

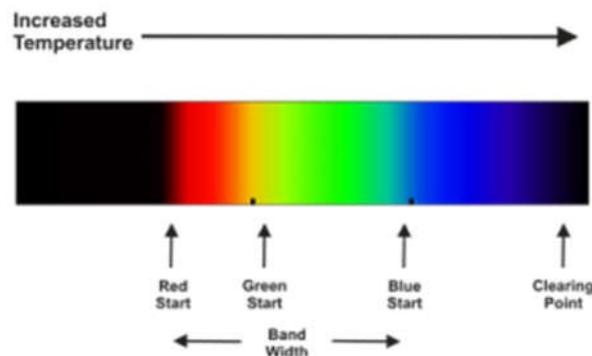
PRODUCT COMPARISON SHEET

Thermochromic Liquid Crystals (TLCs) are optically active mixtures of organic chemicals that can be formulated to be highly temperature sensitive and when used in certain conditions show many different colours as they pass through their liquid crystalline state or they can even be formulated to just change through a single colour.

There are 3 principle types of Thermochromic Liquid Crystal Colour Reactions

1) Standard Red, Green, Blue (RGB) type:

These are the original TLC Mixtures which have been used in producing Thermometer Labels since the late 1970s. Normally printed onto a black background they initially show in a black state below their temperature rating and then pass through the colours of a rainbow as light is reflected at different wavelengths as they pass through their "liquid crystalline" state and then show as black again once the temperature is outside of the range and they are fully liquid in their isotropic state. Accurate to $\pm 0.5^{\circ}\text{C}$ these TLCs can be used to produce thermometers with a resolution as low as 0.5°C for use in hospitals.



Here you can see this type of TLC used in an example of a thermometer. Three colours can be seen as each window is a different liquid crystal phase. You should read the Green window as the temperature, so in this case the temperature is 15°C . If there is no green showing then the temperature is between the Red/Tan and Blue Windows. Temperatures between -30 and 120°C can be produced.



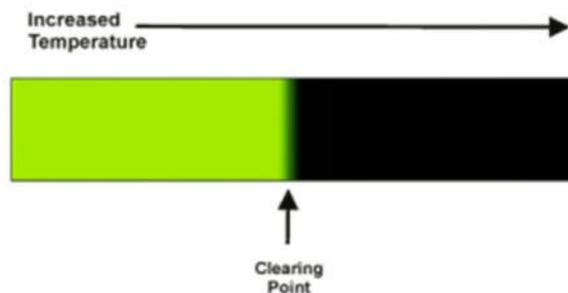
Once graphics have been reverse printed onto a clear polyester substrate these TLCs are screen printed with usually 2 coats for each event and then black backed and adhesive applied before being cut.

Information in this Product Data Sheet is compiled from our general experience and data obtained from various technical publications. While LCR Hallcrest believes that the information provided herein is accurate at the date hereof, no responsibility for its completeness or accuracy can be assumed. The information is provided solely for consideration, investigation and verification by the user. Customer must test the products to ensure they meet their needs and are suitable for use in their process. Revision date

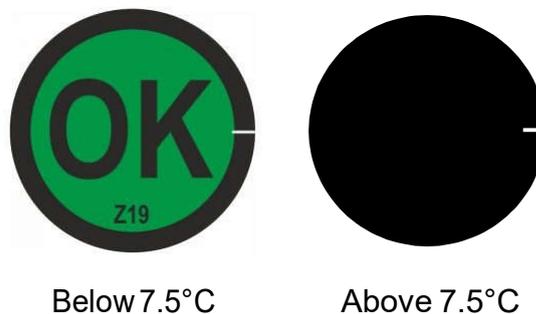
Revision date – August 13th 2019.

2) Easy Read Single Colour Below (SCB) type:

These were initially developed by LCR Hallcrest in the late 90's in response for a need for a simple fridge thermometer that would be easily understood. From this a new generation of temperature indicators using these materials which sharply change colour going from a coloured state below their rating to black when above it were developed. Whilst still accurate to +/-0.5°C the resolution is only possible at 2°C in multi event products.



Here you can see this type of TLC in an one of the original Fridge thermometers which displays the word "OK" when the temperature is below 7.5°C



Below you can see the same materials but used in a thermometer. You should read the first green window to establish the temperature so this milk jug thermometer shows 60°C. Temperatures between 0°C and 75°C for SCB Blue and SCB Red and between 0°C and 100°C for SCB Green can be produced.



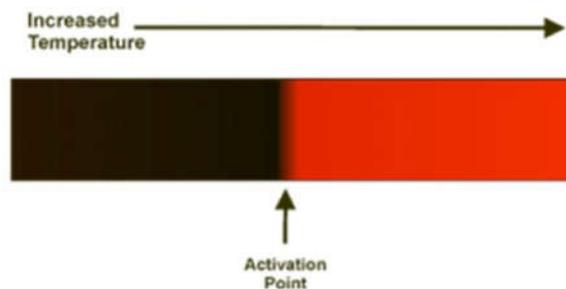
Due to the single colour change these products are easier to read than the traditional RGB ones. They are manufactured in the same way as the RGB products however as they have to be coated around 50% thicker than the RGB type in order to show bright colours this typically means a third print. These SCB TLCs can be produced in 3 colours Green, Blue and Red the brightest of which is Green.

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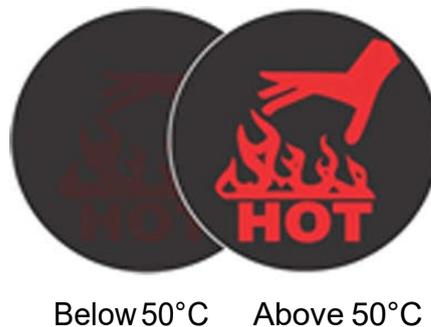
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3) Easy Read Single Colour Above (SCA) Type

These were developed by LCR Hallcrest in 2014 to allow a new range of products to be developed due to requests from customers to be alerted when temperatures exceed a temperature rather than fall below them. These materials sharply change colour going from black below their rating to a coloured state when above it. Accurate to +/-1°C with a recommended resolution of 2°C in multi event products.



Here you can see this type of TLC used in a Hot Hand Warning Label which displays the warning symbol when the temperature is above 50°C



Below you can see the same materials but used in thermometers. You should read the last lit window to establish the temperature so the Fridge thermometer shows 10°C and the Room thermometer shows 20°C. Temperatures between -25°C and 100°C can be produced for SCA Red, Orange and Green.



Due to the fact that only one colour change takes place these products are easier to read than the traditional RGB ones and allow multiple colours to be used. They are manufactured in the same way as the RGB products however as they have to be coated around 50% thicker than the RGB type in order to show bright colours this typically means a third print. These SCA TLCs can be produced in 3 colours Green, Orange and Red the brightest of which is Green.

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