



# zoggavia.com

## Characteristics of Kodachrome Slide film

### Emulsion

Kodachrome is fundamentally different from other transparency and negative color films that have dye couplers incorporated into the emulsion layers. Kodachrome is unique because it has no dye couplers in the emulsion; these are introduced during processing. Without couplers, the emulsion layers are thinner, causing less light scattering and allowing the film to record a sharper image. A Kodachrome slide is discernible by an easily-visible relief image on the emulsion side of the film. Kodachrome has a dynamic range of around 8 stops, or 3.6-3.8D.

### Archival stability

When stored in darkness, Kodachrome's long-term stability under ordinary conditions is superior to other types of color film; images on Kodachrome slides over fifty years old retain accurate color and density. It has been calculated that the least stable color, yellow, would suffer a 20% loss of dye in 185 years. This is because developed Kodachrome retains no unused color couplers. However, Kodachrome's color stability under bright light, for example during projection, is inferior to E-6 process slide films; Kodachrome's fade time under projection is about one hour, compared to Fujichrome's two and a half hours.

Unprocessed Kodachrome may survive long periods between exposure and processing. In one case, several rolls were exposed and then lost in a Canadian forest; upon discovery 19 years later they were processed and the slides were usable.

### Digital scanning and resolution

A 35mm Kodachrome transparency, like other 35mm transparencies on films of comparable ISO rating, contains an equivalent of approximately 20 megapixels of data in the 24 mm x 36 mm image. Scanning Kodachrome



transparencies can be problematic because of the film's tendency to scan with a blue color cast. Some software producers deliver special Kodachrome color profiles with their software to avoid this. However, a calibration with a special Kodachrome calibration target is necessary for accurate color reproduction.

Typically, dust, scratches and fingerprints on the slide are detected and removed by a scanner's software. Many scanners use an additional infrared channel to detect defects, as the long wave infrared radiation passes through the film but not through dust particles. Kodachrome interacts with this infrared channel in two ways. The absorption of the cyan dye extends into the near IR region, and thus this layer is opaque to IR. Kodachrome also has a pronounced relief image that can affect the IR channel. These effects can sometimes cause a slight loss of sharpness in the scanned image when Digital ICE or a similar infrared channel dust removal function is used.

## Processing of Kodachrome films

Main article: K-14 process

Kodachrome processing has undergone four significant alterations since its inception. The current process is designated Process K-14. The process is complex and exacting, requiring technicians with extensive chemistry training, as well as large, difficult-to-operate machinery. This effectively precludes amateurs or small laboratories from processing Kodachrome.

First, the antihalation backing is removed with an alkaline solution and wash. The film is developed using a developer containing phenidone and hydroquinone, which forms three superimposed negative images, one for each primary color.

After washing out the first developer, the film undergoes three re-exposure and re-development stages. Re-exposure exposes the silver halides that are not developed in the first developer, effectively fogging them. Filters exist between each layer to prevent light exposing the incorrect layer. A color developer then develops the fogged image, and exhaustion products form a color dye in the color that is complementary to the layer's sensitivity. For example, the red-sensitive layer forms a cyan dye.

Following color development, the metallic silver is converted back to silver halide salts using a bleach solution. The film is then fixed, making these silver halides soluble and leaving only the final dye image. The film is finally washed to remove chemicals which may cause deterioration of the dye image, dried and cut.

## Legality of paid processing

Due to the complexity of its processing, Kodachrome was initially sold at a price which included processing by Kodak. An envelope was included with the film, in which the photographer would send the exposed film to the nearest of several designated Kodak laboratories. The film was processed, mounted in 2" x 2" cardboard mounts in the case of 35 mm slides, and returned by mail to the sender.

After 1954, as a result of the case *United States v. Eastman Kodak Co.*, this practice was prohibited in the United States as anticompetitive. Kodak entered into a consent decree, ending this product tying practice in the United States, and allowed independent processing laboratories to acquire the chemicals needed to process Kodachrome films.

## Decline

The use of slide film in general declined in the 1980s and 1990s which, combined with competition from Fuji's Velvia slide film, caused a drop in Kodachrome sales. Kodachrome products were gradually discontinued and on June 22, 2009, Kodak announced Kodachrome would no longer be manufactured.

Many Kodachrome processing laboratories, both Kodak-owned and independent, closed because of the decreasing volume of business. The loss of processing availability further accelerated the fall in Kodachrome sales. On July 25, 2006 extensive documentation about Kodak's Lausanne Kodachrome lab's impending closure was sent to the European Parliament by the Dutch office of the European Parliament because, although located in Switzerland, the facility served all of Europe and its closure would affect European photographers. The Parliamentary committees for *Culture and Education*, and for *Internal Market and Consumer Protection* studied the matter.

Kodak no longer processes Kodachrome film and instead subcontracts the processing work to *Dwayne's Photo*, an independent facility in Kansas which as of 2009 is the only remaining Kodachrome processing facility. Dwayne's processing of 35 mm films is fully endorsed by Kodak, but Dwayne's Super-8 process is not endorsed because it requires more agitation. Films sent for processing in the U.S. are mailed directly to Dwayne's, while those sent for processing in Europe are sent to the Lausanne facility's address, hence they are forwarded to Dwayne's.

Kodak had previously attempted to increase the availability of K-14 processing through the K-Lab program, where small labs equipped with smaller Kodak processing machines would supplement Kodak's own processing services. These labs have all closed.

## Recently-discontinued Kodachrome products

- **Kodachrome 64** film in 120 format was discontinued in 1996.
- **Kodachrome 25** was discontinued in 2002. Many point to the introduction of Velvia or the decline in quality of processing as the reason for its demise.
- **Kodachrome 200** was discontinued in November 2006. The last emulsion batch was numbered 2672, labeled with an expiration date of September 2008.
- **Kodachrome 64** and **Kodachrome 64 Professional** 135 format were discontinued in June 2009.

## Product timeline

	<b>Film</b>	<b>Date</b>
Kodachrome film	16 mm, daylight (ASA 10) & Type A (ASA 16)	1935–1962
	8 mm, daylight (ASA 10) & Type A (ASA 16)	1936–1962
	35 mm and 828, daylight & Type A	1936–1962
Kodachrome Professional film (sheets)	daylight (ASA 8) and Type B (ASA 10)	1938–1951
<b>K-11 process</b>		
Kodachrome film	35 mm and 828, Type F (ASA 12)	1955–1962
Kodachrome Professional film	35 mm, Type A (ASA 16)	1956–1962
Kodak Color Print Material	Type D (slide duping film)	1955–1957
<b>K-12 process</b>		
Kodachrome II film	16 mm, daylight (ASA 25) and Type A (ASA 40)	1961–1974
	8 mm, daylight (ASA 25) and Type A (ASA 40)	1961–1974
	S-8, Type A (ASA 40)	1965–1974
	35 mm and 828, daylight (ASA 25)	1961–1974

	Professional, 35 mm, Type A (ASA 40)	1962– 1978
Kodachrome-X film	35 mm (ASA 64)	1962– 1974
	126 format	1963– 1974
	110 format	1972– 1974

### **K-14 process**

Kodachrome 25 film	35 mm, daylight	1974– 2001
	Movie film, 16 mm, daylight	1974– 2002
	Movie film, 8 mm, daylight	1974– 1992
	Professional film, 35 mm, daylight	1983– 1999
Kodachrome 64	35 mm, daylight	1974– 2009
	126 format, daylight	1974– 1993
	110 format, daylight	1974– 1987
	Professional film, 35 mm, daylight	1983– 2009
	Professional film, daylight, 120 format	1986– 1996
Kodachrome 200	Professional film, 35 mm, daylight	1986– 2004
	35 mm, daylight	1988– 2007