

# Rallison Wisdom

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## Refrigeration

DCG stores well at low humidity in a refrigerator or freezer but containers must prevent contamination, condensation, freezer burn and frost which can all destroy surface quality. Film of 10 to 20 microns or more store best and are good for at least a year. At room temperature and 50% RH, thin films are good for a few hours, thick films typically last a week or more. The addition of a small quantity of TMG to the mixture will greatly increase storage time at room temperature by increasing the pH.

## Light bulb as an alternative to the fixer

Developing is simply a process of reducing the remaining chromate ions and thereby uniformly hardening the gelatin. Too much hardening will give a clean, clear but weak and green result. Too little hardening will leave the hologram milky and weak and reddish or yellowish. Development is done either optically or chemically using fluorescent or incandescent lamps or any suitable reducing agent or tanning solution.

[Rallison used either Kodak fixer or a 100W lamp at 6 inches from the hologram, for time periods of between 5 and 15 seconds. But he was also exposing at 441nm which would do a much better job than 532nm. By the way, I use the light bulb immediately after the dark reaction (before swelling with any water). I've used Knox gelatin with exposure at 457nm, and this is usually hard enough by itself to require neither fixer nor light bulb.]

## Film codes

The film mixtures vary in dichromate and gelatin percentages. The variations depend on the specific use that a DCG film plate has. The film code currently used contains three numbers. The first being the gram-weight of the ammonium dichromate, the second being the gram-weight of the gelatin, and the third being the gram-weight (ml) of the water to be used in the film mixture. (Usually mixed in a 500 ml poly bottle.) The code for film used in broadband image holograms is 8-30-350. Thus, 8 grams dichromate, 30 grams gelatin, and 350 grams (ml) of water are mixed together. The mixture code for "red" holograms is 3-30-200. Most holographic optics are made in 10-30-250 to 8-30-150.

In using the film code for a variety of mixtures, the 30-gram gelatin weight number always remains constant. Thus, when a thicker emulsion is desired, the water number decreases. And when more absorption is desired, the dichromate number increases, an increase in thickness narrows the bandwidth and an increase in dichromate shifts the color toward the blue.

As a general rule, thicker emulsions require longer process times but are easier to make uniform. The dichromate concentration determines light absorption and the center reconstruction wavelength of the hologram. For higher dichromate concentrations, the increased absorption produces larger gradients of index modulation. Lower the dichromate concentrations produce more uniform index modulations. Larger gradients yield slightly larger bandwidths and the removal of higher percentages of dichromate during processing results in thinner and thus bluer holograms.

When a specific bandwidth is desired, along with a specific reconstruction wavelength; it is best to experiment with various film mixtures. Usually starting with a standard mixture and then adjusting the thickness, and dichromate content to achieve the desired results. The color controllability and uniformity of DCG film improves with thicker film emulsions. Consequently, they are more forgiving in their exposing and developing parameters.

Extremely thick (25 micron) emulsions (X-30-150, a 5 to 1 water-to-gel ratio) are difficult to use. They are prone to excess bubbles, premature jelling, film pits, low viscous flow, increased impurities and during processing sometimes pull up off the substrate.

## **Ageing and thickness**

The film is ready for exposure after it has been aged an hour or so for a 350 mixture or a day later for a 150 mixture. The addition of 1 or 2 ml of TMG will extend the useful room temp life of 350 film to a day or two and will make 150 film last for several weeks in a 21 degree C, 50% RH environment. The thicknesses of the commonly used mixtures after spinning at 80 RPM and after processing are as follows: 350 yields 5-6 microns, 250 yields 8-9 microns, 200 yields 10-12 microns, 150 yields 20-24 microns.

## **Bandwidths and color**

The relative bandwidths run from 50 to 150 nm for 350 film, depending on processing used. 250 and 200 film make 10 to 50 nm bandwidths depending on processing and 150 film can get down to 8 nm but also runs as high as 30 nm. The color of a film made from a 3-30-200 mixture is around 630 nm when shot at 514 nm. The color of 6-30 film is around 590 for a 514 shot and a 10-30 mixture will easily be tuned to play back at the same wavelength it was shot at.