

Pericentric Lenses Explained

PERICENTRIC LENSES IMAGE BOTH THE TOP AND LATERAL SIDES OF A ROUND OBJECT USING A SINGLE CAMERA. By Joe Gugliotti



Sometimes we need to view the top of a cylinder and just enough of the upper sides to image key features, such as the crimp or printing on the upper sides of a medical vial or short shots on the sides of an injection-molded cap. A common method of imaging the top and sides of a small cylinder involves the use of multiple cameras, arrayed with a top-down camera and up to four side-view cameras, typically placed at 90° to each other.

It's not always possible to configure this [imaging solution](#) due to physical space limitations on the sides of the line, as well as having cylindrical containers that may lack the pitch on the conveyor to provide a clear view from each side camera.

What Kind Of Image Is Provided By A Pericentric Lens?

A [pericentric lens](#) provides a view of the top AND a limited vertical section of the lateral sidewalls of a cylindrical object, from the top surface downward. There are often key features that are visible on the sides of a cylindrical object within this limited height range.

The diameter and vertical height of the viewed region are dependent upon the working distance between the bottom of the lens and the top of the cylindrical object. The side view of the pericentric lens is at a maximum 24° from vertical. The following field-of-view ranges are typical of a pericentric lens:

- The field-of-view at a working distance of 80mm is 20mm diameter X 60mm height.
- The field-of-view at a working distance of 20mm is 60mm diameter X 20mm height.

The 360° image may be used “as is” for the detection of patterns or features on the side, such as short shots, label presence, printed code presence, and the imaging of other features. The circular 360° image, in many cases, does not have a bearing on the application, as long as the image appears consistent.

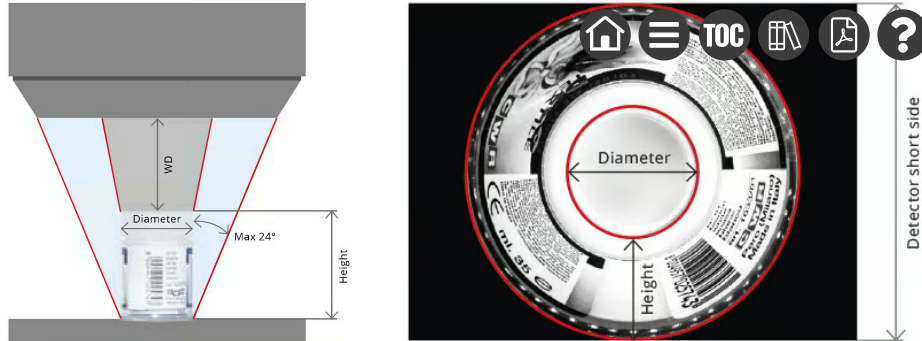


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The 360° image can also be “unwrapped” using software, such that the image may be used for barcode reading, pattern matching, or other inspection task that requires a minimally-distorted image.



Image Circle Diameter

Pericentric [lenses](#) work in 360° and specific models are compatible with 1/3”, 1/2”, and 2/3” camera sensors. Because the field-of-view is circular, the image circle size must fully fit within the *vertical dimension* of the camera sensor used. This is an important consideration when a sensor size other than one of the standard formats is used.

- Pericentric lenses for 1/3” sensors project a 3.6mm image circle
- Pericentric lenses for 1/2” sensors project a 4.8mm image circle
- Pericentric lenses for 2/3” sensors project a 6.6mm image circle

Note: This is different than having the lens be the same or larger format than the camera sensor size. In this case, the lens projects a fixed size image circle and it must fit within the vertical dimension of the sensor to provide a full 360° image.

What Are Some Typical Applications For A Pericentric Lens?

Inspecting For Quality And Printing On Medical Vial Caps

To inspect the medical vial’s cap, we’ll need to image the top and sides of the cap. The pericentric lens is used to 1) image the top of the cap to inspect the rubber stopper and the needle hole, 2) image the crimp region at the base of the cap to look for deformation, and 3) verify the presence of the printing or, depending on the application, image a code printed around the side of the cap.

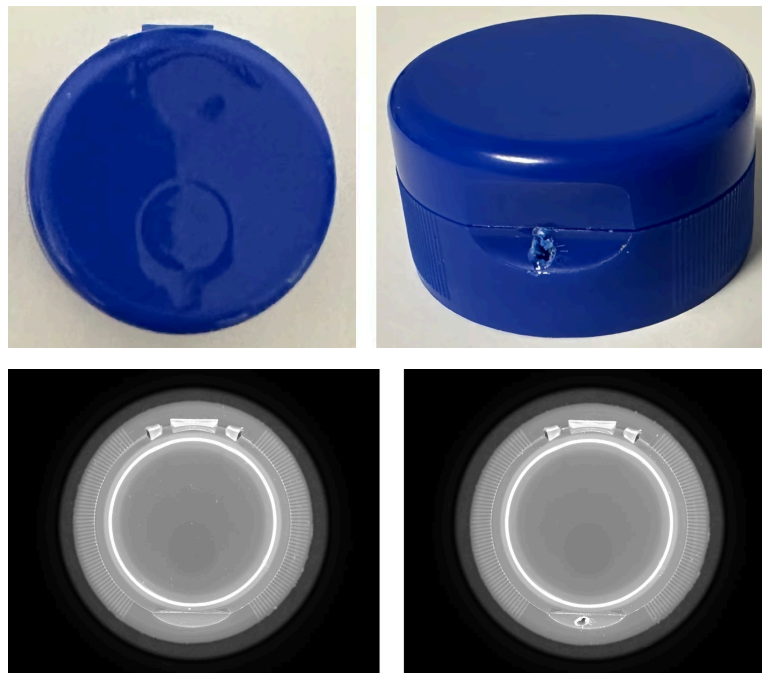
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Imaging Short Shots And Defects On Injection-Molded Caps

Short shots on injection-molded plastic components are typically furthest from the “gate” and tend to appear at the edges of the cap’s lid and regions farthest from the gate into the mold. The top-view image of the blue cap below does not provide any information about the sides, where a short-shot or defect may be present. In this example, there’s a hole within the finger notch of the cap that cannot be imaged from a top-only view, but is clearly visible with a pericentric lens.



Imaging Sprockets And Gears

When imaging objects with a height below the maximum viewable height of the pericentric lens configuration, it’s possible to view the entire side height. While still somewhat distorted because of the side view’s angle of view, inspections, such as the sprocket inspection below, can check for debris or an improper geometry within each gear tooth.

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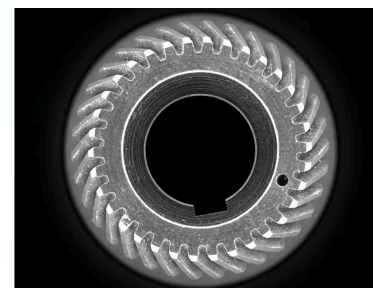


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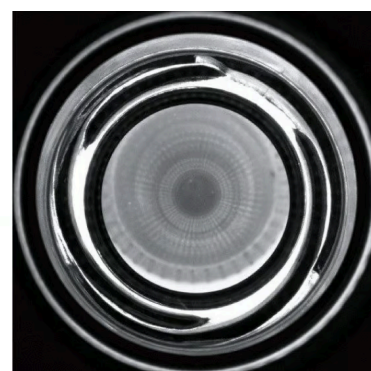
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Imaging Pre-Form And Bottle Threads

Imaging the top and threads of a bottle pre-form or a finished container may focus on circularity of the top and the presence of the threads or other features only visible from the angled side view.



What Kind Of Light Is Typically Used With A Pericentric Lens?

A pericentric lens creates a 360° image. A diffuse LED ring light is the most flexible means of illumination, in that the light provides better coverage, it is a softer light without visible LEDs reflecting off the object, and the diffuse ring light is less prone to creating random specular reflections off the object's edges or surface that may inhibit the inspection algorithm.

The diffuse LED ring light may be triggered and strobed for moving object image acquisition. As with any LED lighting application, the wavelength of the light may have an effect on the image contrast within the object.

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The diffused ring light may or may not be the best choice depending on the application requirements, but is a good place to start when experimenting with a pericentric lens. Diffuse LED ring lights are available to fit on the end of the pericentric lens.

Presentation Of The Objects

It's important to present the object upright and in a single file as it is conveyed beneath the center point of the lens. Since the pericentric lens is imaging the lateral sides of the object, be sure there is a space of about one object diameter between objects on the conveyor so there is no blockage of the lateral imaging capability of the pericentric lens.

Conclusion

The pericentric lens's primary benefit is the ability to provide a top view AND a 360° lateral view of a section of the sides of a cylindrical object. Remember the importance of selecting the appropriate lens format so that the full 360° image circle is contained within the vertical dimension of the camera sensor.

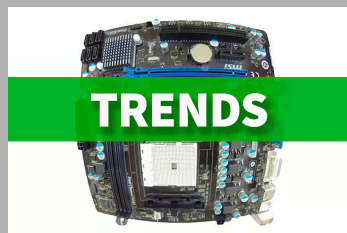
Although the viewing angle of 24° from vertical is not going to provide the same type of image as a straight-on view from the side, a pericentric lens can provide enough of a side-view to meet the requirements of many applications. By obviating the need for dedicated side-view cameras, the cost and complexity of the imaging solution can be reduced.

Images Source: R.J. Wilson, Inc. and their specialty lens manufacturer

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