

Celsi®...Temperature Sensing Labels

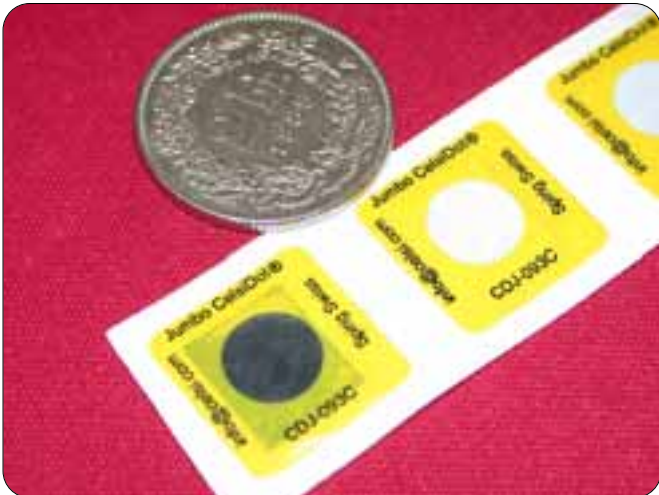
Apply and Forget! irreversible temperature level recording labels. Self-adhesive, easy applicable on any surface. Forty levels to choose from +40°C (105°F) to +260°C (550°F) and arranged in various combinations. Accuracy $\pm 1,5\%$. Permanent blackening of the original white level clearly indicates that level had been exceeded.



CelsiStrip® with 5 temperature levels. Also 8 levels (not shown here) available. Here 60°C are exceeded but 77°C never reached.



CelsiClock® with 5 temperature levels. CelsiClock®'s are also available with other temperature values and arrangements.



JUMBO-CelsiDot® with one level at 93°C. Left CDJ exceeded sometime in the past its 93°C level. CDJ to the right not heated.



MICRO-CelsiStrip® with temperature levels 60 and 71°C surely exceeded. The 82°C never reached in the label's watch mission.



CelsiPoint® with one 82°C level. CP on left side exceeded and on right side never exposed to or above 82°C.



CelsiDot®'s with 93°C level and **MICRO-CelsiStrip®'s** on an assembly before test.

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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) rather than a chemical reaction to translate the temperatures level(s) into visible form. There are also temperature indicators on the market whose indications are based on chemical reactions of the indicating materials used. Such chemical reactions depend obviously on both the temperature **AND** the exposure time.

SPIRIG manufactures only physical response temperature recording labels. Exposure time does not alter or modify the readings.

FUNCTION

CelsiLabels® use the melting point of chemicals. The principle is described here in a simplified way. A black blotting paper is covered with a white chemical coating. The black colour is hidden under the white coating. If the white coat would melt, then the liquefied coating material will be drawn by capillary forces into the black paper. The black paper becomes visible.

Worst case tolerance: $\pm 2,5\%$ (of full scale).

The now black paper surface is **the 100%** irreversible proof that the coating exceeded its specific melting point sometimes in the past (seconds or a year) and was in a liquid state to penetrate the black paper.

The CelsiLabel® combine chemicals with different melting points, levels arranged in an increasing scale like on a thermometer.

RULE NO. 1

The "graying" of the white sensitive coating is NOT an indication of an exceeded temperature level. It 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 thermomelt material, however there is a degrading with time and ambient storage temperature level for the "permeability / wettability" of the black background substrate by the melt material. Another shelf life limiting factor is the tendency of the adhesive layer to "dry" and loose tackiness with time.

Expected shelf life: 12 month after Spirig's delivery.

Storage:

Dry, **cool**, **no light** and sealed in plastic envelope / sachet.

Interpretation of Readings on Labels

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

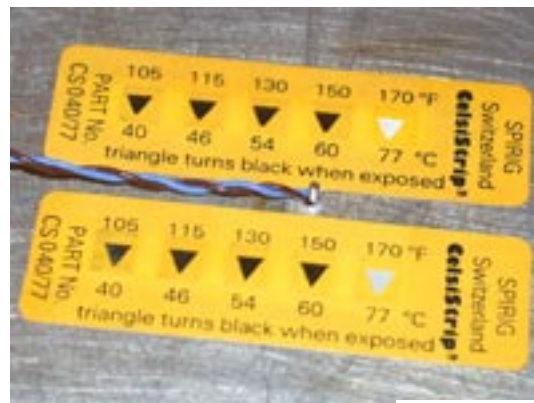
If the thermo sensitive area exposes the black paper background, then its specific temperature has been exceeded. The background paper is of a deep black colour. If there is still an uncertainty left, then the following test will give a clear answer:

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. 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.