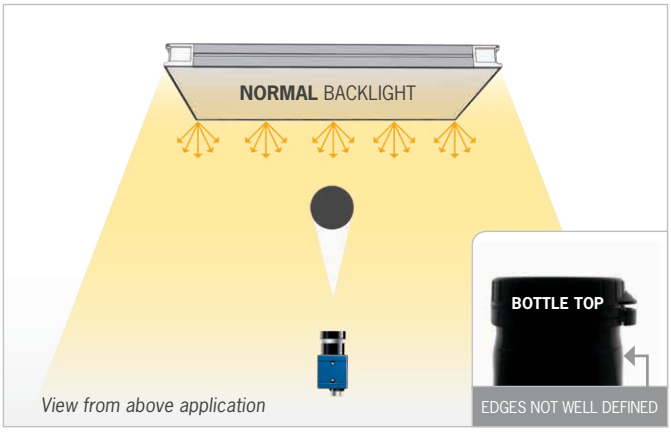
TECH NOTE

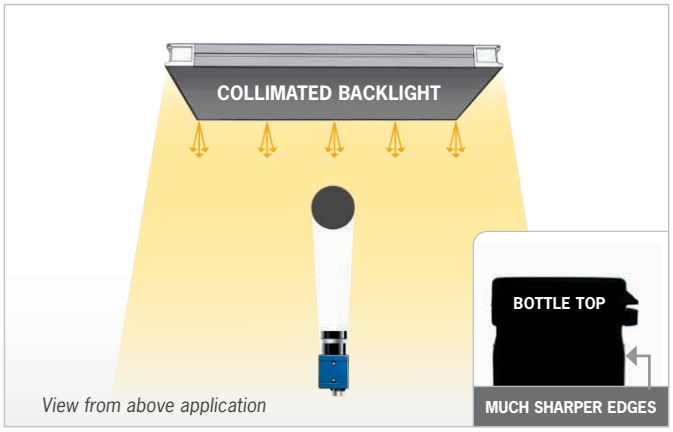
TPL VISION
Active LED solutions

COLLIMATED ILLUMINATION FOR MACHINE VISION

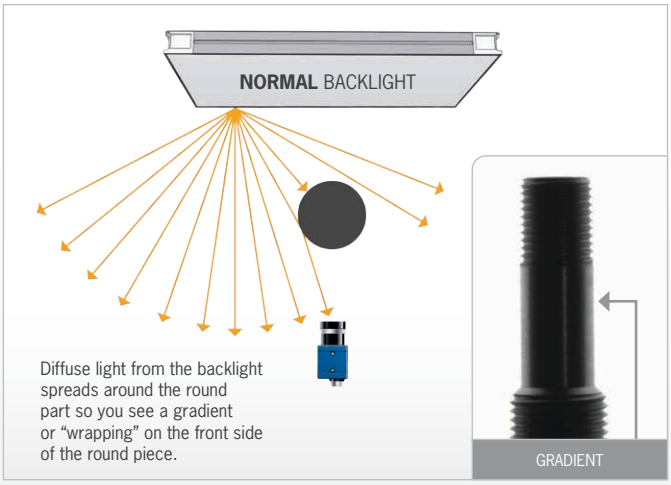
WHAT IS A COLLIMATED LIGHT?

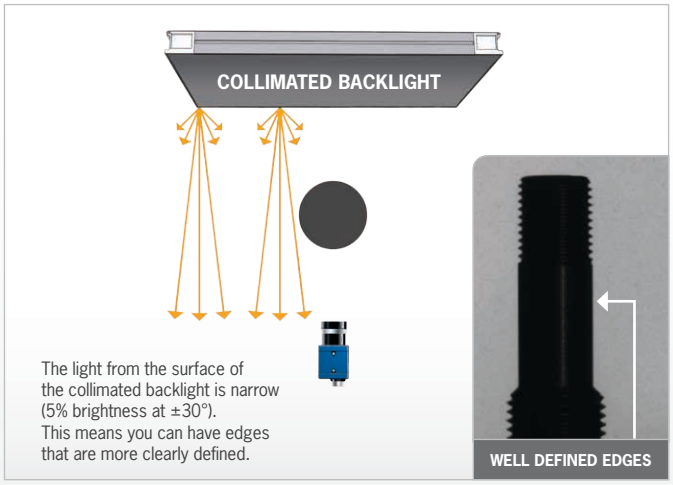
A collimated light is a type of backlight used in Machine Vision applications to help create **sharper images**. These backlights use a special film to block the light which is spread from the diffuser of a traditional backlight.





In a bottle top inspection application, you can see in the image on the left that the diffuse light from the sides of the backlight "wraps" around the bottle top. Whereas the collimated light eliminates this effect and creates a perfect black on white silhouette, with **sharper edges** as seen in the image on the right.





The best method for illuminating highly precise measurement applications is to use a telecentric lens combined with a light, but this is often considered too expensive a solution for many applications. Introducing a collimated backlight illumination to these applications enables users to switch to using normal C-mount lenses rather than telecentric lenses, bringing significant cost advantages and simplicity to the application. The collimated backlight also works with a telecentric lens, but careful setup is required as the working distance between the part being inspected and the light is critical.

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PHONE +44 (0)**1738 310 392**
EMAIL **contact**@tpl-vision.co.uk

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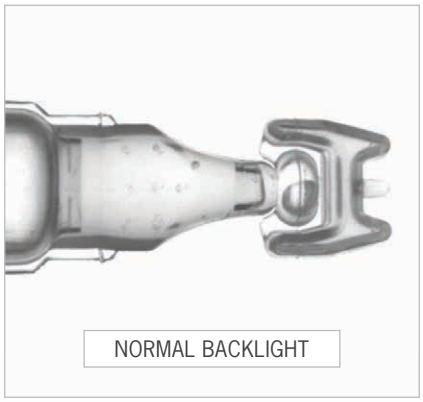
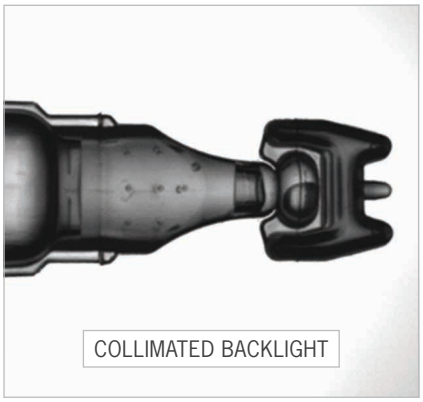
Another advantage of a collimated light is the effect that it creates on transparent parts:



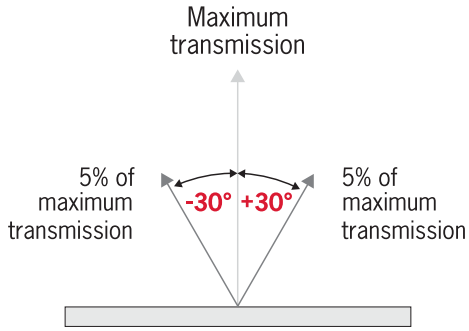


With the traditional backlight (middle image), the diffuse lighting coming in from all directions on the parts can “wash-out” the definition of edges and features on clear parts that are being inspected. Whereas with a collimated light (right image), the edges are no longer washed out and are shown with improved contrast.

In TPL Vision’s light, the collimation effect is defined on the right. The light in a ±30° viewing angle is still visible. The fall off from max transmission of light to 5% of this brightness is in the 15-30° region on either side.

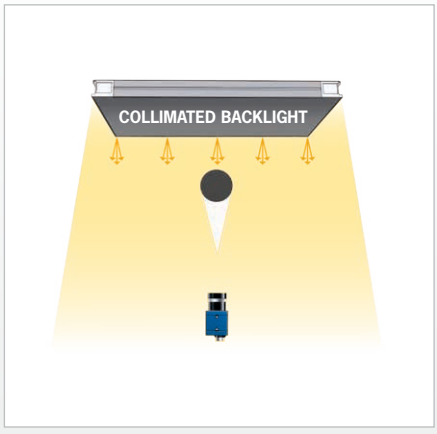
Notes: *all sample images shown in this document have been taken with a standard lens.*

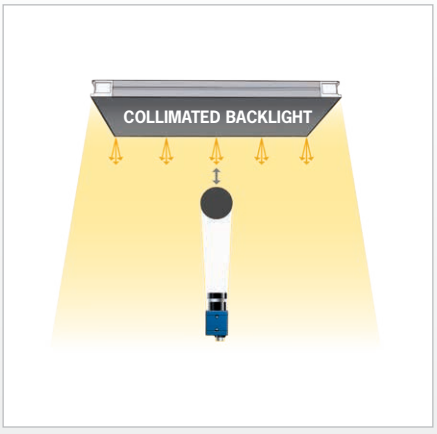
COLLIMATION EFFECT

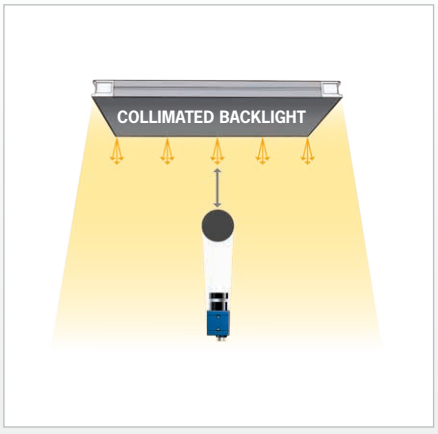


HOW DO YOU SET UP A COLLIMATED LIGHT?

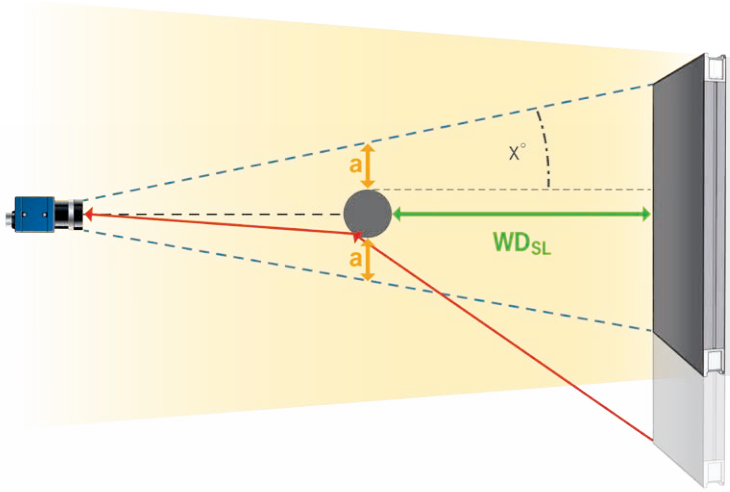
To correctly set up an application you must understand how the working distance affects the collimation effect. It also depends on the type of sample that you are inspecting. Let’s start with the round part:





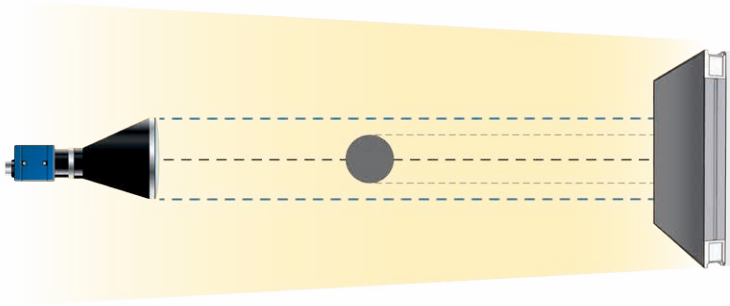


When inspecting a round part with a collimated light, **you want to reduce the "wrapping" effect produced by the ±30° beams**. The best way of doing this is to reduce the size of the collimated light and increase the working distance from sample to light (WD_{SL}). This will reduce the angle x° in the image below. Dimension "**a**" is the size of the field of view around the part, and the **blue lines** show the field of view of the camera. Dimension "**a**" depends on the size of the part and the tolerances required in the vision system. Ideally, angle x° would be less than 10°, but this depends on your required edge definition/accuracy for round or thick parts.



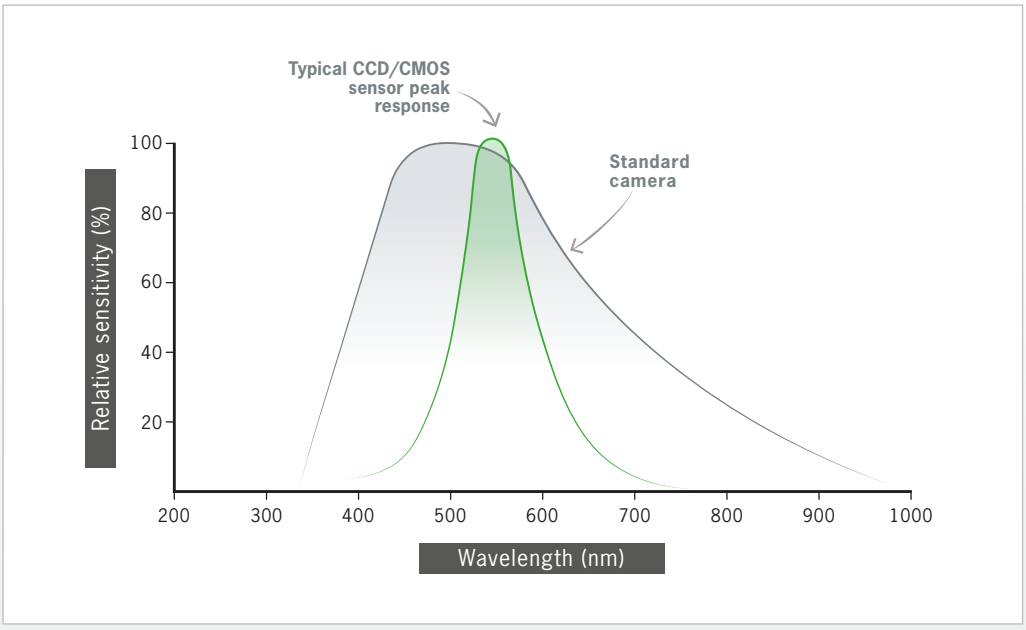
By reducing the size of the light, you remove any unwanted light wrapping around the round part.

If a larger light is used, the **red lines** in the diagram on the left illustrate the light path to the camera, which creates the unwanted "wrapping" effect.



You can reduce the angle x° to 0° by using a telecentric lens on the camera. This brings all the camera's field of view onto a parallel with the optical axis. It also allows you to reduce the size of the light to the diameter of the lens. This is recommended for the best precision of the edges.

To further increase measurement accuracy, a green light is recommended as most CCD/CMOS sensors have a peak response between the green and red band of the spectrum (480 - 560 nm).



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PHONE +44 (0)1738 310 392
EMAIL contact@tpl-vision.co.uk
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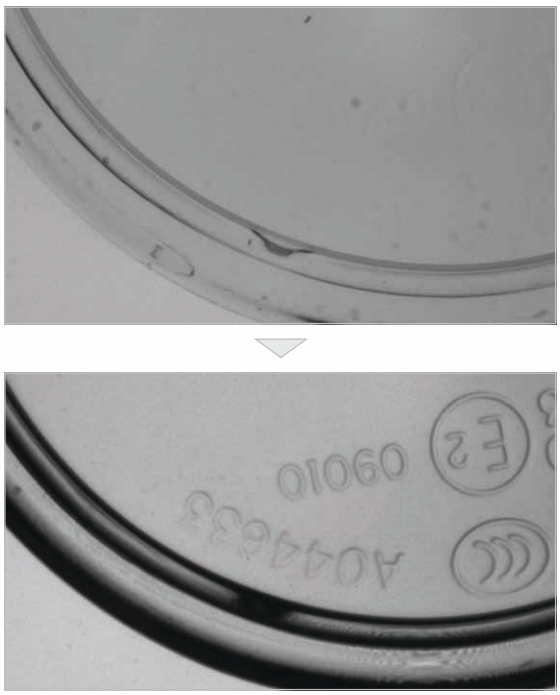
TYPICAL APPLICATIONS?

2 important application areas for the collimated backlight are the inspection of round parts for measurement and profile inspection, and also the inspection of clear parts to highlight features that are typically challenging to see.



1. **Round parts** will always have the problem of light wrapping around the component when using a traditional backlight. This problem can be greatly reduced by changing to a collimated backlight, producing sharper images and revealing more detail. In cases where high precision in the ±0.01mm range is required, the collimated light will need to be very far away from the sample. If additional measurement accuracy is required, it would be recommended to also add a telecentric lens, as this will further improve accuracy. The collimated effect is also excellent for inspecting the quality of threads, looking at placement of lids and analysing the profile of thick and round parts.

2. For **clear parts**, the collimated effect is perfect for looking at defects and features on clear glass and plastic. 2 examples of this would be:
   - **a.** Looking at plastic parts inside food packaging, the edge of the parts can be very clearly defined.
   - **b.** Looking for cracks and extruded details on clear plastic.

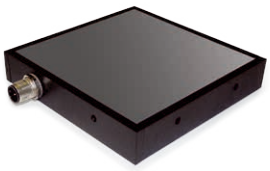
LIGHTS AVAILABLE FROM TPL VISION

TPL Vision has **2 backlight products** that are available with the collimation effect. One for smaller fields of view and one for larger:

	CSBACK	CMBACK+
Minimum size	50x50mm	200x200mm
Maximum size	200x200mm	400x400mm
Increments (either direction)	50mm	100mm
Thickness	21mm	45mm
Power Supply (current control integrated)	24VDC	24VDC
Mounting	M4 threads on border	T-Slot on border, screw points in each corner
Surface Homogeneity*	90%	85%
Connector	M12 4P	M12 4P (T-power)
IP rating	40	40

*surface homogeneity is at this level if using telecentric lens to cover the entire field. If you are using a standard optic, depending on the size of the light and the working distance you may see reduced brightness due to the light being at 5% of the brightness at ±30°.

CSBACK



High intensity collimated backlight, perfect for inspection of small round parts and transparent objects on small fields of view, starting at 50x50mm.

Link: www.tpl-vision.fr/en/backlight/collimated-csback

CMBACK+

Powerful collimated backlight perfect for large fields of view. Ideal for pick and place applications to identify the edges of clear film wrapping. Sizes start at 200x200mm.

Link: www.tpl-vision.fr/en/backlight/collimated-medium-cmback