

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: ± 1,5% (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.

Storage preferably at +5 to +15 °C.

Shelf life: 24 month approx

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.



CST_10954_0945r.jpg

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 values of the meter.

FUNCTION / OPERATION

Temperature Recording Labels**CelsiStrip® CelsiClock® CelsiDot® CelsiPoint®****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 board. Store in a folder. Do not press Celsi®labels. Additional tech details Spirig considers as restricted and to be protected Know-how.

Shipping / Storage of Celsi@s

The hot summer months in 2018 and recently again in 2019 do request for the lower temperature level Celsi@s specific heat shielding protection during transport from Spirig to User.

During transport with UPS, DHL, Fedex or other transport carriers the cabin temperature levels inside the car can easily reach and pass 50°C and this especially if parked, even short time exposed to sun.

Despite heat shielding with foam material based baskets and added cool-packs, it has happened and can happen that the lowest t-levels, like +40°C .. are recording their own transport location temperature and have blackened. This actually being an unwanted transport max temperature level recording.

Such blackening is not covered by the Spirig Celsi® warranty.

The Celsi® function still exist for the higher, still white temperature level spots.

By the way temperature measuring and recording technology seems to be an easy-to-handle application task, but in practice it is often easy to run into measurement errors, like shown in below image.

The CelsiStrip® below had been applied on a metalized rough surface.

The 110 °C spot shows a greyed area, the next higher 121 °C level and above are still in their original, unchanged white condition.

What creates this greying result?

This CelsiStrip® was not evenly applied to the rough heat source surface. Underneath the physical location of the 110°C spot a thin layer of air did exist and hindered the transfer of the temperature hot surface to the sensing spot.

Air is actually a bad, heat conductor. The rear strip temperature did not fully reach the 110°C melting point of the sensing material

The white temperature sensing melting material did not get fully fluid, it only reached a sort of pasty nature with limited mobility and therefore could not be drawn by capillary forces into the black background substrate. The black surface of the substrate only can shine slightly through the sensing material layer still sitting on top.

TIP!

Make sure that your applied Celsi® is in good contact with its test surface, but do not squeeze too heavy on the Celsi® surface.

How to check the 110°C spot on its function?

- (1) careful loosen the Celsi from its test surface.
- (2) Do heat a cooking plate to for example 140°C
- (2) Contact the Celsi® with that hot surface.
- (3) Within seconds that grey area will turn completely into black.

Additional tools recommended:

CelsiMeter® Electronic Thermometers.



CelsiPick® Electronic Temperature Loggers.