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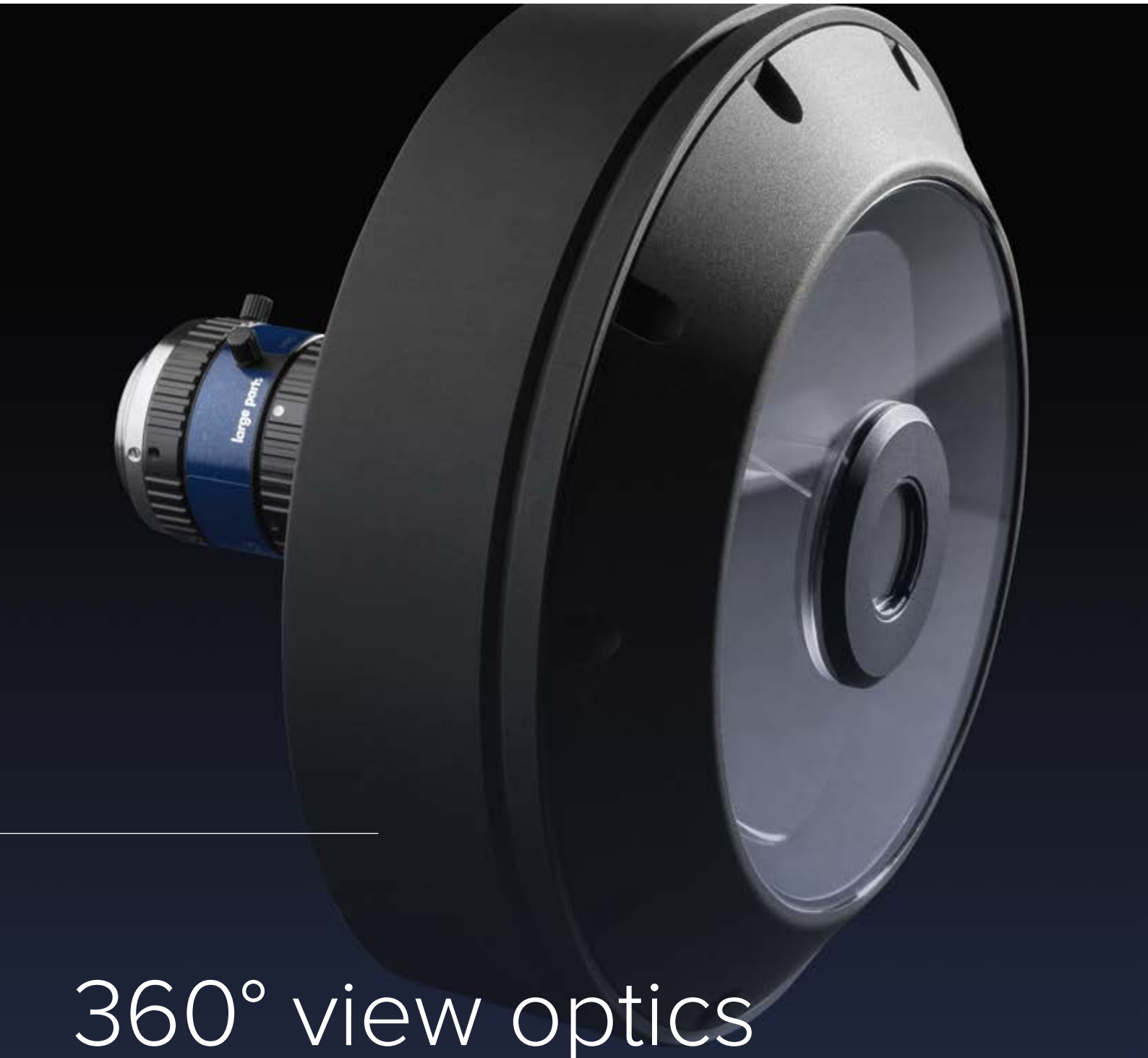

360° view optics

2014

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360° view optics

One of the most recurring demands of the machine vision market
is to be able to view every surface of an object with as few cameras as possible.

This request is becoming more and more common in a variety
of market areas, like the beverage, pharmaceutical and automotive industries.

Opto Engineering designed these incredible optical solutions:
just one camera shot is enough to capture the top and side views
of an object or the bottom and inside views of an holed object.

Most of these special optics are unique and patented by Opto Engineering:
their names are registered trademarks and you will not find
similar products on the market featuring the same build quality
and the same optical performances.

ACCESSORIES

Our 360° View optics family is complemented by a full set of accessories:

CLAMPING MECHANICS

RING LED ILLUMINATORS

OTHERS

Please refer to our website www.opto-engineering.com to browse our complete product range.

PC series

Pericentric lenses for 360° top and lateral view with just one camera

PC series is an exclusive product family developed by Opto Engineering to enable 3D peripheral vision of objects without the aid of mirrors. By means of this unique optical design, just one camera shot is enough to capture the top and side views of an object.

The name "pericentric" comes from the specific path of the light rays: the aperture pupil is seen from the object space as if it were moving around the peripheral zone of the front optical group.

EXTENDED RANGE

New compact PC xx030XS lenses for inspection of objects with diameter down to 7.5 mm.

Now also available for high resolution 2/3" detectors.

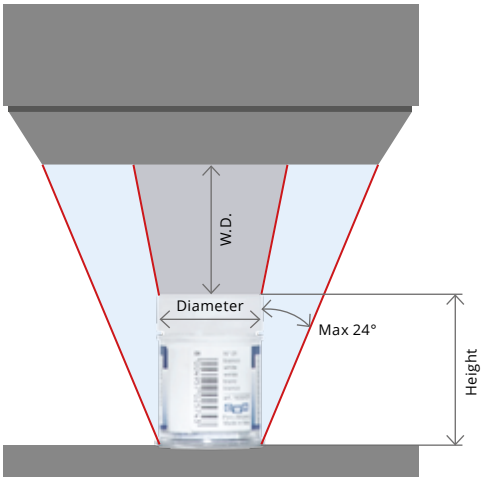
KEY ADVANTAGES

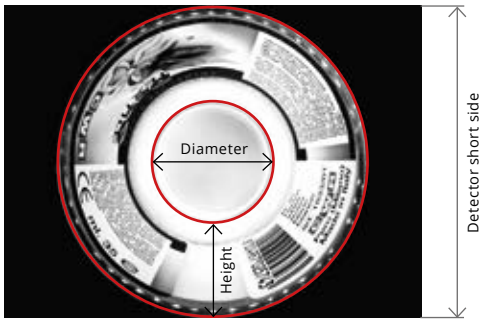
Just one camera
No need for multiple cameras placed around and over the object.

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.





$$r\,(\%) = \frac{\text{Side view height [pixels \#]}}{\text{Detector short side [pixels \#]}} * 100$$

Unwrapped image

PC optics are designed to work with 1/3", 1/2" and 2/3" detectors. The choice of such detectors ensures the most appropriate optical magnification factor to achieve the field depth required by high resolution 3D pericentric imaging.

The image of the top of the object and its sides are inscribed into the short side of the camera detector.

The smaller the object diameter, the larger the object height which can be inspected, while thin objects can be inspected over a larger diameter.

The tables in the next page show possible combinations of object diameters and heights along with the appropriate working distance and recommended F-number; the "r" parameter for each configuration is also listed.

The "r" parameter is the ratio between the side view height (the circular crown thickness) and the detector short side.
It provides information about side view resolution. The higher the "r", the higher the resolution that can be achieved in the side view.

PC series

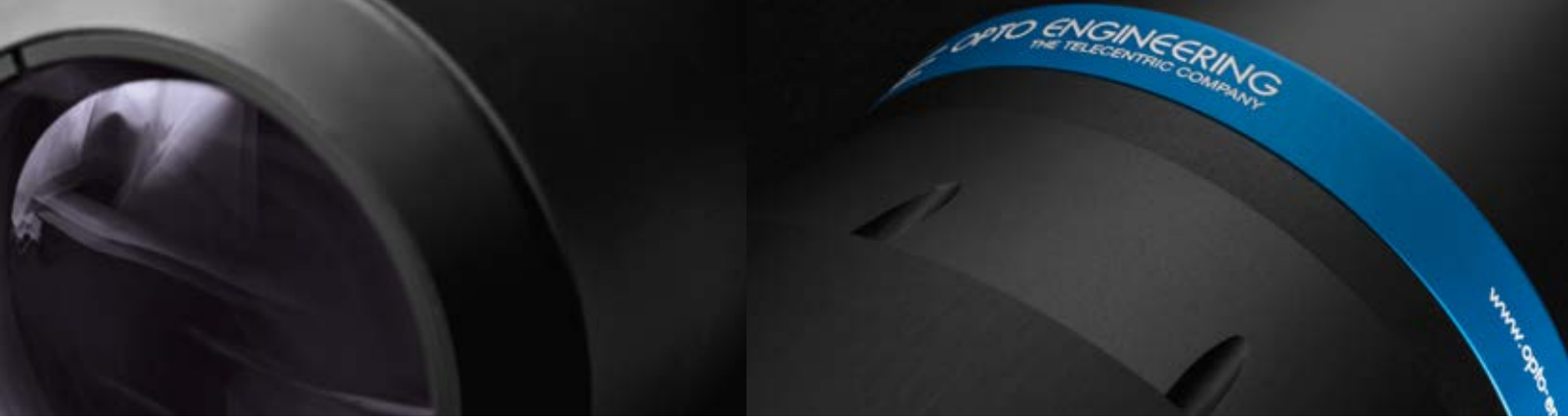
Pericentric lenses for 360° top and lateral view with just one camera

EXTENDED RANGE

New compact PC xx030XS lenses for inspection of objects with diameter down to 7.5 mm.

Now also available for high resolution 2/3" detectors.

Part number		PC 13030HP	PC 12030HP	PC 13030XS	PC 12030XS	PC 23030XS
Detector type		**1/3"**	**1/2"**	**1/3"**	**1/2"**	**2/3"**
Field of view	**(diam x height)**					
Min	(mm x mm)	20 x 60	20 x 60	7.5 x 5	10 x 5	15 x 5
Typical	(mm x mm)	30 x 30	30 x 30	30 x 30	30 x 30	30 x 30
Max	(mm x mm)	60 x 20	60 x 20	55 x 20	55 x 15	55 x 12
Optical specifications						
Wavelength range	(nm)	450 .. 650	450 .. 650	450 .. 650	450 .. 650	450 .. 650
Working distance	(mm)	20 .. 80	20 .. 80	20 .. 85	20 .. 80	20 .. 80
CTF @ 50 lp/mm	(%)	> 30	> 25	> 40	> 30	> 25
F-Number		4-16	4-16	4-16	4-16	4-16
Mechanical specifications						
Diameter (max)	(mm)	197	197	116	116	116
Length	(mm)	448	448	378	378	378
Weight	(g)	6800	6800	2950	2950	2950
Mount		C	C	C	C	C



Field of view selection chart

PC 13030HP field of view

Diam. (mm)	Height (mm)	W.D. (mm)	F/#	r (%)	Height (mm)	W.D. (mm)	F/#	r (%)	Height (mm)	W.D. (mm)	F/#	r (%)	Height (mm)	W.D. (mm)	F/#	r (%)	Height (mm)	W.D. (mm)	F/#	r (%)	Height (mm)	W.D. (mm)	F/#	r (%)
20	7	79	16	10	13	79	8	20	20	65	16	26	30	61	12	30	40	55	14	34	60	25	16	37
25	8	71	4	17	17	63	12	21	25	55	16	26	38	40	14	30	50	30	16	30				
30	10	65	4	13	20	55	8	19	30	42	12	25	45	35	12	29								
40	13	52	6	12	27	43	12	20	40	27	12	25												
50	17	36	6	13	33	20	8	15																
60	20	23	4	11																				

PC 12030HP field of view

Diam. mm	Height (mm)	W.D. (mm)	F/#	r (%)	Height (mm)	W.D. (mm)	F/#	r (%)	Height (mm)	W.D. (mm)	F/#	r (%)	Height (mm)	W.D. (mm)	F/#	r (%)	Height (mm)	W.D. (mm)	F/#	r (%)	Height (mm)	W.D. (mm)	F/#	r (%)
20	7	76	16	10	13	70	24	15	20	65	24	28	30	55	16	32	40	45	24	32	60	27	24	35
25	8	72	12	11	17	63	12	18	25	54	16	28	38	40	16	32	50	29	16	32				
30	10	66	12	11	20	56	12	19	30	45	16	25	45	30	16	35								
40	13	54	6	11	27	36	16	20	40	27	24	23												
50	17	32	12	13	33	20	16	18																
60	20	22	12	11																				

PC 13030XS field of view

Diam. (mm)	Height (mm)	W.D. (mm)	F/#	r (%)	Height (mm)	W.D. (mm)	F/#	r (%)	Height (mm)	W.D. (mm)	F/#	r (%)	Height (mm)	W.D. (mm)	F/#	r (%)	Height (mm)	W.D. (mm)	F/#	r (%)	Height (mm)	W.D. (mm)	F/#	r (%)
7,5	5	85	16	19																				
10	5	84	16	14	10	77	16	20																
15	5	75	6	10	10	70	8	15	15	65	16	20	20	60	16	22	25	54	16	24	32	45	16	28
20	10	62	8	12	20	52	14	18	30	42	14	22	40	32	16	26								
25	5	62	6	6	15	52	12	15	25	42	12	19	35	32	12	24	45	22	12	27				
30	10	52	4	9	20	42	8	17	30	32	8	20	40	22	16	23	50	12	16	27				
35	5	48	4	7	15	38	4	12	25	28	8	16	35	18	8	20	42	10	12	22				
40	10	38	4	9	20	28	4	13	30	20	8	16	37	10	16	19								
45	5	34	6	7	15	30	6	9	25	20	8	12	35	10	16	15								
50	5	25	4	8	15	20	6	9	25	10	8	13												
55	10	20	6	6	20	10	8	10																

PC 12030XS field of view

Diam. mm	Height (mm)	W.D. (mm)	F/#	r (%)	Height (mm)	W.D. (mm)	F/#	r (%)	Height (mm)	W.D. (mm)	F/#	r (%)	Height (mm)	W.D. (mm)	F/#	r (%)
10	5	82	18	18												
15	5	73	16	14	15	63	16	23								
20	5	66	16	9	10	61	16	14	20	51	16	22				
25	10	56	12	10	20	46	16	18	30	36	16	23				
30	10	48	8	10	20	38	16	15	30	28	16	20	40	18	16	24
35	5	48	12	5	15	38	12	12	25	28	12	17	35	18	16	21
40	10	37	14	8	20	27	16	13	30	17	16	17				
45	10	32	8	7	20	22	8	12	30	12	16	16				
50	10	25	10	7	20	15	16	12								
55	5	23	16	5	15	13	16	10								

PC 23030XS field of view

Diam. mm	Height (mm)	W.D. (mm)	F/#	r (%)	Height (mm)	W.D. (mm)	F/#	r (%)	Height (mm)	W.D. (mm)	F/#	r (%)	Height (mm)	W.D. (mm)	F/#	r (%)
15	5	78	8	12	15	68	16	19								
20	10	62	16	12	20	52	16	18								
25	10	57	8	10	20	47	12	16	30	37	16	21				
30	15	45	8	12	25	35	12	17	35	25	16	20	45	13	16	23
35	10	45	16	8	15	40	16	11	25	30	16	15				
40	10	38	12	8	20	30	12	13	30	20	16	17				
45	10	33	16	7	20	23	16	11								
50	10	25	16	5	20	15	16	11								
55	12	12	16	6												

PCCD series

Catadioptric lenses for 360° top and lateral view with just one camera

KEY ADVANTAGES

360° imaging of small objects
Parts down to 7.5 mm in diameter can be imaged.

Very 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.

EXTENDED RANGE

PCCD 023 now available for high resolution 2/3" detectors.

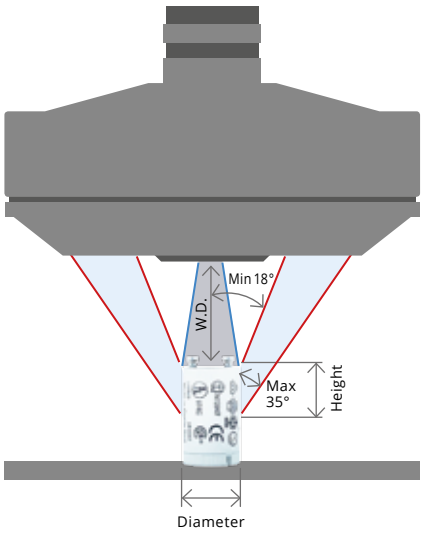
NEW ACCESSORY

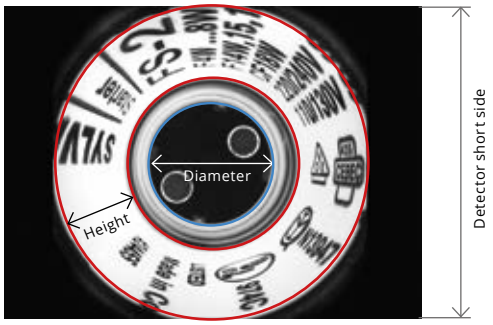
PCCDLFAT Field of view extender for inspection of objects with diameter > 25 mm.

PCCD series are catadioptric lenses exclusively developed and produced by Opto Engineering to enable the 360° side view imaging of small objects. Their innovative optical design, based on a catadioptric system, makes it possible to image objects with diameters as small as 7 mm.
The sides of the object are imaged through the catadioptric system, while the top surface is directly imaged onto the center of the detector. The compactness and high resolution performances of these lenses make them the perfect choice for the inspection of components like pharmaceutical containers, plastic caps, pre-forms, bottle necks, screws and other threaded objects.
PCCD series can work either with 1/2", 1/3" and 2/3" detectors. The sides of the object being inspected are observed over a wide view angle, approaching 45° at its maximum; this feature makes it possible to inspect complex object geometries under a convenient perspective.

Part number		PCCD 013	PCCD 012	PCCD 023
Detector type		**1/3"**	**1/2"**	**2/3"**
Field of view	**(diam x height)**			
Min	(mm x mm)	7.5 x 5	7.5 x 5	7.5 x 5
Typical	(mm x mm)	15 x 10	15 x 10	15 x 10
Max	(mm x mm)	25 x 17	25 x 17	25 x 17
Extended with PCCDLFAT	(mm x mm)	35 x 26	35 x 26	35 x 25
Optical specifications				
Wavelength range	(nm)	450 .. 650	450 .. 650	450 .. 650
Working distance	(mm)	28 .. 53	28 .. 53	24 .. 47
Working distance with PCCDLFAT	(mm)	5 .. 11	5 .. 11	5 .. 11
CTF @ 50 lp/mm	(%)	> 35	> 30	> 30
F-Number		6 - 24	8 - 32	8 - 24
Mechanical specifications				
Diameter	(mm)	143	143	143
Length	(mm)	110.5	110.5	110.5
Weight	(g)	980	990	990
Mount		C	C	C

Sample Images taken with PCCD optics





$$c\,(\%) = \frac{\text{Top view diameter [pixels \#]}}{\text{Detector short side [pixels \#]}} * 100$$

Unwrapped image

The image of the external walls of the object, captured through the catadioptric system, is inscribed into the short side of the camera detector within a circular crown. On the other hand, the top of the object is directly imaged onto the central part of the detector area: both the lateral and top view of the object are in perfect focus at the same time.

The tables show possible combinations of object diameters and heights along with the appropriate working distance and recommended F-number; the "c" parameter for each configuration is also listed.

The "c" parameter describes the dimension of the top view image: it is calculated as the ratio between the central top view diameter and the short side of the detector. The typical ratio between the object height and its diameter is 2/3 which means that, for a given object diameter (i.e. 15 mm), the recommended inspection height will be around 67% of the diameter (10 mm). However, this parameter can be modified to accommodate for different aspect ratios (up to 100%) by adjusting the lens working distance, focus and F-number.

Field of view selection chart

PCCD 013 field of view

Diameter (mm)	Height (mm)	W.D. (mm)	F/#	c (%)
7.5	5.0	53	24	11
10	6.7	49	16	15
15	10.0	42	12	22
20	13.3	35	8	30
25	16.7	28	6	37
Extended FOV with PCCDLFAT				
30	22	11	8	36
35	26	5	8	37

PCCD 012 field of view

Diameter (mm)	Height (mm)	W.D. (mm)	F/#	c (%)
7.5	5.0	53	32	13
10	6.7	49	24	17
15	10.0	42	16	25
20	13.3	34	12	33
25	16.7	28	8	42
Extended FOV with PCCDLFAT				
30	22	11	8	37
35	26	5	8	37

PCCD 023 field of view

Diameter (mm)	Height (mm)	W.D. (mm)	F/#	c (%)
7.5	5.0	47	24	12
10	6.7	45	24	16
15	10.0	38	16	24
20	13.3	30	12	32
25	16.7	24	8	40
Extended FOV with PCCDLFAT				
30	22	14	8	37
35	25	10	8	45

PCCD accessories

PCCDLFAT is an accessory designed to extend the FOV of PCCD optics and inspect objects with even larger diameters (beyond 25 mm). This accessory can be easily mounted on PCCD optics by the user: simply remove the pre-assembled protective window and replace it with PCCDLFAT.

PCCD optics are complemented by a full set of accessories, including **CMHO PCCD**: specific clamping mechanics designed to securely hold catadioptric lenses.
LTRN series: specific matching LED ring illuminators.

PCHI series

Hole inspection optics for 360° inside view in perfect focus

KEY ADVANTAGES

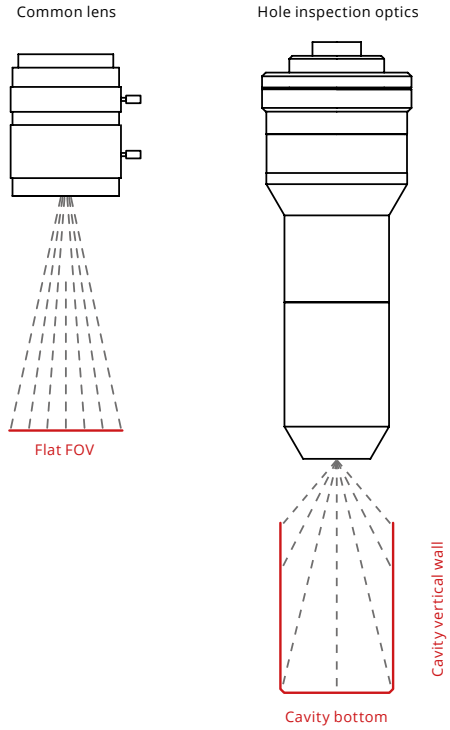
Perfect focusing of holed objects
Both the walls and the bottom of a cavity are imaged in high resolution.

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 unwrapped by the lens under a convenient perspective to clearly display their features.

PCHI optics have been developed by Opto Engineering to enable the perfect viewing of holed objects, cavities and containers. Unlike common optics or so called "pinhole lenses" which can only image flat fields of view, hole inspection optics are specifically designed to image both the bottom of a hole and its vertical walls.



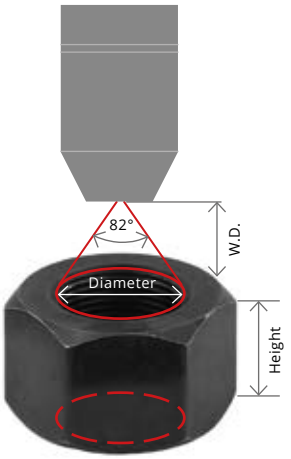
Thanks to the large view angle (>82°) and innovative optical design, these lenses are compatible with a wide range of object diameters and thicknesses. Hole inspection optics are the perfect solution to inspect a variety of different object shapes such as cylinders, cones, holes, bottles or threaded objects.

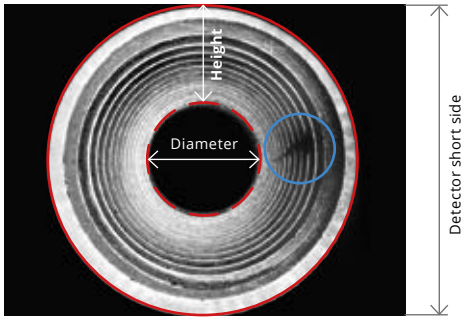
Sample images taken with PCHI optics

Perfect focusing is maintained throughout the entire depth of a hole.

Conical cavity inspection is possible from both sides.

Square, polygonal or irregular cross section objects can be inspected.





$$r\,(\%) = \frac{\text{Side view height [pixels \#]}}{\text{Detector short side [pixels \#]}} * 100$$

Unwrapped image

Part number		PCHI 013	PCHI 012	PCHI 023
Detector type		**1/3"**	**1/2"**	**2/3"**
Field of view 1	**(diam x height)**			
Min	(mm x mm)	10 x 10	10 x 10	10 x 10
Max	(mm x mm)	120 x 190	120 x 190	120 x 190
Optical specifications				
Wavelength range	(nm)	450 .. 650	450 .. 650	450 .. 650
Working distance	(mm)	5 .. 35	5 .. 35	5 .. 35
CTF @ 50 lp/mm	(%)	> 40	> 40	> 30
F-Number 2		4.7	5.8	8.3
Mechanical specifications				
Diameter	(mm)	28.0	28.0	28.0
Length	(mm)	102.0	104.0	108.5
Weight	(g)	250	250	250
Mount		C	C	C

1 Certain CS-mount cameras may affect PCHI 0xx range of focusing (especially for large diameters). Contact us to check compatibility with your specific camera.
2 Working F-number: the real F-number of a lens when used as a macro.

EXTENDED RANGE

PCHI 023 now available for high resolution 2/3" detectors.

Field of view selection chart

PCHI 013, PCHI 012 and PCHI 023 field of view

Hole diameter	High res. imaging Cavity height	r	Normal res. imaging Cavity height	r	Working distance
(mm)	(mm)	(%)	(mm)	(%)	(mm)
10	6	23.5	10	28	5
15	8.5	22.5	14.5	29	6.5
20	13	26.5	22	32.5	9
25	18	26	31	33	11
30	22	26	37	32	14
40	31	26.5	53	32	18
50	40	27	68	32	23
60	50	28.5	85	32.5	29
70	60	28	102	33	35
80	75	29.5	120	34	41
100	97	30	155	34.5	52
120	120	31	190	35	62

PCHI optics can image cavities whose diameters and thicknesses span over a wide range of values.

For a given hole diameter, the table on the left lists the maximum cavity height allowed for both high resolution imaging (small pixel sizes) and normal resolution imaging (>5 micron pixels) applications; the "r" ratio indicates how much of the detector area gets covered by the image of the hole inner walls.

The listed working distance values ensure that the object image is exactly inscribed into the short side of the detector, thus maximizing "r" ratio and image resolution.

PCBP series

Boroscopic probes for panoramic cavity imaging and measurement from inside

KEY ADVANTAGES

Inspection of cavities from inside
Hidden internal features and defects are clearly viewed.

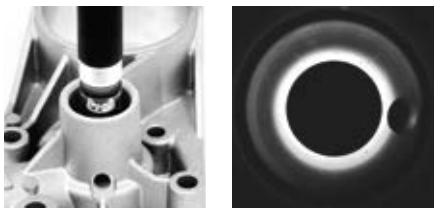
High resolution
The catadioptric design enables the detection of tiny defects over a very wide view angle.

Flaw detection
Coarse deformations revealed using direct illumination.

Surface defect enhancement
Mixing direct and indirect illumination makes it possible to emphasize tiny and scarcely visible defects.

PCBP probes are used to inspect holed objects such as engine parts, containers and tubes whose hidden features can only be controlled by introducing a probe into the cavity.
The catadioptric (refracting + reflecting) optical design ensures much higher resolution than fiber-based probes and enables a complete 360° inner view throughout the entire cavity length. Boroscopic probes can be handled by a Robot Arm or S.C.A.R.A. in order to scan even the deepest cavities. Built-in illumination keeps the device very compact and makes it suitable for simple 3D profile and diameter measurements by means of panoramic triangulation techniques.

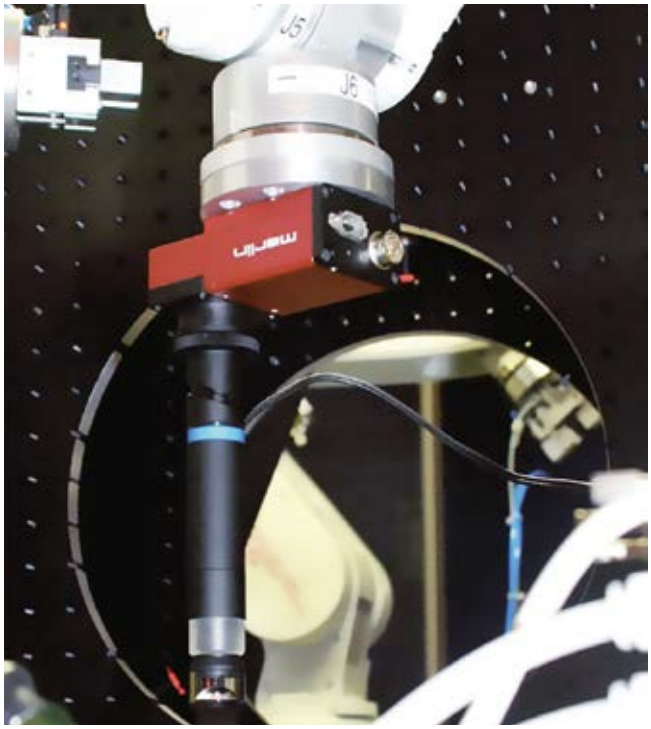
Sample images taken with a PCBP optics

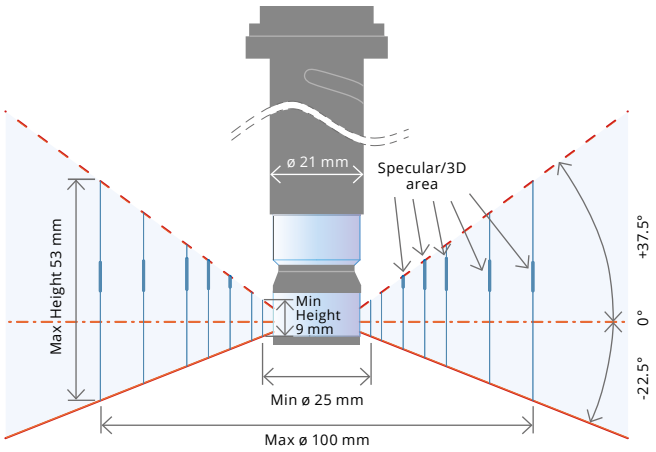


Inspection of holed parts of an engine.

Tube scanning for integrity inspection.

Defect and impurities detection inside containers.

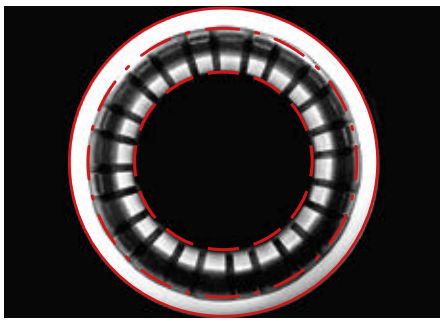




PCBP probes can image cavities whose diameter ranges from 25 mm to 100 mm and over: the table below shows the inspection range allowed.

Inspection area

Diameter (mm)	Height (mm)
25	9
30	12
40	18
50	23
60	29
80	41
100	53



An integrated LED source illuminates the cavity both diffusely and directly (specular illumination). The diagram on the left shows the different illumination areas. The diffused illumination is used for defect detection and component inspection.

The direct/specular illumination can be efficiently used to check for surface deformation on metal and highly reflective objects as well as to measure the hole diameter.

The image of the cavity covers around 50% of the detector height; the continuous red line indicates the bottom view of the cavity (-22.5°), the dashed line shows the upper view (+37.5°) while the dashdotted line refers to the lateral view (0°).

Unwrapped image

Part number		PCBP 013	PCBP 012
Detector type		**1/3”**	**1/2”**
Field of view	**(diam x height)**		
Min	(mm x mm)	25 x 9	25 x 9
Max	(mm x mm)	100 x 53	100 x 53
Optical specifications			
Wavelength range	(nm)	450 .. 650	450 .. 650
Viewing angle	(deg)	60	60
CTF @ 50 lp/mm	(%)	> 25	> 20
F-Number		14	16
Mechanical specifications			
Diameter	(mm)	21	21
Length	(mm)	167	137
Weight	(g)	113	92
Mount		C	C
Electrical specifications			
LED Voltage	(V)	16 .. 24	16 .. 24
LED Power	(W)	< 2.0	< 2.0

The LED illumination device is integrated into the unit. The optical tip of the probe **PCBPTIP** can be easily replaced in case of damage.

The best focus is achieved by means of a lockable focusing mechanism. Power supply cables exit the device nearby the C-mount.

PCPW series

Polyview optics for multiple side views with one shot

KEY ADVANTAGES

Just one camera
No need for multiple cameras placed around and over the object.

Wide viewing angles
45° side view makes otherwise hidden features visible.

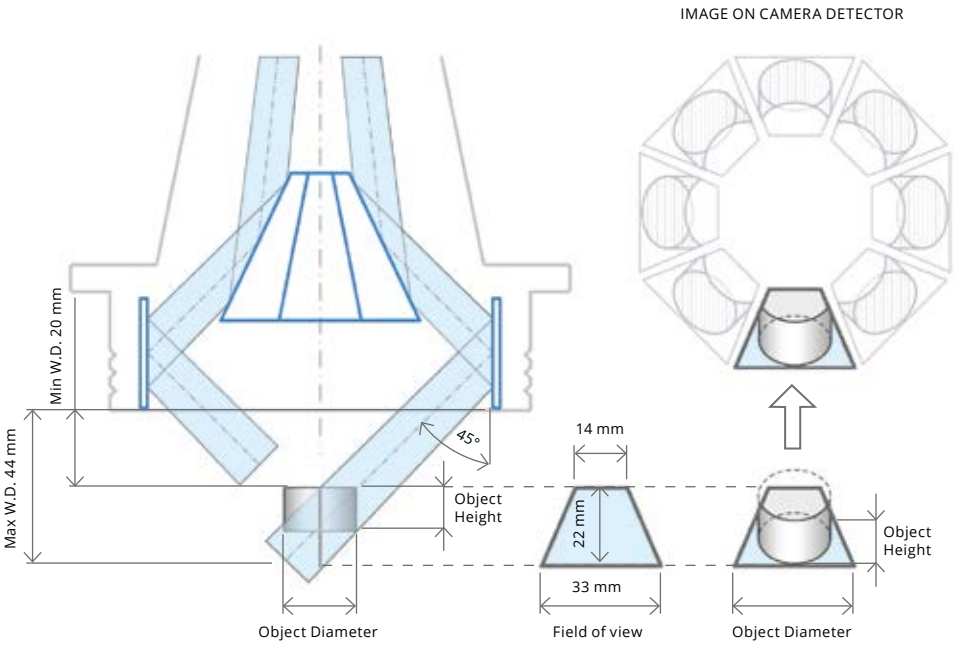
Complete surface inspection
Both inner and outer object surfaces can be imaged in one shot.

Very high resolution
Even the tiniest defects can be detected.

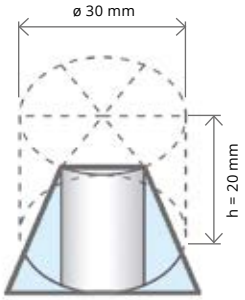
PCPW optics provide eight different views of the side and top surfaces of an object. A wide perspective angle (45°) makes these components suitable for the inspection of the side features of an object (i.e. the threads of a screw or a nut) otherwise impossible to image with a single camera.
Both the external walls of an object and its top can be imaged at the same time. Internal surfaces of holed objects can be completely inspected from the outside. A combined view of the internal and external surfaces is possible and an image displaying both the inner walls and the bottom of a cavity can be obtained. In addition to these unique features, Polyview optics also ensure a very high image resolution and very good image brightness.

Sample images taken with PCPW optics

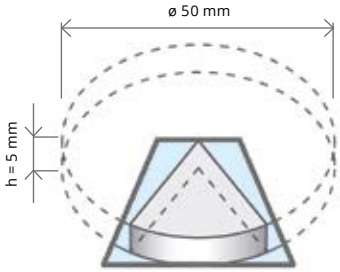
Part number		PCPW 013	PCPW 012	PCPW 023
Detector type		**1/3”**	**1/2”**	**2/3”**
Max object diameter for SIDE inspection				
Height 20 mm	(mm)	30	30	30
Height 5 mm	(mm)	50	50	50
Max object diameter for SIDE + TOP inspection				
Height 10 mm	(mm)	30	30	30
Optical specifications				
Wavelength range	(nm)	450 .. 650	450 .. 650	450 .. 650
Working distance	(mm)	20 .. 40	20 .. 40	20 .. 40
CTF @ 50 lp/mm	(%)	> 60	> 50	> 40
F-Number		4-12	6-16	8-16
Mechanical specifications				
Diameter	(mm)	140	140	140
Length	(mm)	224	224	224
Weight	(g)	990	990	990
Mount		C	C	C



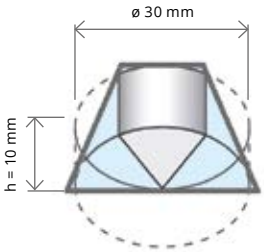
The diagram shows how Polyview optics image a cylindrical object. The object is observed at a 45° viewing angle, from eight different points of view. Eight different trapezoidal fields of view are obtained: all the object features included in such a trapezoid will be imaged on the corresponding image portion. 45° viewing angle allows for imaging both the sides of a cylindrical object and its top; if the object is a hollow cylinder (hole or cavity), the inner wall of the cavity will be imaged instead of the top, thus enabling both outer and inner sides inspection.



When the object height is maximum (20 mm) up to 30 mm diameter objects can be inspected.



Up to 50 mm diameter objects can be inspected, provided their thickness doesn't exceed 5 mm.



Combined view of both the inner sides and the bottom of a cavity is possible when objects are up to 30 mm diameter and 10 mm height.

Maximum field of view

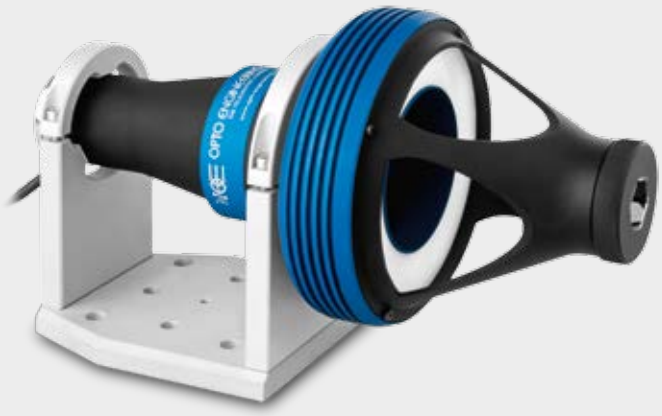
In order to perform a complete 360° inspection, each of the eight image portions should image at least 1/6 of the cylindrical surface; this condition ensures a good overlapping between two different lateral views, since part of the object features will be shared by two neighboring image portions.

Part number		LTRN 050 W 45
Light color		**white, 6300 K**
Dimensions		
Outer diameter	(mm)	54.0
Inner diameter	(mm)	15.2
Height	(mm)	18.0
Weight	(g)	30.0
Mount		threaded retaining ring
Voltage	(V, DC)	24
Power	(W)	3
Compatible PC lenses		PCPW 0xx, PCHI 0xx
Other compatible lenses		TC 23 00x, MC3-03X

LTRN 050 W 45 is a small LED ring illuminator compatible with different OE products and suitable for a variety of inspections. This illuminator is also perfectly suitable for illuminating the inner sides of a cavity imaged by a Polyview lens; the illuminator flange is threaded to fit PCPW series inner mounting interface.

PCMP series

Micro-polyview optics for 3D measurement and imaging of small parts



KEY ADVANTAGES

Small parts lateral imaging
Inspection of objects whose size ranges from 1 to 10 mm.

Measurement capability
The top and the lateral views show the same magnification.

High field depth
The top and the lateral views are imaged without significant defocusing.

PCMP optics are 3D, multi-image lenses designed to completely measure and inspect objects whose dimensions range from 1 to 10 mm, such as electronic components, solder paste and micro-mechanics. Six different lateral views are provided by an array of mirrors interfaced to a bi-telecentric lens; the top of the object is directly imaged at the center of the field of view.

The lateral views feature exactly the same magnification and the images remain in perfect focus even when the object is displaced from its nominal position. All the views can be used to precisely measure the dimension of components from different angles.
PCMP series integrates LED illumination with the most appropriate lighting geometry for this optical configuration.

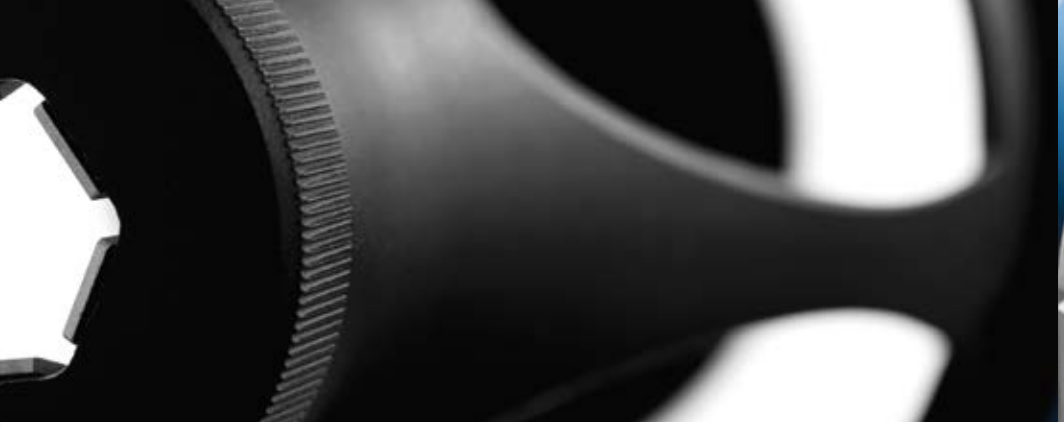
DO YOU KNOW?

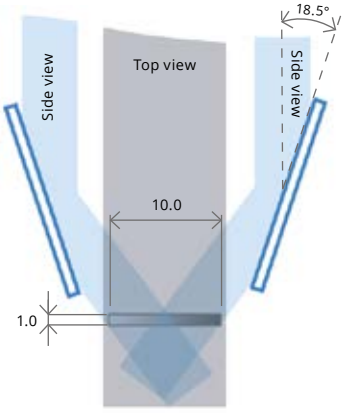
Customized versions with:
- different number of views
- different view angles
- asymmetric or special mirror arrays
can be supplied upon request.

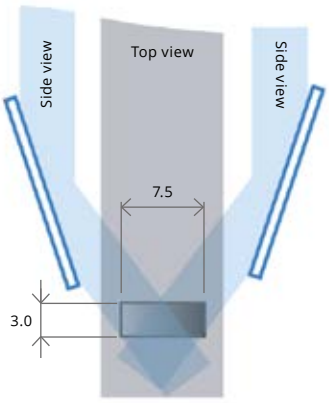
Part number		PCMP 012	PCMP 023
Detector type		**1/2"**	**2/3"**
Max object inspection height			
With diameter 2.5 mm		6	6
With diameter 5 mm		4.5	4.5
With diameter 7.5 mm		3	3
With diameter 10 mm		1	1
Optical specifications			
Wavelength range	(nm)	450 .. 650	450 .. 650
Working distance	(mm)	1.5 .. 5	1.5 .. 5
CTF @ 50 lp/mm	(%)	> 40	> 40
F-Number		8	8
Mechanical specifications			
Diameter	(mm)	119	119
Length	(mm)	262	262
Weight	(g)	980	980
Mount		C	C
Electrical specifications			
Illuminator voltage	(V, DC)	24	24
Illuminator power	(W)	18	18

The suggested working distance ranges from 1.5 to 5 mm. The best focusing can be achieved by adjusting the number of spacers in the C-mount interface or by vertically positioning the illuminator+mirror assembly.
The image orientation phase can be adjusted by simply rotating the mirror cage or the whole assembly.

The top and side views show exactly the same magnification; however the side views appear to be compressed because of the perspective angle. Thanks to telecentric imaging such compression is purely linear and therefore very easy to compensate.







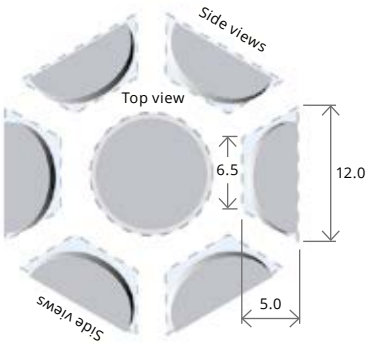
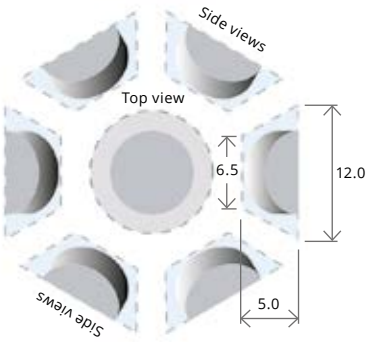


IMAGE ON CAMERA DETECTOR



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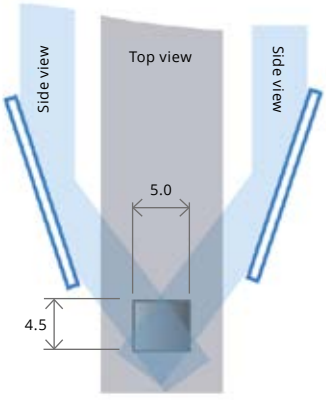
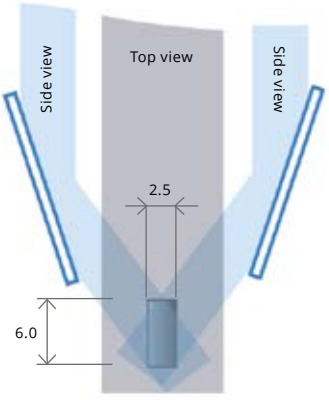




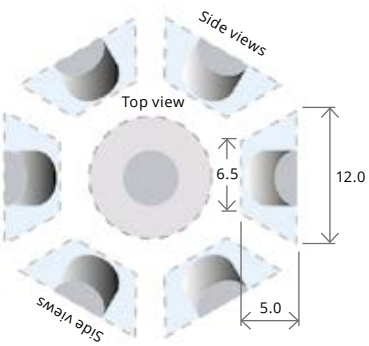


IMAGE ON CAMERA DETECTOR

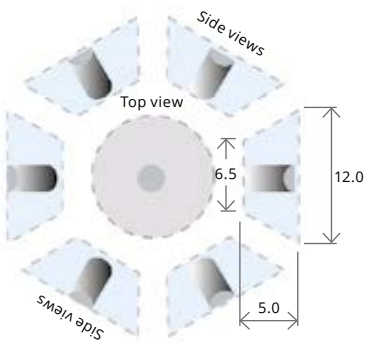


IMAGE ON CAMERA DETECTOR

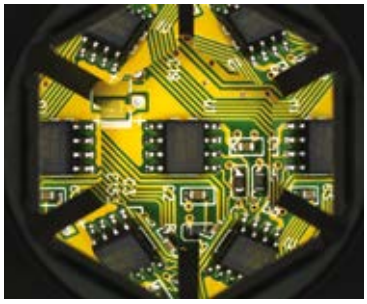
Application examples:

Mechanical components inspection

Thread integrity, pitch and diameter can be verified and measured.

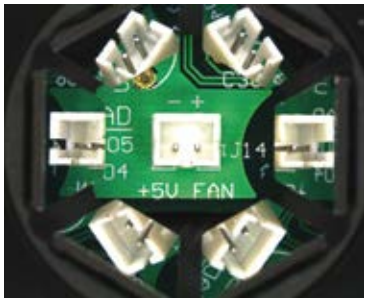
SMD components inspection

Integrated circuit position, rotation, pin integrity and bonding can be checked.



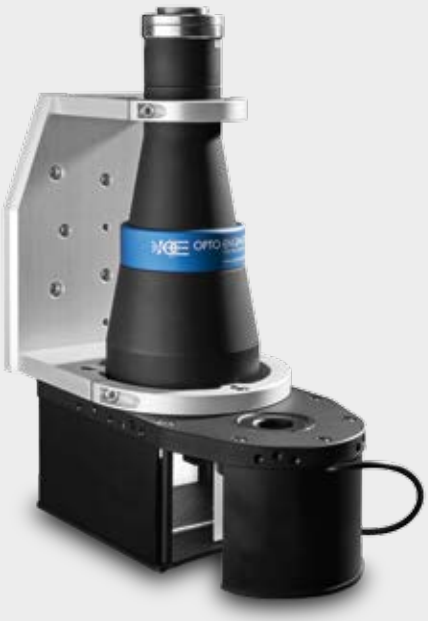
Electronic connector check

Presence/absence, alignment and length of pins can be precisely measured.



TCCAGE series

Bi-telecentric system for multiple side imaging and measurement at 90°



KEY ADVANTAGES

90° lateral imaging
The four orthonormal views allow visualization of object features that are hidden when looked at from the top.

Long and thin object inspection
The characteristic aspects ratio of the four image segments perfectly fits long and thin objects.

Built-in illumination
The device also incorporates two different light sources, for back and direct illumination.

Suitable for measurement
The telecentric optics makes this module perfect for any multiple-measurement application.

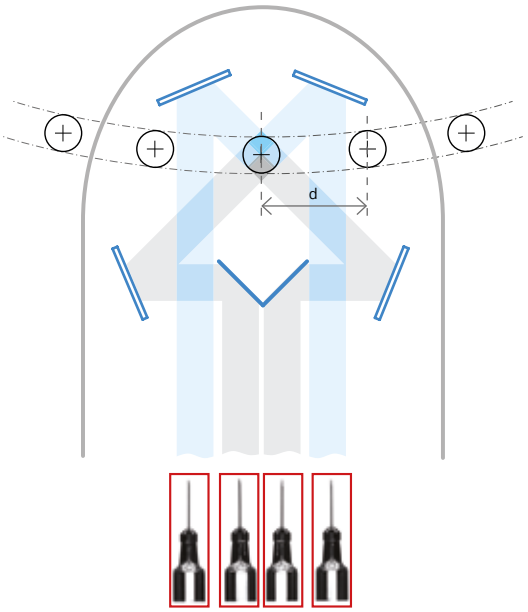
TCCAGE is an integrated opto-mechanical system designed to fully inspect and measure parts from their side without any need of rotation. Four orthonormal views of an object are provided by a bi-telecentric lens through an array of mirrors.

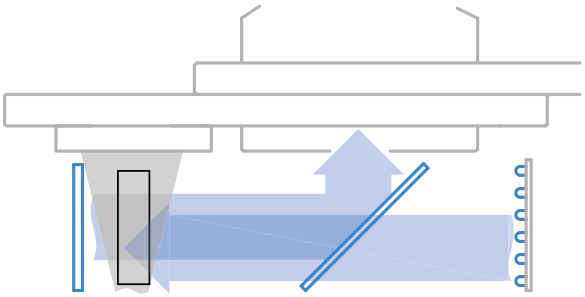
The optical path is designed so that the displacement angle between the views is exactly 90°; this optical layout ensures complete coverage of the object lateral surface.

Furthermore, telecentric imaging makes the system insensitive to off-centered parts and therefore suitable for measurement applications.

TCCAGE is the perfect solution for inspecting parts whose features would be hidden when looked at from the top and for all those applications where an object must be inspected or measured from different sides. Two different illumination devices are built into the system to provide either backlight or direct part illumination.

Part number		TCCAGE 12048	TCCAGE 23048	TCCAGE 12096	TCCAGE 23096
Detector type		**1/2"**	**2/3"**	**1/2"**	**2/3"**
Max object diameter	(mm)	8	8	16	16
Max object height	(mm)	32	32	68	68
Optical specifications					
Wavelength range	(mm)	450 .. 650	450 .. 650	450 .. 650	450 .. 650
CTF @ 50 lp/mm	(%)	> 40	> 40	> 40	> 40
F-Number		8	8	8	8
Mechanical specifications					
Width	(mm)	111	111	179	179
Length	(mm)	192.8	192.8	323	323
Height	(mm)	248	248	421	421
Weight	(g)	2700	2700	5800	5800
Mount		C	C	C	C
Electrical specifications					
Ring illumination voltage	(V, DC)	24	24	24	24
Ring illumination power	(W)	3	3	3	3
Back illumination voltage	(V, DC)	24	24	24	24
Back illumination power	(W)	9	9	18	18





NEW FEATURES

- 5x more powerful backlight illumination
- improved design

Sample images taken with TCCAGE

Working principle

A bi-telecentric lens observes the object from four different positions through a mirror assembly, ensuring that the optical path is the same for all four view points.
The four views are equally spaced every 90° and partially overlapped, obtaining complete coverage of the object lateral surfaces.
The system can thus tolerate off-centered components without any significant decay of the image quality thanks to the telecentric optics, which ensures that magnification is maintained in each image segment. The system is designed so as to allow components to pass unobstructed through the mirror cage, for in-line applications.

When TCCAGE system is used for in-line inspection, consider the following minimum distance "d" between two consecutive objects in order to avoid image overlapping

TCCAGE xx048	d [mm] ≅ 25 + $\varnothing_{object}$/2
TCCAGE xx096	d [mm] ≅ 50 + $\varnothing_{object}$/2

Illumination geometry

TCCAGE series integrate both direct and backlight illumination devices. Direct illumination (grey cone in the drawing) is provided by a ring illuminator placed on the top of the part that can be used to enhance surface defects.
Back lighting (indicated by the blue arrows) is obtained by means of a diffusive source which illuminates the object through the mirror system; this type of illumination is suggested for measurement purposes or to inspect transparent objects.

Additional port

TCCAGE series is provided with an additional port placed right, placed right above the object. This port can be used to inspect the top of the part by means of an additional lens and camera system (i.e. a hole inspection lens, a macro or a telecentric lens). The aperture can also host other types of illuminators.

OPTO ENGINEERING
THE TELECENTRIC COMPANY

Contact us

EUROPE

Opto Engineering
Europe headquarters
Circonvallazione Sud, 15
46100 Mantova, IT
phone: +39 0376 699111
contact@opto-engineering.com

Opto Engineering
Germany
Agnes-Pockels-Bogen, 1
80992 München, DE
phone: +49 0 89 18930918
de@opto-engineering.com

UNITED STATES

Opto Engineering
USA
11261 Richmond Ave
Ste G-108 - Houston, TX 77082
phone: +1 832 2129391
us@opto-engineering.com

ASIA

Opto Engineering
China
Room 2405, n°885, Renmin RD
Huangpu District 200010
Shanghai, China
phone: +86 21 61356711
info@deepview.cn

Opto Engineering
India
contact@opto-engineering.com

Opto Engineering
Korea
kr@opto-engineering.com

www.opto-engineering.com