Lightfastness of offset and letterpress inks

What does lightfastness mean?

The Standard Specifications DIN 16 525 “Testing of Prints and Printing Inks of the Graphic Industry” (available from Beuth-Vertrieb GmbH) distinguish basically the testing and classification of lightfastness of

a) prints that have been produced in any given graphic process on any given substrate under no specific conditions, and

b) printing inks for which testprints have been made according to exactly defined specifications of DIN 16 519.

The lightfastness of prints specifies their resistance against the influence of light without direct influence of the weather. The lightfastness of printing ink specifies the resistance of a standard testprint according to DIN 16 519 against the influence of light without direct influence of the weather.

How to produce a standard testprint

The indication of the lightfastness on the label of an offset or letterpress ink refers to the standard testprint of the respective printing ink. A standard testprint is a print produced on a white, light-resistant, wood-free art paper without optical whiteners (APCO II/II, Papierfabrik Scheufelen) acc. to DIN 16 519 T2. The printed ink filmweight is 1.5 g/m^2.

How is the degree of lightfastness established?

The lightfastness is established only on the printed solid. To measure it the testprint and a lightfastness standard are jointly exposed to daylight. Lightfastness testing devices equipped with Xenon high pressure lamps permit quicker tests and provide results similar to the exposure with daylight. The degree of lightfastness is determined by establishing which step of the lightfastness standard has noticeably changed at the same time as the sample.

The lightfastness standard consists of a graded set of blue coloured wool in 8 lightfastness steps, therefore referred to as the wool scale. The degrees of lightfastness determined in this way are classified as follows:

1 = very poor	2 = poor	3 = moderate	4 = fairly good
5 = good	6 = very good	7 = excellent	8 = maximum lightfastness

What do the different degrees of lightfastness mean?

What conclusions can be drawn in practice from the indication of the lightfastness? How important is it for the work produced by the printer? All he wants to know is whether the prints he produces meet the requirements in practice. He must have an idea how many days or weeks a certain degree of lightfastness stands up to the influence of daylight whereby the season and the geographical position etc. play a decisive roll. The following table gives approximate indications:

degrees of lightfastness	summer	winter
WS 3	4 – 8 days	2 – 4 weeks
WS 4	2 – 3 weeks	2 – 3 months
WS 5	3 – 5 weeks	4 – 5 months
WS 6	6 – 8 weeks	5 – 6 months
WS 7	3 – 4 months	7 – 9 months
WS 8	over 18 months	

The pigments determine the lightfastness

Only few anorganic pigments have a practically unlimited lightfastness. All organic and numerous anorganic pigments change under the influence of light sooner or later to a lesser or greater extent. The degree of alteration is influenced among other things by the chemical constitution, the concentration, the physical state of the pigment (grain size and distribution and crystal modification) and last not least by the vehicle enveloping it.

The pigment crystalloids are not destroyed at once but slowly and the result is a slow or faster fading of the colour, a change to a darker shade or a darkening with subsequent fading. Consequently, it would be best to describe the lightfastness by means of a curve showing the alteration of the colorimetric data of the print in relation to the radiant energy. Unfortunately, the determination of such curves is still very complicated and difficult which is why it is still necessary to refer to the comparison with the wool scale. However, one should realize that in this way one tries to characterize a curve by a single measuring point.

Pigments with high fastness properties are generally quite expensive. For this reason alone the decision maker should consider which lightfastness is really required for a specific printing job. In some cases where the fastness properties are of no relevance a cheaper printing ink with relatively low lightfastness (according to DIN 16 525) may be sufficient if it remains visible long enough and does not change too much.

Indications of lightfastness of special inks

Since the lightfastness test require longer periods precise indications to this effect on the labels are possible only for standard inks. For newly developed inks and special matches only approximate lightfastness properties can be indicated on the basis of the results of lightfastness tests with the pigments contained in such inks. If necessary, precise indications can be submitted later after completion of the lightfastness test of the respective ink.

Hints to be observed by the printer:

- When translating the degrees of lightfastness into the requirements of practice it must also be taken into consideration that a number of deviations from the standard conditions influence the fastness of a print: e.g. a highly wood-containing substrate of low lightfastness will soon yellow and it would be of little benefit to print on it with a blue ink of maximum lightfastness. Although its pigments will not be affected but the colour of the print will change, nevertheless, to a more greenish shade through the influence of the yellowing of the paper. This underlines the importance of the selection of suitable substrates.
- The filmweight thickness of the standard specifications will also not always be maintained. It will very substantially depending on the substrate to be printed and the printing forme. A higher filmweight thickness than indicated in the standard specifications will result in an increase of the lightfastness of the print because there will be more pigment particles in a given area to withstand longer the destructive influence of the light. The same applies to a more concentrated printing ink. On the other hand will a lesser film thickness and the lightening of an ink with cover or transparent white in most cases reduce the lightfastness. Moreover, the lightfastness in the halftone areas is generally lower than in the solids, which is particularly true for very light halftones.
- Varnishing and foil lamination of a print generally improves its lightfastness.
- If two or more printing inks of different lightfastness properties are being mixed the weak one is not improved by the good one but the good one is always impaired in its lightfastness which

means that in a mixture the ink of the lowest lightfastness determines the lightfastness of the mixed ink.

- Lightening of an ink diminishes its lightfastness. As a rule of thumb the following correlation can be assumed:

Lightening with transparent white	Reduction of lightfastness
1 : 1	1 grade
1 : 3	2 grades

The above information will be of assistance to the printer when selecting the inks for the jobs he has to do and give him an idea of their approximate lightfastness. He should moreover be aware of the fact that the demand for high lightfastness often requires the use of very expensive pigments resulting in a high price of the ink. Moreover, slight colour deviations from the approved shade are sometimes unavoidable if maximum lightfastness and other fastness properties are demanded.