

FUNCTION / OPERATION

Temperature Recording Labels**CelsiStrip® CelsiClock® CelsiDot® CelsiPoint®****PRINCIPLE OF OPERATION**

The basic function of the CelsiLabel® depends on the **melting point** (a well defined physical action) of chemical compounds, rather than on a chemical reaction between reagents to translate the temperatures level(s) into visible form. There are temperature indicators on the market whose indication are based on chemical reactions of the materials used. Such chemical reactions depend on the temperature **AND** the exposure time.

SPIRIG manufactures irreversible temperature recording labels responding only to physical changes. Exposure time does not alter or modify the readings.

FUNCTION

CelsiLabels® use the melting point of chemicals. In a simplified description the function is as follows:

A black "blotting" paper is covered with a white chemical coating. The black paper is hidden under the white coating. If the white coating melts, then the coating material will be drawn by capillary forces into the black paper. The black paper becomes visible. The material transfer is irreversible.

Worst case tolerance: ± 2,5% (of full scale).

The white to black changed surface is **the 100%** irreversible proof that the coating exceeded its specific melting point at some time in the past (a few seconds or a year ago).

The CelsiLabel® combines compounds with different melting points, levels arranged in an increasing scale like a thermometer.

RULE NO. 1

The "graying" of the white thermo-sensitive coating is NOT an indication of an exceeded temperature level. This is an aging process depending on many factors, one of them being time, environment, etc.

Graying is **not** a displacement of the coating material, and consequently the melting point is or was **not** exceeded.

RULE NO. 2

The melting point slightly depends on the ambient air pressure imposed on the chemicals. In general materials melting points do depend more or less on the pressures applied. The ratings on the CelsiLabel® are for usual ambient atmospheric pressures between sea level and up to 1000 meters (3000 feet).

If an application is either in a pressure or a vacuum chamber, the user has to "cross-reference" the readings printed on the labels against his specific pressure or vacuum in use.

Shelf life limitation:

There is basically no theoretical shelf life limitation on the phase change process and dislocation of the thermosensitive melt material. There might develop with time a slight loss of phase change speed / response of the wetting / starting of capillary forces pulling the white compounds into the black carrier. There is also a slight degrading of the adhesive layer tackiness with storage time. Storage conditions should be:

Dry, cool, no light. Labels left sealed in the original plastic envelope / boxes as supplied. Long term storage preferably at 5°C.

Shelf life: 24 month approx

Life tests showed that even after 5 years the CelsiLabel@s operate perfect.

Understanding the Readings on CelsiLabel@s

Aging and other influences might alter the surface colour from white to grey. Questions on how to understand the changes might arise after application.

If the thermosensitive area exposes the black paper background, then its specific temperature has been exceeded. The background paper is of a deep black colour. If there is still an uncertainty left, then the following test will give a clear answer:

Carefully remove label from test surface. Use a small hot soldering iron tip and touch the heat sensitive area from the adhesive side of the label.

If the sensitive area responds within parts of a second by blackening, then that specific temperature level on the label had **not** been previously exposed above its rated temperature level.

Reasons for potential errors in applications

The strip should not be exposed to direct radiation of infrared heating energy or ultraviolet UV curing light. The strip and its heat sensitive surface areas will absorb heat radiation at a different absorption rate (or reject heat at a different reflection rate) than the target surface the temperature should be monitored does. A major measurement error might occur. The strip will not measure the surface temperature to which it is applied. The CelsiLabel® is put behind a shield (into the "heating" shadow) protecting the CelsiLabel® from direct exposure to the heat radiation.



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FUNCTION TEST

Two CelsiStrips are applied here on a 100 mm thick by 250 x 250 mm wide aluminum plate electro heated from below. A thermocouple wire ends 3 mm deep in a hole in the center of this plate. The heavy thermal mass of the plate ensures in the center of its surface an even temperature level. The high mass also limits the temperature rate of increase (gradient) at a given electric heating input. The colour change from white to black can easily and clearly be seen. The test can also be put on a video, eg using the almost "for free" iMovie® software from Apple. With a convenient arrangement it would also be possible to "mirror in" the the temperature measurement values from the electronic thermometer or to store the spoken out read values of the meter.

Warranty:

Spirig Quality Control try's to ship only performing materials. By the nature of the product a 100% test is impossible. In case of a material failure warranty covers explicitly only the materials exchange provided storage was correct. Any other warranties, claims or obligations for Spirig towards the customer / user are explicitly excluded and void.

Archiving:

Put used Celsi@labels in plastisizer free plastic sachets. Close airtight. Place sachet on a paper sheet or card and store in a folder / ring binder. Do not press Celsi@labels.