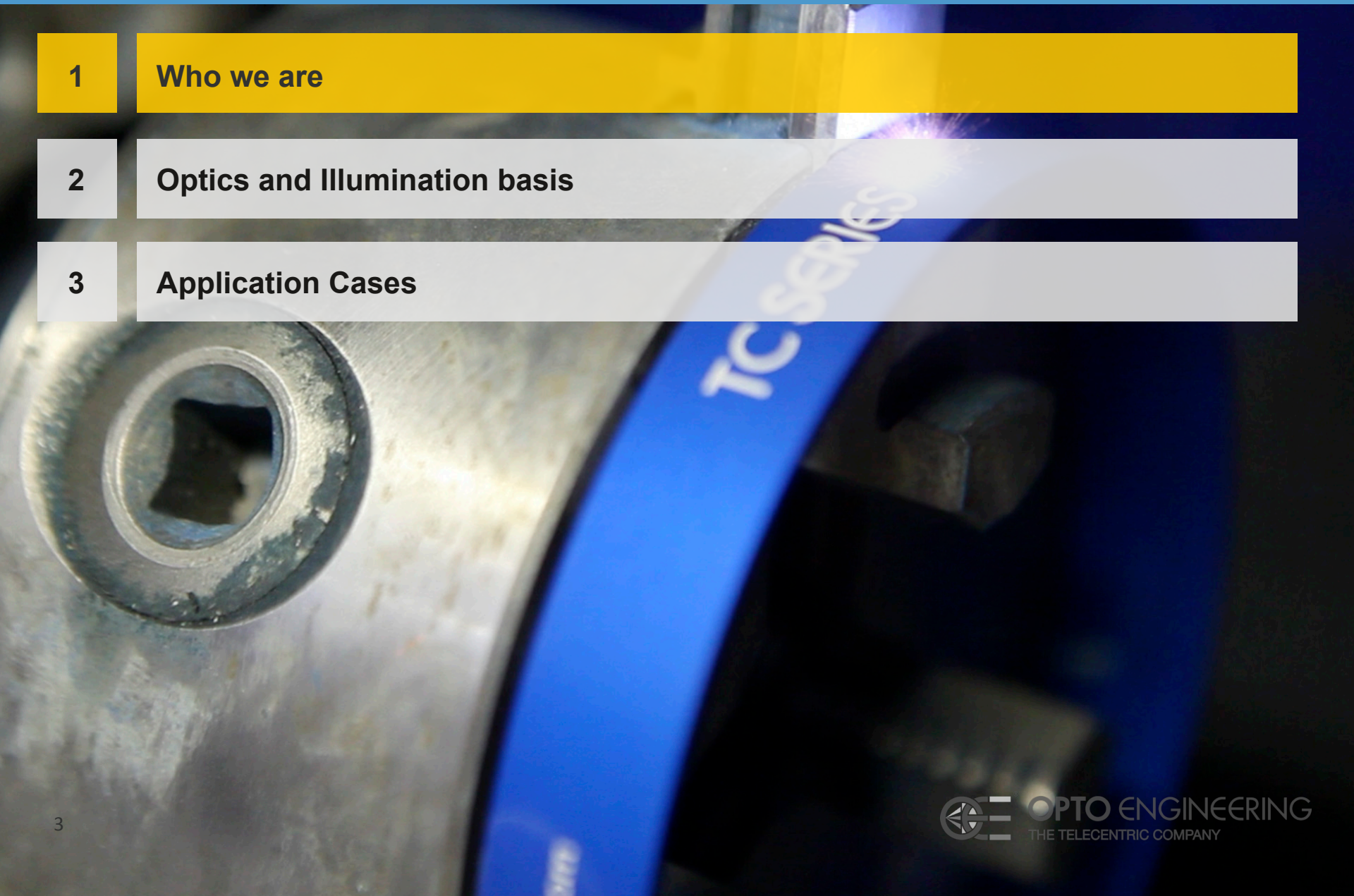

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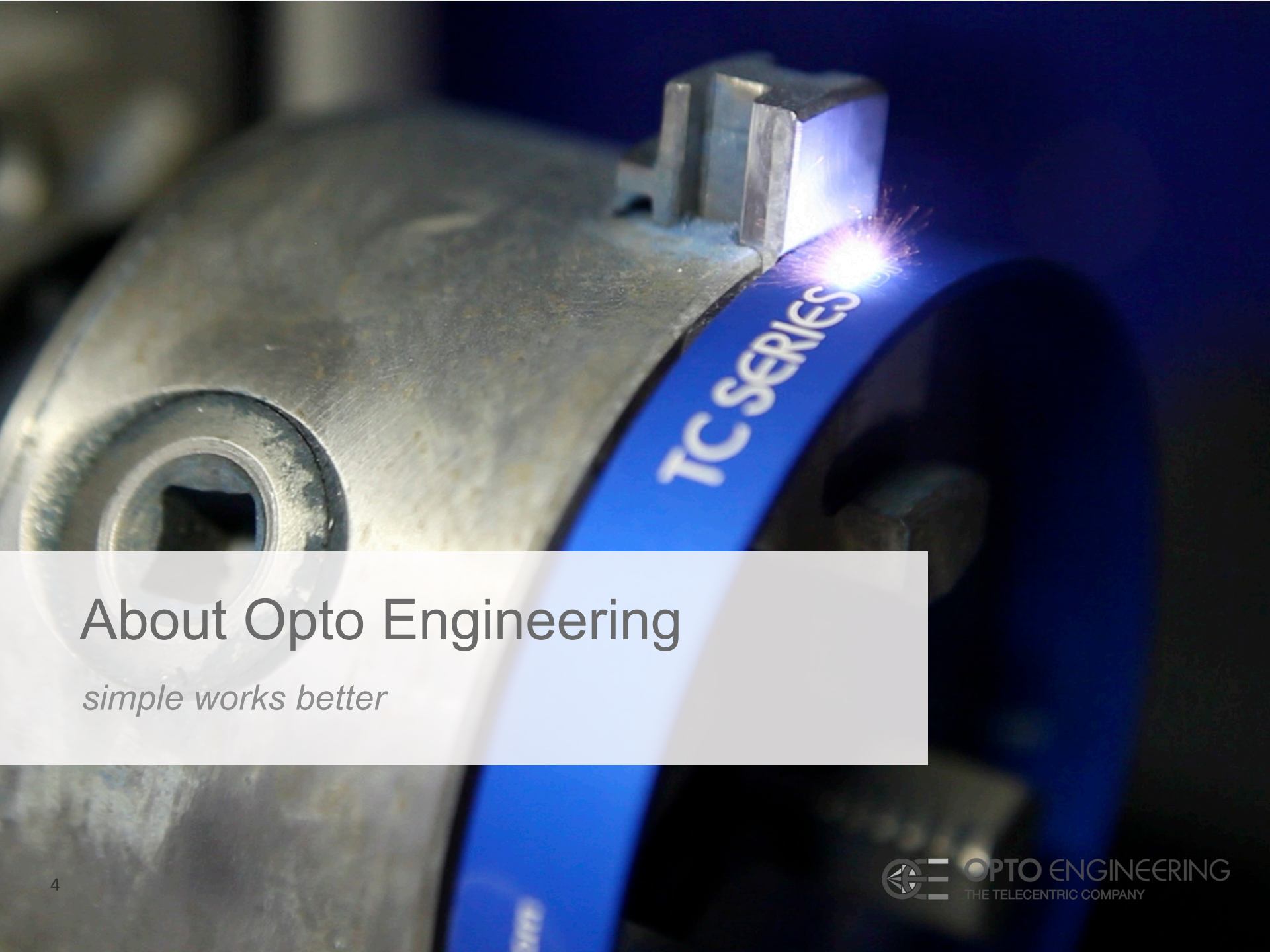

About Opto Engineering

simple works better

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THE TELECENTRIC COMPANY

About Opto Engineering

WHO WE ARE

Opto Engineering designs and manufactures optical and illumination systems for the machine vision industry since 2002.

Telecentric

2003

360° optics

2009

Zoom

2011

Illuminators

2014

OPTO ENGINEERING
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Global presence

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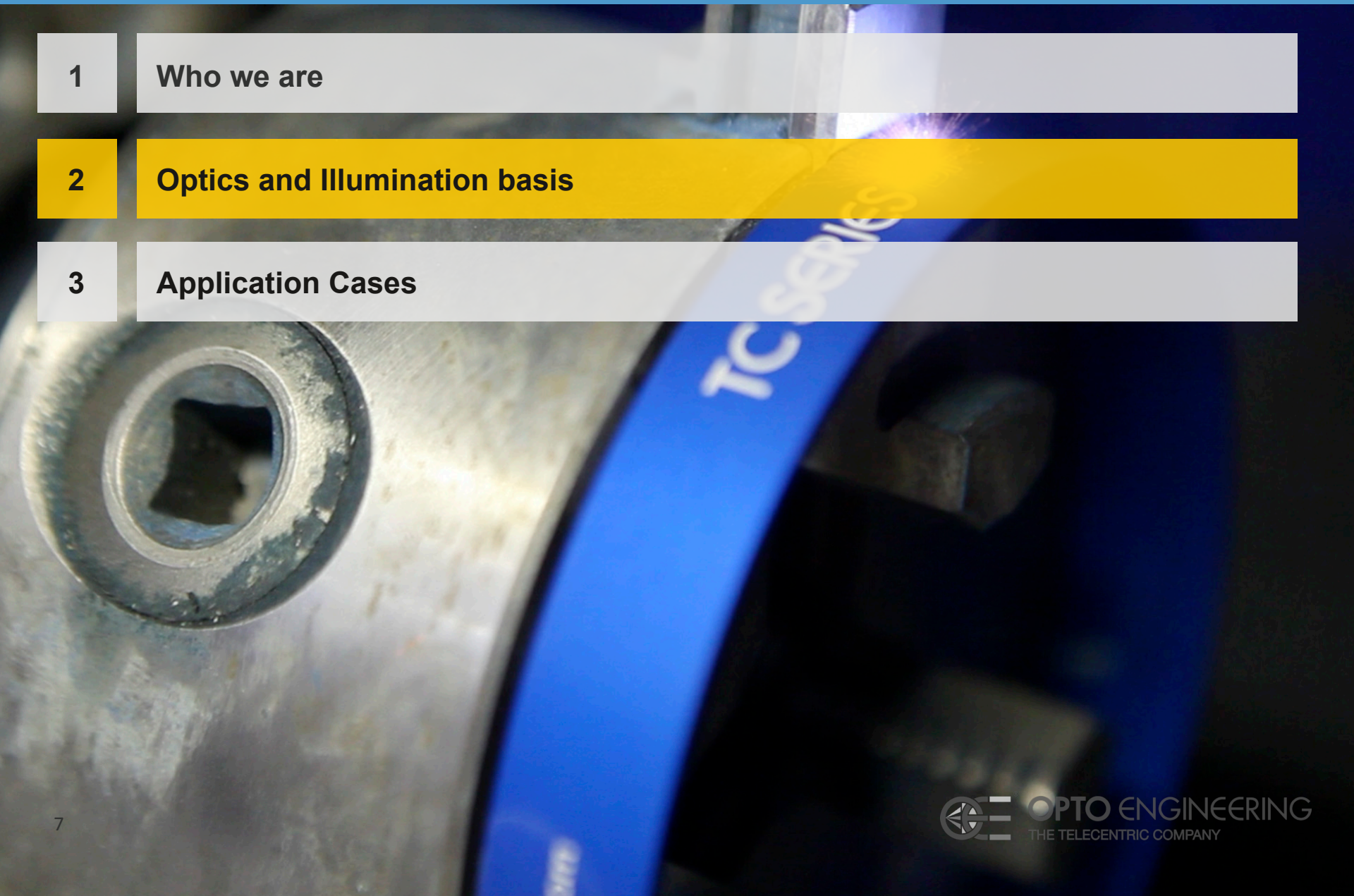

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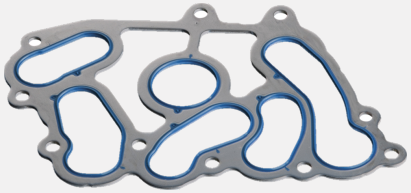
Introduction

CRITICAL AUTOMOTIVE PARTS

Crank shaft

Connecting rod



Gasket

O-ring

CHALLENGE

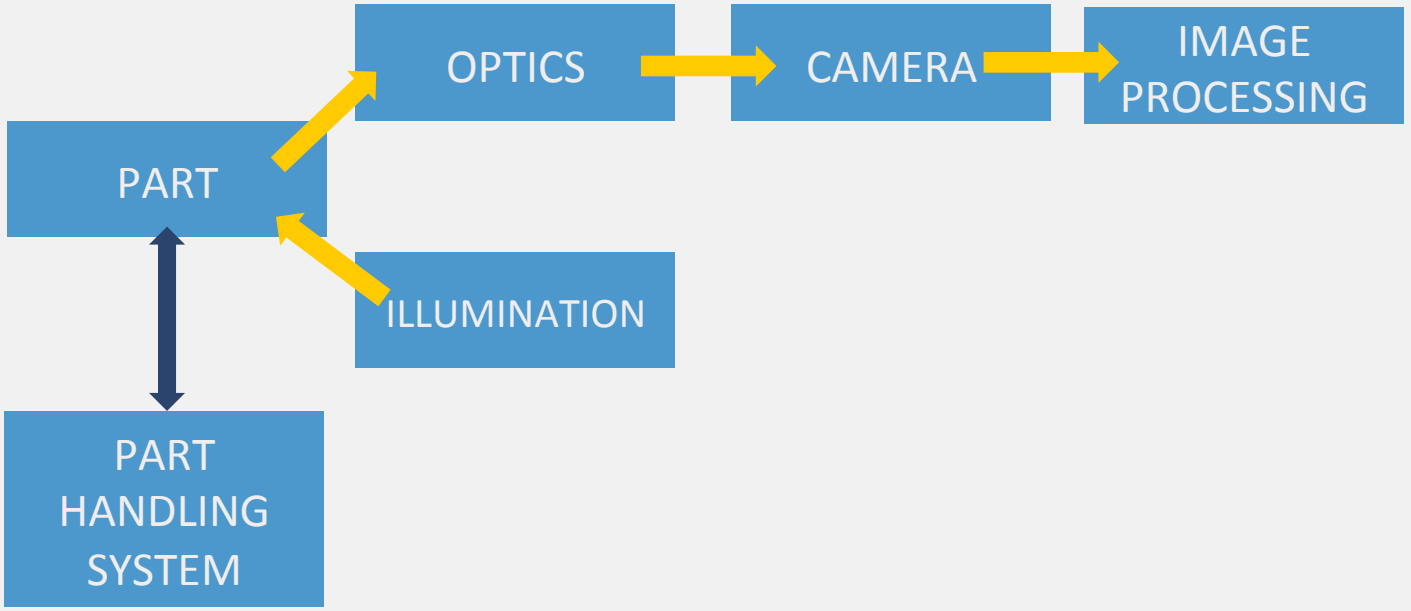
RAISE QUALITY

CUT COSTS

MACHINE VISION

Introduction

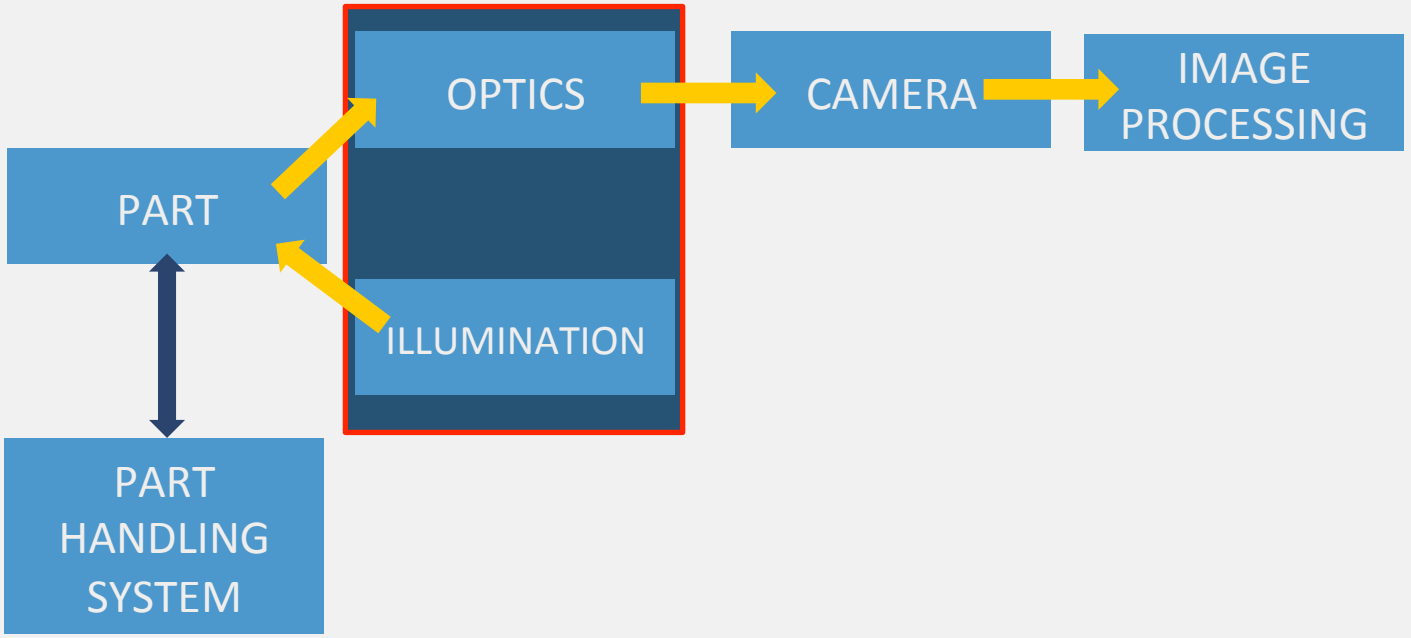
MACHINE VISION SYSTEM – KEY COMPONENTS



Machine vision systems are like a chain: *only as strong as their weakest link*

Introduction

MACHINE VISION SYSTEM – KEY COMPONENTS



Machine vision systems are like a chain: *only as strong as their weakest link*

IT'S ALL ABOUT LIGHT

Optics and illumination can often be the limiting factor in a system's performance

Optics – basic lens types

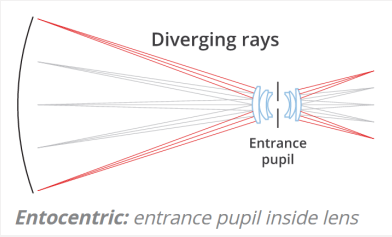
ENTOCENTRIC

TELECENTRIC

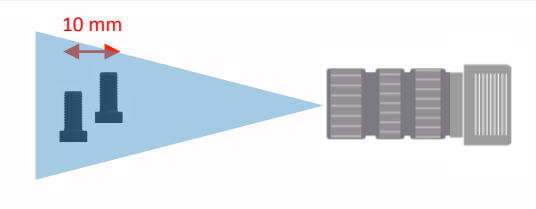
PERICENTRIC

Optics – basic lens types

ENTOCENTRIC



Entocentric: *entrance pupil inside lens*



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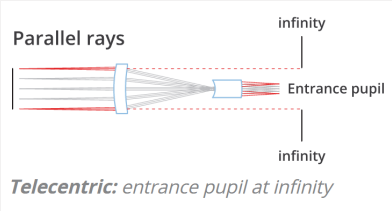
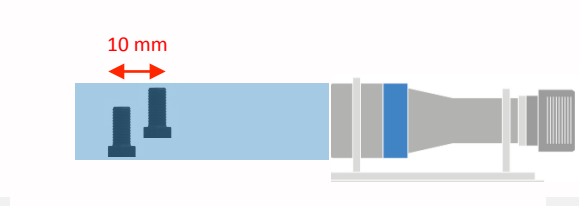
Optics – basic lens types

TELECENTRIC





Telecentric lenses are required for any dimensional measurement imaging application

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Optics – basic lens types

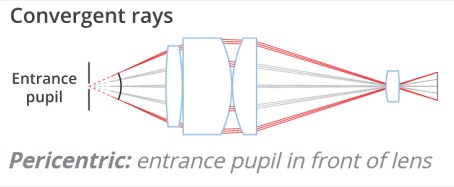
TELECENTRIC

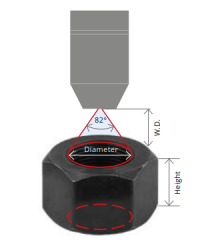
WHEN TELECENTRIC LENSES SHOULD BE USED

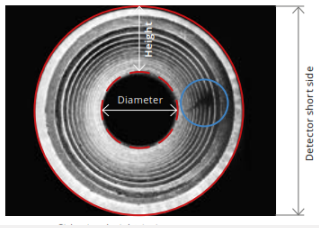
- When a thick object (thickness > 1/10 FOV diagonal) must be measured
- When different measurements on different object planes must be carried out
- When the object-to-lens distance is not exactly known or cannot be predicted
- When holes must be inspected or measured
- When the profile of a piece must be extracted
- When the image brightness must be very even
- When a directional illumination and a directional “point of view” are required

Optics – basic lens types

PERICENTRIC







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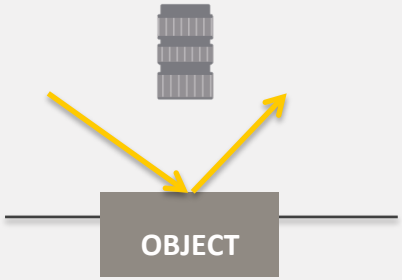
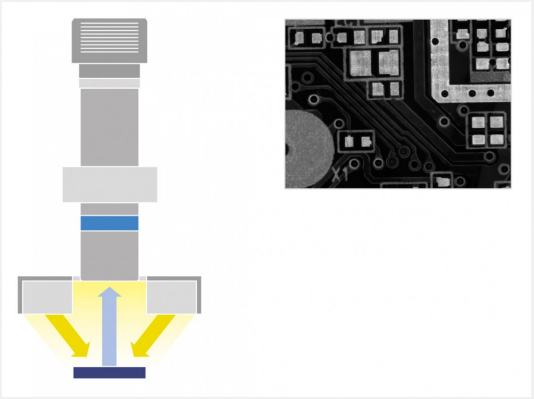
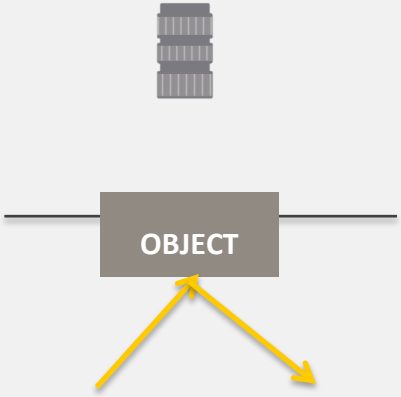
Illumination – basic illumination techniques

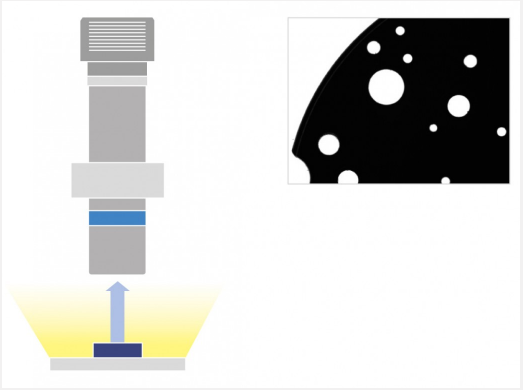
FRONT LIGHT ILLUMINATION





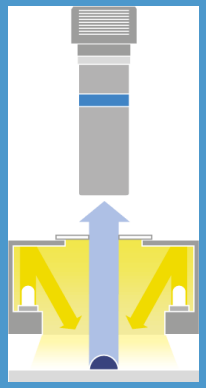
BACK LIGHT ILLUMINATION



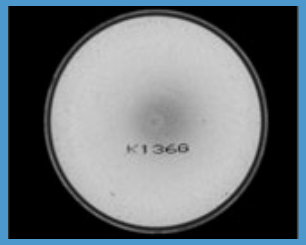


Illumination – basic illumination techniques

FRONT LIGHT ILLUMINATION

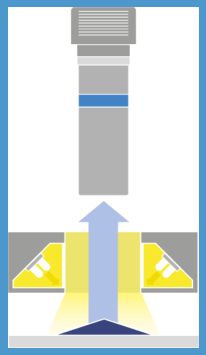


DIFFUSED DOME- Bright field



For complex shapes with curved and shiny surfaces

BACK LIGHT ILLUMINATION



LOW ANGLE RING LIGHTS- Dark field

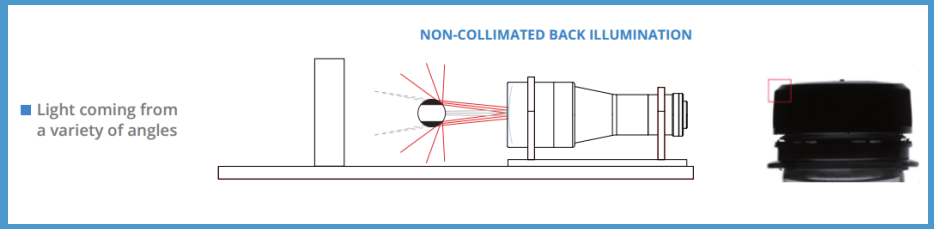
To enhance surface features or textures

Illumination – basic illumination techniques

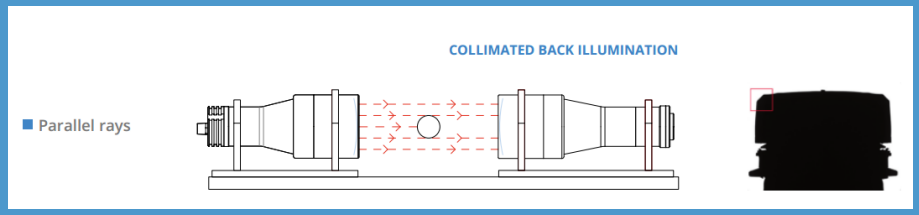
FRONT LIGHT ILLUMINATION

BACK LIGHT ILLUMINATION

DIFFUSED BACKLIGHT



TELECENTRIC BACKLIGHT



- Border effects removal - Enhanced Field Depth

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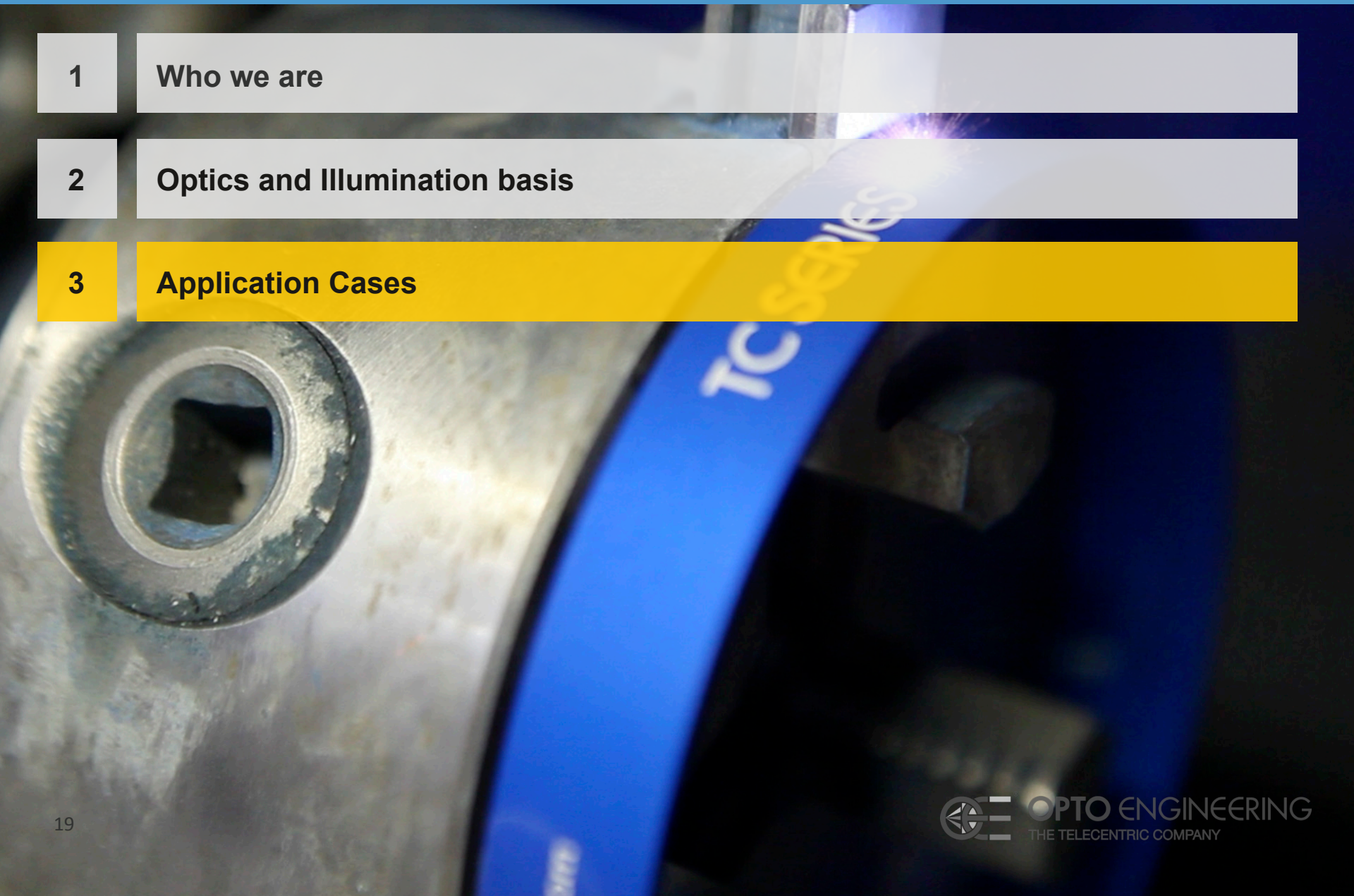

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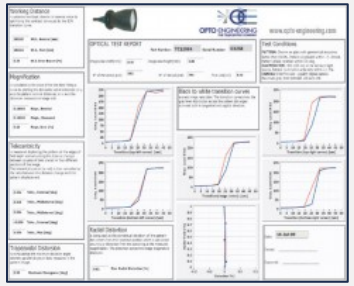
Applications – CASE 1

PRODUCT: Telecentric lens + telecentric illuminator

- BI telecentricity
- Nearly zero distortion
- Excellent resolution
- Simple and robust design (fixed aperture)
- Detailed test report with measured optical parameters
- Matching telecentric illuminator

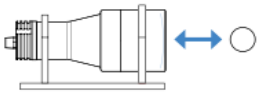


Applications – CASE 1

Product: Telecentric lens + telecentric illuminator

- **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

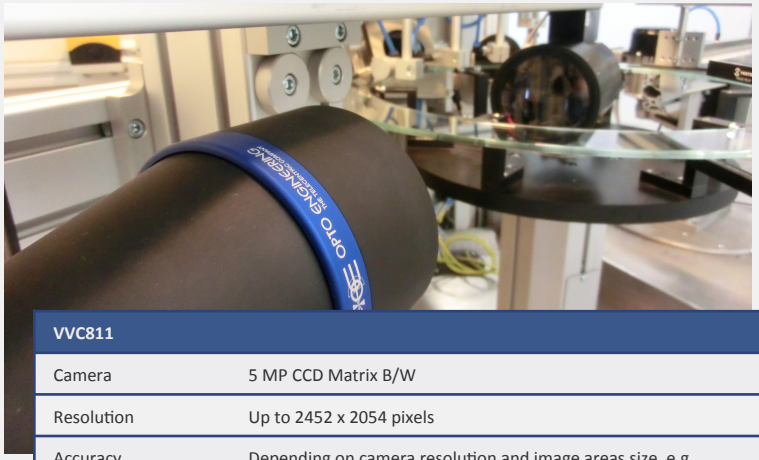
- **Field depth and telecentricity improvement**
  Collimated illumination geometry increases a telecentric lens natural field depth

Applications – CASE 1

PRODUCT : Telecentric lens + telecentric illuminator

Application: Videochek VVC811

Measuring and sorting of low-size turned or pressed parts wherever high throughput is required with very high accuracy



VVC811	
Camera	5 MP CCD Matrix B/W
Resolution	Up to 2452 x 2054 pixels
Accuracy	Depending on camera resolution and image areas size, e.g. 32x24 mm < 0,01 mm with 780 x 580 pixels 32 x 24 mm < 0,003 mm with 2452 x 2054 pixels, each with subpixel factor 4
Performance	Up to 700 parts /min (depending on part size and feeding system)
Rotary table drive	Programmable servo drive with safety clutch
	Factory calibration certificate
	Granite / aluminium sandwich design

Turned pressed parts flat formed part

Inspection images with scannings

Measuring value display

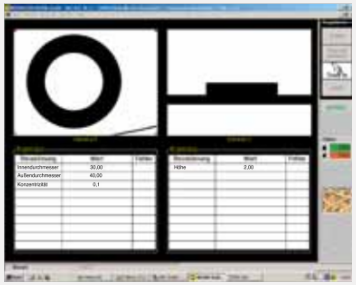


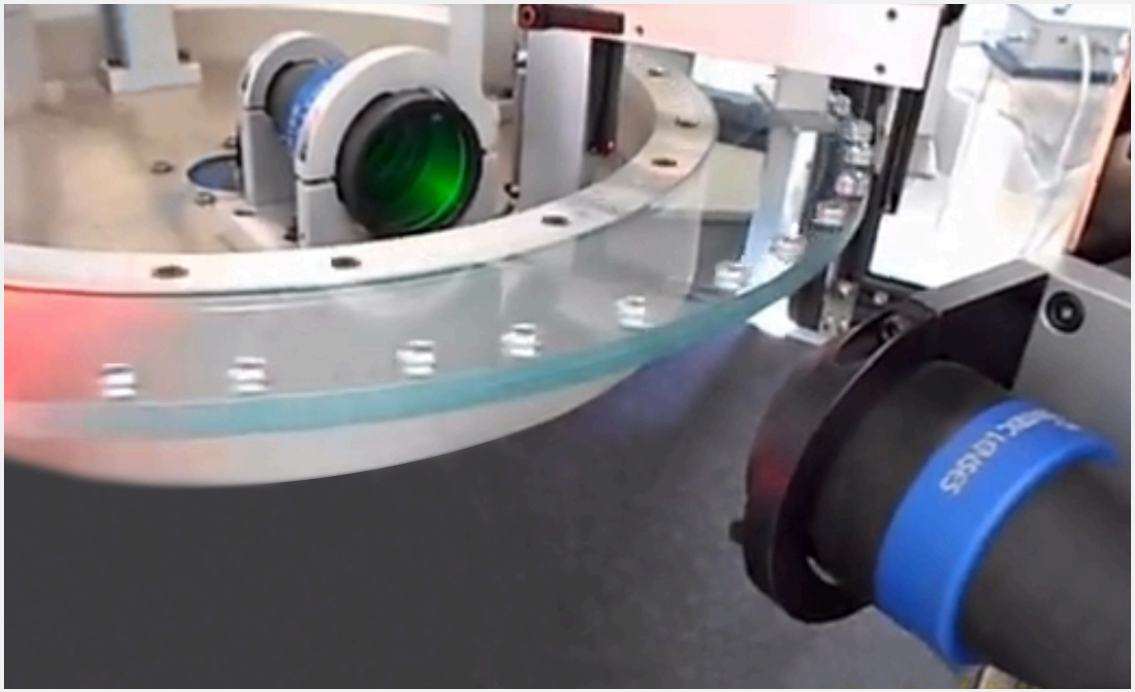
Image courtesy VESTER Elektronik

Applications – CASE 1

Product: Telecentric lens + telecentric illuminator

Application:

Inspection Machine for nuts with rotary glass table

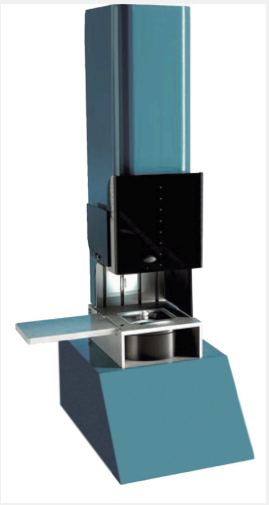


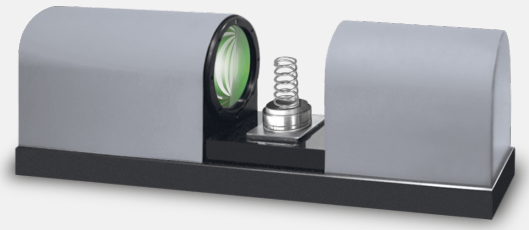
Applications – CASE 1

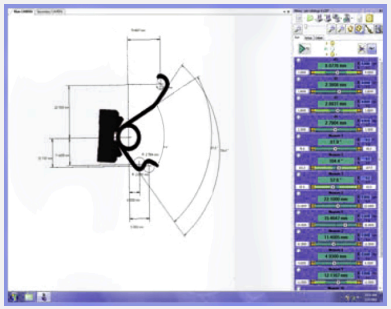
Product: Telecentric lens + telecentric illuminator

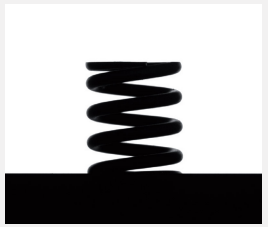
Application

OFF LINE optical devices for coil / spring measurement







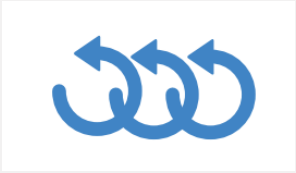


Model	Field of View	Test Accuracy	Smallest allowable thickness
A	61 x 51 mm	0.008 mm + 0.05%	0.15 mm
B	90 x 75 mm	0.01 mm + 0.05%	0.25 mm
C	138 x 115 mm	0.01 mm + 0.05%	0.3 mm

Applications – CASE 2

Product: TCZR072
8X 4 STEP MOTORIZED BI-TELECENTRIC ZOOM LENS FOV: 72 mmm

One of the most important parameters in specifying motorized zoom lenses is:



MAGNIFICATION REPEATABILITY

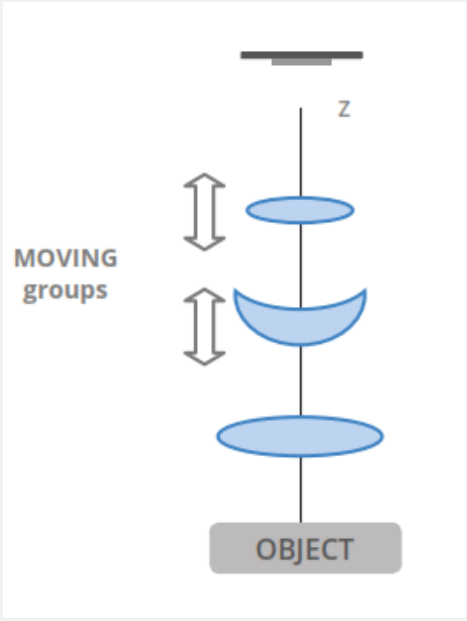
Magnification repeatability shows to what extent the lens will achieve:

the same magnification over a number of zoom cycles

Applications – CASE 2

Product: TCZR072
8X 4 STEP MOTORIZED BI-TELECENTRIC ZOOM LENS FOV: 72 mmm

Conventional zoom



Magnification change achieved through
Lens displacement along the axial position

Uncertainty about the lens position along the z axis
limits to the lens position resolution along the z axis

UNCERTAINTY
about
magnification repeatability

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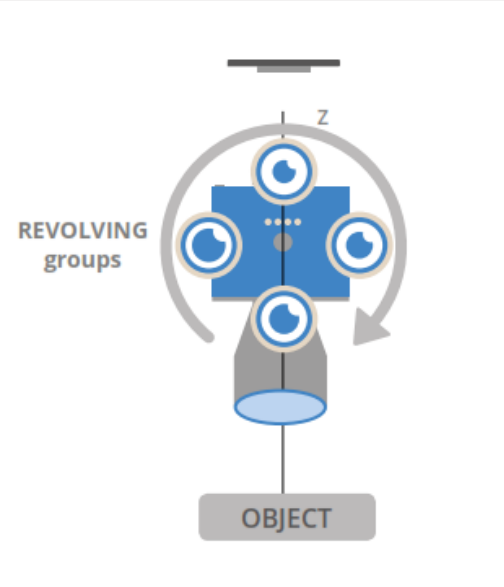
Applications – CASE 2

Product: TCZR072
8X 4 STEP MOTORIZED BI-TELECENTRIC ZOOM LENS FOV: 72 mmm

TCZR



Magnification change achieved through
Internal carousel

No uncertainty
about the lens position along the z axis

UNMATCHED REPEATABILITY
MAGNIFICATION CONSTANCY

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Applications – CASE 2

Product: TCZR072
8X 4 STEP MOTORIZED BI-TELECENTRIC ZOOM LENS FOV: 72 mmm

PERFECT MAGNIFICATION CONSTANCY
No need of re-calibration,after zooming

EXCELLENT IMAGE CENTER STABILITY
Each magnification maintainsits FOV center

PERFECT PARFOCALITY
No need of refocusing when changing magnification

4X FLEXIBILITY
Provides 4 different magnifications

Ease of use
Increased reliability
Time saving

Applications – CASE 2

Product: TCZR072
8X 4 STEP MOTORIZED BI-TELECENTRIC ZOOM LENS FOV: 72 mmm

Application: V-CAD Rapid
Optical device for the measuring of 2D geometries in back and surface lights for the measurement of length, diameter, distance, radii, angle, thread, groove, contour generation, CAD comparison…

SPECS V-CAD RAPID	
Objective	Telecentric 4-step motorised zoom lens
Field of View X/Y	4 different fields of view for spot-on measurement 65.5 x 55 mm - 32.5 x 27.5 mm - 16 x 13.5 mm - 8 x 6.5 mm
Magnification	0,125x – 0,25x - 0,5x – 1,0 x
Depth of field	45,0 mm – 11,0 mm – 2,80 mm – 0,70 mm
Focus length Z	50 mm
Working Distance	150 mm
Repeatability	0,001 mm
Length measurement uncertainty	E2 = 3.5 + (L/50 mm) µm

Application
Piston rings
Bar steel, wire
Cutting tools for wood
Wooden parts
Turned parts
Rubber sealing profile
(also with metal part inside)
Plastic profiles
Aluminium profiles
Springs
Circuit boards
Extrusion dies

Image courtesy Schneider MessTechnik

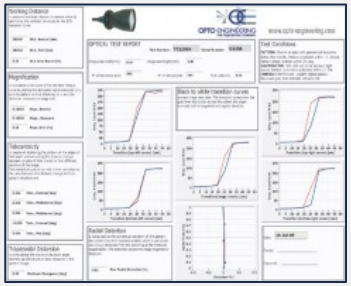
Applications – CASE 3

Products: TC4K090 + LTCL4K090-G

Flat telecentric lenses and illuminators for 4k linescan cameras
FOV = 90 mm

- **Compact design**

  UNIQUE “Flat” shape for easy integration
- **High telecentricity & low distortion**
- **Detailed test report** with measured optical perfomances
- Dedicated 45° mirror accessories
- **Enhanced field depth** when TC4K + LTCL4K are combined



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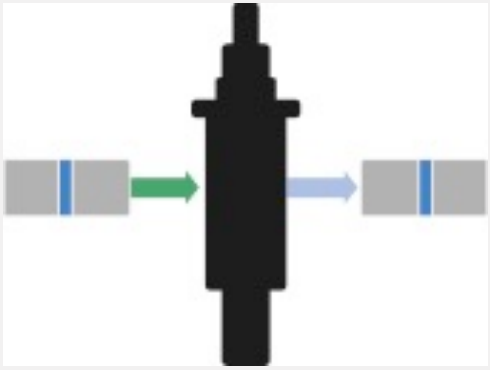
Applications – CASE 3

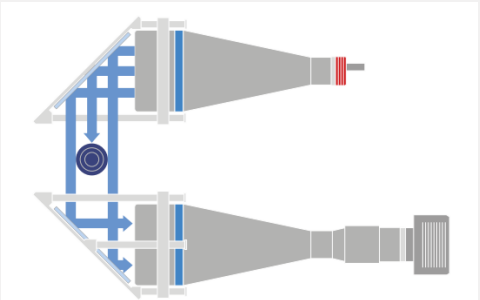
Products: TC4K090 + LTCL4K090-G

Flat telecentric lenses and illuminators for 4k linescan cameras
FOV = 90 mm

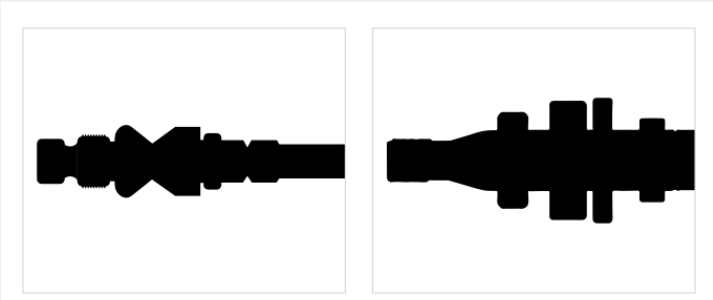
Application:
SHAFT MEASURING MACHINE
Optical device for crank shafts, gear shafts, cyliner liners/sleeves meaurement



SCHEMATICS



IMAGES



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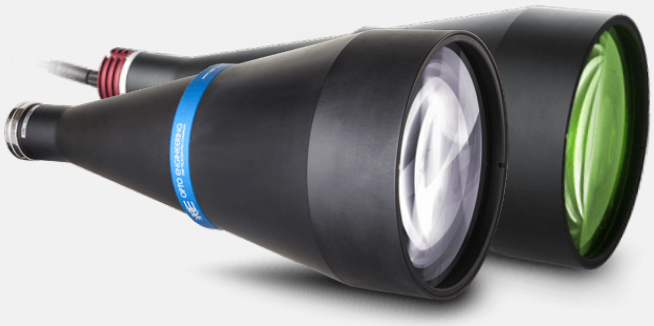
Applications – CASE 4

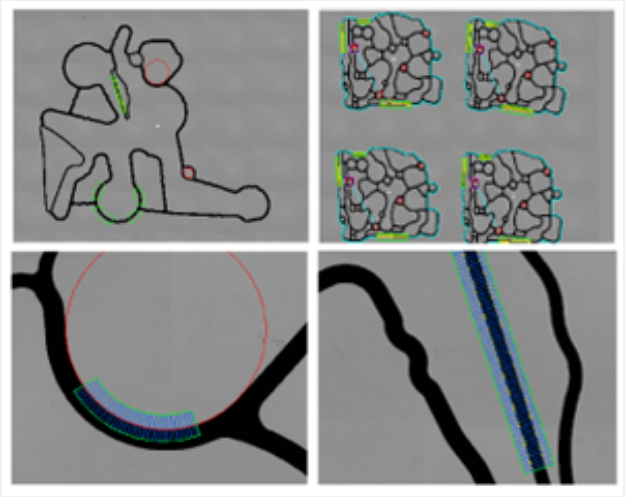
PRODUCT: Telecentric lens TC12096 + Collimated Illuminator LTCLHP096-G



APPLICATION:

Automatic visual inspection machines for sealings (circular and complex pieces) rubber gaskets, plastic items, metal parts and most other components

SPECS	
Field of View	500x500 mm
Max. sample dimension OD	Ø500 mm
Min sample dimension OD	Ø 1,8 mm
Min ID dimension	Ø 0,8 mm
Min CS dimension	Ø 0,5 mm
Resolution	0,001 mm
Accuracy for size less than 90 mm (± 3 sigma)	± 0,009 mm
Accuracy for size bigger than 90 mm (± 3 sigma)	± 0,020 mm
Max sample thickness	30 mm



Applications – CASE 5

PRODUCT: Dome + Low angle illumination system LTDMLAB2-WW

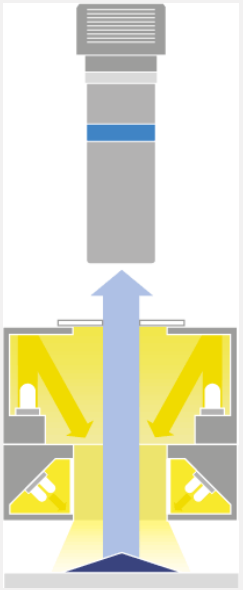
Illumination area Ø = 60 mm

Two independent illumination units in one single solution
Dome unit for homogeneous illuminations and low angle unit for dark field lightning can be independently operated.

Ultra-high power light output and strobe mode only operation
For the inspection of fast moving object and extended LED lifetime.

Rugged industrial design with built-in industrial connector
For easy integration into any machine vision system.

Compatible LTDV strobe controllers available
For easy and appropriate power, control and synchronization of the illuminator.



Applications – CASE 5

PRODUCT: Dome + Low angle illumination system LTDMLAB2-WW

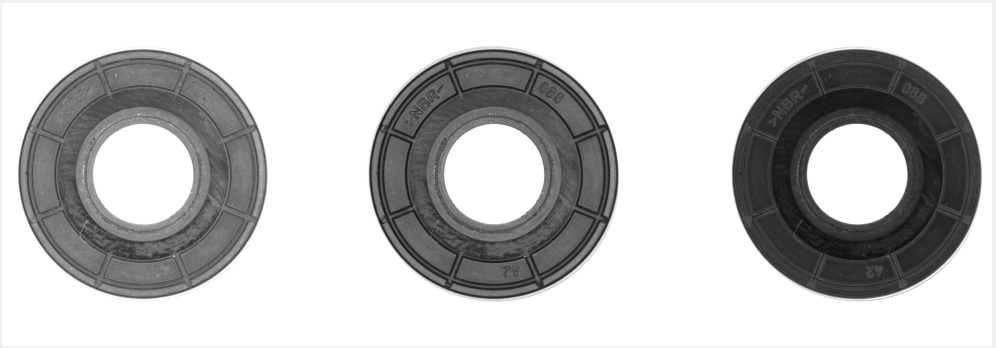
Illumination area Ø = 60 mm

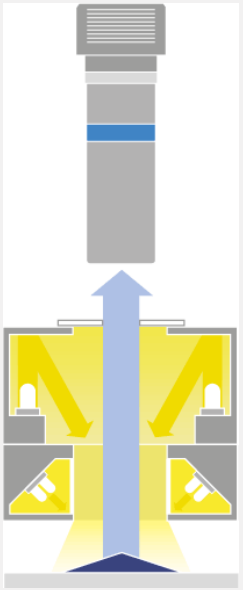
APPLICATION: SURFACE INSPECTION OF RUBBER, PLASTIC AND METAL SEALINGS

Type of check: - Cuts – Scratches - Inclusions - Haloes

OBJECT **IMAGE**

mix **dome** **low angle**





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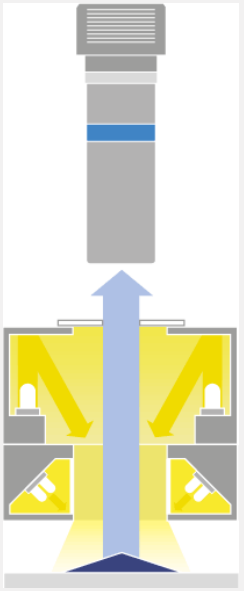

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Thank you

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