

KODAK Ultima Lifetime Calculation

The lifetime of storage media is usually estimated by use of the Arrhenius equation. This equation expresses the lifetime at a given temperature in terms of a pre-exponential time constant and an activation energy. The mathematical form of the Arrhenius equation is

$$t = A \times e^{E/kT}$$

where t = lifetime,
 A = pre-exponential time constant,
 E = activation energy,
 k = Boltzmann's constant, and
 T = absolute temperature.

By using this equation, one can use lifetime data collected at one temperature to estimate lifetime at another. The benefit is that lifetime data can be collected at an accelerated temperature where the lifetime is relatively short and used to estimate the lifetime at standard use conditions where the lifetime could be very long and take an extraordinary long time to measure directly. The drawback is that to make this type of extrapolation, either the pre-exponential time constant or the activation energy must be known or assumed.

There are a number of reports on the lifetime of CD media from which an activation energy can be extracted. In this report we will use these reported values to estimate the lifetime of Kodak Ultima media from accelerated keeping data.

The specification for KODAK Ultima media is that it withstand a minimum of three weeks incubation at the accelerated condition of 80 C (176 F) with 85% relative humidity without any loss of data. We will use this time at this temperature as the accelerated condition from which a lifetime under normal use conditions may be estimated. The table below shows the estimated lifetime for Kodak Ultima media at 30 C based on the choice of reported activation energy.

Source	Media	Activation Energy (eV)	Estimated lifetime (years)
Company 'A'	CD-ROM (aluminum)	0.94	9
Company 'B'	CD-R (silver)	1.65	443
Kodak	CD-R (gold)	2.10	5,083

Clearly, the estimated lifetime is strongly dependent on the choice of activation energy. We expect the activation energy for KODAK Ultima media to lie somewhere between that of CD-R (silver) and CD-R (gold) since it is composed of gold-fortified silver alloy. Even if we use the CD-R (silver) activation energy, however, the estimated lifetime is well beyond the warranted life of 100 years.

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