For Stock Nos. 72-370 - 72-375, 83-903 - 83-908; Kit Stock No. 61-161

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TEMPERATURE SENSITIVE LIQUID CRYSTAL SHEETS

The films of Liquid Crystals (LC) which you have purchased are ready for your immediate use. These are handy for research laboratories and industry. Each allows for a broad range of testing applications, and only minimal experimentation is required to conduct tests and be able to interpret the results. Individual sheets of Encapsulated Liquid Crystals are available only in the 12" x 12" size.

These films are constructed of a sheet of Mylar covered with black ink and LC (on one side). The ink provides a dark background which absorbs any light transmitted through the LC and allows the selectively reflected light (determined by temperature) to be viewed without light interference. The viewing of the LC colors is done through the Mylar.

Because these liquid crystals are protected, they are not subject to contamination by dust, smudges, etc., which would cause unprotected crystals to lose their characteristic properties within a matter of days or weeks. Provided that normal handling precautions are observed, the LC films will retain their color characteristics for many months. The liquid crystals are finely dispersed within a polymer matrix too small (3-5 microns) to be seen with the naked eye; but the film is durable and will not rupture unless subjected to abnormal pressure, such as that exerted by a ball point pen or other sharp object under heavy hand pressure. Temperatures higher than 125° C are likely to damage the capsule wall structure.

OPERATION

The LC sheets supplied have indefinite temperature ranges. Each sheet is identified by a five digit stock number. This stock number appears on an easily removed label which is attached to each sheet. The temperature range for each sheet is as follows:

Stock No.	Temperature Range
72-370, 83-903	40-45°C (104-113° F)
72-371, 83-904	35-40°C (95-104° F)
72-372, 83-905	35.0-36.0°C (95-96.8° F)
72-373, 83-906	30-35°C (86-95° F)
72-374, 83-907	25-30°C (77-86° F)
72-375, 83-908	20-25°C (68-77° F)

All the liquid crystals on these sheets exhibit the total color spectrum as the temperature changes. Blue colors are associated with warmer temperatures and red colors with cooler temperatures. Because the colors result from scattering (reflecting) incident light, it follows that they will be more intense with bright light sources.

As you handle these films, you will probably notice that the #72-373 and #72-371 sheets react to the temperature of your hands. If you have not been in a cold environment, you may be able to cause a reaction on the #72-372 sheet.

An immediate reaction may be obtained on the #72-375 sheet by lightly wetting the surface with your finger. The cooling that takes place due to evaporation will cause a color change because this sheet has a color-temperature range that is generally less than room temperature. Thus, in order to see color on this sheet, the temperature must be lowered.

The #72-370 sheet has the highest temperature range and must be heated by a light bulb, floodlight or other suitable heating element to bring out the colors.

DEFINITIONS

The following definitions are of terms that describe the functions of liquid crystals and related materials:

Photochromism is the reversible change in color of a substance when it is exposed to radiant energy, such as light.

Thermochromism is the tendency of a material to alter its color under the influence of heat radiation. It does not necessarily imply the action of visible light nor does it necessarily imply reversibility.

Thermotropism is a condition in which a difference in temperature determines orientation. In other words, the reversible changing of a color with change in temperature. Here again, the action of visible light is not implied.

Thermophotochromism involves a chemical reaction which is temperature-dependent but which also requires the presence of light. Thus, liquid crystals more nearly fall under this descriptive term.

SUGGESTED EXPERIMENTS

The experiments that can be performed with these sheets are too numerous to describe completely. However, we have listed a few which will suggest others. Keep in mind that the back side of the film must be placed immediately in contact with whatever test subject is used. Any air pockets caught between the film and the object will cause different color changes, indicating a different temperature. Rubber cement, thinly applied to the test subject, will insure reasonably good contact. This technique, however, should not be used if the film is to be reused on other objects. Removal could cause seperation of the LC from the plastic sheet and make it ineffective for further use.

1) Dampen the tip of a small cloth or sponge with water and "write" with it on the surface of the #72-375 sheet. The evaporative cooling that takes place will cause color changes.

2) Place the #72-375 film in a refrigerator and observe the change in colors (from blue to red to black). Remove it from the refrigerator and observe the reverse order of color as the temperature rises (black to red to blue). In the winter time, a window pane may also be used to cool the film.

3) Using the #72-373 and #72-371 sheets you can determine the relative hand skin temperatures of a group of people. Due to variations in blood circulation, and depending on whether a person had been holding a cold glass or had been holding a hot cup of liquid, a wide range of temperature results may be obtained in the group. Even though normal body temperature is 37° C, you will note immediately that skin temperatures fluctuate considerably from this value. Should a person not be able to cause a color reaction on even the #72-373 sheet, move the sheet away from the finger tips to the wrist area. You eventually will contact a warmer temperature.

4) You may test an object having a simple flat surface as well as a complicated inner structure which is invisible to the eye. Some examples are objects which have: a honeycomb structure; a flat surface made up of different types of metal or plastic; and a flat surface having a different thickness. Place LC sheet in direct contact with the structure. The black side of the sheet should touch the object. Slowly apply heat to the opposite side of the structure. Use a floodlight, heat gun, light bulb, heating pad, or any other suitable heat source. Heat will "flow" through the object to the surface having the LC film. However, it will flow at different thermal conductivity values encountered. Because of this, the film will show distinctly structural characteristics which would not otherwise be viewed.

These simple experiments are introductory in nature and serve primarily to acquaint you with the flexibility and sensitivity of LC. After you have finished these experiments, you probably will be able to think of many additional applications for the LC. These applications may be in a factory, laboratory, school, office, or even a home.