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TECHNICAL INFORMATION

DFO (1,8-Diazafluoren-9-One)

Catalog Nos. LV500, LV5001, DFS200P

INTRODUCTION

DFO is a ninhydrin analog used for developing latent prints on porous surfaces. Its fluorochrome properties make it especially useful on multi-colored surfaces where the background would interfere with subsequent photography. DFO reacts with the amino acid content of fingerprint residue, and it will not interfere with subsequent analysis using ninhydrin, silver nitrate or physical developer. In fact, some labs report that DFO use improves the results gained with ninhydrin.

According to the "Manual of Fingerprint Development Techniques" published by the Police Scientific Development Branch of the British Home Office, DFO will develop more fingerprints than ninhydrin. Testing in the U.S. indicates that DFO will develop 2 1/2 times as many prints as ninhydrin. Other testing indicates that DFO is also effective for developing latent blood prints.

DFO developed latent

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On occasion, DFO will produce lightly colored (pink) latent prints, but its real strength is in its fluorescent properties. DFO fluorescence may be produced using a UV light source such as BLUEMAXX™, FAL3000 Forensic Alternative Light Source Kit, and other alternative light sources.

DFO is now packaged in a pump spray which contains 100ml of pre-mixed reagent for better control and less waste. DFO in crystal form is available for those labs preparing their own formulations.

CAUTIONS

- Before using this kit, consult the appropriate Material Safety Data Sheets (MSDS) found on our website at www.sirchie.com/support.
- Use only in well-ventilated area or with a fume hood. Wear latex gloves, safety glasses, and an organic vapor respirator.
- Some DFO formulations are flammable and highly toxic.
- Use DFO prior to applications of ninhydrin.
- DFO can interfere with the forensic examination of handwriting (inks may run), indented impressions, body fluids including DNA profiling, fibers, hairs, paint and other types of evidence.
- Handle objects with gloved hands before and after treatment.

PREPARATION

DFO Pump Spray

Catalog No. DFS200P is a DFO formula that is delivered from a pump spray bottle. Be certain that the subject paper is dry and that all preliminary examinations of ink or handwriting have been completed. To apply the reagent, shake the bottle well, and then spray the surface from a distance of from six to nine inches. Cover the entire surface with an even spray. Apply the reagent in a well-ventilated area or within the confines of a fuming hood. DFS200P has a useful life of up to one year.

To accelerate development, treat the object in a 212ºF (100ºC) oven for 10 to 20 minutes. Examine the object under UV light such as the BLUEMAXX™ or FAL3000 Forensic Alternative Light Source Kit. ***Note:*** *See the section on photography for recording the evidence.*

DFO Powder Formulations

Special Considerations: *Due to the limited shelf life of some solutions prepared in the laboratory, DFO should be stored in its powder form until needed.* Working solutions should not be prepared until you are ready to develop prints. FBI Working Solutions have a useful life of about 6 months. Wear gloves to prevent weakening or contamination of the solutions with sweat components from hands and possible staining of skin. Solution should be prepared in a well-ventilated area or within the confines of a fuming hood.

FORMULA NO. 1	
FBI FORMULATION (Stock Solution)	
1 gram DFO Crystals	200ml Ethyl Acetate
200ml Methanol	40ml Glacial Acetic Acid
Combine and stir with a magnetic stirrer until ALL the ingredients are dissolved. ***CAUTION: Highly flammable!***	
(Working Solution)	
Add Petroleum Ether to the Stock Solution until total volume is 2 liters.	

FORMULA NO. 2	
STANDARD (Stock Solution)	
.25 gram DFO Crystals	20ml Glacial Acetic Acid
40ml Methanol	
1- Dissolve .25g of DFO in 250ml beaker with 40ml of Methanol.	
2- Then, and 20ml of Glacial Acetic Acid and mix until all DFO is desolved into the solution.	
CAUTION: Highly flammable!	
(Working Solution)	
*Add 940ml of 3M NOVEC Fluid HFE-7100 to the Stock Solution. Cover and allow to settle for approx. 30 minutes.**	

***FORMULA NO. 2 NOTE:** A thin, oily film may form on top of the working solution. It consists of water, excess Methanol and DFO—it must be removed prior to use following one of these methods:*

1. *Use a separatory funnel to process the working solution. Allow to settle for 30 min. and drain the bottom phase into a storage container. Stop draining when separate, clear-looking solution nears the bottom of the funnel, or approx. 50-100ml of solution remains in funnel. This remainder contains undissolved ethanol, water and DFO and should be discarded in a proper waste container for flammable solvents.*
2. *Use a pipette to skim the oily film from the top of the working solution. Again, discard this in a proper waste receptacle as described above.*
3. *Use a squirt bottle to contain the working solution. This will help insure a clean solution. When the solution level is below the straw, discard the remainder in a proper waste receptacle as described above.*

PROCEDURE

Dip the specimen to be processed into the working solution for about ten seconds and then allow it to air dry. It is possible to apply the reagents mixed according to Formula No. 1 and Formula No. 2, using a pump spray, but care should be taken. The technician should spray only in a fume hood (Fig. 1).

After drying the specimen, development may be accelerated by applying heat at 212ºF (100ºC) for 10-20 minutes. For the optimum acceleration environment, SIRCHIE designed several heat chambers including the No. DFC100 and No. DFC200. After acceleration is complete, remove the object from the heat chamber and examine under UV light. Suggested wavelengths for viewing DFO prints are 450nm, 485nm, 525nm and 530nm with orange filter goggles for most porous surfaces such as paper (white or pastel) and glassine envelopes. Yellow legal pad papers are best viewed at 570nm to 590nm with a red filter.

FIGURE 1—DFO will often produce visible prints using the No. AC632 Forensic Workstation.

Photography

Note: *Video and film cameras may not exhibit spectral sensitivity identical to the human eye. Put another way, what you see you may not be what you get. As a consequence, it is difficult to develop hard and fast rules for the use of these instruments in recording fluorescence. It is possible, however, to develop general rules for fluorescence photography.*

Use of Light Meters—Unless you are fortunate enough to have a highly specialized spot meter, you will find that normal hand-held or in-camera light meters are of no use in fluorescence photography. Do not rely on the camera's automatic mode or upon recommendations that its light meter may offer. Use bracketing techniques and expect exposure times of a half-minute or longer.

Steady The Camera—Because of the extremely low light levels involved with fluorescence, photography involves long exposures. Photography must be done with the camera mounted on a sturdy tripod and the room should be totally dark or you must use a light-tight enclosure.

Illumination Techniques—The only illumination present must be from a suitable UV light such as the BLUEMAXX™ or FAL3000 Forensic Alternative Light Source Kit. Stray light must be eliminated and illumination must be as even as possible. Good practice suggests that you "paint" the light onto the surface being photographed by moving the illumination spot around during exposure. This will tend to even out the illumination over the period of the exposure.

Fill The Frame—Fluorescence intensity falls off with distance so it is important to position the camera as close to the subject as possible while filling the viewfinder frame with the image. If you use a commercial lab for film processing, allow a 20% border around the subject to allow for their cropping of the photos. If you are using a 35mm camera, specify 4" x 6" prints.

Use A Barrier Filter—A barrier filter on the camera is necessary because of the same reason you needed one for your eyes. If you are using standard UV light sources, equip the camera with a filter that is the same color as the goggles used to view the fluorescence.

Although it is possible to photograph through the barrier filters supplied with BLUEMAXX™ lights, we recommend filters specifically designed for use with your camera. Please note that some commercially available filters may fluoresce weakly when exposed to the BLUEMAXX™ beam. This will result in hazy or foggy photos. Specify non-fluorescing threaded filters or Cokin®-type sheet barrier filters available from your local camera distributor.

Films—All films are sensitive to blue light. If a barrier filter were not used, the blue light would overpower the fluorescence and mask it. In this application Daylight films are superior to specialty films such as "Tungsten" or similar light compensated films. Daylight films generally have red, green and blue layers of equal sensitivity. Tungsten films are manufactured to be especially sensitive to blue and are not suitable for UV photography. Use the highest speed film you can find. Reduce the effect of graininess by filling the frame, thus reducing the enlargement factor. Use a large format camera for the same reason. Black & white films are excellent for recording fluorescence due to their high speed and relatively fine grain. A barrier filter is still necessary with black and white film.

Aperture Settings—The camera's aperture setting controls the size of the opening in the lens iris and thus controls the amount of light reaching the film. Because fluorescence is so weak, you may be tempted to open the aperture as wide as possible to reduce exposure times. But keep in mind that the aperture also controls depth of field or depth of focus. Use of a small aperture means sharpest focus over an extended object. Focus is especially critical when photographing at close range. We recommend using longer exposures and smaller apertures (f/8 to f/22).

Reciprocity Failure—If you experiment with the relationship between the amount of light present from a

scene, the length of time that the camera shutter is open, and the density of the exposure created on film, you will find that for normal photography, a simple relationship exists: *exposure=light intensity x time.* When exposures are long or light intensities are either very low or very high, this relationship fails to hold together. This is known as reciprocity failure. The consequences of this in fluorescence photography are seen in color shifts and in a general decrease in film speed. Color shifts can be compensated for with color-compensating filters if it is felt necessary. (Consult photography texts for assistance.) You will find that camera settings no longer scale in a linear fashion (i.e., doubling the aperture size or exposure time does not double the density of the exposure). What all of this leads up to is that fluorescence photography is an art.

Keeping Records—Successful fluorescence photography requires practice, experience and patience. As you gain experience, your judgment of exposure times will improve. The learning curve can be greatly reduced if you record your experiences in a notebook. Data worth recording will include the subject being photographed, aperture settings, film used, exposure times, and a copy of the resultant photograph.

Starting Point—The table shown to the right was developed to provide a starting point for your photographic efforts:

Using Digital Camera Equipment

Digital photography is rapidly replacing the use of film cameras. Among the many advantages digital equipment offers to the law enforcement photographer are:

1. The LCD screen provides instant viewing of the photos taken.
2. Portable digital printers permit quick printouts of photos at the crime scene.
3. All photo records can be stored on a computer and easily accessed.
4. Pricing is now within the range of most agencies.

Digital cameras are used in the same manner as film cameras in that they are available with adjustable set-

tings for ISO/ASA, shutter speeds, and aperture settings. Using the suggested starting points given for film cameras, the evidence photographer can determine the proper settings to use.

FILM SPEED: ASA/ISO400—*Camera-to-Subject Distance = 8" (20.3cm)*		
SUBJECT	APERATURE	TIME
Latent Fingerprints	f/8	10 seconds

We recommend that the digital camera be set up for an ISO/ASA of 100. Most digital cameras offer a range of quality settings. Use the highest quality setting available. For crime scene use, we recommend a camera with a high resolution.